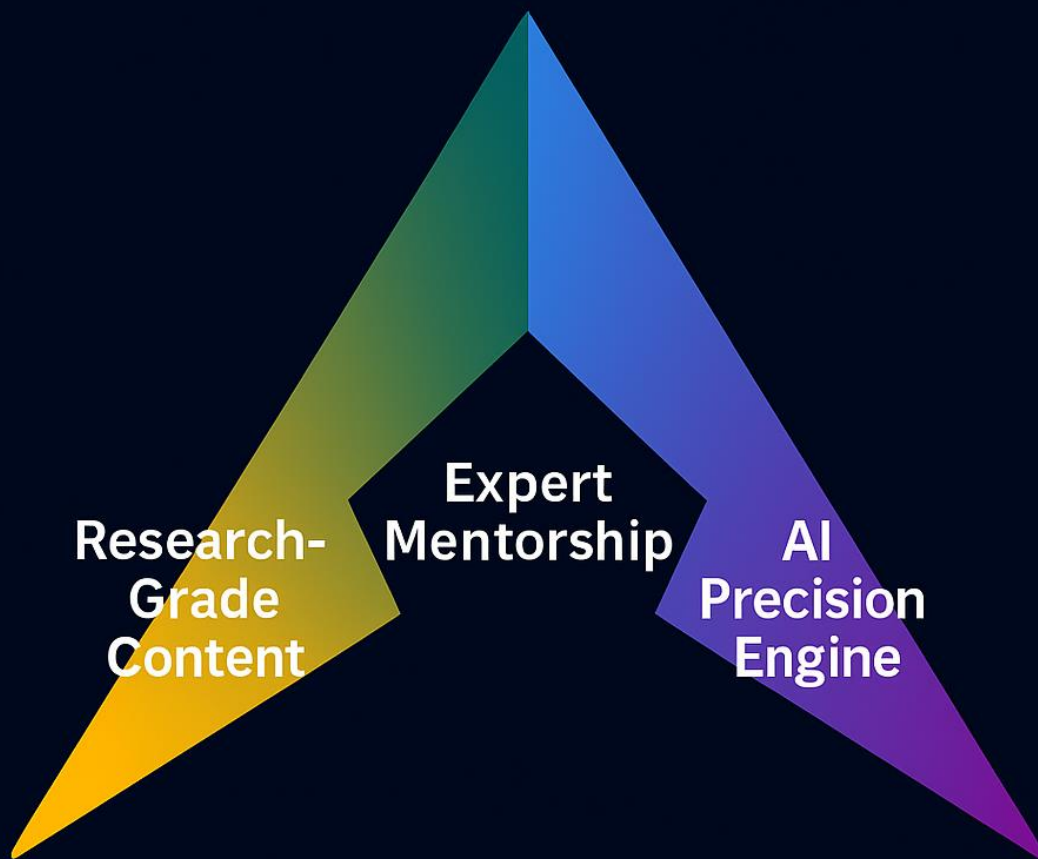


PrepAlpine

The Next-Generation UPSC Institution

Where Research Meets Mentorship & Precision



Preparation Meets Precision

A Next-Generation Learning Institution

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PrepAlpine — Where Research-Grade Content Meets Mentorship, and AI Makes It Personal

PrepAlpine is India's next-generation UPSC institution — built by educationists, retired bureaucrats, IITians, and experienced educators, and powered by a 500+-member technology firm specialising in AI-driven education infrastructure.

We're not another coaching platform — we're a complete preparation ecosystem that unites:

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Every content is crafted and reviewed by civil servants, educators, and scholars, and follows UPSC's Intro–Body–Conclusion format. Content is built from official reports, verified data, and visual pedagogy — flowcharts, frameworks, maps, and comparative tables.

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PrepAlpine — From Aspirant to Authority. Lead the State, Not the Struggle.

DAILY CURRENT AFFAIRS DATED 20.11.2025

GS Paper II: Current Affairs

1. India's Critical Minerals Sector and the Rationale behind Royalty Reforms

a. Understanding Critical Minerals and Their Importance

Critical minerals are essential raw materials needed for modern technologies, clean energy systems, and national security infrastructure. They are scarce, geographically concentrated, and difficult to process, making global supply chains highly vulnerable.

Examples include lithium, cobalt, nickel, graphite, rare earths, caesium, rubidium, and zirconium—all fundamental to electric vehicles, batteries, electronics, solar PVs, drones, missile guidance systems, and semiconductor industries.

India currently imports most of these minerals. This dependence becomes risky because China dominates global processing and refining, controlling large portions of the supply chain. For long-term strategic autonomy, India must strengthen exploration, mining, processing, and domestic value chains.

b. The Idea of Royalty in the Mining Sector

i. What Royalty Means

Royalty is the payment mining companies make to the government for extracting minerals—essentially the price for using a public natural resource.

ii. Two Global Royalty Models

- Fixed Royalty: Constant amount per tonne, regardless of market price.
- Ad Valorem Royalty: A percentage of the mineral's sale price—rises when prices rise, falls when they decline.

Fixed vs Ad Valorem Royalty: Global Approaches	
Fixed Royalty	Ad Valorem Royalty
Fixed ₹/tonne	% of sale price
Ignores price fluctuations	Adjusts automatically with markets
Predictable for govt	Shares price risk
Risky for companies during downturns	Preferred for strategic minerals
Unsuitable for volatile minerals	Aligns with global norms

iii. Why Ad Valorem Suits Critical Minerals

- Critical minerals have extremely volatile prices.
- Linking royalty to market price reduces risks for investors.
- It better reflects international practice in strategic minerals.

c. Recent Royalty Reforms Introduced by India

i. Revised Royalties for Key Minerals

- High-grade graphite: 2% ad valorem
- Low-grade graphite: 4% ad valorem
- Caesium: reduced from 12% → 2%
- Rubidium: reduced from 12% → 2%
- Zirconium: reduced from 12% → 1%

ii. Transparency through Published Prices

- The Indian Bureau of Mines publishes the average sale price (ASP) monthly.
- ASP-based royalty brings predictability for investors.

iii. Core Objective

- Ensure royalty rates do not discourage mining.
- Improve participation in auctions for critical mineral blocks.

d. Why These Reforms Became Necessary

i. Poor Auction Performance

- Since 2023, 81 blocks were offered but only 34 received bids.
- High royalties made extraction commercially unattractive.
- Uncertainty prevented long-term investment.

ii. Rising Global Tensions

- China imposed export restrictions on minerals like graphite.
- This intensified supply risks for import-dependent countries like India.

iii. Rapidly Growing Domestic Demand

- Renewable energy commitments require more lithium, nickel, and rare earths.
- EV and battery industries are expanding fast.
- Semiconductor manufacturing needs speciality minerals.

iv. Processing Weaknesses

- India lacks advanced refining and separation facilities.
- Dependence on raw ore exports + processed mineral imports adds vulnerability.

e. Advantages of Ad Valorem Royalties

i. Flexibility for Investors

- Payments decrease when market prices fall.
- Encourages mining of low-grade deposits, which are otherwise unviable.

ii. Revenue Stability for States

- Royalties increase automatically when global prices rise.
- Enhances state revenue without altering policy repeatedly.

iii. Alignment with Global Best Practices

- Major mineral-producing countries use ad valorem systems.
- Boosts investor confidence in India's mining regime.

iv. Encouragement for Exploration

- Lower risk attracts more companies to bid for blocks.
- Improves the discovery of new deposits.

f. Are Royalty Reforms Sufficient to Transform the Sector?

i. Positive Outcomes Expected

- Better auction participation for mineral blocks.
- Stronger investor confidence and improved exploration.
- Gradual reduction in import dependence.

ii. Persistent Structural Challenges

- Incomplete geological mapping: many regions remain poorly surveyed.
- Weak processing capacity: India often exports raw ore and imports refined minerals.
- High capital requirements: many companies face financing constraints.
- Slow approvals & regulatory overlaps: delay mining projects.
- Dependence on foreign technology: reduces self-reliance.
- Missing value chains: industries using these minerals remain disconnected from domestic mines.

g. Way Forward

i. Strengthen Geological Surveys

- Expand mapping using modern technologies—LiDAR, hyperspectral imaging, satellite surveys.

ii. Build Domestic Processing & Refining Capacities

- Establish separation facilities for lithium, rare earths, and graphite.
- Promote technology transfer and R&D initiatives.

iii. Streamline Approvals and Incentivise Exploration

- Reduce duplication across ministries.
- Provide incentives for high-risk exploration companies.

iv. Deepen International Partnerships

- Collaborate with Australia, Argentina, Chile, Namibia, and other rich suppliers.
- Join global critical mineral alliances.

v. Create Strategic Reserves

- Stockpile minerals with high geopolitical risk.
- Ensure supply security during global disruptions.

vi. Integrate with National Industrial Programmes

- Link mining with Make in India, PLI schemes, and Atmanirbhar Bharat.
- Develop full value chains—from mining → refining → manufacturing.

Conclusion

Royalty reforms are a timely and important step toward making India's critical minerals sector more competitive and investor-friendly. By shifting to flexible ad valorem rates, India aligns itself with global practices, improves auction performance, and reduces one of the major barriers to exploration. However, true self-reliance will require a comprehensive transformation—stronger geological surveys, domestic processing capacity, efficient regulations, stable technology access, and robust value chains. Royalty reform is therefore the starting point of India's critical minerals strategy, not its conclusion.

GS Paper II: Environment

2. Climate Action and the Rising Leadership of the Global South

a. Introduction

The term Global South refers to developing regions across South Asia, Africa, Latin America, and the island nations of the Indian and Pacific Oceans. Traditionally, these countries were viewed mainly as victims of climate change—highly vulnerable and dependent on external financial support.

This perception is now rapidly shifting. The Global South is beginning to position itself not just as a vulnerable region but as a centre of climate innovation and practical solutions. With COP 30 in Brazil approaching, debates on climate justice, finance, and equitable governance have brought these countries to the forefront of global climate diplomacy.

Today, nations of the Global South are showing leadership in affordable clean technologies, biodiversity conservation, climate data systems, and community-based environmental governance.

b. Why the Global South Matters for Climate Action

i. High Vulnerability to Climate Impacts

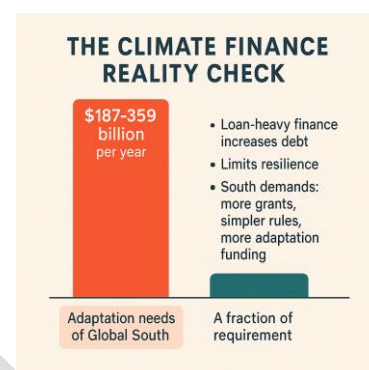
- Regions face severe threats: Himalayan glacier melt, cyclones, heatwaves, floods, and droughts.
- These hazards threaten food security, water availability, and livelihoods.

ii. Innovation in Adaptation and Resilience

- Bangladesh: cyclone shelters, early-warning systems.
- India: world-leading solar parks, green hydrogen mission.
- Brazil: forest governance and Amazon conservation successes.
- Indonesia: mangrove restoration at scale.
- Nepal: community-led conservation and climate monitoring.

iii. Combination of Risk and Capability

- Countries most exposed to climate threats are also pioneering low-cost, high-impact solutions.
- This mix of vulnerability + innovation makes them central to global climate progress.



c. The Role of Data in Climate Credibility

i. Why Climate Data Matters

- Emissions, forest cover, and adaptation outcomes must be accurately monitored and verified.
- Data influences global negotiations, climate finance access, and even trade policies like carbon border taxes.

ii. How the Global South Is Strengthening Its Data Systems

- Brazil: sophisticated satellite network monitoring Amazon deforestation.
- India: ISRO-based climate satellites track emissions, land use, and extreme weather.
- Nepal & Indonesia: community-level climate and forest reporting systems.

iii. Benefits of Strong Data Systems

- Demonstrates real progress instead of relying on external assessments.
- Allows developing countries to challenge flawed narratives.
- Strengthens negotiation power and protects against unfair trade measures.

d. Forests as Strategic Assets

i. Forests as Global Public Goods

- Tropical forests store massive amounts of carbon and support crucial biodiversity.
- They are essential for global climate stability, not just local ecosystems.

ii. Shifting Perspective: Forests as Value, Not Burden

- Forests are not liabilities needing compensation—they are strategic assets.
- They enable bio-economies, cultural preservation, and sustainable livelihoods.

iii. Importance of Indigenous and Community Rights

- Indigenous stewardship is proven to reduce deforestation.
- Brazil's recent success in lowering Amazon forest loss highlights this community-led model.

e. The Persistent Gap in Climate Finance

i. Vast Financial Needs

- Adaptation costs for the Global South are estimated at \$187–359 billion annually.
- Current international support is nowhere close to this requirement.

ii. Loan-Heavy Finance Burden

- Much climate finance is provided as loans, adding to already high national debt.
- This reduces long-term resilience and limits adaptation planning.

iii. What the Global South Is Demanding

- More grants, fewer loans.
- Simple, accessible rules for climate funding.
- Greater finance for adaptation and loss and damage, not just mitigation.
- Flexibility for countries to choose how funds are used.

f. Changing Dynamics Between the Global North and Global South

i. Old Cooperation Model

- North paid → South complied.
- Technology and expertise flowed mainly from developed countries.
- Decision-making structures reflected global power imbalances.

ii. Emerging New Model

- Focus on shared responsibility and equal partnership.
- Recognition of indigenous knowledge and community governance.
- Climate finance tied to green jobs, resilience, and local priorities—not donor agendas.

iii. More Assertive Negotiating Position

- The Global South is defining the conversation rather than reacting to it.
- It is rejecting unfair conditions and advocating for equitable global systems.

g. Expectations from COP Thirty

i. Fair and Accessible Climate Finance

- Operationalising the Loss and Damage Fund.
- Reforming access rules for green finance.

ii. Trade and Technology Issues

- Challenging carbon border taxes and other measures that penalise developing economies.
- Seeking affordable access to clean technologies.

iii. Strengthening Nature-Based Solutions

- Supporting bio-economies and local sustainable value chains.
- Expanding indigenous rights and community-led forest protection.

iv. Regional and Global Partnerships

- Platforms like BRICS, G-20, AU, ASEAN, BIMSTEC are key to coordinated action.
- Joint systems for monitoring forests and emissions.

v. Youth, Jobs, and Green Growth

- Focus on green employment for young populations.
- Training in climate tech, biodiversity conservation, and clean energy.

h. Why This Transformation Matters for India

i. India as a Climate Innovator

- Rapid growth in renewable energy capacity.
- Green hydrogen mission and major clean-energy investments.

ii. Strong Community and Conservation Networks

- Proven models in watershed development, afforestation, and disaster resilience.

iii. Digital and Data Leadership

- Advanced digital public infrastructure aids climate monitoring and early-warning systems.

iv. India's Development–Climate Link

- For India, climate action is tied to jobs, energy security, and inclusive development.
- Sustainable growth pathways are central to both national and global climate progress.

Conclusion

The Global South is emerging as a powerful and credible force in global climate action. No longer seen only as vulnerable or dependent, it is shaping climate governance through innovation, community-centred models, transparent data systems, and assertive diplomacy. As COP 30 approaches, the call for climate justice is evolving into a demand for equity, partnership, and shared responsibility. The leadership of the Global South—supported by large populations, rich biodiversity, and grounded adaptation experience—is now essential for meaningful global progress on climate change.

GS Paper III: Science and Technology

3. Indigenous Gene-Editing Alternative to CRISPR–Cas for Indian Agriculture

a. Introduction

Gene editing refers to the precise modification of an organism's DNA to bring about desirable traits. Globally, the CRISPR–Cas system—especially Cas9 and Cas12a—has become the dominant tool for this purpose. These enzymes act like molecular scissors that locate specific DNA sites and cut them for editing.

However, most CRISPR–Cas systems are patented by foreign institutions. This means Indian researchers must pay licensing fees, which restricts large-scale use in agricultural crop improvement.

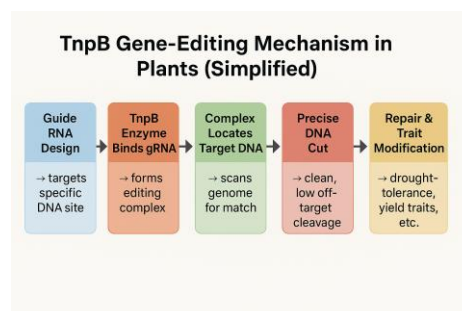
To overcome these limitations, Indian scientists have created a miniature, fully indigenous, IP-free gene-editing system. This innovation represents a major step toward technological self-reliance and affordable agricultural biotechnology.

b. The New Indian Gene-Editing Technology

Indian researchers at the Indian Council of Agricultural Research (ICAR) have built a novel editing system based on a protein family called TnpB, marking a shift away from conventional CRISPR–Cas enzymes.

i. Understanding TnpB

TnpB proteins occur naturally in transposable elements, often referred to as “jumping genes” because they can move within the genome.



- Natural role: They assist mobile genetic elements in cutting and inserting themselves at new positions in DNA.
- Editing ability: Despite being smaller than Cas proteins, TnpB can cut DNA with accuracy suitable for gene editing.
- Delivery advantage: Their compact size makes them easier to transport into plant cells—one of the biggest technical challenges in crop biotechnology.

ii. Why the Miniature Size Matters

- Easier entry into cells: Small enzymes pass through plant cell barriers more efficiently.
- Lower off-target effects: Reduced size means less interference with cellular processes.
- Simplified editing process: It reduces technical complexity and time required for editing experiments.
- Cost efficiency: Lower resource requirements translate into cheaper crop improvement programmes.

c. Why India Needs an Alternative to CRISPR–Cas

i. Patent-Linked Restrictions

- Global CRISPR tools are covered by strong international patents.
- Licensing for commercial use is expensive and bureaucratically heavy.
- Public institutions and state universities often cannot afford these costs, limiting farmer-oriented innovation.

ii. High Research and Development Costs

- Royalty fees consume limited research budgets.
- Many promising ideas remain stuck at the academic stage instead of reaching real-world crop fields.

iii. Need for Long-Term Technological Self-Reliance

- India must rapidly develop climate-resilient, high-yield, nutrient-rich crops.
- An indigenous, IP-free tool gives India full freedom to innovate at scale.
- It aligns with Atmanirbhar Bharat and national food-security strategies.

d. Features and Advantages of the TnpB-Based System

i. Fully Indigenous and IP-Free

- No foreign patents or royalties.
- Free use by public institutions and agricultural universities.
- Allows unrestricted scaling in national crop-breeding programmes.

ii. Compact and Efficient Enzyme

- TnpB is significantly smaller than Cas9/Cas12a.
- Improves efficiency of gene delivery into plant tissues.

iii. High Precision and Target Accuracy

- Maintains the precise DNA-cutting ability needed for targeted editing.
- Reduces chances of unwanted changes.

iv. Lower Cost of Crop Development

- No licensing fees.
- Lower lab-level resource requirements.
- Makes genome editing accessible to small research groups.

v. Broad Crop Applicability

- Suitable for cereals, pulses, oilseeds, fruits, and vegetables.
- Useful for both high-tech research labs and field-level breeding programmes.

e. Potential Applications in Indian Agriculture

i. Climate-Resilient Crop Development

- Drought-tolerant crop varieties.
- Flood- and salinity-resistant rice.
- Heat-resilient wheat and pulses.

ii. Nutritional Enhancement

- Biofortified cereals enriched with iron or zinc.
- Oilseeds with higher oil content.
- Fruits with improved vitamin profiles.

iii. Pest and Disease Resistance

- Enhanced defence against major fungal, bacterial, and viral diseases.
- Reduced reliance on chemical pesticides.

iv. Faster Breeding Cycles

- New varieties can be developed in 2–3 years instead of 7–10.
- Enables rapid response to climate change and emerging crop threats.

f. Challenges Ahead

i. Regulatory Uncertainty

- Guidelines for genome-edited crops are still evolving.
- Clear protocols are needed for field trials and commercial release.

ii. Public Awareness Gaps

- Gene editing is often incorrectly equated with GM crops.
- Misunderstandings can slow adoption and acceptance.

iii. Strengthening Biosafety Assessments

- Robust field-level testing frameworks are needed.
- State agricultural departments require training and resources.

iv. Research Capacity Requirements

- Labs need updated equipment and long-term funding.
- Skilled personnel must be trained in the new TnpB platform.

g. Way Forward

i. Regulatory Streamlining

- Implement clear, time-bound approval pathways under DBT guidelines.
- Provide separate norms for non-transgenic genome-edited crops.

ii. Strengthening Research Ecosystems

- Expand ICAR and agricultural university capacities.
- Create dedicated gene-editing hubs across states.

iii. Public-Private Partnerships

- Collaborate with seed companies for large-scale field deployment.
- Support start-ups working on genome editing.

iv. Outreach and Education

- Awareness campaigns for farmers and civil society.
- Transparent communication about the safety and benefits of gene editing.

v. Alignment with National Goals

- Support SDG-2 (Zero Hunger) and SDG-13 (Climate Action).
- Enhance national food security and agricultural resilience.

Conclusion

India's indigenous, miniature TnpB-based gene-editing system represents a landmark achievement in agricultural biotechnology. By eliminating dependence on foreign patents and reducing research costs, it empowers Indian scientists to develop climate-resilient, high-yielding, and nutritionally enhanced crop varieties. As regulatory clarity improves and research ecosystems strengthen, this technology can greatly accelerate India's journey toward self-reliant, farmer-friendly, and future-ready agriculture.

GS Paper III: Security

4. Digital Tradecraft in Contemporary Terrorism

a. Introduction

The digital age has fundamentally reshaped the way terrorist organisations plan, communicate, recruit, and operate. The term digital tradecraft refers to the advanced use of digital tools and covert online techniques to hide identity, coordinate operations, and evade state surveillance.

It is the technological parallel of traditional espionage tradecraft—covert meetings and safehouses have now shifted to encrypted apps, private servers, digital anonymity tools, and remote coordination

systems. As a result, modern terror networks can function without physical proximity, making detection significantly harder.

b. Why Terror Groups Have Shifted Towards Digital Tradecraft

i. High Levels of Privacy and Concealment

- Encrypted platforms hide both message content and user identity.
- Minimal metadata makes it difficult for agencies to reconstruct communication patterns.

ii. Global, Cheap, and Instant Connectivity

- Unlike conventional telephony, digital platforms enable seamless connections across borders.
- Coordinated operations can occur without any physical meetings.

iii. Ability to Erase Evidence Effortlessly

- Auto-deletion features and volatile data formats help terrorists remove digital footprints.
- Temporary accounts and disposable identities make backtracking extremely difficult.

Traditional vs Digital Tradecraft: Key Differences	
Old Tradecraft	Digital Tradecraft
Physical meetings	Encrypted channels
Human couriers	Digital dead drops
Paper trails	No traceable messages
Physical safehouses	Virtual safehouses (servers)
Geographically constrained	Borderless coordination

c. Core Techniques Used in Digital Tradecraft

i. Encrypted Messaging Platforms

- End-to-end encryption prevents third-party access to content.
- Some apps do not require phone numbers or store metadata.
- Self-operated encrypted apps used by certain modules remove the service provider from the surveillance chain.

ii. Self-Hosted Private Servers

- Terror cells increasingly maintain their own privately hosted communication servers.
- These servers keep no logs and remain outside national jurisdictions.
- They create a closed communication ecosystem inaccessible through normal interception routes.

iii. Digital Dead Drops via Email Drafts

- A shared email account is accessed by multiple operatives.
- Messages are typed as drafts, read by others, and deleted—nothing is sent.
- Since no email transmission occurs, surveillance systems detect no communication trail.

iv. Anonymity Tools: VPNs and Onion Routing

- VPNs mask IP addresses and encrypt browsing habits.
- Tor and layered proxy networks hide device identity and physical location.
- These tools also help bypass platform bans and geolocation restrictions.

v. Operational Digital Cleanliness

- Frequent clearing of histories, deletion of apps, and use of offline maps.
- Avoidance of social media or creation of only minimal, misleading profiles.
- Switching off devices periodically to break tracking patterns.

d. Why Digital Tradecraft Constitutes a Major Security Challenge

i. Collapse of Traditional Surveillance Foundations

- Older intelligence models depended on call logs, metadata, and communication footprints.
- Encrypted tools erase or obscure these data points completely.

ii. Remote and Silent Operational Planning

- Modules coordinate across continents without any visible activity.
- Digital anonymity allows unknown operatives to collaborate without ever meeting.

iii. Highly Educated Recruits with Technical Skills

- Many modules include individuals skilled in coding, servers, cybersecurity, and system manipulation.
- They adapt quickly to platform bans, monitoring patterns, and algorithmic detection.

iv. Radicalisation in Encrypted, Closed Ecosystems

- Extremist ideology spreads through private groups, hidden channels, and closed forums.
- These digital echo chambers remain invisible to law enforcement.

v. Cross-Border Coordination Becomes Easier

- Encrypted platforms bypass geographical restrictions.
- Foreign handlers can coordinate with domestic modules in real time.

e. Insights from Research and Global Trends

i. Shift Toward Encrypted and Decentralised Ecosystems

- Studies show a steady movement from physical networks to encrypted digital infrastructures.
- Terrorism is adopting the same secure tools used by activists, journalists, and cybersecurity communities.

ii. Anonymous Browsing and Decentralised Operations

- Terror networks increasingly mimic decentralised hacker groups.
- The lack of physical infrastructure makes dismantling networks far harder.

iii. Global Predictive Patterns Are Being Confirmed

- Research predicted growing anonymity, encryption, and self-managed communication systems.
- These predictions now fully match the behaviour of contemporary modules.

f. Strengthening India's Response

i. Advanced Digital Forensics Capabilities

- Deep memory extraction from seized devices.
- Breaking or bypassing VPN layers and anonymous routing.
- Recovering deleted data using specialist tools.

ii. Modern Regulatory and Legal Frameworks

- Laws must address encrypted networks, draft-only exchanges, and self-hosted servers.
- Mechanisms for lawful, court-authorised access to foreign-hosted platforms are essential.

iii. Stronger Intelligence–Cybersecurity Integration

- Cyber units and counter-terror agencies must work in a unified framework.
- Combining behavioural analytics with digital surveillance improves detection.

iv. Monitoring Technically Skilled Recruits

- Some modules recruit highly educated individuals with STEM backgrounds.
- Universities, tech hubs, and research centres need early-warning systems to detect ideological grooming.

v. International Cooperation

- Collaboration with global intelligence agencies and cybercrime bodies.
- Partnerships with hosting providers, technology platforms, and CERTs.

vi. Public Awareness and Digital Hygiene

- Citizens should recognise early signs of online radicalisation.
- Awareness campaigns strengthen community-level prevention.

Conclusion

Terrorism has evolved into a highly digitalised form, where encrypted channels, anonymous networks, VPNs, and digital dead drops play as crucial a role as physical logistics. As terror modules become more technologically advanced, traditional surveillance becomes less effective. India must therefore upgrade to a digital-first counter-terror strategy, combining forensic expertise, legal reforms, international cooperation, and advanced intelligence systems. Mastery over the digital domain is no longer optional—it is fundamental to protecting national security in an era defined by encryption, anonymity, and decentralised communication.

Reader's Note — About This Current Affairs Compilation

Dear Aspirant,

This document is part of the PrepAlpine Current Affairs Series — designed to bring clarity, structure, and precision to your daily UPSC learning.

While every effort has been made to balance depth with brevity, please keep the following in mind:

1. Orientation & Purpose

This compilation is curated primarily from the UPSC Mains perspective — with emphasis on conceptual clarity, analytical depth, and interlinkages across GS papers.

However, the PrepAlpine team is simultaneously developing a dedicated Prelims-focused Current Affairs Series, designed for:

- factual coverage
- data recall
- Prelims-style MCQs
- objective pattern analysis

This Prelims Edition will be released separately as a standalone publication.

2. Content Length

Some sections may feel shorter or longer depending on topic relevance and news density. To fit your personal preference, you may freely resize or summarize sections using any LLM tool (ChatGPT, Gemini, Claude, etc.) at your convenience.

3. Format Flexibility

The formatting combines:

- paragraphs
- lists
- tables
- visual cues

—all optimised for retention.

If you prefer a specific style (lists → paras, paras → tables, etc.), feel free to convert using any free LLM.

4. Monthly Current Affairs Release

The complete Monthly Current Affairs Module will be released soon, optimized to a compact 100–150 pages — comprehensive yet concise, exam-ready, and revision-efficient.

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