NITIN SIR CLASSES

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Daily News Analysis

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India's maiden dedicated solar mission, Aditya-L1, launched aboard PSLV-C57 on September 2, 2023, has provided an unprecedented view of the Sun's activity. Situated at the Sun-Earth Lagrangian point L1, the mission allows continuous monitoring of the Sun without interruption. Using its Visible Emission Line Coronagraph (VELC) payload, Aditya-L1 has, for the first time, captured spectroscopic observations of a coronal mass ejection (CME) in the visible wavelength range, marking a significant milestone in solar physics research.

Daily News Analysis

Aditya-L1 gets a close look at eruptions from the sun

Scientists from IIA and NASA study very first spectroscopic observations of coronal mass ejection in the visible wavelength range; the solar observatory is expected to observe more such eruptions

Hemanth C.S.
BENGALURU

Using the Visible Emission Line Coronagraph (VELC) payload aboard India's first dedicated space-based solar mission, Aditya-L1, scientists at the Indian Institute of Astrophysics (IIA), along with NASA, have collaborated to estimate the crucial parameters of a coronal mass ejection (CME), very close to its lift-off from the sun.

Scientists associated with the project said that these are the very first spectroscopic observations of a CME in the visible wavelength range.

They said that the unique spectroscopic observations with the VELC has let them study the CMEs very close to the sun's visible surface itself, for the first time.

"In addition, it provides a sustained view of the sun for 24 hours every day because of being at the sun-earth Lagrangian L1 location where the sun never sets," they said.

Taking advantage of these factors, V. Muthupriyal, VELC project scientist, and her colleagues at the VELC payload operations centre at the IIA estimated the electron density, energy, mass, temperature and speed of a CME very close to the sun.

Solar study: PSLV-C57, carrying India's maiden solar mission Aditya-L1, lifts off from Sriharikota on September 2, 2023. PTI

Vital statistics

R. Ramesh, senior Professor at the IIA and principal investigator of the VELC project, told *The Hindu* that the observations are by far the closest to the sun where spectroscopic observations of a CME in the visible wavelength range have been obtained with a space coronagraph.

His team calculated that there are about 370 million electrons per cubic centimetre in the CME observed with the VELC. The corresponding number for the non-CME corona near the sun is much less, in the range 10-100 million electrons per cubic centimetre.

"The CME energy in the present case is approximately 9.4 * 10^21 joules. The mass in the CME is nearly 270 million tons. For comparison, the mass of the iceberg that sank the Titanic is estimated to be 1.5 million tons. The initial speed of the CME is 264 km/sec. The CME temperature is 1.8 million degrees on the Kelvin scale," Professor Ramesh said.

More eruptions

He added that though there are observations of CMEs at comparatively larger distances from the sun, with instruments other than the VELC, an understanding of the parameters of a CME in relation to how much is lost from the sun during a CME *per se* is crucial, and the unique near-sun spectroscopic observations with the VELC is precisely providing us the necessary data.

Professor Ramesh added that with the sun nearing the maximum activity phase of the current sunspot cycle 25 and with the VELC now stabilised in its operations, more energetic eruptions from the sun are expected to be observed.

Key Highlights and Significance:

1. **First-of-its-kind observations:**

- VELC has enabled scientists to study CMEs very close to the Sun's visible surface, providing data not previously attainable with space coronagraphs in visible light.
- Collaboration between the Indian Institute of Astrophysics (IIA) and NASA has facilitated these analyses.

2. **CME Parameters Measured:**
   - Electron density: ~370 million electrons per cubic centimetre in the CME (compared to 10–100 million in the surrounding corona).
   - Energy: ~9.4×10^{21} joules.
   - Mass: ~270 million tons (compared to 1.5 million tons of Titanic's iceberg).
   - Initial speed: 264 km/s.
   - Temperature: 1.8 million K.
3. **Scientific Importance:**
   - Understanding near-Sun CME characteristics is crucial to estimate mass and energy loss from the Sun, and its potential impact on space weather, including geomagnetic storms affecting satellites, communication networks, and power grids on Earth.
   - The observations provide insight into the Sun's activity cycle, especially as it approaches the peak of Solar Cycle 25, which is associated with heightened solar eruptions.
4. **Technological Edge:**
   - Placement at L1 point ensures 24-hour continuous observation, overcoming limitations of Earth-orbiting telescopes.
   - VELC's visible-wavelength spectroscopic capability complements existing instruments that typically study CMEs at larger distances or in other wavelengths.

Conclusion:

Aditya-L1's observations mark a significant advancement in India's space-based solar research capabilities, providing crucial data for understanding CMEs and their implications for space weather. These first spectroscopic measurements of a CME close to the Sun pave the way for future studies of solar eruptions, contributing not only to fundamental science but also to practical applications in space weather prediction and satellite safety. With the Sun entering a more active phase of its cycle, Aditya-L1 is poised to revolutionize near-Sun solar observations and establish India as a key player in heliophysics research.

Daily News Analysis

UPSC Prelims Practice Question

Ques: With reference to the Aditya-L1 mission, consider the following statements:

1. It is India's first dedicated solar mission.

2. It is placed at the Sun-Earth Lagrangian point L2.

3. The mission carries the Visible Emission Line Coronagraph (VELC) payload.

Which of the above statements is/are correct?

A) 1 only

B) 1 and 3 only

C) 2 and 3 only

D) 1, 2 and 3

Ans: b)

UPSC Prelims Practice Question

Ques: Coronal Mass Ejections (CMEs) can significantly affect Earth's technological systems. Explain the importance of near-Sun observations of CMEs and how Aditya-L1 contributes to space weather forecasting. **(150 Words)**

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Daily News Analysis

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A recent study by the Indian Council of Agricultural Research (ICAR), led by its Director-General Mangi Lal Jat and coordinated by the Indian Institute of Soil Science, Bhopal, highlights that unscientific fertilizer use and climate change are degrading soil organic carbon (SOC) across India. Using 2,54,236 soil samples from 620 districts in 29 States, the six-year study (2017–2023) provides a comprehensive assessment of SOC in arable lands, published in the international journal Land Degradation & Development.

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Daily News Analysis

Climate change, imbalance in fertilizer use impacts soil's organic carbon: ICAR study

A. M. Jigeesh
NEW DELHI

A detailed study conducted by eight scientists of the Indian Council of Agricultural Research (ICAR), including its Director-General, Mangi Lal Jat, has found that the unscientific use of fertilizers and climate change are contributing to degradation of organic carbon in arable areas of the country.

The study, primarily coordinated by the ICAR's Indian Institute of Soil Science in Bhopal, has used 2,54,236 soil samples from 620 districts covering 29 States to reach the conclusions. A research paper based on the six-year study started in 2017 has been published now in the England-based international research journal *Land Degradation & Development*.

Talking to *The Hindu* about the research, coordinator of the project Arvind K. Shukla said organic carbon was not only part of the chemistry of the soil, but it covered all the aspects of the physics, chemistry and biology of soil. He said a study published by the United Nations' Food and Agriculture Organisation about 25 years ago flagged this issue, but the samples were very low.

Land development: The study has used 254,236 soil samples of 620 districts covering 29 States to reach the conclusions. FILE PHOTO

"In this study, we have taken samples extensively, and the sample collection was well designed. We have covered both arable and barren land, mostly arable land," he said.

Carbon dynamics

The study has found that if the organic carbon is low, then the deficiency of micronutrients in the soil is high, and if the organic carbon is high, the deficiency is low. The team used an earlier study that said rainfall and temperature determined organic carbon. "We correlated this across the country. We found that organic carbon is highly correlated with the elevation. If the elevation of the land is high, then the organic carbon content is high. But if we move from hills to low land, then the organic carbon content is low," he added.

Mr. Shukla said organic soil carbon is negatively correlated with temperature. "For example, in Rajasthan and Telangana, the temperature is very high and their organic carbon content is low," he added.

The study noted that irrespective of the crops and cropping patterns, temperature, rainfall and elevation are the three important factors which decide the organic carbon concentration in the soil. The team of scientists developed an 'agri-ecological base' map to assess the impact of cropping systems and the use of fertilizers on organic carbon.

The scientists have prepared a map which can help in making policy decisions, particularly for the carbon credit and assessing the land degradation. "We found that wherever imbalanced fertilizer application was there, then the organic carbon contained in the soil had declined. Haryana, Punjab, and parts of western Uttar Pradesh have intensified the fertilizer application, skewed towards urea and phosphorus, which was mostly scientific application, and it has negatively impacted organic carbon in the soil," the scientist added.

The study noted that climate change also has an impact on organic carbon. "If the temperature is rising, then there are chances that soil organic carbon will decline further in future, and that will not only impact soil health, but will also impact the carbon credit and heat emission from soil." Mr. Shukla said.

Key Findings and Significance:

1. **Soil Organic Carbon and Soil Health:**
   - SOC is a key indicator of soil quality, encompassing physical, chemical, and biological aspects of soil.
   - Areas with low SOC have higher micronutrient deficiencies, affecting crop productivity, while higher SOC correlates with better soil fertility.
2. **Environmental Factors:**
   - Temperature: Negatively correlated with SOC (e.g., Rajasthan and Telangana have high temperatures and low SOC).

- Rainfall and Elevation: Higher rainfall and elevation are associated with higher SOC levels.
- These factors are largely independent of crop types or cropping patterns.

3. **Impact of Fertilizer Use:**
   - Imbalanced fertilizer application, particularly in Punjab, Haryana, and western Uttar Pradesh (excess urea and phosphorus), has reduced SOC, despite high productivity.
   - Highlighting the need for scientific, balanced nutrient management.
4. **Climate Change Implications:**
   - Rising temperatures due to climate change may further deplete SOC, threatening soil health, carbon credit potential, and contributing to heat emissions from soils.
   - The study provides an 'agri-ecological base' map to guide policy decisions, sustainable land management, and carbon credit schemes.

Conclusion:

The ICAR study underscores the critical link between soil management, climate change, and agricultural sustainability. Maintaining and enhancing SOC is essential not only for crop productivity and soil fertility, but also for climate mitigation strategies. Policymakers can use these findings to promote balanced fertilizer use, sustainable cropping systems, and land degradation prevention, ensuring long-term soil health and environmental resilience.

UPSC Prelims Practice Question

Ques : Consider the following statements about Soil Organic Carbon (SOC):

1. SOC is related to the chemical, physical, and biological properties of soil.

2. High SOC leads to micronutrient deficiency in soil.

3. SOC depletion can impact carbon credit potential.

Which of the statements are correct?

A. 1 and 2 only

B. 1 and 3 only

C. 2 and 3 only

D. All of the above

Ans : b)

UPSC Prelims Practice Question

Daily News Analysis

Ques : Discuss the role of soil organic carbon (SOC) in maintaining soil health, crop productivity, and climate mitigation. **(150 Words)**

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Daily News Analysis

The 30th Conference of the Parties (COP30) to the United Nations Framework Convention on Climate Change

COP30: beginner's guide on what to expect from the climate summit

COP30 is being called the 'Implementation COP' because it is expected to translate commitments into action. Guided by the Global Stocktake, the summit focuses on energy, industry, and transport transitions; stewardship of forests, oceans, and biodiversity; and transformation of food systems

Indu K. Murthy

A decade has passed since the member countries of the United Nations Framework Convention on Climate Change (UNFCCC) adopted the Paris Agreement – a milestone global pact that committed them to keeping the world's average surface temperature from rising well under 2°C and striving to limit it to 1.5°C above pre-industrial levels.

However, climate finance has lagged, global emissions continue to rise, and the gap between pledges and practice has only widened since.

Against the backdrop of record-breaking heat, intensifying climate impacts, and mounting public frustration with global inaction, the 30th Conference of the Parties (COP30) to the UNFCCC begins in Belém, Brazil, today.

It is both symbolic and strategic that COP30 is being hosted in Belém, which is a point of entry to the Amazon rainforest. The Amazon is one of the world's largest and most important carbon sinks (estimated at 150-200 billion tonnes) and biodiversity reserves on the planet – and it is threatened by deforestation and land conversion to non-forest use. As a result, it is tipping towards irreversible decline.

Equity and inclusion are central to climate negotiations. But paradoxically, even before the negotiations began, COP30 faced an unexpected test: inclusion. This is because Belém has limited logistical options, leaving hotel room rates to skyrocket and rendering it difficult for representatives from low-income nations and civil society organisations to participate. Such logistical exclusions have, in some ways, undercut the moral weight of the process.

'Implementation COP'

For starters, COP30 is being called the 'Implementation COP' because it is expected to be a watershed event where commitments are expected to be translated into concrete action. Guided by the Global Stocktake (GST) – which is a mandatory review that countries have to undertake every five years to assess their progress on addressing climate change, identify gaps, and draft plans – COP30 is expected to advance mitigation, adaptation, and means of implementation.

Its programme will thus focus on six key areas, including energy, industry, and transport transitions; stewardship of forests, oceans, and biodiversity; transformation of food systems; resilience in cities, infrastructure, and water; and human and social development.

The Baku-to-Belém Roadmap on Climate Finance is a plan led by the COP presidency, developed by Azerbaijan and Brazil under the UNFCCC's guidance, to show how countries and institutions could scale finance for developing nations to at least $1.3 trillion a year by 2035.

It's less a binding pledge and more a menu of actions to inform negotiations after the $300-billion New Collective Quantified Goal (NCQG) decision at COP29. Now, as the first major stocktake after the Roadmap, participants are looking at COP30 to set a new collective goal for 2035. In addition to revisiting emission reduction and climate finance goals, it's also expected to reaffirm the fact that protecting forests and indigenous communities is central to global climate resilience.

Ultimately, COP30 will seek to mobilise all actors to accelerate climate action.

Adaptation in negotiations

Climate adaptation is imperative for the survival of millions of people in the Global South. But because adaptation is context-specific, what works in a coastal delta is unlikely to work in a mountain village. As a result, negotiations surrounding the Global Goal on Adaptation (GGA) have been difficult. The GGA aims to establish quantifiable goals and metrics for resilience, organise funding that matches the need, and create a system for accounting and quantifying adaptation outcomes. This long-delayed framework is expected to be established at COP30.

As discussions progress, experts around the world emphasise the need to consider local and indigenous knowledge systems in this process. Across India, for example, traditional seed varieties, water-harvesting structures, and community based ecosystem restoration efforts offer proven models of resilience.

Finance: the missing piece

Under the Paris Agreement, economically developed countries pledged $100 billion per year to finance climate action in developing nations. At COP29, a breakthrough agreement called the NCQG on Climate Finance was reached. This target is expected to triple climate finance from $100 billion to $300 billion annually by 2035 and scale up finance from all actors, both public and private, to $1.3 trillion per year by 2035.

However, it should be noted that the $300 billion is significantly less than the estimated trillions of dollars needed by economically developing countries, with the latter arguing that the use of "all actors" to scale up finance has diluted the common but differentiated responsibilities principle, which also includes historical emissions. "All actors" means every potential source of climate finance, not just developed-country governments. It lumps together public treasuries, multilateral development banks, private investors, philanthropies, sub-national authorities, and even developing countries' own private sectors.

The Loss and Damage Fund, set up in COP28, is also grossly underfunded, receiving less than a billion dollars against an annual need running into hundreds of billions of dollars. For developing countries, this finance is an enabler of ambition, enhancing preparedness for extreme climate events, expanding climate-resilient agriculture, and accelerating the adoption of renewable energy.

COP30 is expected to finalise the reporting requirements and financing arrangements under the NCQG. One looming question at Belém is: will a credible pathway emerge for moving from the $300 billion to the $1.3 trillion target and build confidence in developing countries? And will Belém also finalise the modalities of finance: who will pay, who will gain, and how it will be accounted for?

Transition and ambition

Transitions must be fair as economies move towards net zero (i.e. that humans add no net greenhouse gases to the atmosphere over a period; emissions are reduced almost to zero, and any residual sources are balanced by removals, e.g. restoring forests and carbon capture) – and transformation can't be fuelled solely by finance. Access to reasonably priced technology and capacity building are equally important for many developing countries, be it efficient water systems, resilient crops, or clean energy, which are frequently hindered by high costs or intellectual property issues.

Beyond promises, COP30 should lead to North-South collaborations for training, innovation, and technology sharing. Otherwise, climate transition runs the risk of becoming yet another area of inequality. In countries like India, investments in low-carbon manufacturing, renewable energy, ecosystem restoration, green skills development, small businesses, and alternative livelihoods must all be part of a "just transition."

Countries were expected to update their Nationally Determined Contributions (NDCs) through 2035 and submit them by February 2025. However, according to Climate Action Tracker, many countries are yet to submit their reports. The ones submitted so far account for only 19% of global emissions.

Negotiations at COP30 are expected to address the insufficient ambition of climate targets and reveal whether countries are prepared to put aside rhetoric and match science and ambition, a significant challenge in the absence of climate finance.

Climate-nature nexus

A key spotlight of Belém is the long-overdue integration of climate and biodiversity agendas. Brazil is pushing for an innovative financing model for conservation, known as the 'Tropical Forest Forever Facility'. The proposal aims to compensate more than 70 developing countries with tropical forests for their efforts to preserve them.

This growing recognition that climate and biodiversity crises are interlinked could make climate finance more effective, directing funds to ecosystem restoration, agroforestry, and community-led conservation.

India at COP30

At Belém, India will be championing climate justice and the principle of common but differentiated responsibilities, urging developed nations to take the lead in emission cuts and financial support. In fact, at the mid-year climate talks in Bonn, India played a pivotal role in coordinating the G77+China bloc of developing countries to advocate for a fair and predictable finance goal under the NCQG framework.

This positioning reinforces India's role as both a responsible power and a representative of broader southern concerns while serving as a bridge between the Global North and South.

However, while India's domestic targets are ambitious, efforts in the institutional landscape remain a work in progress, as reflected in initiatives such as green budgeting, sovereign green bonds, and the proposed national carbon market expected by 2026.

This gap must be viewed in the context of India's developmental realities, which continue to shape its climate choices and actions.

The stakes could not be higher at COP30. The Amazon setting underscores the urgency of protecting the world's ecosystems while tackling emissions. For India, it is a moment to shape the conversation, striking a balance between domestic imperatives and global responsibilities. What unfolds in Belém will go a long way towards determining whether the international community can still bend the curve of emissions and whether emerging economies, such as India, can secure the space and support they need for economic growth that is resilient to climate change.

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(L-R) Finland President Alexander Stubb, Comoros President Assoumani Azali, Chile President Gabriel Boric, UN Secretary General Antonio Guterres, Brazil President Luiz Inacio Lula da Silva, and Governor of northern Brazilian state Para, Helder Barbalho, at the Leaders Summit ahead of the COP30 UN climate conference in Belem, Brazil on November 7. AFP

The stakes could not be higher at COP30. The Amazon setting underscores the urgency of protecting the world's ecosystems while tackling emissions. For India, it is a moment to shape the conversation, striking a balance between domestic imperatives and global responsibilities

A bird's eye view of Belém. AP

(UNFCCC) began in Belém, Brazil, amid intensifying climate impacts worldwide. A decade after the Paris Agreement, which aimed to limit global warming to well below 2°C and strive for 1.5°C above pre-industrial levels, global emissions continue to rise and climate finance lags behind commitments.

- COP30, symbolically hosted near the Amazon rainforest, a critical carbon sink and biodiversity hotspot, is being termed the 'Implementation COP', focusing on translating pledges into tangible action guided by the Global Stocktake (GST).

Key Highlights and Significance:

1. **Focus Areas:** COP30 is expected to advance mitigation, adaptation, and means of implementation across six thematic areas:
    - Energy, industry, and transport transitions toward low-carbon pathways.
    - Stewardship of forests, oceans, and biodiversity, including protection of indigenous communities.
    - Transformation of food systems for sustainability.
    - Resilience in cities, infrastructure, and water management.
    - Human and social development, ensuring a just transition.
2. **Climate Finance and the NCQG:**
    - Developing countries require trillions in finance, but commitments have lagged. COP29 set the New Collective Quantified Goal (NCQG) of $300 billion annually, aiming to scale up to $1.3 trillion by 2035.
    - COP30 will discuss mechanisms to mobilize public and private finance, clarify accountability, and ensure predictability for developing nations.
    - Adequate climate finance is critical for adaptation, renewable energy adoption, climate-resilient agriculture, and disaster preparedness.
3. **Adaptation and the Global Goal on Adaptation (GGA):**
    - Adaptation is context-specific and vital for the Global South, where extreme climate events threaten livelihoods.
    - COP30 is expected to finalize the GGA framework, including measurable metrics, funding mechanisms, and accounting systems.
    - Indigenous knowledge, traditional practices, and local resilience models, such as community-based water management in India, are central to effective adaptation.
4. **Transitions and Technology Access:**
    - Fair transitions to net-zero economies require access to affordable technology, capacity building, and innovation sharing, especially for developing countries.
    - Without technology transfer and capacity support, low-carbon transitions risk reinforcing global inequalities.
5. **Climate-Nature Nexus:**

- COP30 highlights the integration of climate and biodiversity agendas, including proposals like Brazil's 'Tropical Forest Forever Facility', which incentivizes tropical forest preservation.
- Recognizing the link between climate mitigation and ecosystem conservation is essential for effective and sustainable climate finance.

6. **India's Role:**
   - India is advocating for climate justice and the principle of common but differentiated responsibilities (CBDR), urging developed nations to lead in emissions reduction and financing.
   - India is also promoting domestic measures such as green budgeting, sovereign green bonds, and a proposed national carbon market by 2026, reflecting its dual role as a responsible emerging power and representative of Global South interests.

Conclusion:

COP30 is a pivotal moment in global climate governance, emphasizing implementation over rhetoric. With global temperatures rising, record-breaking heat events, and ecosystems under threat, Belém symbolizes the urgent need to protect carbon sinks and biodiversity while reducing emissions. For developing countries like India, COP30 is an opportunity to secure finance, technology, and support for a just transition, balancing developmental imperatives with climate responsibilities. The outcomes of COP30 will shape whether the world can bridge the gap between pledges and action and whether global climate governance can remain effective in achieving the 1.5°C target and fostering sustainable development for all.

UPSC Prelims Practice Question

Ques : Consider the following statements regarding COP30:

1. COP30 is being hosted in Belém, Brazil, near the Amazon rainforest.

2. COP30 is called the "Implementation COP" because it focuses on finalizing the Paris Agreement.

3. The Global Stocktake (GST) guides the discussions on climate action at COP30.

Which of the statements is/are correct?

A) 1 and 2 only

B) 1 and 3 only

C) 2 and 3 only

D) 1, 2 and 3

Ans: b)

UPSC Mains Practice Question

Ques: Examine India's role and priorities at COP30. How can India balance its developmental imperatives with global climate responsibilities? **(250 Words)**

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Daily News Analysis

Recent studies and observations indicate that climate change is accelerating, with multiple environmental systems

Warm-water corals are in an almost irreversible die-off from marine heatwaves, marking what could be the first climate tipping point. RSL

What's the latest in climate science?

Reuters

With the pace of climate change speeding up, extreme weather and other impacts are taking an increasing toll on populations and environments across the globe. Here are some of the developments this year.

Warmer, faster: Global temperatures are not just climbing, they are now climbing faster than before, with new records logged for 2023 and 2024, and at points in 2025. That finding was part of a study in June that updated baseline data used in the science reports done every few years by the UN Intergovernmental Panel on Climate Change. The new research shows the average global temperature rising at a rate of 0.27 C each decade, almost 50% faster than in the 1990s and 2000s when the warming rate was around 0.2 C per decade.

Sea levels are rising faster, at about 4.5 mm/year over the last decade compared to 1.85 mm/year measured across the decades since 1900. The world is now on track to cross the 1.5 C warming threshold around 2030, after which scientists have warned we will likely trigger irreversible consequences. Already, the world has warmed by 1.3-1.4 C since the pre-industrial era, according to the World Meteorological Organisation.

Tipping points: Warm-water corals are in an almost irreversible die-off from successive marine heatwaves, marking what would be the first so-called climate tipping point, when an environmental system begins to shift into a different state. Researchers in October also warned that the Amazon rainforest could begin to "die back" and transform into a different ecosystem, such as savannah, if rapid deforestation continues as global warming crosses 1.5 C.

They also said meltwater from the thawing ice sheet atop Greenland could help cause an earlier collapse in the ocean current called the Atlantic Meridional Overturning Circulation,

Global temperatures are climbing faster than before. That finding was part of a study that updated baseline data used in the science reports done every few years by the UN Panel on Climate Change

which keeps winters mild in Europe. In Antarctica, where ice sheets are also under threat, scientists are worried about declining sea ice surrounding the southernmost continent. Similar to what is happening in the Arctic, ice loss exposes dark water that can absorb more solar radiation, which amplifies the overall warming trend. It also jeopardises the growth of phytoplankton that consume much of the world's CO_2.

Along with heatwaves and drought, wildfires still threaten to be frequent and severe. This year's State of Wildfires report, led by a group of weather agencies and universities, counted some 3.7 million sq. km as having burned between March 2024 and February 2025, an area about the size of India and Norway combined.

That was slightly less than the annual average burned for the last two decades. But the fires produced higher CO_2 emissions than before.

Deadly heat: Researchers are working on ways to assess heat-related health risks and tolls, as U.N. health and weather agencies estimate about half the world's population is already struggling. The agencies also estimate worker productivity dropping 2-3% for every degree above 20 C, while another study in *The Lancet* in October estimated global losses of more than $1 trillion from that lost productivity for last year alone.

approaching critical thresholds or tipping points. Global average temperatures, sea-level rise, extreme weather events, and ecosystem degradation are occurring at rates faster than previously recorded. These trends underscore the urgent need for global climate action, adaptation, and mitigation strategies to prevent irreversible damage to both human and natural systems.

Key Developments:

1. **Rising Temperatures:**
   - The global average temperature is rising at approximately 0.27°C per decade, nearly 50% faster than in the 1990s and 2000s.
   - Since the pre-industrial era, global temperatures have risen by 1.3–1.4°C, and projections indicate the 1.5°C threshold could be crossed by 2030, heightening risks of irreversible impacts.
2. **Sea-Level Rise:**
   - Sea levels are increasing at 4.5 mm per year, compared to 1.85 mm/year over the 20th century.
   - Accelerated ice sheet melting in Greenland and Antarctica threatens coastal regions and disrupts ocean currents, such as the Atlantic Meridional Overturning Circulation, which moderates European winters.
3. **Tipping Points in Ecosystems:**
   - Warm-water corals are undergoing near-irreversible die-offs due to repeated marine heatwaves, marking the first potential climate tipping point.
   - The Amazon rainforest could shift to savannah-like ecosystems if deforestation and warming continue beyond 1.5°C.
   - Arctic and Antarctic ice loss reduces albedo, amplifying warming and threatening phytoplankton populations, critical for CO_2 absorption.
4. **Extreme Weather Events:**
   - Wildfires, heatwaves, and droughts continue to intensify. In 2024–25, about 3.7 million sq. km burned globally, producing higher CO_2 emissions than in previous years.
   - Heat-related mortality and productivity losses are increasing, with global economic losses exceeding $1 trillion in 2024 due to heat stress impacts on labor.
5. **Human and Societal Impacts:**
   - Half of the world's population is already experiencing heat stress, reducing workforce efficiency and impacting livelihoods.
   - These environmental changes exacerbate food insecurity, water scarcity, and health risks, especially in vulnerable regions.

Conclusion:

The latest climate science confirms that the world is approaching critical thresholds across multiple environmental systems, from coral reefs to ice sheets and tropical forests. The accelerating pace of warming, rising seas, and increasing extreme weather events highlight the need for urgent global mitigation, adaptation, and climate-resilient

development strategies. Policymakers must integrate these scientific findings into national and international climate action plans, ensuring that efforts to limit warming, enhance resilience, and protect ecosystems are evidence-based, equitable, and scalable. The coming decade is pivotal in determining whether humanity can avoid the most severe consequences of climate change.

UPSC Mains Practice Question

Ques: The world is approaching multiple climate tipping points, including the die-off of warm-water corals and potential dieback of the Amazon rainforest. Critically examine the concept of climate tipping points and discuss the implications of crossing these thresholds for global ecosystems and human societies. **(150 Words)**

Daily News Analysis

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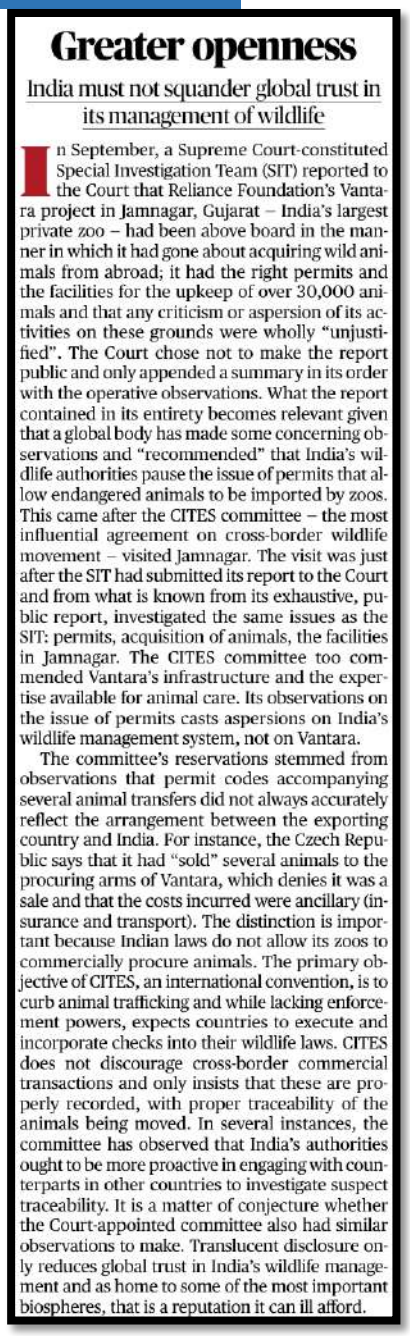
India's management of wildlife is under international scrutiny following the Supreme Court-constituted Special Investigation Team (SIT) report on Reliance Foundation's Vantara project in Jamnagar, Gujarat, India's largest private zoo.

- While the SIT concluded that the zoo had the necessary permits, infrastructure, and capacity for the care of over 30,000 animals, recent observations by the CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) committee have raised concerns about the accuracy of permit documentation for cross-border animal transfers.
- The issue highlights the need for greater transparency and engagement with international bodies to maintain global trust in India's wildlife governance.

Key Issues and Significance:

1. **SIT Report vs. CITES Observations:**
    - The SIT verified that Vantara's acquisition of animals was compliant with Indian law and infrastructure standards.
    - CITES, while commending the zoo's facilities and expertise, noted that permit codes did not always reflect the exact nature of the transactions, e.g., whether animals were "sold" or costs were ancillary (transport, insurance).
    - This discrepancy can cast doubts internationally about India's adherence to cross-border wildlife protocols.
2. **Legal and Regulatory Context:**
    - Indian law prohibits commercial procurement of wild animals by zoos.
    - CITES does not forbid commercial transactions but emphasizes accurate documentation, traceability, and transparency to curb illegal wildlife trade.
    - The observations indicate a need for proactive engagement by Indian authorities with exporting countries to verify records and traceability.
3. **Implications for Global Trust and Reputation:**
    - India is home to some of the world's richest biodiversity hotspots, including critical ecosystems that are globally significant.
    - Any opacity in reporting or weak traceability mechanisms can erode international confidence in India's wildlife governance.
    - Transparent disclosure of investigations and findings would strengthen credibility and facilitate India's leadership in global wildlife conservation initiatives.



Greater openness

India must not squander global trust in its management of wildlife

In September, a Supreme Court-constituted Special Investigation Team (SIT) reported to the Court that Reliance Foundation's Vantara project in Jamnagar, Gujarat – India's largest private zoo – had been above board in the manner in which it had gone about acquiring wild animals from abroad; it had the right permits and the facilities for the upkeep of over 30,000 animals and that any criticism or aspersion of its activities on these grounds were wholly "unjustified". The Court chose not to make the report public and only appended a summary in its order with the operative observations. What the report contained in its entirety becomes relevant given that a global body has made some concerning observations and "recommended" that India's wildlife authorities pause the issue of permits that allow endangered animals to be imported by zoos. This came after the CITES committee – the most influential agreement on cross-border wildlife movement – visited Jamnagar. The visit was just after the SIT had submitted its report to the Court and from what is known from its exhaustive, public report, investigated the same issues as the SIT: permits, acquisition of animals, the facilities in Jamnagar. The CITES committee too commended Vantara's infrastructure and the expertise available for animal care. Its observations on the issue of permits casts aspersions on India's wildlife management system, not on Vantara.

The committee's reservations stemmed from observations that permit codes accompanying several animal transfers did not always accurately reflect the arrangement between the exporting country and India. For instance, the Czech Republic says that it had "sold" several animals to the procuring arms of Vantara, which denies it was a sale and that the costs incurred were ancillary (insurance and transport). The distinction is important because Indian laws do not allow its zoos to commercially procure animals. The primary objective of CITES, an international convention, is to curb animal trafficking and while lacking enforcement powers, expects countries to execute and incorporate checks into their wildlife laws. CITES does not discourage cross-border commercial transactions and only insists that these are properly recorded, with proper traceability of the animals being moved. In several instances, the committee has observed that India's authorities ought to be more proactive in engaging with counterparts in other countries to investigate suspect traceability. It is a matter of conjecture whether the Court-appointed committee also had similar observations to make. Translucent disclosure only reduces global trust in India's wildlife management and as home to some of the most important biospheres, that is a reputation it can ill afford.

4. **Way Forward:**
    - Ensure complete, public reporting of wildlife investigations, including SIT findings, to pre-empt misinterpretations by international bodies.
    - Strengthen coordination with CITES and other exporting countries for verification of permits and traceability.
    - Enhance domestic regulations and monitoring mechanisms to ensure compliance with both Indian law and international conventions.

Conclusion:

India's wildlife management systems are robust in terms of infrastructure and expertise, as seen in Vantara, but maintaining global trust requires greater transparency and proactive engagement with international protocols like CITES. Accurate documentation, traceability of species, and open communication are essential not only to uphold India's legal framework but also to protect its global reputation as a steward of critical biodiversity. As India continues to engage in wildlife conservation at the global level, it must prioritize openness, accountability, and compliance to strengthen its credibility and leadership in conservation.

UPSC Prelims Practice Question

Ques: Under Indian law, which of the following is true regarding private zoos acquiring wild animals?

A) They can commercially purchase endangered species

B) They require permits and cannot engage in commercial procurement

C) They are exempt from international conventions

D) They need only approval from state forest departments

Ans : b)

UPSC Mains Practice Question

Ques: In the context of global wildlife conservation, discuss the importance of transparency and accountability in India's wildlife management. How can India strengthen international trust while complying with CITES? **(250 Words)**

NITIN SIR CLASSES

THE HINDU
INDIA'S NATIONAL NEWSPAPER SINCE 1878

Daily News Analysis

Page : 08 Editorial Analysis

Does India need nutritional transformation?

What are functional foods and smart proteins? Why is it necessary to ensure nutritional security? Which country was the first to approve the commercial sale of cultivated chicken? How is the smart protein ecosystem faring? How can public scepticisms about 'lab-food' be tackled?

EXPLAINER

Shambhavi Naik

The story so far:
Society's relationship with food and nutrition is constantly evolving. The next transformation involves functional foods and smart proteins.

What are functional foods?
Functional foods are enriched foods that promote health or prevent disease, such as vitamin-enriched rice or omega-3-fortified milk. Functional foods leverage several technologies such as nutrigenomics (the study of how nutrition interacts with genes), bio-fortification, 3D food printing, and bioprocessing.

Smart proteins refer to proteins sourced using biotechnology that aim to reduce reliance on conventional production. These include plant-based proteins (restructured extracts from legumes, cereals, or oilseeds to mimic animal meat and dairy); fermentation-derived proteins (produced by microbial systems); and cultivated meat (animal cells grown in bioreactors without slaughter).

Why does India need them?
India's nutritional landscape remains highly uneven. More than one-third of Indian children are stunted, and although adult protein intake has improved, an urban-rural divide remains. As the economy grows and household incomes increase, societal expectations from food will change from being simply filling to being genuinely nourishing. This shift demands a reorientation of India's policy from ensuring food security to nutritional security, providing food rich in proteins, antioxidants, and vitamins to meet health and developmental goals.

The challenge lies in achieving this nutritional transformation while balancing sustainability. India must scale food production systems without worsening environmental degradation or deepening climate change impacts.

GETTY IMAGES

Where does India stand today?
Functional foods and smart proteins are a thematic area recognised under India's Biotechnology for Economy, Environment, and Employment (BioE3) policy. The Department of Biotechnology (DBT) and its public-sector partner Biotechnology Industry Research Assistance Council (BIRAC) have initiated funding programmes in these areas.

On the functional food front, scientists are developing bio-fortified crops such as zinc-enriched rice (developed at IIRR, Hyderabad) and iron-rich pearl millet (from ICRISAT). Several private players – Tata Consumer Products, ITC, and Marico – are investing in fortified staples and health-focused food lines. The smart protein ecosystem is also growing. In 2023, there were an estimated 377 products (meat, eggs, or dairy) sold by over 70 smart protein brands across India. Startups such as GoodDot, Blue Tribe Foods, and Evo Foods are pioneering plant-based meat and egg alternatives. The Centre for Cellular and Molecular Biology has received a substantial ₹4.5 crore grant from the DBT for research on cultivated meat.

While both segments are developing in India, there are several gaps, most notably in regulatory clarity. The Food Safety and Standards Authority of India (FSSAI) is yet to issue definitive guidance on novel foods such as cultivated meat or precision-fermented proteins.

How are other countries faring?
In the 1980s, Japan was the first country to put forth the concept of functional foods and devise a framework for its regulation. Smart proteins on the other hand, are a more novel category of food. Singapore became the first country to approve the commercial sale of cultivated chicken in 2020. China has prioritised alternative proteins as part of its food-security and innovation agenda. The European Union is investing heavily in sustainable protein production through its "Farm to Fork" strategy.

What should be the way forward?
On the health front, functional foods and smart proteins will be vital contributors to India's nutritional security. On the economic front, the global plant-based foods market is estimated to be anywhere between $85 billion (as per UBS) and $240 billion (as per Credit Suisse) by 2030. India, with its strong agricultural base and expanding biotech industry, could play a major supplier. If that happens, these industries could generate thousands of agriculture, manufacturing, and logistics jobs within India. However, India risks either lagging in innovation or facing a flood of unverified, mislabelled products. The transition to biomanufacturing will demand major workforce upskilling to enable employment of agricultural workforce, and poor implementation could concentrate market power among a few large corporations. Public perception poses another challenge, and scepticism of "lab-made" food can only be overcome through transparent communication and public trust.

Therefore, a national regulatory framework for novel foods under FSSAI should provide clarity on definitions, safety evaluation, and labelling for functional and alternative protein products. Inter-ministerial coordination is also needed to ensure coherent policy support. Public-private partnerships can help scale biomanufacturing infrastructure and indigenise critical technologies such as precision fermentation. And finally, public education and inclusion of farmers in new value chains will be essential to ensure that biotechnology's benefits extend across society.

Shambhavi Naik is chairperson, Takshashila Institution's Health & Life Sciences Policy, and CEO at CloudKrate.

THE GIST

- Functional foods are enriched foods that promote health or prevent disease, such as vitamin-enriched rice or omega-3-fortified milk.
- In 2023, there were an estimated 377 products (meat, eggs, or dairy) sold by over 70 smart protein brands across India.
- On the health front, functional foods and smart proteins will be vital contributors to India's nutritional security.

GS. Paper 2 Social Justice

UPSC Mains Practice Question: Does India need a nutritional transformation? Discuss the role of functional foods and smart proteins in achieving nutritional security. **(150 Words)**

Daily News Analysis

Context :

India is at a critical juncture in its food and nutrition landscape. While the nation has made strides in ensuring food security, persistent malnutrition, protein deficiencies, and rising lifestyle-related health issues highlight the urgent need to shift focus toward nutritional security. The government's BioE3 policy framework envisions leveraging biotechnology to drive this transformation through functional foods and smart proteins, addressing health, economic, and environmental imperatives.

- Functional Foods: Functional foods are nutrient-enriched or fortified foods designed not only to provide calories but also to enhance health and prevent disease. They may contain vitamins, minerals, antioxidants, or other bioactive compounds supporting immunity, digestion, and heart health.

Technologies Used:

- **Nutrigenomics:** Studies how diet interacts with genes to optimize health.
- **Biofortification:** Enhances the nutrient content of crops during growth (e.g., iron-rich pearl millet, zinc-enriched rice).
- **Bioprocessing**: Uses microbes or enzymes to improve nutrient absorption and shelf life.
- **3D Food Printing:** Customizes food shape, texture, and nutrient content, especially for healthcare needs.

Smart Proteins: Smart proteins are biotechnology-derived proteins that provide sustainable alternatives to conventional meat, dairy, and eggs, reducing environmental impact while meeting protein demand.

Types:

- Plant-Based Proteins: Extracted from legumes, cereals, or oilseeds to mimic meat and dairy textures.
- Fermentation-Derived Proteins: Microbial systems produce proteins, enzymes, or fats identical to animal products.
- Cultivated Meat: Animal cells are grown in bioreactors, producing real meat without slaughter.

Daily News Analysis

India's Emerging Ecosystem:

- **Startups:** Over 70 companies, including GoodDot, Blue Tribe Foods, and Evo Foods, market 377 plant-based and alternative protein products.
- **Government Support:** DBT and BIRAC fund R&D in cultivated and fermentation-based proteins.
- **Research Milestones:** CCMB received ₹4.5 crore from DBT for cultivated meat research.
- **Private Sector Innovations:** Tata Consumer Products, ITC, and Marico invest in fortified staples and health-focused foods.

Why India Needs Nutritional Transformation:

- **Persistent Malnutrition:** Over 35% of children are stunted; 57% of women are anaemic (NFHS-5).
- **Protein Deficiency:** Average intake is 47 g/day vs. 60 g/day recommended by ICMR.
- **Changing Consumer Preferences:** Rising incomes and health awareness demand nutrient-dense and ethically produced foods.
- **Environmental Sustainability:** Traditional livestock farming contributes to 5% of global GHG emissions and strains land and water resources.
- **Economic Rationale:** Malnutrition costs India $12 billion annually in lost productivity (World Bank, 2023).

Global Experience:

- **Singapore:** First to approve cultivated chicken (2020).
- **European Union:** Promotes sustainable protein production under the "Farm to Fork" strategy.
- **Opportunity:** India can become a key player in the $85–240 billion global smart protein market by 2030.

Way Forward for India:

- **National Regulatory Framework:** FSSAI should establish clear safety, labelling, and quality standards for functional and novel foods.
- **Policy Coordination:** Align Agriculture, Biotechnology, and Health ministries to synergize innovation, regulation, and nutrition goals.
- **Public-Private Partnerships:** Scale biomanufacturing and precision fermentation, ensuring affordability and access.
- **Public Awareness:** Build trust in lab-grown foods through transparent communication and education campaigns.
- **Farmer Inclusion & Skill Development:** Integrate farmers into biofortification and alternative protein value chains to ensure inclusive growth.

Conclusion:

India's next food revolution must prioritize quality over quantity — nourishing its population while protecting the planet. By combining biotechnology, robust regulation, and public engagement, functional foods and smart proteins can bridge nutritional gaps, promote sustainable diets, and position India as a global hub for innovation in nutrition and sustainable food systems. A science-led, inclusive approach is critical to achieving health, environmental, and economic objectives simultaneously.