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1.1. POLITY & GOVERNANCE

1.1.1. BUILDING A RESILIENT KNOWLEDGE ECONOMY

Context

Recent protests over the 2026 NEET-UG paper leak highlight a systemic crisis in competitive exam administration. This exposes a broader governance deficit characterized by **persistent leaks, poor legal accountability, and a decade-long decline in the Education Ministry's budget share.**



Introduction

India's demographic dividend depends on merit-based recruitment and robust human capital investment. However, **frequent examination breaches and shrinking educational budgets** reveal severe institutional deficits, threatening the nation's long-term socioeconomic mobility and equitable growth.

How Extensive is the Examination Integrity Deficit?

- **Over the past decade, question papers have been compromised in over 150 competitive examinations** across India.
- An investigation into **45 major exam paper leaks** over two decades—each involving over 1,00,000 candidates—resulted in **only two legal convictions.**
- The majority of these cases remain stalled in judicial proceedings, creating a **pervasive sense of legal impunity for organized cheating syndicates.**

What Do the Fiscal Allocations Between 2009 and 2026 Reveal?

- **The Ministry of Education's relative budget share plummeted from 4.6% in 2013–14 to a mere 2.5% in 2025–26,** despite the overall Union Budget growing by an annual average of 10.4%.
- The budget share for the **Department of School Education and Literacy was reduced by more than half over 12 years,** while the Department of Higher Education's share contracted to nearly 60% of its former allocation.
- Despite national priorities under the Skill India initiative, the **Ministry of Skill Development and Entrepreneurship's budget share slid from 0.06% in 2015–16 to 0.05% in 2025–26.**
- Combined allocations for Education and Health dropped from 6.5% (2013–14) to 4.5% (2025–26), while the **Ministry of Road Transport and Highways saw its share nearly treble from 1.8% to 5.8%,** exemplifying a severe imbalance favoring physical capital over human capital.

Why is Reforming the Education and Examination Ecosystem Crucial for India?

1. **Preserving the Demographic Dividend requires transparent testing mechanisms** and adequate public funding to transform youth potential into high economic productivity.
2. **Ensuring Socioeconomic Mobility is highly dependent on competitive public examinations,** which serve as the primary meritocratic channel for underprivileged and rural aspirants.

3. **Restoring Institutional Trust is imperative**, as eliminating examination fraud rebuilds public faith in state institutions, testing bodies, and the fairness of government recruitment.
4. **Enhancing Economic Competitiveness relies directly on robust funding for higher education** and vocational skilling, which strengthens research output, innovation, and global labor parity.
5. **Mitigating Youth Disaffection is achieved by securing examination integrity**, thereby preventing widespread socioeconomic frustration and unrest among the youth demographic.

What are the Primary Challenges Associated with the Education and Examination Sector?

1. **A severe conviction deficit and legal impunity** persist because weak prosecutorial frameworks and protracted trial timelines fail to create a credible deterrent.
2. **Sub-optimal public spending on education remains a critical bottleneck**, as the current outlay falls significantly below the National Education Policy (NEP) 2020 target of 6% of GDP.
3. **A persistent fiscal bias toward hard infrastructure crowds out social sector funding**, prioritizing immediate physical asset creation over long-term human capability development.
4. **Technological and administrative vulnerabilities plague decentralized paper-based logistics**, leaving examinations highly susceptible to localized breaches, printing leakages, and transit tampering.
5. **An underfunded skilling architecture limits institutional capacity**, making it difficult to align vocational training with modern industrial standards and artificial intelligence trends.

What Global Best Practices Can India Adopt for Examination Governance?

1. **The United Kingdom's Ofqual Framework operates as an independent statutory body** that regulates national examinations and conducts rigorous, impartial audits on testing agencies to prevent malpractices.
2. **Singapore's Integrated SkillsFuture Strategy combines high public spending on education with an integrated lifelong skilling model** that is directly tied to evolving technological and industrial requirements.

What Steps Must the Government Take to Secure the Education Ecosystem?

1. **The state must vigorously implement the Public Examinations (Prevention of Unfair Means) Act, 2024**, deploying specialized fast-track courts to ensure rapid and severe convictions.
2. **Fiscal planning must align Union and State budget outlays with NEP benchmarks**, progressively increasing the education expenditure toward the 6% of GDP target.
3. **The government should establish an independent National Examination Audit Authority** tasked with conducting periodic, mandatory security audits of all public testing agencies and third-party vendors.
4. **Testing agencies must transition entirely to encrypted computer-based testing (CBT) architectures** featuring end-to-end encryption, biometric authentication, and secure network protocols.
5. **Macroeconomic policy must harmonize social and capital outlays**, ensuring that investments in health and education grow proportionately alongside physical infrastructure spending.

6. **Financial allocations for the Ministry of Skill Development must be substantially expanded** to establish industry-partnered training centers that address modern labor market demands.

Conclusion

Sustainable development requires balancing physical infrastructure with robust human capital formation. Securing India's demographic potential mandates **restoring examination integrity and reinforcing fiscal commitments to education**.

Q. Critically analyze how recurring examination paper leaks and declining budgetary allocations for education threaten India's demographic dividend. 15 Marks

1.1.2. DEMOCRATIC DISSENT AND POLICE BRUTALITY

Why is in news

The issue gained prominence after video evidence showing police personnel assaulting protesters. The incident has revived the debate on **police accountability, protection of fundamental rights, and the urgent need for police reforms in India**.

Introduction

- The recent incident involving alleged police brutality against students in **Delhi** has reignited concerns regarding the **misuse of police powers, excessive use of force, and accountability of law enforcement agencies**.
- Videos circulating on social media reportedly showed police personnel assaulting students and using disproportionate force during a protest.
- The incident has once again highlighted the delicate balance between **maintaining public order and protecting citizens' fundamental rights** in a constitutional democracy.



When Can Police Use Force During Public Demonstrations?

Constitutional Background

- Though ARTICLE 19(1)(a) and Article 19(1)(b) right to Freedom of Speech and Expression and right to assemble peacefully and without arms, under Article 19(2) & 19(3) state may impose Reasonable Restrictions.**
- The State may impose restrictions on these rights in the interests of Sovereignty and integrity of India, Security of the State, Public order.

Legal Provisions Governing Police Use of Force

- Bharatiya Nagarik Suraksha Sanhita (BNSS), 2023-** the BNSS (which replaced the Code of Criminal Procedure, 1973) empowers Executive Magistrates and police to maintain public order.
- State Police Acts authorize police to Prevent breaches of peace, Regulate assemblies.

- **UN Basic Principles on the Use of Force and Firearms (1990)** says law enforcement officials should Use **non-violent means first** Resort to force only when unavoidable.

Major Issues include

1. Excessive Use of Force by Police

- Physical assault, lathi charge without imminent threat, assault on unarmed protesters, violence against journalists reflect **disproportionate use of force**, violating constitutional safeguards.
- This was observed in Delhi protest 2019 against Citizenship (Amendment) Act.

2. Lack of Accountability

- Lacadesical approach on suspension to responsible personnel.
- Identification of other officers remains pending, delay in disciplinary action weakens public confidence.

3. Violation of Constitutional safeguards

- **Article 14 – Right to Equality** - arbitrary police violence violates the principle of **non-arbitrariness** under Article 14.
- **Article 19(1)(a) ensures** Freedom of Speech and Expression, police cannot suppress peaceful expression through excessive force.
- **Article 19(1)(b) allows** Right to Assemble Peacefully reasonable restrictions may be imposed under Article 19(3), but force must remain proportionate.
- **Article 21 upholds** Right to Life and Personal Liberty including human dignity, protection against torture, fair procedure and freedom from arbitrary state action. Hence police brutality directly violates Article 21.
- Article 22 may gets undermined the safeguards against arbitrary arrest.

4. Chilling Effect on Democratic Protests

- Fear of police violence discourages citizens from exercising their constitutional right to peaceful assembly, this undermines the spirit of participatory democracy.

5. Transparency and Public Trust

- Video recordings have become important evidence against abuse of authority. Failure to act despite visual evidence erodes trust in institutions.

6. Broader Implications

- **Governance**

Weakens constitutional morality and encourages abuse of executive authority.

- **Democracy**

Shrinks democratic space and discourages peaceful civic participation.

- **Judiciary**

Increases burden of judicial oversight and highlights gaps in executive accountability.

- **Society**

Erodes public trust in police and deepens fear among vulnerable communities.

- **Rule of Law**

Sends a perception that State officials enjoy impunity.

Way Forward / Mitigation Measures

1. Institutional Reforms

- Fully implement **Prakash Singh (2006)** police reforms across all States and Union Territories.
- Operationalize independent **Police Complaints Authorities** with adequate powers.

2. Strengthen Accountability

- Mandatory registration of FIRs where prima facie evidence of police assault exists.
- Time-bound departmental inquiries.
- Independent judicial or magistrate-led investigations in cases involving serious injuries.

3. Technology-Based Monitoring

- Universal use of **body-worn cameras** during protests and arrests.
- CCTV coverage in police stations and detention centres.
- Digital preservation of video evidence to prevent tampering.

4. Capacity Building

- Regular training on Human rights, Crowd-control techniques, De-escalation methods, Gender sensitivity, Constitutional values.

5. Legal Reforms

- Enact a modern police law replacing the colonial framework.
- Codify clear standards on the proportional use of force.
- Incorporation of National Human Right Commission (NHRC) in the precedure of invetigation.

6. Judicial Oversight

- Ensure strict compliance with **D.K. Basu** guidelines.
- Fast-track adjudication of cases involving custodial violence and police excesses.

7. Community Policing

- Promote trust-based policing through dialogue with civil society.
- Encourage transparent grievance-redressal mechanisms.

8. Constitutional measures

- **Article 22** Provides safeguards against arbitrary arrest.
- **Article 32 & Article 226** citizens can approach the Supreme Court or High Courts for enforcement of Fundamental Rights.

9. Statutory Provisions includes

- **Bharatiya Nagarik Suraksha Sanhita (BNSS), 2023 for** Regulating arrest procedures, prescribing safeguards against arbitrary detention, also mandates lawful use of force during arrests.
- **Bharatiya Nyaya Sanhita (BNS), 2023 for** police officials may be prosecuted if criminal assault or grievous hurt is established.
- **Protection of Human Rights Act, 1993** Empowering the National Human Rights Commission (NHRC) to inquire into allegations of police excesses.

Important Supreme Court Judgments

1. Prakash Singh v. Union of India (2006) directed

- Establishment of State Security Commissions.
- Fixed tenure for police officers.
- Police Establishment Boards.

2. People's Union for Civil Liberties (PUCL) v. State of Maharashtra (2014)

Issued detailed guidelines on investigation of police encounter deaths.

3. K.S. Puttaswamy v. Union of India (2017)

Though primarily a privacy case, the Court reiterated that **State action must satisfy the tests of legality, necessity, and proportionality**, principles equally relevant to the use of police force.

Conclusion

- While the police have a legitimate duty to maintain public order, the exercise of coercive power must always be **lawful, necessary, proportionate, and accountable**.
- Effective implementation of judicial directives, independent oversight, police modernization, and a rights-based approach to law enforcement are essential to preserve the **Rule of Law**, protect **Fundamental Rights**, and strengthen citizens' faith in democratic institutions.

Q. The Indian Constitution has provisions for holding civil servants accountable for their actions. Explain. (10 marks)

1.2. INTERNATIONAL RELATIONS

1.2.1. STRATEGIC CONVERGENCE AND RESET IN INDIA–CANADA RELATIONS

Context

The **2026 visit of Canadian PM Mark Carney** to India marked a historic reset following diplomatic strains, driven by **geopolitical shifts, defense modernization, clean energy needs**, and **economic complementarities**.



Introduction

The **India–Canada reset** transitions bilateral ties toward **pragmatic cooperation** in defense, trade, nuclear energy, and technology. Canada's focus on **defense reinvestment** and **supply chain diversification** complements India's **Viksit Bharat 2047** clean energy and growth goals, though overcoming **security concerns** remains vital.

The Nuances of the Bilateral Reset

- **Diplomatic Transition:** Shifts relations from past friction toward **pragmatic, future-oriented cooperation**.
- **Economic Target:** Sets a goal to double bilateral two-way trade to **USD 50 billion by 2030** through renewed **CEPA negotiations**.

- **Civil Nuclear Contract:** Secures a **USD 2.6 billion Cameco uranium deal** to support India's target of **100 GW nuclear capacity by 2047**.
- **Defense Dialogue:** Establishes the first-ever **India–Canada Defence Dialogue** alongside joint naval participation in **RIMPAC** and **Talisman Sabre**.
- **Critical Mineral Supply Chains:** Signs an MoU on the **Critical Minerals Value Chain** to integrate Canada's **31 critical minerals** into Indian manufacturing.
- **Tech & Global Alliances:** Joins Canada to the **International Solar Alliance (ISA)**, **Global Biofuels Alliance (GBA)**, and the **ACITI tech partnership**.

Significance of the India–Canada Partnership

1. **Clean Energy & Nuclear Security:** Sourcing **high-grade Canadian uranium** (up to 15% ore grade) directly powers India's **clean energy transition** and reduces single-supplier risks.
2. **Strategic Indo-Pacific Alignment:** Aligns with Canada's **Indo-Pacific Strategy**, positioning India as a vital anchor for a **free, open, and rules-based order**.
3. **Supply Chain Resilience:** Integrates Canadian **rare earths, cobalt, and tungsten**, helping diversify high-tech and defense supply chains away from monopolistic markets.
4. **Capital Flow & Trade Synergies:** Connects **Canadian pension funds** (over **USD 75 billion invested in India**) with India's expanding industrial and consumer market.
5. **Diaspora & Soft Power Bridge:** Capitalizes on the **1.8 million Indian diaspora** (4% of Canada's population) to strengthen **academic, research, and talent mobility**.

Challenges Associated with Bilateral Relations

1. **Separatist Extremism:** Persistent **anti-India separatism** and transnational organized crime networks hinder institutional trust between security agencies.
2. **Trade & Regulatory Hurdles:** Differences over **agricultural tariffs**, non-tariff barriers, and **IPR rules** create delays in finalizing **CEPA**.
3. **Consular & Visa Backlogs:** Diplomatic staff cutbacks during previous tensions created severe **visa processing bottlenecks** for students and professionals.
4. **Domestic Political Pressures:** Bilateral momentum remains vulnerable to internal **electoral dynamics** and vote-bank politics in Canada.
5. **Execution Bottlenecks:** Delays in operationalizing **defense R&D** and joint initiatives risk losing initial diplomatic momentum.

Way Forward

1. **Strict Security Coordination:** Implement the joint **NSA action plan** to target **violent extremism** and organized crime.
2. **Early Harvest Trade Agreement:** Finalize an **interim trade deal** in non-controversial sectors while negotiations for **CEPA** continue.
3. **Streamline Visa Capacity:** Restore full **consular staffing** in Ottawa and New Delhi to eliminate **visa backlogs**.
4. **Operationalize Defence Engagements:** Institutionalize regular **Defence Dialogue meetings** and promote **subsystem defense manufacturing**.

5. **Expand Clean Energy Supply Chains:** Leverage Canadian entry into the **ISA** and **GBA** for joint ventures in **bio-energy and solar storage**.
6. **Strengthen Track II Ties:** Re-activate the **India–Canada CEO Forum** and expand academic frameworks like the **AICTE–Mitacs internships**.

Conclusion

The **India–Canada reset** marks a shift from historical friction to **strategic pragmatism**. By addressing **security concerns** and leveraging **economic, energy, and defense complementarities**, both nations can build a resilient alliance that anchors **Indo-Pacific stability**.

Q. Examine the key pillars of strategic convergence in the recent India–Canada bilateral reset and discuss the major challenges in sustaining this momentum. 15 Marks

1.2.2. NATO'S 2026 ANKARA SUMMIT

Context

The 32 NATO member nations convened at the Ankara Summit (July 7–8, 2026) to operationalize commitments from the 2025 Hague Summit. The primary focus was on enforcing collective defense, achieving a 5% GDP defense spending target, and scaling industrial capacity amidst complex global security challenges.



Introduction

The 2026 Ankara Summit marks a strategic transition for NATO, shifting its focus from political discourse to tangible military readiness and industrial expansion. This reorientation reflects the alliance's response to an increasingly volatile security environment and heightened superpower competition.

Key Dimensions and Structural Challenges in NATO's Strategic Pivot

1. Unprecedented Financial Commitments and Collective Defense

- **Reaffirming Article 5:** The 32 allies endorsed an ironclad commitment to collective defense under Article 5 of the Washington Treaty and the preservation of the transatlantic bond.
- **The Hague Defence Commitment:** Allies unanimously backed a benchmark to allocate at least 5% of their respective Gross Domestic Products (GDPs) to defense by 2035—a significant hike over the historic 2% target.
- **Shift from declaration to execution:** The summit focused heavily on transforming political promises into tangible military capability through sustained investment, industrial scaling, and innovation.

2. Bottlenecks in the European Defence Industrial Base (DIB)

- **Severe production deficits:** European defense majors like MBDA and Rheinmetall have warned of systemic shortages in conventional ammunition and critical military hardware.

- **Exposed strategic mismatches:** High-intensity engagements, such as the conflict in Ukraine and US operations in the Middle East, have highlighted critical shortages in air defense interceptors, precision-guided munitions, and artillery rockets.
- **Lack of alliance-wide coordination:** Despite capable individual defense industries across Europe, the lack of synchronized procurement priorities across the 32 member states continues to fragment manufacturing output.

3. Deepening Structural Dependence on the United States

- **Escalating import share:** Nearly 50% of Europe's defense spending between 2022 and 2024 went toward US suppliers, up from 28% in 2019–2021.
- **Surge in Foreign Military Sales (FMS):** US FMS notifications for European customers quadrupled since 2008, reaching \$76 billion in 2024.
- **Risk to strategic autonomy:** Without a self-sustaining domestic defense industry, increased European spending risks deepening long-term technological and logistical dependency on Washington.

4. Shift in Global Arms Market Dynamics

- **Transition to a seller's market:** As NATO members massively scale up procurement, the global arms bazaar is shifting inexorably from a buyer's market to a seller's market.
- **Resource diversion and supply delays:** Global suppliers are prioritizing NATO replenishment orders, leading to extended delivery timelines for non-aligned nations.
- **Strained Western stockpiles:** High consumption rates in concurrent conflicts are depleting precision weapon inventories faster than the current global defense manufacturing base can replace them.

5. Strategic Fallout for Developing Defense Economies and India

- **Supply chain disruptions:** Rising NATO demand is directly causing procurement delays for non-aligned nations, exemplified by delays in foreign supply of critical fighter jet engines for indigenous programs like the Tejas LCA.
- **Escalating acquisition costs:** Competition for key components, raw materials, and high-tech defense sub-assemblies is driving up global defense procurement budgets.
- **Imperative for indigenous self-reliance:** Vulnerabilities in global supply chains emphasize that critical security needs cannot rely on overstretched foreign suppliers who face their own domestic compulsions.

Strategic Frameworks & Comparative Models

- **Licensed Co-Production Models (e.g., Patriot Systems in Ukraine):** NATO's initiative to permit localized production of advanced equipment under license offers a model for rapid technology transfer and capacity building.
- **Unified Joint Procurement (EU Defense Mechanisms):** Emerging efforts to pool defense orders across European states seek to eliminate duplicate R&D spending and reduce unit costs.
- **Aatmanirbhar Bharat Framework (India):** India's push for indigenization through Positive Indigenization Lists, Defense Industrial Corridors, and private sector integration acts as a counter-strategy against international supply chain chokepoints.

Way Forward

- **Accelerate Domestic Indigenization (Aatmanirbhar Bharat):** India must rapidly advance its indigenous manufacturing capabilities across critical defense sectors to insulate its military modernization from global supply chain shocks.
- **Focus on Emerging and Disruptive Technologies (EDTs):** Prioritize national R&D investments in new-age defense domains, including Artificial Intelligence, autonomous systems, cyber warfare, quantum technologies, and resilient communication networks.
- **Diversify Strategic Defense Partnerships:** Cultivate multi-aligned defense manufacturing joint ventures and technology transfers to avoid critical single-source supply dependencies.
- **Strengthen Public-Private Defense Collaboration:** Foster deeper integration between defense public sector undertakings (DPSUs), private defense firms, and MSMEs to scale domestic production capacity rapidly.
- **Institutionalize Co-Development and Local Production:** Require foreign OEMs (Original Equipment Manufacturers) engaging in domestic defense contracts to establish long-term maintenance, repair, overhaul (MRO), and localized production facilities within India.

Conclusion

The 2026 Ankara Summit signals NATO's definitive shift towards sustained military preparedness and industrial scaling. While strengthening European deterrence, it inadvertently strains global arms supply chains. Consequently, India must prioritize building a self-reliant defense industrial base to secure its strategic autonomy.

Q. 'The expansion and strengthening of NATO and a stronger US-Europe strategic partnership works well for India.' What is your opinion about this statement? Give reasons and examples to support your answer. 15 marks

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Prelims Test Series

2.1. ENVIRONMENT

2.1.1. BURIED QUESTIONS: TUNNEL DISASTER AT TEESTA STAGE-VI

Context

A methane gas burst inside the under-construction Teesta Stage-VI Hydroelectric Project tunnel in Sikkim's Namchi district killed several workers.

Introduction

The Teesta Stage-VI tunnel accident is not merely an industrial accident but a reminder of the **complex interaction between development, fragile ecology, geological risks, and worker safety**. It highlights the need to reconcile India's clean energy ambitions with environmental sustainability and disaster resilience.



Why are Himalayan Hydropower Projects the Need of the Hour, Yet Highly Vulnerable?

1. Strategic Energy Potential vs Geological Fragility

The Himalayas possess immense **hydropower potential** essential for India's clean energy transition, but their **young, seismically active geology** makes dams and tunnels highly susceptible to landslides, earthquakes, and structural failures.

2. Infrastructure Expansion vs Hidden Geological Hazards

Rapid development of tunnels, roads, and hydropower projects is crucial for **energy security and regional connectivity**, yet underground excavation may encounter **methane pockets, fault zones, aquifers, and weak rock strata**, posing serious safety risks.

3. Climate Goals vs Climate-Induced Risks

Hydropower supports India's **net-zero and renewable energy ambitions**, but **glacial retreat, GLOFs, extreme rainfall, and flash floods** are increasing the vulnerability of Himalayan infrastructure.

4. Regional Development vs Ecological Fragility

Hydropower drives **economic growth, employment, and energy access** in Himalayan states; however, **multiple dams, tunnelling, deforestation, and unplanned development** can destabilise fragile ecosystems and heighten disaster risks.

Recurring Incidents Highlighting Infrastructure Risks

- Teesta Stage-VI Tunnel, Sikkim (2026):** A **methane gas burst** during tunnel excavation killed several workers, highlighting the risks of underground construction in the fragile Himalayas.
- Silkyara Tunnel Collapse, Uttarkashi, Uttarakhand (2023):** A tunnel collapse trapped **41 workers for 17 days**, exposing deficiencies in geological assessment, engineering design, and emergency preparedness.
- Illegal Coal Mine Explosion, Meghalaya (2026):** A **methane gas explosion** at an illegal coal mine killed around **30 workers**, exposing poor mine safety standards, inadequate gas monitoring, and weak regulatory enforcement.

Challenges Associated with Himalayan Hydropower Projects

1. Geological and Climate Vulnerability

- The young, seismically active Himalayan terrain, coupled with hidden fault lines, methane pockets, and weak rock strata, makes tunnelling and dam construction inherently risky.
- Climate change has intensified hazards through glacial retreat, GLOFs, extreme rainfall, and flash floods, increasing the likelihood of infrastructure failures.

2. Worker Safety and Disaster Preparedness

- Inadequate gas detection systems, ventilation, safety drills, and occupational safety protocols expose workers to fatal risks during underground construction.
- Weak emergency response mechanisms, rescue infrastructure, and real-time monitoring delay disaster mitigation and increase casualties.

3. Environmental and Ecological Degradation

- Hydropower projects fragment river ecosystems, destroy habitats, obstruct fish migration, and reduce ecological connectivity, threatening Himalayan biodiversity.
- Large-scale tunnelling, blasting, and deforestation destabilise mountain slopes, increasing landslides, erosion, and long-term ecological fragility.

4. Weak Environmental Governance

- Poor compliance with Environmental Clearance (EC) conditions, inadequate geological investigations, and limited cumulative impact assessments undermine sustainable project execution.
- Weak post-clearance monitoring, compliance audits, and inter-agency coordination reduce accountability and increase environmental risks.

5. Technical and Project Planning Deficiencies

- Inadequate geological modelling, hazard mapping, and risk assessment often fail to identify subsurface hazards before construction begins.
- Deficiencies in tunnel alignment, engineering design, and construction methodology lead to delays, cost overruns, and increased accident risks.

6. Socio-Economic Challenges

- Hydropower projects often displace local communities, disrupt livelihoods, and increase disaster vulnerability in ecologically sensitive regions.
- Frequent delays, rising construction costs, and financial distress of developers reduce project viability and burden public finances, as seen in the **Teesta Stage-VI** takeover by NHPC.

7. Institutional and Policy Challenges

- Fragmented coordination among agencies such as **MoEFCC, CEA, GSI, NDMA, and State authorities** leads to gaps in planning, monitoring, and disaster management.
- The recurrence of incidents like the **Silkyara Tunnel collapse (2023)**, **Meghalaya mine explosion (2026)**, and **Teesta tunnel accident (2026)** indicates systemic governance failures rather than isolated events.

Committee Recommendations on Himalayan Hydropower Projects

1. Ravi Chopra Committee (2014) – Sustainable Basin-Level Hydropower Development

Recommended **basin-level planning, cumulative impact assessments, ecological flow (E-flow) maintenance, and restricting hydropower projects in ecologically fragile Himalayan regions.**

2. High Powered Committee (Char Dham) & NDMA – Disaster-Resilient Infrastructure

Emphasised **minimising hill cutting and tunnelling, integrating multi-hazard risk assessments, strengthening landslide mitigation, early warning systems, and disaster preparedness.**

3. Kasturirangan Committee, NGRBA & GSI – Scientific Environmental Governance

Advocated **identifying ecologically sensitive areas, conducting rigorous geological investigations, maintaining environmental flows, and ensuring continuous environmental monitoring before and during project execution.**

Way Forward for Sustainable Himalayan Hydropower Development

1. Scientific and Risk-Informed Planning

Undertake **advanced geological mapping, 3D seismic imaging, geophysical surveys, and hazard assessments** before project approval to minimise geological risks.

2. Strengthen Environmental Governance

Ensure **strict compliance with Environmental Clearance (EC) conditions** through independent audits, third-party inspections, and transparent monitoring.

3. Adopt Basin-Level Integrated Planning

Shift from **project-wise approvals to Integrated River Basin Management (IRBM), Cumulative Environmental Impact Assessment (CEIA), and Strategic Environmental Assessment (SEA).**

4. Build Climate-Resilient Infrastructure

Incorporate **GLOF risk assessment, climate projections, and nature-based disaster mitigation measures** into the design and operation of hydropower projects.

5. Enhance Tunnel and Worker Safety

Deploy **continuous gas detection, automated ventilation, real-time monitoring systems, emergency escape infrastructure, and regular safety drills** to protect workers.

6. Strengthen Institutional Coordination and Disaster Preparedness

Improve coordination among **MoEFCC, CEA, GSI, NDMA, and State agencies** with robust early warning systems and comprehensive emergency response plans.

7. Promote Sustainable and Community-Centric Development

Balance energy security with ecological conservation by **protecting biodiversity, ensuring local community participation, fair rehabilitation, and long-term environmental sustainability.**

Conclusion

The **Teesta Stage-VI tunnel disaster** underscores that **development in the Himalayas must be ecology-led, science-driven, and disaster-resilient rather than engineering-centric.** Achieving India's clean energy goals requires **robust environmental governance, scientific planning, worker safety, climate resilience, and community participation**, ensuring that development remains both **sustainable and safe.**

Q. *Hydropower development in the Himalayas involves a delicate balance between energy security and ecological sustainability. In the context of the Teesta Stage-VI tunnel disaster, examine the vulnerabilities of Himalayan hydropower projects and suggest measures for building disaster-resilient infrastructure. 15 Marks*

2.2. SCIENCE & TECHNOLOGY

2.2.1. VIKRAM-1 LAUNCH: INDIA'S PRIVATE SPACE SECTOR TAKES FLIGHT

Context

Skyroot Aerospace successfully launched **Vikram-1**, becoming the **first Indian private company to achieve an orbital launch**, marking a major milestone in India's space sector liberalisation after the **Indian Space Policy, 2023**.



Introduction

The successful launch of **Vikram-1** signifies India's transition from a **state-led space programme** to a **public-private partnership model**. It reflects the government's vision of transforming India into a **global commercial space hub** while allowing ISRO to focus on frontier research and strategic missions.

Why is Vikram-1 Significant?

1. India's First Private Orbital Launch

- **Historic milestone:** Vikram-1 is the first launch vehicle developed by an Indian private company to successfully place a payload into orbit, marking a new chapter in India's space programme.
- **Global recognition:** It makes India one of only a handful of countries where private enterprises have independently demonstrated orbital launch capability, showcasing the maturity of its private space ecosystem.

2. Beginning of a New Space Era

- **From monopoly to competition:** The launch reflects the success of space sector reforms that ended ISRO's exclusive role in launch services and opened the sector to private participation.
- **Innovation-driven ecosystem:** It signals the emergence of Indian space startups capable of designing, manufacturing, and operating end-to-end launch vehicles, strengthening India's commercial space industry.

3. Engineering Achievement

- **Advanced launch vehicle design:** Vikram-1 is a four-stage launch vehicle built using lightweight carbon-composite structures, improving payload efficiency and lowering manufacturing costs.
- **Optimised for small satellites:** The rocket is specifically designed to cater to the rapidly growing small satellite market, offering dedicated and efficient launch solutions.

4. Commercial Innovation

- **Dedicated launch service:** Unlike rideshare missions, Vikram-1 provides exclusive launch opportunities, allowing customers to avoid delays and orbital compromises caused by sharing rockets with multiple payloads.
- **Customer-centric flexibility:** Satellite operators can choose their preferred orbit, launch schedule, and mission profile, making the service similar to booking a "**cab**" rather than travelling in a **shared bus**, albeit at a higher cost.

Background: Space Sector Reforms

Before 2020

1. ISRO's Monopoly over Launch Activities

- ISRO exclusively carried out all launch vehicle development and space missions in India.

2. Private Firms as Component Suppliers

- Private companies were limited to manufacturing components and providing technical support to ISRO.

Since 2020: Major Space Sector Reforms

1. Opening Launch Services to Private Players

- Private companies were allowed to develop, own, and operate launch vehicles and satellites.

2. Creation of IN-SPACe

- **IN-SPACe** was established as the regulator and single-window facilitator for private participation in the space sector.

3. Establishment of NewSpace India Limited (NSIL)

- **NSIL** was created as ISRO's commercial arm to promote the commercial utilization of space technologies and services.

4. Indian Space Policy, 2023

- The policy provides a clear framework defining the roles of ISRO, NSIL, IN-SPACe, and private entities.

5. 49% FDI under Automatic Route (2024)

- Up to **49% FDI** was permitted under the automatic route to attract foreign investment and technology into the launch vehicle sector.

Challenges Ahead for Vikram-1 and India's Private Space Sector

1. **Commercial Viability:** Skyroot must achieve consistent launches with reliable schedules and competitive pricing to build a sustainable commercial business.
2. **Intense Global Competition:** Established players like **SpaceX**, **Rocket Lab**, and emerging Chinese companies offer cost-effective launch services, making market penetration difficult.
3. **Limited Dedicated Launch Market:** The demand for premium dedicated launches remains uncertain as many customers prefer cheaper rideshare missions.
4. **Scaling Manufacturing:** Expanding from prototype production to mass manufacturing requires maintaining quality, supply chain efficiency, and production consistency.

5. **Regulatory and Legal Uncertainty:** The absence of a comprehensive **Space Activities Act** creates ambiguity regarding licensing, liability, insurance, and dispute resolution.
6. **High Capital and Technology Requirements:** Developing reusable launch technologies, advanced propulsion systems, and launch infrastructure demands significant long-term investment and continuous innovation.

Way Forward for India's Private Space Sector

1. **Enact a Space Activities Act:** Enact a comprehensive **Space Activities Act** to provide legal clarity on licensing, liability, insurance, and commercial space operations.
2. **Strengthen the Private Space Ecosystem:** Promote private space enterprises through long-term funding, tax incentives, infrastructure access, and government procurement support.
3. **Encourage International Partnerships:** Expand global launch contracts, technology collaborations, and foreign investments to enhance India's competitiveness in the global space market.
4. **Develop Domestic Supply Chains:** Strengthen indigenous capabilities in propulsion systems, advanced materials, and space-grade electronics to reduce import dependence.
5. **Expand the Domestic Space Market:** Increase demand by promoting small satellite manufacturing, defence space programmes, Earth observation services, and satellite constellations.
6. **Foster Innovation and R&D:** Invest in advanced technologies such as reusable launch vehicles, next-generation propulsion systems, and AI-enabled space applications to ensure long-term global leadership.

Conclusion

The successful launch of **Vikram-1** marks the dawn of India's **New Space Age**. Sustained policy support, innovation, and commercial competitiveness will be crucial to making India a **global space launch hub** and achieving its **\$44 billion space economy target by 2033**.

Q. "The launch of Vikram-1 marks a paradigm shift in India's space sector from a state-led model to a commercially driven ecosystem." Discuss the significance of this development. Examine the challenges faced by India's private space industry and suggest measures to enhance its global competitiveness. 15 marks

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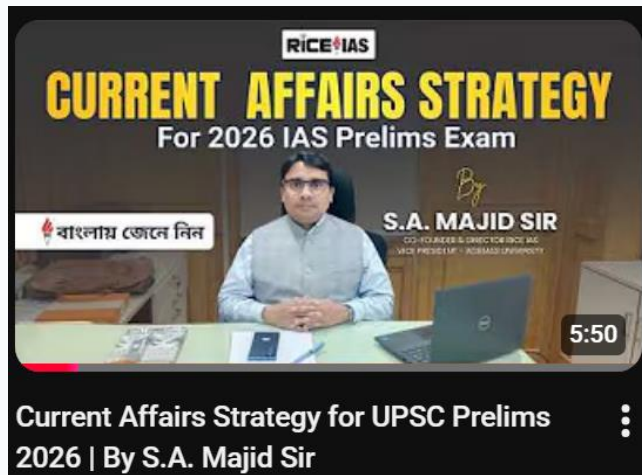
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