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Page 01:GS 1 : Art & Culture

Prime Minister Narendra Modi, at GangaikondaCholapuram during the AadiThiruvathirai festival, paid homage to the Chola emperors RajarajaChola and RajendraChola I, calling their legacy a roadmap for modern India's development—emphasising unity, defence, democracy, cultural integration, and heritage conservation.

Legacy of Chola dynasty provides road map for modern India: PM Modi

Prime Minister announces statues for Rajaraja Chola and Rajendra Chola I; like Cholas, India too accords high priority to national security, gave firm response during Operation Sindoor, he says

The Hindu Bureau
GANGAIKONDA CHOLAPURAM

Paying glowing tributes to the military might and administrative acumen of Chola dynasty emperors Rajendra Chola I and his father Rajaraja Chola, Prime Minister Narendra Modi on Sunday said the heights reached by the emperors were a source of inspiration, providing an ancient road map for India to become a developed nation.

"The economic and strategic advancements during the Chola era remain a source of inspiration to modern India. To become a developed nation, we must prioritise unity, strengthen our navy and defence forces, and look for new opportunities, while safeguarding our core values," Mr. Modi said at the valediction of the Aadi Thiruvathirai festival marking the birth anniversary of Rajendra Chola I at Gangaikonda Cholapuram in Tamil Nadu.

Mr. Modi also released a commemorative coin in honour of Rajendra Chola I. The king had built Gangaikonda Cholapuram, the ancient capital of the Imperial Cholas, along with the Brihadisvara Temple and the Cholagangam, a massive lake, after his victorious expedition to the Gangetic plains about 1,000 years ago.

Steeped in history: Prime Minister Narendra Modi at Brihadisvara Temple in Gangaikonda Cholapuram in Ariyalur on Sunday. SPECIAL ARRANGEMENT

The Prime Minister said the Centre would install grand statues of the two emperors in Tamil Nadu to serve as pillars of the country's historical consciousness. "The legacy of Rajaraja Chola and Rajendra Chola is synonymous with India's identity and pride. The history and heritage of the Chola Empire proclaim the true potential of India," he said.

Cholas' democracy

Rajaraja Chola built a powerful navy; his son Rajendra Chola I strengthened it. The Cholas strengthened local administration and established extensive trade and cultural links. The Chola rulers extended their diplomatic and trade relations to Sri Lanka, the Maldives, and Southeast Asia, he said.

India, too, accorded the highest priority to national security, Mr. Modi said, adding that during Operation Sindoor, the world witnessed the firm and decisive response of the country to any threat to its sovereignty.

Mr. Modi said the dynasty was not only known for its military strength but also for being the mother of democracy by introducing the *kudavolai* system of electing local representatives. The global discourse at present revolved around water management and ecology preservation, but our ancestors understood the importance of these issues long ago, he said, citing the water management systems created by the Cholas.

"The Chola rulers had woven a thread of cultural unity. Our government is carrying forward their ideals," he said, referring to the conduct of the Kashi Tamil Sangamam and the Saurashtra Tamil Sangamam to reinforce the centuries-old bonds of unity. Over the past decade, the nation had worked in mission mode to preserve its cultural legacy. About 600 ancient statues and artefacts, which were stolen and sold abroad, had been brought back to India since 2014. Of them, 36 belonged to Tamil Nadu.

Tamil Nadu Governor R.N. Ravi, Union Minister of State for Information and Broadcasting L. Murugan, State Ministers Thangam Thennarasu and S.S. Sivasankar, and Chidambaram Lok Sabha Member Thol. Thirumavalavan were present.

Significance of the Chola Dynasty in Indian History

Administrative and Military Excellence:

- The Cholas had a highly organised administrative system, including local self-government through village assemblies.

- They built a formidable navy, projecting power across Southeast Asia (Srivijaya empire, modern Indonesia and Malaysia).
- Emphasis on strategic expansion, including military expeditions to Sri Lanka and the Gangetic plains.

Democratic Foundations:

- Cholas introduced the Kudavolai system, a form of electoral democracy at the local level—arguably an early expression of participatory governance.
- Inscriptions at Uttaramerur temple testify to detailed norms for elections and public accountability.

Cultural Unity and Soft Power:

- Promoted Tamil literature, art, and temple architecture (e.g., Brihadisvara Temple).
- Established cultural links with Southeast Asia—projecting India's soft power long before the modern era.

Water Management and Ecology:

- Constructed intricate water harvesting systems (e.g., Cholagangam lake).
- Embodied principles of sustainable development and resource management, which resonate with present-day ecological concerns.

Modern Parallels

National Security:

- PM Modi compared the Chola naval strategy to India's current emphasis on maritime security (e.g., Indian Ocean outreach, SAGAR doctrine).
- Linked to Operation Sindoor, showcasing India's readiness to defend its sovereignty—drawing parallels with the Chola navy's strategic role.

Revival of Cultural Heritage:

- Mention of retrieval of 600 stolen artefacts since 2014 (36 from Tamil Nadu).
- Emphasis on cultural diplomacy and national pride—connecting with events like Kashi Tamil Sangamam and Saurashtra Tamil Sangamam.

Statue Announcements:

- Grand statues of RajarajaChola and RajendraChola I to be installed—an act of national historical assertion and cultural identity building.

Conclusion:

The Prime Minister's speech is a strategic blend of history and nation-building narrative. By positioning the Cholas as paragons of military, administrative, and cultural prowess, the government seeks to invoke historical pride while drawing policy parallels—a move with both cultural and political resonance in contemporary India.

UPSC Mains Practice Question

Ques: The Chola dynasty exemplifies the integration of strong governance, maritime prowess, and cultural unity. Discuss the relevance of the Chola model for modern India's aspirations to become a global power. **(250 words)**

Page 06:GS 3 : Indian Economy

Prime Minister Narendra Modi's recent *Mann Ki Baat* highlights India's evolving strengths, particularly in the textile sector, scientific innovation, cultural preservation, and civic engagement. This provides insights into key government narratives and developmental priorities.

Textile sector is emerging as strength of the country: Modi

In *Mann Ki Baat* address, PM says start-ups are lending global stature to India's handloom identity; he also underscores the rising interest in science among children post-Chandrayaan-3 launch

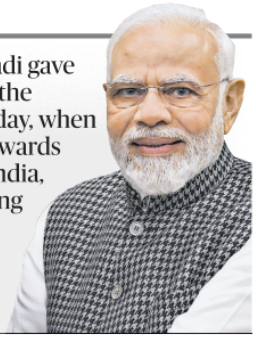
The Hindu Bureau
NEW DELHI

Prime Minister Narendra Modi said on Sunday that the textile industry, which was an expression of India's cultural diversity, now had more than 3,000 active start-ups, and the driving force behind its rapid growth were women from villages, designers from cities, elderly weavers, and young entrepreneurs.

During the *Mann Ki Baat* address, Mr. Modi said start-ups had given global stature to India's handloom identity. Commenting on the 10th anniversary of National Handloom Day, which is celebrated on August 7 every year to commemorate the launch of the Swadeshi movement in 1905, he said, "Just like Khadi gave new strength to the freedom movement ..., today as the country progresses towards becoming a developed nation, the textile sector is turning out to be the country's strength."

"In these 10 years, lakhs of people associated with this sector have scripted many success stories," he said, citing the example of Kavita Dhawale from Paithan village in Maharashtra, who, with government support, is now earning three times more by selling self-made Paithani saris. About 650 tribal women from Mayurbhanj (Odisha) have revived the Santhali sari. The family of Naveen Kumar from Nalanda (Bihar), who has been associated with the sector for generations, has incorporated a modern approach to transform the business.

> Just like our Khadi gave new strength to the freedom movement... today, when the country is moving towards becoming a developed India, the textile sector is turning out to be the strength of the country
>
> **NARENDRA MODI**
> Prime Minister



Referring to Group Captain Shubhanshu Shukla's return from space, Mr. Modi said the entire country was filled with pride. He said the Inspire-Manak Abhiyan scheme – in which five children are selected from each school – had promoted innovation among youngsters. After Chandrayaan-3's launch, the number of children joining the campaign had doubled. The number of start-ups in the space sector grew from 50 to 200 in just five years.

The Prime Minister praised Devesh Pankaj, Sandeep Kuchi, Debdutt Priyadarshi, and Ujjwal Kesari for winning medals in the International Chemistry Olympiad.

Mr. Modi also spoke about 12 Maratha forts which have been recognised by UNESCO as World Heritage Sites.

Paying homage to Khudiram Bose, the 18-year-old freedom fighter who was hanged on August 11, 1908, in Muzaffarpur, Bihar, Mr. Modi said, "Inside the jail, British officers were preparing to hang a young man. There was no fear on the face of that youth; rather it was full of pride ..."

On wildlife conservation, the Prime Minister said that for the first time, a grassland bird census had been conducted in Kaziranga National Park (Assam) and 40 species were identified using sound recording devices and AI.

On the cleanliness drive, he said this year, more than 4,500 cities and towns had joined and over 15 crore people participated all over the country. " ... Amid the showers of Sawan, the country is once again going to be adorned by the fervour of festivals.... many best wishes to all of you for these holy festivals," he added.

1. Textile Sector: Emerging as a Strategic Strength

Key Highlights:

- Over 3,000 active start-ups in the textile space.

- Women from villages, elderly weavers, and young designers are driving growth.
- Textile sector is now being equated to Khadi's role in the freedom movement.
- Celebrated as part of the 10th National Handloom Day, linked to the 1905 Swadeshi Movement.

Significance:

- Socio-economic empowerment: Highlights rural entrepreneurship, especially women-led enterprises (e.g., KavitaDhawale's success with Paithani saris).
- Revival of tribal and traditional crafts: E.g., Santhali sari by tribal women of Mayurbhanj.
- Fusion of tradition with modernity: As seen in modernized practices by families like Naveen Kumar's in Nalanda.

2. Science and Innovation: Nurturing Scientific Temper

Highlights:

- Space sector start-ups grew from 50 to 200 in five years.
- After Chandrayaan-3, interest in science among children surged.
- Inspire-ManakAbhiyan encourages school-level innovation.

Implications:

- A robust STEM ecosystem is taking shape.
- Promotion of scientific temper and innovation aligns with constitutional duties (Art. 51A).
- Start-up boom reflects India's transition towards a knowledge economy.

3. Heritage and Cultural Identity

UNESCO recognition of 12 Maratha forts:

- Emphasizes India's civilizational legacy and global recognition.
- Promotes cultural tourism, regional pride, and heritage conservation.

Homage to Khudiram Bose:

- Revisits freedom struggle narratives to inspire nationalism among youth.

4. Wildlife and Environmental Conservation

Kaziranga National Park bird census:

- First-time use of AI and sound recording to identify 40 grassland bird species.
- Reflects integration of technology in conservation efforts.

5. Civic Participation and Swachh Bharat

15 crore people participated in cleanliness drives:

- Over 4,500 cities and towns involved.
- Reflects growing community engagement and behavioral change.

Conclusion:

PM Modi's address underlines the government's holistic development approach — from economic empowerment and scientific progress to cultural revival and ecological awareness. These initiatives are not only transformative at the grassroots but also help project India's identity globally.

UPSC Prelims Practice Question

Ques: With reference to India's textile sector, consider the following statements:

1. National Handloom Day is celebrated to commemorate the launch of the Non-Cooperation Movement.

2. Over 3,000 start-ups are currently active in the textile sector.

3. The revival of the Santhali sari is credited to tribal women from Jharkhand.

4. KavitaDhawale from Maharashtra has been successful in promoting Paithani saris with government support.

Which of the statements given above are correct?

A. 1, 2, and 3 B. 2 and 4 only

C. 1 and 3 only D. 2, 3, and 4

Answer: B)

Page : 09 :GS 3 : Science & Technology

The healthcare sector is undergoing rapid transformation due to AI, digital health, and personalised medicine. Yet, medical professionals—despite their intimate understanding of patient care—are often sidelined in the innovation process. The article argues for a paradigm shift toward doctor-led innovation to create solutions that are both clinically relevant and technologically advanced.

The need for doctor-led innovation

Dr Abdul Ghafur

Consultant in Infectious Diseases, Apollo Hospital, Chennai, and Lead Strategist, QuorumVeda Consulting Services

Y.K.Gupta

National Scientific Co-ordinator, Pharmacovigilance Programme of India

The world of medicine is evolving at an unprecedented pace, fuelled by advancements in artificial intelligence, digital health, and personalised medicine. However, despite the transformative changes, medical professionals often find themselves on the periphery of innovation. Engineers and entrepreneurs increasingly shape the future of healthcare, while doctors are largely confined to their roles as service providers, rather than creators of new medical solutions. This paradigm needs to change if we are to foster the next generation of medical breakthroughs and solve the pressing challenges of our time.

Why doctors must innovate

Medical professionals, with their deep understanding of patient care, clinical workflows, and treatment protocols, are ideally positioned to drive innovation. Healthcare systems worldwide are under increasing pressure to meet the demands of rising patient populations, chronic diseases, and limited resources. By leveraging their insights, doctors can create solutions that address these systemic issues. Doctor-led innovation would ensure that new technologies are not only groundbreaking but also clinically applicable.

However, medical professionals face several obstacles in becoming entrepreneurs. The demanding nature of medical practice, combined with patient care and administrative responsibilities, leaves little time for innovation. Medicine is also inherently risk-averse, to ensure the safest possible care. This cautious mindset contrasts sharply with the risk-taking required in innovation. The discomfort with uncertainty and failure can deter doctors from pursuing entrepreneurship.

Moreover, a lack of exposure to financial management and product development further hinders doctors' transition into entrepreneurship. Medical education is primarily clinical, leaving professionals unprepared for the complexities of creating healthcare solutions. Many doctors also perceive innovation as the domain of engineers. Despite these challenges, successful examples of doctors who have become deep-tech entrepreneurs show that combining both areas is possible.

Engineers and entrepreneurs increasingly shape the future of healthcare, while doctors are largely confined to their roles as service providers, rather than creators of new medical solutions. This paradigm needs to change

While starting a clinic or hospital is a form of entrepreneurship, the primarily focus is on conventional service delivery rather than disruptive innovation. While clinics and hospitals enhance healthcare access, they do not fundamentally transform medical practice. True innovation involves developing new treatment methods, medical devices, or digital health solutions that redefine patient care.

This means medical colleges must introduce courses in entrepreneurship, bio-design, and digital health. The curriculum should encourage entrepreneurial thinking alongside clinical practice. Interdisciplinary collaborations between medical and engineering students would enable doctors to understand product development while allowing engineers to gain clinical insights. Innovation hubs and incubators should support problem-solving in healthcare.

Internships in biotech incubators should be integrated into medical education, exposing doctors to startup environments and the commercialisation of healthcare innovations. Hospitals should establish innovation hubs to help doctors test new ideas. Mentorship programmes must connect medical professionals with engineers and funding sources to help them navigate regulatory pathways. Government incentives and streamlined regulatory processes should support med-tech startups to ensure financial and bureaucratic barriers do not stifle innovation.

In India, MedTech entrepreneurs benefit from a wide array of supportive systems aimed at fostering innovation and growth. Government initiatives such as the Biotechnology Industry Research Assistance Council, Startup India, and Atal Innovation Mission offer funding, grants, and infrastructure support, while incubators such as the Centre for Cellular and Molecular Platforms, Venture Center, and the Bangalore Bioinnovation Centre, provide mentorship, research and development facilities, and financial assistance. The Make in India initiative supports MedTech entrepreneurs by promoting local manufacturing, reducing reliance on imports, and offering incentives such as tax benefits and easier regulatory approvals for domestic production of medical devices. Academic collaborations with institutions such as the Indian Institutes of Technology and the Indian Institute of Science drive innovation through research partnerships. The India Health Fund, supported by Tata Trusts, finances innovations in healthcare, particularly in infectious diseases.

The path forward

Innovation in healthcare is no longer optional; it is essential. Doctors must take charge, not just as caregivers but as entrepreneurs and problem-solvers. To facilitate this shift, medical professionals should enrol in short-term courses on product development. Hospitals and medical associations should foster an environment that is innovation-friendly by establishing dedicated funds and organising events where doctors can present ideas to investors. De-stigmatising failure in medical entrepreneurship is crucial. Just as failed experiments contribute to scientific progress, unsuccessful startups provide lessons for future success. The medical community must embrace calculated risk-taking and take ownership of healthcare's future. The white coat should not only represent clinical expertise but also leadership in healthcare innovation.

Why Doctor-led Innovation is Necessary

- **Clinical Insight:** Doctors understand the intricacies of patient care, clinical workflows, and systemic challenges better than engineers or policymakers.

- **Improved Relevance:** Innovations by doctors are likely to be more practical, patient-centric, and applicable in real-world clinical settings.
- **Systemic Challenges:** With rising chronic diseases, ageing populations, and limited healthcare resources, innovative solutions are vital to enhance efficiency and accessibility.

Challenges Faced by Doctors in Becoming Innovators

1. **Time Constraints:** Medical practice is time-intensive, leaving little room for entrepreneurial efforts.
2. **Risk Aversion:** The medical field prioritises safety, which conflicts with the trial-and-error nature of innovation.
3. **Lack of Training:** Medical curricula lack exposure to:
    - Financial planning
    - Product development
    - Entrepreneurial thinking
4. Perception Barrier: Innovation is often seen as the domain of engineers, not physicians.

Current Ecosystem Supporting MedTech in India

- **Government Initiatives:**
    - Startup India
    - Atal Innovation Mission (AIM)
    - Biotechnology Industry Research Assistance Council (BIRAC)
- **Incubators:**
    - Centre for Cellular and Molecular Platforms (C-CAMP)
    - Bangalore Bioinnovation Centre
    - Venture Center
- **Industry-Academic Collaboration:**
    - IITs and IISc are actively engaging in joint research and development in MedTech.
- **Private Initiatives:**
    - India Health Fund (Tata Trusts) supports healthcare startups, especially in infectious diseases.
- Make in India: Promotes domestic production of medical devices through incentives and easier regulatory pathways.

The Way Forward

1. Educational Reforms

- Introduce entrepreneurship, bio-design, and digital health into the MBBS curriculum.
- Encourage interdisciplinary collaboration between medical and engineering students.

2. Institutional Mechanisms

- Hospitals should set up innovation hubs and incubators.
- Create mentorship programs linking doctors, engineers, and investors.
- Promote internships in biotech and healthcare startups for medical students.

3. Policy and Funding Support

- Government incentives and seed funding for doctor-led startups.
- Streamline regulatory approvals for medical devices and digital solutions.

4. Cultural Shift in Medicine

- De-stigmatise failure in medical entrepreneurship.
- Encourage a mindset of calculated risk-taking and experimentation.
- Recognise doctors as leaders and change-makers, not just caregivers.

Conclusion

Doctor-led innovation is not just a desirable trend but a necessity for a resilient and self-reliant healthcare system. By equipping medical professionals with tools for entrepreneurship and enabling an ecosystem of support, India can drive inclusive, accessible, and sustainable healthcare innovation. The white coat must also symbolize leadership in innovation, not just clinical practice.

UPSC Mains Practice Question

Ques: Evaluate the role of interdisciplinary collaboration in fostering innovation in healthcare. In this context, discuss the importance of doctor-engineer partnerships in solving India's healthcare problems.

Page 10 :GS – 3 – Disaster Management

The recent GLOF event in Nepal's Lende River basin (July 2024), which destroyed a China-built bridge and damaged key hydropower infrastructure, has reignited concerns over the growing risk of Glacial Lake Outburst Floods (GLOFs) in the Himalayan region. With climate change accelerating glacial melt, the Indian Himalayan Region (IHR) — home to over 7,500 glacial lakes — faces an escalating threat, demanding urgent attention towards early warning systems, risk assessment, and community-level preparedness.

How is India preparing against GLOF events?

How many Glacial Lake Outburst Flood events has Nepal witnessed in recent times? What are the two most prominent types of glacial lakes found in the Indian Himalayan Region? How is the National Disaster Management Authority mitigating risks associated with GLOF events?

EXPLAINER

Safi Ahsan Rizvi

The story so far:

On July 8, Nepal experienced a catastrophic Glacial Lake Outburst Floods (GLOF) event which caused a flash flood along the Lende river, flowing from Tibet to Nepal, and washed away a China-built friendship bridge. The bridge had serviced the 10-year old inland container port at Rasuwagadhi in Rasuwa (north of Kathmandu). The catastrophe is also reported to have made four Nepalese hydro-power plants along the Bhote Koshi river unusable, obliterating 8% of the country's power supply. With rising temperatures and subsequent glacial melt, the increased risk of GLOF's is threatening life and property in the higher Himalayas.

Do trans-boundary watersheds diminish possibilities of early warning?

While Chinese authorities have as yet refrained from confirming the cause, most Nepalese scientists and officials confirmed a GLOF event in Tibet, where a supra-glacial lake had burst, diminishing its surface area to 43 hectares from 63 hectares a day before. Nepalese officials were quoted lamenting in local media that neither did the Chinese authorities provide an early warning, nor was there an established system of doing so, despite a recent increase in supra-glacial lakes on the Tibetan side.

Hours later, on the same day, another GLOF event occurred at a moraine-dammed lake in the northern part of the Mustang district in Nepal (north-west of Kathmandu). Two months before, two glacial lakes in the Humla district (far-north corner of Nepal) had witnessed significant GLOF events, while in 2024, a GLOF in the Solukhumbu district had destroyed the Thame village in Nepal, the base camp for Mount Everest climbers. The need for trans-boundary collaborations in setting up early warning protocols seems paramount, given that Nepal has lost many lives and much infrastructure in successive GLOF events.

Similar events have impacted Nepal regularly, including the GLOF in Cirenma Co, a glacial lake, in Tibet in 1981, which released 20 mcm of water raising the Bhote Koshi river by 30 metres. Several decades later the same lake was reported to have rejuvenated and was rated high-risk. Other significant events include the Dig Tsho GLOF event in 1985, and the Tama Pokhari GLOF event in 1998. In response, Nepal has conducted risk mitigation works on the Imja Tsho and Tsho Rolpa lakes by drawing down water levels through artificial channels, a challenging task at heights above 5,000 m, and has further plans to target half a dozen more at-risk glacial lakes.

What is the nature of GLOF risk for India?

As per India's National Remote Sensing Centre, the Indian Himalayan Region (IHR) is home to 11 river basins and 28,000 glacial lakes. There are two prominent types of glacial lakes found in the IHR. The first are supraglacial lakes, formed in depressions on glaciers from meltwater, highly prone to melting in the summer months. The second are moraine-dammed lakes, formed by meltwater at the toe/snout of a glacier, dammed by loose debris or ice-cores, making them prone to sudden failure.

Definite risk: The south-end of the Shako Cho lake (5,200 m) in north Sikkim. The south-end shows the weak debris that forms its moraine-dam. NDMA

Almost two-thirds of GLOF events are triggered by ice avalanches or landslides, and the remaining due to excessive meltwater pressure on weak moraine dams and earthquakes.

With 2023 and 2024 being the hottest years on Earth, extreme temperatures in smaller geographies have been higher, thereby causing more glacial melt in certain pockets, making some glacial lakes highly risky.

In addition to rising heat, is the problem of scale. 7,500 glacial lakes are situated in India, with most above 4,500 metres in height, hence approachable for surveys only during a short window in the summer season. There are almost no weather and water monitoring stations in these regions due to inaccessibility, lack of sustainability and cost, leaving this growing risk largely unmapped.

The only credible means is measuring growth in surface area via remote sensing over periods of time, a measure which is post facto and provides little by way of risk assessment or early warning of any sort.

Additionally, vulnerability of the immediate geography is critical to determining the exact nature of risk. This includes damage to homesteads, livelihoods, biodiversity, bridges and hydro-power projects along rivers that relay GLOFs downstream. The South Lhonak GLOF in 2023 in Sikkim wiped out the $2 billion and 1250 MW generating Chungthang dam and also intensified the flash flood causing massive silting downstream. Since then, the Central Water Commission has found that the Teesta riverbed has risen several metres, significantly reducing its carrying capacity and increasing the chances of its banks overflowing.

Besides the Sikkim GLOF, one of the most damaging events in recent times was the Chorabari GLOF in 2013, which turned into a cascading disaster accompanied by cloudbursts and landslides, known as the Kedarnath catastrophe – causing hundreds of casualties and billions in infrastructure damage.

How can India reduce GLOF risk?

The National Disaster Management Authority (NDMA) has markedly accelerated its efforts to manage these increasing risks. With respect to mitigation, it has initiated a proactive shift from mere post-disaster response to risk reduction through its Committee on Disaster Risk Reduction (CoDRR). This national coordination effort brought together related central scientific agencies, academic and research institutions, and States/UTs to study, monitor, warn, and mitigate GLOF risk in India. As a result, the central government finalised its first national programme of $20 million, prioritising 56 at-risk glacial lakes. The list has now been expanded to 195, categorised into four risk levels. Following the expected award of the 16th Finance Commission for the period FY2027 to FY2031, there are plans to scale up this programme, significantly.

Objectives of this programme are five-fold – hazard assessment of each at-risk lake; installing Automated Weather and Water Stations (AWWS); establishing Early Warning Systems (EWS) downstream; mitigating risk by drawing down water levels or building flow through retention structures; and community engagement, an essential element of risk reduction. Under the programme, States where glacial lakes are resident were encouraged to take the lead in sending scientific expeditions to 40 of the highest at-risk lakes in the summer of 2024.

One of the critical parameters in the exercise was to encourage Indian technology, systems and scientific expertise, one of which is the science of SAR interferometry – the art of analysing micro-changes in slope stability (upto a centimetre) using remote sensing satellite imagery as high as 10-metre resolution. The near-absence of usage of this scientific method to predict GLOFs and landslides is an identified gap that needs to be plugged through this programme. Another significant gap is the absence of well-resourced Indian foundations and innovative technology providers in the business of risk reduction in the Himalayan cryosphere.

What is status of mitigation efforts?

Several multi-institutional expeditions returned with success stories, across J&K, Ladakh, Himachal Pradesh, Uttarakhand, Sikkim and Arunachal Pradesh with a couple of light-hearted tales for their archives. One such expedition lost its way in bad weather, and another had to leave behind an expedition member in the village as security so that the rest of the expedition did not pollute the sacred lake by entering its holy waters. These episodes were evidence of the critical need for community engagement, to integrate the local community in expeditions and the need to convince residents of the credibility and sincerity of the exercise.

The successful expeditions conducted bathymetry to assess the volume of water in the lakes; used Electrical Resistivity Tomography (ERT) to understand the existence of ice-cores under moraine-dams, a key reason for dam breaks; and performed UAV and slope surveys of surrounding land/ice forms. Monitoring stations were installed at two lakes in Sikkim, which relay weather and water data every 10 minutes, with a daily dose of pictures of both ends of the lake and its shoreline. In subsequent summers, States will be installing more such systems, thereby overcoming an oft repeated data-gap in the IHR cryosphere. In the absence of automated early warning mechanisms, Indo Tibetan Border Police (ITBP) deployments in high reaches have been oriented towards the role of manual early warning. After the monsoon this year, States/UTs are gearing up for another round of expeditions.

Safi Ahsan Rizvi is an IFS officer and adviser to the NDMA.

THE GIST

As per India's National Remote Sensing Centre, the Indian Himalayan Region (IHR) is home to 11 river basins and 28,000 glacial lakes.

The National Disaster Management Authority (NDMA) has markedly accelerated its efforts to manage these increasing risks. With respect to mitigation, it has initiated a proactive shift from mere post-disaster response to risk reduction through its Committee on Disaster Risk Reduction (CoDRR).

One of the critical parameters in the exercise was to encourage Indian technology, systems and scientific expertise, one of which is the science of SAR interferometry.

Recent GLOF Events in Nepal:

Nepal has witnessed at least 4 significant GLOF events in 2024 alone:

- Lende River (July 2024): Destroyed a key inland port and hydropower plants.
- Mustang (same day): Moraine-dam breach.

- Humla district (May 2024): Twin GLOFs in high-risk glacial lakes.
- Solukhumbu (early 2024): Wiped out Thame village, a base for Everest expeditions.

These are in addition to historical disasters like Digi Tsho (1985) and Tama Pokhari (1998). Despite mitigation attempts at ImjaTsho and TshoRolpa, Nepal struggles due to lack of trans-boundary early warning protocols, particularly from upstream China.

Types of Glacial Lakes in Indian Himalayas:

The IHR, which spans 11 river basins and 28,000+ glacial lakes, primarily has two GLOF-prone lake types:

1. Supraglacial lakes: Formed on glacier surfaces, prone to intense summer melt.
2. Moraine-dammed lakes: Formed at glacier snouts, dammed by loose debris or ice-cores — structurally weak and highly prone to outbursts.

Nature of GLOF Risk in India:

- High-altitude inaccessibility (above 4,500 m) restricts regular monitoring.
- Lack of automated stations makes early warning nearly impossible.
- Satellite data helps track glacial lake expansion, but only post-facto.
- GLOFs impact infrastructure, river morphology, biodiversity and human settlements — as seen in:
    - South Lhonak GLOF (Sikkim, 2023): Destroyed Chungthang dam.
    - Kedarnath GLOF (2013): Led to cascading floods and mass casualties.

India's Institutional Response:

NDMA-Led Mitigation Plan:

The National Disaster Management Authority (NDMA) has shifted from reactive to proactive GLOF risk management:

- Launched a $20 million national programme, now expanded to 195 high-risk lakes (classified into 4 risk levels).
- To be significantly scaled after 16th Finance Commission (2027–2031).

Five Key Objectives:

1. Hazard assessment of individual lakes.
2. Installation of Automated Weather and Water Stations (AWWS).
3. Establishing Early Warning Systems (EWS) for downstream communities.
4. Risk mitigation via water drawdown or retention structures.
5. Community engagement, critical for local trust and sustainability.

Scientific & Technological Efforts:

- Use of SAR interferometry to detect slope stability changes.
- Electrical Resistivity Tomography (ERT) to identify ice cores under moraine dams.
- UAV mapping and bathymetry for water volume and terrain data.
- AWWS installed in two Sikkim lakes transmit 10-minute updates and daily images.
- In absence of automation, ITBP acts as manual early-warning network.

Challenges:

- Lack of trans-boundary coordination, particularly with China, limits early warnings.
- Data gaps and limited ground infrastructure hinder real-time risk assessments.
- Absence of private sector and innovation ecosystem in Himalayan cryosphere risk management.
- Local beliefs and logistical hardships pose obstacles for scientific teams.

Conclusion:

The Himalayas, often referred to as the Third Pole, are experiencing a climate crisis with rising GLOF threats. India's multidisciplinary approach through NDMA, leveraging indigenous technology, scientific expertise, and local participation, is a critical step forward. However, international collaboration, especially with China and Nepal, along with scaling community-centric adaptive strategies, is indispensable to safeguarding fragile mountain ecologies and vulnerable downstream populations.

UPSC Prelims Practice Question

Ques: Discuss the geomorphological and climatic factors responsible for Glacial Lake Outburst Floods (GLOFs) in the Indian Himalayan Region. How do they differ from other types of floods?

Page 12:GS 3 : Environment

India is increasingly grappling with climate-induced extreme events—flash floods, landslides, droughts, and erratic monsoons—that have not only become more frequent and intense, but also harder to predict. Between 2019–2023, India suffered over $56 billion in climate-related losses, nearly a quarter of Asia-Pacific's total. In this context, parametric insurance has emerged as an innovative financial tool to build climate resilience and economic security, particularly in vulnerable sectors like agriculture and renewable energy.

ILLUSTRATION: SAINATH B.

India's emerging shield against the climate crisis

As extreme events become more frequent and harder to predict, conventional insurance models need a fundamentally different approach ; parametric insurance offers an alternative

CLIMATE OF SAFETY

Tarun Mathur

In the span of a few days, Himachal Pradesh was battered by over 20 flash floods, series of landslides, and cloudbursts, events that upended daily life and damaged critical infrastructure in the State. Events like these are now part of an unsettling pattern. The return period for such catastrophic weather events is shortening, making them more frequent, and far less predictable.

India recorded 764 major natural disasters since 1900 with almost half of them occurring after 2000. A clear pattern is emerging: climate volatility and global warming are accelerating and with them, scale and complexity of economic disruption.

Between 2019 and 2023 alone, India suffered over $56 billion in losses from weather-related disasters. That's nearly a quarter of all climate losses in the Asia-Pacific during the same period and the highest in South Asia by far.

As extreme events become both more frequent and harder to predict, conventional insurance models need a fundamentally different approach

Parametric insurance offers an alternative built for speed and clarity. It pays out the moment a predefined threshold is breached – rainfall crossing a certain mark, seismic activity above a set magnitude or wind speed crossing destructive limits. Payouts are triggered automatically, based on independently-verified data, and given within hours.

> Parametric cover is finding applications across transportation, manufacturing and even livestock farming where claim delays can lead to financial stress

> Globally, countries in Africa, the Pacific Islands, and even U.K. have used parametric products to cover everything from droughts and floods to cyclone winds

How it works

At its core, parametric insurance is a simple proposition: it pays out when a pre-agreed index threshold is breached.

These thresholds, such as rainfall below a certain level or temperatures above a critical mark, are based on verified data from sources like the India Meteorological Department, NASA MERRA or other accredited global satellite systems. Everything, from trigger to payout, is defined upfront.

This is finding application across transportation, manufacturing and even livestock farming where claim delays can hugely compound financial stress.

A microfinance institution in Jharkhand, for instance, could structure a parametric policy that automatically covers loan repayments for small farmers if rainfall during the sowing season falls below 300 mm or temperatures cross 40°C.

This would help protect income during weather extremes, without requiring damage inspections.

Even in emerging sectors like renewable energy, such insurance has a role to play. A solar power firm operating in Rajasthan can link its policy to solar irradiance data. If sunlight hours drop significantly below expected levels for a given month, payouts will compensate for lost output. When climate-linked disruptions strike, liquidity is needed immediately– to buy seeds, cover interest costs, and quickly restore working capital. Parametric models remove subjectivity and replace it with automation.

Where it's working

Parametric insurance is already being deployed across India and beyond. In parts of Rajasthan and U.P, a pilot protected thousands of women small-holder farmers from drought. It used a water balance index and delivered payouts automatically when water availability dropped below a defined threshold. When sowing conditions fail on rainfall deficits or extreme temperatures, the policy triggers loan support – aiding borrowers avoid defaults and maintain livelihoods. Globally, countries in Africa, the Pacific Islands, and even the U.K. have used parametric products to cover everything from droughts and floods to cyclone winds and flood depths. The examples prove such insurance works across contexts.

What India needs next

Parametric insurance has demonstrated its ability to deliver fast, transparent relief when climate volatility strikes. The building blocks are already in place–robust climate data, digital delivery platforms, and early success stories across agriculture, energy, and disaster-prone geographies. What's needed now is scale – and a clear framework to finance it.

In 2024, Nagaland became the first Indian state to purchase multi-year parametric cover for landslides and extreme rainfall, using disaster mitigation funds. Other States now have the green light to act pre-emptively.

India must treat parametric insurance as essential climate infrastructure, much like UPI did for payments. That means expanding data networks, encouraging State-level adoption, and embedding smart cover into public disaster response. In a future shaped by climate uncertainty, it offers something rare viz. speed, trust and financial resilience when it matters most.

(The writer is co-founder & CBO, Policybazaar for Business)

Why Conventional Insurance is Inadequate:

- Traditional indemnity-based insurance requires physical damage assessment and lengthy claim processing.
- Climate disasters often need immediate liquidity, especially for smallholder farmers, daily-wage workers, and microenterprises.
- Subjectivity and dispute over loss verification delay payouts, often causing long-term income and credit stress.

Parametric Insurance: The Mechanism

- **Operates on predefined thresholds:** e.g., rainfall below 300 mm, temperature above 40°C, or wind speeds crossing a set limit.
- Payouts are automated and triggered instantly based on independently verified data from IMD, ISRO, NASA, etc.
- Designed to provide liquidity within hours, reducing vulnerability and ensuring quick recovery.

Applications in India:

- **Jharkhand:** A microfinance institution linked parametric cover to rainfall and temperature thresholds for small farmers, protecting loan repayments.
- **Rajasthan & U.P.:** Pilot projects for women smallholder farmers used a water balance index to auto-trigger drought relief.
- **Nagaland (2024):** Became the first state to buy multi-year parametric cover for landslides and extreme rainfall using disaster mitigation funds.
- **Renewable energy:** Solar firms link cover to solar irradiance data, protecting against energy generation losses.

Global Examples:

Countries across Africa, Pacific Islands, and the UK have used parametric insurance to cover:

- Droughts and floods (Kenya, Malawi)
- Cyclones and earthquakes (Fiji, Tonga)
- Crop yield failures and livestock deaths

These prove that the model works across diverse geographies and economies.

Benefits of Parametric Insurance:

- Speed: Immediate payout post-trigger.
- Transparency: Eliminates subjectivity in claims.

- Financial resilience: Ensures quick access to working capital.
- Scalability: Applicable across sectors and regions.
- Inclusiveness: Especially useful for poor, remote, and vulnerable populations.

Challenges and Way Forward:

Challenges:

- Limited awareness and trust among end-users.
- Inadequate granular climate data in remote areas.
- Need for standardized regulatory framework for adoption and monitoring.

Way Forward:

1. Scale up State-level adoption like Nagaland.
2. Integrate into national disaster relief frameworks.
3. Treat parametric insurance as core climate infrastructure, akin to UPI in fintech.
4. Expand climate data networks and predictive modelling using AI and remote sensing.
5. Encourage private sector innovation and partnerships with government.

Conclusion:

In a future shaped by climate uncertainty, parametric insurance represents a paradigm shift—from reactive compensation to proactive resilience. Its blend of automation, speed, and equity makes it a crucial tool for India's climate adaptation strategy. As climate events become the new normal, India must mainstream parametric insurance into its disaster management architecture and social protection schemes to ensure timely recovery, trust, and economic stability for its most vulnerable populations.

UPSC Mains Practice Question

Ques: Discuss the advantages and limitations of parametric insurance as a tool for climate risk management in disaster-prone regions of India. **(250 words)**

Page : 08 Editorial Analysis

Not the way

Criminalising adolescent sex will undermine the aim of the POCSO Act

The key objective of the Protection of Children from Sexual Offences (POCSO) Act, 2012 is the protection of children, but over the past few years, courts around the country and rights activists have called for some exemptions. Noticing a trend that adolescents, above 15 years but under 18, in voluntary relationships and having consensual sex were often being persecuted, the courts sought a review. In that backdrop, senior advocate Indira Jaising's written submission to the Supreme Court that consensual sex between teenagers aged 16-18 years must not be criminalised is a welcome move. She was appointed *amicus curiae* and her submissions are part of a petition filed by advocate Nipun Saxena. Her brief challenged the designation of 18 years as the age of consent. She said the only solution lies in declaring that sex between consenting adolescents between the age of 16, an almost universal age of sexual maturity, and 18, is not a form of 'abuse'. Ms. Jaising called for this exception to be read into the POCSO Act and Section 63 (sexual offences), of the Bharatiya Nyaya Sanhita (BNS). "Such an exception would preserve the protective intent of the statute while preventing its misuse against adolescent relationships that are not exploitative in nature," she said.

In a 2023 report, the Law Commission had said that it was against changing the age of consent. It advised "guided judicial discretion" instead, while sentencing in cases that involve children between 16 and 18 years in a voluntary, consensual relationship. Under the POCSO Act and under several provisions of the Indian Penal Code and the BNS, whoever commits a penetrative sexual assault on a child – who is anyone below 18 years – can face stringent punishment under Section 6 of the POCSO Act, Section 9 of the Prohibition of Child Marriage Act, 2006, and provisions of the IPC and BNS. A 16-year-old is considered a "child" under Section 2(d) of the POCSO Act and hence her consent does not matter. But caveats have to be put in place so that the broad intent of the law is adhered to, as the Madras High Court suggested in 2021, in *Vijayalakshmi vs State Rep*. The High Court said the age difference in consensual relationships should not be more than five years to ensure that a girl of an impressionable age is not taken advantage of by an older person. Educating adolescents about the law on sexual offences and its consequences is a must too. Criminalising normal adolescent behaviour is not the way to protect against non-consensual, exploitative sexual offences.

GS. Paper 01 **IndianSociety**

UPSC Mains Practice Question: **Criminalising consensual sexual activity between adolescents under the POCSO Act contradicts the Act's protective intent." Critically examine this statement in the light of recent judicial and legal debates on age of consent in India. (250 words)**

Context :

The Protection of Children from Sexual Offences (POCSO) Act, 2012 was enacted to safeguard children under 18 from sexual abuse. However, a growing number of legal experts, rights activists, and High Courts have flagged its unintended consequence: criminalising consensual sexual relations between adolescents, especially those aged 16 to 18 years. The recent submission by senior advocate Indira Jaising, appointed amicus curiae in a pending Supreme Court case, revives the debate on age of consent, agency, and legal reform.

What's the Legal Issue?

- **Current legal framework:** POCSO defines any person under 18 as a child. Therefore, consent is legally invalid for anyone under that age. Any penetrative act is treated as statutory rape, regardless of mutual agreement.
- **Problematic application:** Adolescents in consensual relationships are increasingly being prosecuted under POCSO, often due to complaints from disapproving parents or communities.
- **Jaising's submission:** Advocates non-criminalisation of consensual sex between adolescents aged 16–18, as 16 is widely considered an age of sexual maturity globally.
- **Proposed exception:** To be read into both POCSO and Section 63 of the Bharatiya Nyaya Sanhita (BNS) — so that adolescent intimacy is not equated with abuse.

Judicial Perspective:

- **Madras High Court (2021) – Vijayalakshmi vs State:** Recommended that if the age gap is within 5 years, such relationships should not attract prosecution.
- **Law Commission (2023):** Opposed lowering the age of consent but supported "guided judicial discretion" during sentencing, especially for consensual relationships between teenagers.

Concerns Over Misuse:

1. **Over-criminalisation:** Treating normal adolescent behaviour as criminal leads to trauma, stigma, and can derail futures.
2. **Misuse by families:** Cases often filed by disapproving parents rather than the alleged victim.
3. **Undermines agency:** Ignores adolescent autonomy, and can be counterproductive to POCSO's core objective — protecting against exploitation, not mutual consent.
4. **Delays in justice:** Diverts legal resources away from genuine cases of abuse.

Why Reform is Needed:

- Globally, several countries have close-in-age exemptions to avoid criminalising teenage relationships.
- India lacks a nuanced approach — zero-tolerance policy even when there is no element of coercion or exploitation.
- Instead of blanket criminalisation, legal reform must focus on context, intent, and age-gap.

Way Forward:

1. Introduce judicial discretion formally into the statute for 16–18 age group cases.
2. Legislative amendment or judicial reading to allow "close-in-age" exemptions.
3. Educate adolescents about legal consequences, sexual health, and consent.
4. Ensure POCSO's original intent — protection, not punishment — is upheld.

Conclusion:

The spirit of POCSO lies in protecting children from exploitation and abuse, not penalising consensual adolescent relationships. Without sensitive legal reform, the Act risks alienating the very group it seeks to protect. As Indira Jaising rightly argues, criminalising consensual intimacy undermines both justice and adolescent rights. A balanced, context-sensitive approach is essential to ensure that legal systems protect the vulnerable without being punitive toward normal human development.