



**Secure Synopsis compilation for January-2026**

**General Studies-3**

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## **Indian Economy and issues relating to planning, mobilization, of resources, growth, development and employment.**

**Q. Explain the components of national income. Analyse the challenges involved in estimating India’s national income in a structurally diverse economy. Also suggest institutional reforms to strengthen estimation of national income. (15 M)**

### **Introduction**

National income aggregates form the analytical foundation for macroeconomic policy, fiscal planning and welfare design. In an economy marked by informality, sectoral heterogeneity and rapid structural change, their accurate estimation demands both conceptual clarity and strong statistical institutions.

### **Body**

#### **Components of national income**

1. **Gross domestic product at market prices:** Captures the total value of final goods and services produced within national boundaries, reflecting the combined contribution of all productive sectors.  
**Eg: India’s GDP is estimated using production, income and expenditure approaches to cross-validate sectoral value added,** ensuring internal consistency across estimates.
2. **Net national income:** Represents income accruing to residents after accounting for depreciation and net factor income from abroad.  
**Eg: Persistent net outward flow of investment income moderates India’s net national income despite robust domestic output growth,** highlighting the distinction between production and income accrual.
3. **Personal income:** Measures income actually received by households, including wages, interest, rent and transfer payments, but excluding retained corporate earnings.  
**Eg: Expansion of direct benefit transfers has increased the visibility of transfer income in household accounts,** particularly among lower-income groups.
4. **Disposable income:** Personal income net of direct taxes, indicating households’ effective consumption and saving capacity.  
**Eg: Digitisation of income tax administration has improved tracking of post-tax income trends,** aiding better consumption forecasting.

#### **Challenges in estimating national income in a structurally diverse economy**

1. **Dominance of the informal sector:** A large share of production occurs outside formal reporting systems, necessitating indirect estimation methods.  
**Eg: Informal manufacturing and services output is often inferred from employment and productivity benchmarks,** which may not capture local or temporal variations accurately.
2. **Sectoral and regional heterogeneity:** Wide differences in productivity, enterprise size and data quality across states complicate aggregation.  
**Eg: Variations in service sector reporting across states affect the consistency of value added estimates,** especially in trade and transport services.
3. **Measurement of emerging and digital activities:** Rapid growth of platform-based and digital services challenges conventional valuation methods.  
**Eg: Quality improvements in digital payments, e-commerce and online services are difficult to deflate accurately,** potentially understating real growth.
4. **Dependence on administrative databases:** Corporate sector estimates rely heavily on formal filings, which may not represent the entire enterprise universe.  
**Eg: Small and micro enterprises below statutory reporting thresholds remain weakly captured,** biasing productivity and income distribution estimates.

### **Institutional reforms to strengthen national income estimation**

1. **Statistical autonomy and capacity building:** Enhancing functional independence and technical resources of statistical institutions improves credibility.  
**Eg: Greater professional autonomy for national statistical agencies strengthens trust in GDP estimates,** reducing perceptions of policy influence.
2. **Deeper integration of administrative data systems:** Linking tax, labour, social security and business registries can improve coverage and timeliness.  
**Eg: Systematic integration of GST, income tax and social security databases can reduce reliance on proxies for informal sector estimation.**
3. **Frequent benchmarking and base-year updates:** Regular revision cycles help align estimates with structural changes in the economy.  
**Eg: Timely base-year revisions incorporating new consumption patterns and technologies enhance relevance of national income series.**
4. **Improved price statistics and deflators:** Strengthening price data collection for services and digital sectors improves real output measurement.  
**Eg: Developing service-sector-specific price indices can better capture inflation-adjusted growth in modern economic activities.**

### **Conclusion**

Credible national income estimation in India requires moving beyond proxy-based methods towards integrated, technology-enabled statistical systems. Strengthened institutions and adaptive methodologies are essential for aligning macroeconomic measurement with India's evolving economic structure.

### **Q. Distinguish between GDP at factor cost and GDP at market prices. Examine their relevance for fiscal policymaking in India. (10 M)**

#### **Introduction**

National income measurement determines how economic activity is valued and interpreted by the state. The shift in India's accounting framework has direct implications for how fiscal capacity, tax effort, and public expenditure priorities are assessed.

#### **Body**

#### **Distinction between GDP at factor cost and GDP at market prices**

Basis	GDP at factor cost	GDP at market prices
Conceptual basis	Measures value of output based on <b>payments to factors of production</b>	Measures value of output based on <b>final prices paid by consumers</b>
Treatment of taxes	<b>Excludes indirect taxes</b>	<b>Includes indirect taxes</b>
Treatment of subsidies	<b>Includes subsidies</b>	<b>Excludes subsidies</b>
Formula	Value added – indirect taxes + subsidies	Value added + indirect taxes – subsidies
Policy relevance	Reflects <b>income generation to producers</b>	Reflects <b>actual size of the economy</b>
Status in India	Used till <b>2014–15 series</b>	Adopted officially from <b>2015–16 base year</b>

### Relevance for fiscal policymaking in India

1. **Tax buoyancy assessment:** GDP at market prices captures indirect taxes, making it a better denominator for evaluating tax performance.  
**Eg: GST collections since 2017** are assessed against GDP at market prices in the **Economic Survey**, improving accuracy of tax buoyancy estimates.
2. **Fiscal deficit targeting:** Fiscal deficit ratios are calculated using GDP at market prices, ensuring consistency with international fiscal norms.  
**Eg: FRBM Act targets** (3 percent deficit norm) are evaluated using GDP at market prices as reported in **Union Budget documents**.
3. **Subsidy rationalisation decisions:** Separation of subsidies from GDP helps policymakers transparently assess the fiscal cost of welfare support.  
**Eg: Food and fertiliser subsidy rationalisation post-2021**, discussed in **Economic Survey 2022–23**, relies on GDP at market prices for fiscal impact analysis.
4. **Inter-temporal fiscal comparisons:** Market price GDP allows consistent comparison of fiscal indicators across years and countries.  
**Eg: IMF and World Bank fiscal databases** use GDP at market prices, enabling India's cross-country fiscal benchmarking.
5. **Revenue–expenditure alignment:** GDP at market prices better reflects consumption-driven revenue potential, guiding expenditure prioritisation.  
**Eg: Capital expenditure push since Budget 2020–21**, highlighted by **RBI State Finances reports**, is calibrated against market-price GDP growth.

### Conclusion

GDP at market prices provides a fiscally relevant, transparent, and internationally comparable measure of economic size. Its adoption strengthens evidence-based budgeting, deficit management, and long-term fiscal credibility in India.

**Q4. Examine how public capital expenditure influences private investment decisions in India. Analyse its sectoral employment effects. Discuss the sustainability of this strategy under fiscal constraints. (15 M)**

### **Introduction**

Public capital expenditure has emerged as a critical policy lever to revive growth in an uncertain global environment, especially when private investment remains risk-averse. Its significance lies in its ability to influence investment sentiment, employment creation and long-term fiscal sustainability simultaneously.

### **Body**

## Influence of public capital expenditure on private investment decisions

1. **Demand assurance and confidence building:** Sustained public investment creates predictable demand for goods and services, reducing uncertainty and encouraging firms to commit long-term capital.  
**Eg: Large-scale highway and metro expansion since FY21** boosted confidence among **cement, steel and EPC firms**, leading to fresh capacity expansion plans aligned with infrastructure demand.
2. **Reduction in cost of doing business:** Investment in logistics, transport and power infrastructure lowers transaction costs, improving project viability and expected returns for private investors.  
**Eg: Dedicated freight corridors and port modernisation** reduced turnaround times, making **export-oriented manufacturing clusters** more attractive for private capital.
3. **Crowding-in through complementary investment:** Public capex often addresses market failures by providing basic infrastructure, enabling private investment in downstream activities.  
**Eg: Government investment in industrial corridors** catalysed **private manufacturing units, warehousing and MSME clusters** around nodal cities.
4. **Policy commitment and signalling effect:** High and sustained capex signals policy stability and long-term growth intent, reducing policy uncertainty premiums.  
**Eg: Multi-year capital outlay announcements in successive Union Budgets** reassured investors about continuity in infrastructure-led growth strategy.
5. **Risk mitigation in capital-intensive sectors:** Public participation lowers initial risks in sectors with high sunk costs, making them bankable for private players.  
**Eg: Public investment in renewable energy parks and transmission infrastructure** enabled private firms to scale solar and wind generation with lower entry risks.

## Sectoral employment effects of public capital expenditure

1. **High employment elasticity in construction:** Infrastructure projects generate large volumes of direct and indirect employment, especially for semi-skilled and unskilled workers.  
**Eg: Road, rail and urban infrastructure projects** absorbed migrant and informal workers during post-pandemic recovery phases.
2. **Manufacturing job creation through backward linkages:** Capex-driven demand stimulates manufacturing sectors supplying infrastructure inputs.  
**Eg: Increased orders for steel, cement and capital goods** supported factory-level employment and ancillary industries.
3. **MSME employment through supply chains:** Public projects create procurement opportunities for MSMEs, expanding decentralised job creation.  
**Eg: Local contractors and MSME vendors** benefited from public works under large infrastructure programmes.
4. **Services sector spillovers:** Infrastructure expansion improves urban connectivity, boosting employment in logistics, retail and urban services.  
**Eg: Metro rail expansion** increased jobs in **urban services, real estate and last-mile mobility**.
5. **Regional employment balancing:** Public capex in lagging regions helps reduce spatial concentration of jobs.  
**Eg: Infrastructure investment in eastern and central India** created construction and allied employment outside traditional growth centres.

## Sustainability of this strategy under fiscal constraints

1. **Rising interest burden risk:** Persistent high capex financed through borrowing can increase debt servicing costs, constraining future fiscal space.  
**Eg: Higher interest payments in recent budgets** limit flexibility for counter-cyclical spending.

2. **Trade-off with social expenditure:** Excessive focus on capital outlays may crowd out spending on health, education and welfare if revenues do not keep pace.  
**Eg: Compressed revenue expenditure growth** raises concerns about long-term human capital formation.
3. **Dependence on private sector response:** Capex-led growth is sustainable only if private investment eventually takes over as the main growth driver.  
**Eg: Delayed private investment response** could weaken the multiplier impact of public spending.
4. **Efficiency and execution challenges:** Poor project selection or delays can reduce returns on public investment, undermining fiscal sustainability.  
**Eg: Time and cost overruns in infrastructure projects** dilute expected economic benefits.
5. **Need for fiscal consolidation balance:** Long-term sustainability depends on aligning capex growth with revenue mobilisation and asset monetisation.  
**Eg: Use of asset monetisation and disinvestment** to fund infrastructure without excessive borrowing.

### Conclusion

Public capital expenditure can effectively crowd in private investment and generate broad-based employment if it is efficient, targeted and time-bound. Its sustainability ultimately rests on a successful transition to private-led growth supported by prudent fiscal management and rising revenues.

**Q. Examine how public capital expenditure influences private investment decisions in India. Analyse its sectoral employment effects. Discuss the sustainability of this strategy under fiscal constraints. (15 M)**

### Introduction

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**Eg: Dedicated freight corridors and port modernisation** reduced turnaround times, making **export-oriented manufacturing clusters** more attractive for private capital.
3. **Crowding-in through complementary investment:** Public capex often addresses market failures by providing basic infrastructure, enabling private investment in downstream activities.  
**Eg: Government investment in industrial corridors** catalysed **private manufacturing units, warehousing and MSME clusters** around nodal cities.
4. **Policy commitment and signalling effect:** High and sustained capex signals policy stability and long-term growth intent, reducing policy uncertainty premiums.  
**Eg: Multi-year capital outlay announcements in successive Union Budgets** reassured investors about continuity in infrastructure-led growth strategy.
5. **Risk mitigation in capital-intensive sectors:** Public participation lowers initial risks in sectors with high sunk costs, making them bankable for private players.

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### **Sectoral employment effects of public capital expenditure**

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**Eg: Use of asset monetisation and disinvestment** to fund infrastructure without excessive borrowing.

### **Conclusion**

Public capital expenditure can effectively crowd in private investment and generate broad-based employment if it is efficient, targeted and time-bound. Its sustainability ultimately rests on a successful transition to private-led growth supported by prudent fiscal management and rising revenues.

**Q. Assess India's current growth trajectory amid prevailing global economic uncertainty. Explain the factors that underpin India's relative economic resilience. Suggest policy measures required to sustain this resilience over the medium term. (15 M)**

### **Introduction**

Amid persistent global economic uncertainty driven by geopolitical tensions, high interest rates and fragmented trade, India has sustained relatively stable growth. This performance reflects structural demand strength and policy buffers rather than short-term global tailwinds.

### **Body**

#### **India's current growth trajectory amid global economic uncertainty**

- 1. Domestic demand-led growth structure:** Growth remains anchored in household consumption and government spending, limiting exposure to global demand shocks.  
**Eg: MOSPI national accounts** indicate that **private final consumption expenditure** continued to be the largest contributor to GDP growth even as global trade slowed.
- 2. Public capital expenditure as growth stabiliser:** Sustained public capex has supported construction, core industries and logistics during global slowdown phases.  
**Eg: Union Budget 2024-25** maintained elevated allocations for **roads, railways and urban infrastructure**, identified by the **Economic Survey 2023-24** as growth anchors.
- 3. Resilient services sector performance:** Services exports and domestic services activity have cushioned manufacturing volatility.  
**Eg: RBI Annual Report 2023-24** highlights sustained growth in **IT, financial and professional services** despite weak global manufacturing cycles.
- 4. Moderated inflation-growth trade-off:** Growth has been protected without triggering macroeconomic overheating.  
**Eg: RBI Monetary Policy Statements (2024-25)** note calibrated monetary tightening that preserved growth momentum while managing inflation.
- 5. Relative insulation from global financial volatility:** India avoided sharp growth disruptions seen in several emerging economies.  
**Eg: IMF World Economic Outlook 2024** categorised India among economies showing stable medium-term growth prospects despite global uncertainty.

#### **Factors underpinning India's relative economic resilience**

- 1. Large and diversified domestic market:** Scale and diversity reduce dependence on external markets.  
**Eg: World Bank India Development Update 2024** highlights domestic demand as India's key shock absorber.
- 2. Strengthened banking sector balance sheets:** Improved financial health has revived credit growth.  
**Eg: RBI Financial Stability Report, December 2024** reports multi-year lows in **gross NPAs of scheduled commercial banks**.
- 3. Stable macroeconomic policy framework:** Predictable fiscal and monetary frameworks anchor confidence.  
**Eg: FRBM Act and RBI inflation targeting framework** are cited by the **Economic Survey** as credibility-enhancing institutions.

4. **Robust external sector buffers:** Adequate reserves reduce vulnerability to capital flow reversals.  
**Eg: RBI Annual Report 2023–24** notes that **forex reserves remained sufficient to cover multiple months of imports**.
5. **Digital public infrastructure-enabled efficiency:** DPI has improved service delivery and formalisation.  
**Eg: Economic Survey 2023–24** credits **UPI, GSTN and Aadhaar-based platforms** for lowering transaction costs and boosting resilience.

### **Policy measures required to sustain this resilience over the medium term**

1. **Crowding in private investment:** Public capex must translate into sustained private sector participation.  
**Eg: 15th Finance Commission** emphasises improving **contract enforcement and logistics efficiency** to boost private investment.
2. **Productivity-led employment generation:** Growth durability depends on quality job creation.  
**Eg: NITI Aayog Strategy for New India @75** stresses **manufacturing, MSMEs and skilling** to harness demographic potential.
3. **Fiscal consolidation without growth sacrifice:** Medium-term stability requires balancing growth support with debt sustainability.  
**Eg: FRBM glide path reiterated in Budget documents** aims to stabilise debt while sustaining capex.
4. **Export diversification and value addition:** Reducing concentration risks will protect growth from external shocks.  
**Eg: Foreign Trade Policy 2023** prioritises **electronics, services and high-value manufacturing exports**.
5. **Centre-State coordination for growth delivery:** Sub-national execution capacity must align with national priorities.  
**Eg: GST Council and cooperative federalism mechanisms**, highlighted in the **Economic Survey**, support harmonised growth efforts.

### **Conclusion**

India's resilience amid global uncertainty reflects strong domestic demand, institutional stability and reform continuity. Sustaining this advantage requires productivity-enhancing reforms, private investment revival and strategic global integration to convert resilience into durable long-term growth.

**Q. Explain the significance of sustained net FDI outflows for India's external sector. Analyse the underlying structural and cyclical factors. Suggest policy responses to strengthen investment resilience. (15 M)**

### **Introduction**

Sustained net FDI outflows signal a complex phase in India's external sector where strong gross inflows coexist with rising repatriation and disinvestment. This trend has implications for balance of payments stability, investment sentiment and long-term growth financing.

### **Body**

## Significance of sustained net FDI outflows for India's external sector

1. **Pressure on capital account balance:** Persistent net FDI outflows weaken the non-debt-creating component of the capital account, increasing reliance on volatile portfolio flows.  
**Eg: RBI Monthly Bulletin (Nov 2025)** showed net FDI at **-\$446 million**, even as gross inflows stayed robust, highlighting capital account fragility.
2. **Implications for current account financing:** FDI outflows reduce stable financing of the current account deficit, raising vulnerability during global shocks.  
**Eg: Economic Survey 2023–24** emphasised FDI as the most stable CAD-financing source compared to FPI or ECBs.
3. **Exchange rate and reserve management challenges:** Lower net FDI inflows can add depreciation pressure on the rupee during periods of FPI exit.  
**Eg: RBI reports (2025)** linked capital flow volatility with intermittent rupee pressures amid global tightening.
4. **Signal for long-term investor confidence:** Sustained net outflows may be interpreted as weakening long-term commitment despite healthy headline inflows.  
**Eg: Rising profit repatriation and disinvestment by MNCs in 2025**, noted by the **RBI**, shaped cautious investor sentiment.
5. **Impact on domestic investment cycle:** Reduced net FDI constrains technology transfer, productivity gains and non-debt capital formation.  
**Eg: Economic Survey 2022–23** highlighted FDI's role in manufacturing and services-led productivity growth.

## Underlying structural and cyclical factors

1. **High profit repatriation by mature foreign investors:** As projects mature, foreign firms repatriate profits, increasing outward flows structurally.  
**Eg: RBI Bulletin (Nov 2025)** recorded **five-month-high repatriation and disinvestment of \$5.3 billion**.
2. **Global monetary tightening and risk aversion:** Higher interest rates in advanced economies raise opportunity costs for capital in emerging markets.  
**Eg: IMF World Economic Outlook 2024** flagged tighter global financial conditions affecting EM capital flows.
3. **Trade and geopolitical uncertainty:** Uncertainty over major trade relationships dampens fresh investment decisions.  
**Eg: RBI (FY 2025–26)** cited uncertainty around the **India–U.S. trade deal** as affecting both FDI and FPI flows.
4. **Currency volatility:** A weakening or volatile rupee raises hedging costs and affects investor returns.  
**Eg: RBI Annual Report 2023–24** linked exchange rate volatility with short-term capital flow reversals.
5. **Sectoral concentration of inflows:** Heavy concentration in select sectors limits resilience when sector-specific shocks occur.  
**Eg: RBI data (2025)** showed nearly **75% of FDI inflows** going into financial services, manufacturing and trade.

## Policy responses to strengthen investment resilience

1. **Enhancing policy predictability and regulatory stability:** Stable tax and regulatory regimes reduce premature exits.  
**Eg: Economic Survey 2023–24** stressed predictability as a key determinant of long-term FDI retention.

2. **Deepening domestic manufacturing ecosystems:** Strong local supply chains increase reinvestment incentives.  
**Eg: PLI Schemes**, reviewed by **NITI Aayog**, aim to anchor long-term foreign capital in manufacturing.
3. **Managing capital flow volatility through macroprudential tools:** Buffering sudden reversals protects external stability.  
**Eg: RBI's calibrated forex interventions** and flexible inflation targeting framework.
4. **Diversifying source countries and sectors:** Broader FDI bases reduce dependence on a few geographies and industries.  
**Eg: National Investment and Infrastructure Pipeline (NIIP)** promotes sectoral diversification.
5. **Strengthening ease of doing business at subnational level:** State-level reforms improve retention and reinvestment.  
**Eg: DPIIT's State Investment Promotion rankings** incentivise competitive federalism in attracting FDI.

### **Conclusion**

Sustained net FDI outflows are not merely a cyclical concern but a strategic signal for India's external sector management. Strengthening policy credibility, diversification and reinvestment incentives will be key to building resilient, long-term foreign capital inflows.

**Q. What is meant by de-dollarisation in the global economy? Identify the key economic and financial factors driving this trend. Bring out its implications for global financial stability. (15 M)**

### **Introduction**

The international monetary system is undergoing a gradual recalibration as countries seek greater **financial resilience and autonomy**. De-dollarisation reflects a risk-management response to structural shifts in global finance rather than a sudden displacement of the US **dollar**.

### **Body**

#### **Meaning of de-dollarisation**

1. **Reduction in reliance on the US dollar:** De-dollarisation refers to the gradual decline in the use of the US dollar in **foreign exchange reserves, trade invoicing, and cross-border financial assets**.  
**Eg: IMF COFER data (2024)** shows the **US dollar share in global reserves declining to around 58.5 percent**, the lowest level in over three decades.
2. **Shift in reserve composition rather than currency replacement:** De-dollarisation does not imply replacement of the dollar by a single currency but a **rebalancing across assets such as gold, SDRs, and non-dollar currencies**.  
**Eg: IMF Annual Report 2024** notes increased diversification into **gold and selected non-traditional reserve currencies** rather than wholesale substitution.
3. **Functional diversification across financial roles:** The process involves reducing dollar dependence across **multiple functions—store of value, medium of exchange, and unit of account**.  
**Eg: BIS Annual Economic Report 2023** highlights divergence between **trade settlement choices and reserve currency composition**.

#### **Economic and financial factors driving de-dollarisation**

1. **Reserve diversification for risk management:** Central banks seek to reduce concentration risk arising from excessive exposure to dollar-denominated assets.

**Eg: World Gold Council (2025)** reports sustained **net central bank gold purchases** as part of portfolio diversification strategies.

2. **Volatility from advanced economy monetary cycles:** Sharp interest rate cycles in the US transmit volatility to global capital flows and exchange rates.

**Eg: RBI Annual Report 2024–25** flags spillover risks from advanced economy monetary tightening to emerging markets.

3. **Concerns over asset safety and liquidity access:** Freezing of sovereign assets has raised awareness of **custodial and settlement risks** associated with reserve concentration.

**Eg: IMF Global Financial Stability Report 2023** records heightened interest in **jurisdiction-neutral reserve assets**.

4. **Expansion of non-dollar trade settlement mechanisms:** Countries are increasingly settling trade in local or alternative currencies to reduce transaction and hedging costs.

**Eg: BIS Triennial Survey 2022** notes a steady rise in **non-dollar invoicing in commodity and energy trade**.

### Implications for global financial stability

1. **8. Improved shock absorption through diversification:** A diversified reserve system reduces systemic vulnerability to shocks originating in a single currency area.

**Eg: IMF Working Papers on reserve adequacy** highlight diversification as a buffer against global liquidity stress.

2. **9. Short-term volatility during portfolio realignment:** Reallocation of reserves can trigger fluctuations in bond yields, exchange rates, and capital flows.

**Eg: IMF GFSR 2024** cautions against disorderly reserve adjustments affecting financial markets.

3. **10. Rising prominence of non-yielding safe assets:** Increased gold holdings enhance safety but reduce average returns on reserves.

**Eg: RBI Bulletin 2025** shows valuation gains from gold offsetting lower interest income.

4. **11. Fragmentation of global liquidity pools:** Multiple settlement systems may weaken market depth and increase transaction costs.

**Eg: BIS Annual Economic Report 2024** warns of liquidity fragmentation in a multi-currency environment.

### Conclusion

De-dollarisation represents a **measured diversification strategy rather than monetary disruption**.

Ensuring transparency, coordination, and strong global financial institutions will be crucial to managing stability during this transition.

**Q. India's growth challenge today lies less in reviving the business cycle and more in sustaining growth through structural transformation. Examine the limitations of cyclical policy support in the Indian economy. Analyse the key structural bottlenecks that constrain durable growth. Suggest priority reform areas to address these constraints. (15 M)**

### **Introduction**

India's recent growth resilience has been supported by favourable cyclical tailwinds such as fiscal stimulus, monetary easing and external price conditions. However, sustaining high growth over the medium to long

term increasingly depends on resolving deep-rooted structural constraints rather than extending short-term policy support.

## Body

### Limitations of cyclical policy support in the Indian economy

1. **Fiscal space constraints and debt sustainability:** Expansionary fiscal support faces limits due to high public debt and the need for fiscal consolidation to maintain macroeconomic stability.  
**Eg: RBI State Finances Study 2024** highlights the necessity of reducing combined fiscal deficits to stabilise **public debt around 80% of GDP**.
2. **Diminishing returns from public capital expenditure:** Prolonged reliance on public capex risks absorptive capacity constraints and crowding out of private investment.  
**Eg: Union Budget documents (2024–25)** show central capex growth moderating after four years of rapid expansion.
3. **Limited monetary policy headroom:** With inflation broadly anchored and real interest rates already compressed, further easing offers marginal growth gains.  
**Eg: RBI Monetary Policy Statements 2025** indicate real policy rates near historically low levels.
4. **Temporary nature of demand stimuli:** Tax cuts and transfers boost consumption only briefly without sustained income and employment growth.  
**Eg: GST Council rate rationalisation impacts** showed short-term consumption pick-up without durable momentum.
5. **External vulnerability of cyclical growth:** Growth driven by favourable global conditions is exposed to shocks from geopolitics and trade uncertainty.  
**Eg: IMF World Economic Outlook 2025** flags rising global policy unpredictability affecting emerging economies.

### Structural bottlenecks constraining durable growth

1. **Capital-intensive growth bias:** Production structures favour capital over labour, limiting employment generation and mass consumption.  
**Eg: Economic Survey 2023–24** notes weak employment elasticity of growth in manufacturing.
2. **Low labour productivity and skill mismatch:** Workforce skills lag industry needs, constraining competitiveness and income growth.  
**Eg: Periodic Labour Force Survey (PLFS)** shows high informal employment with low productivity.
3. **Human capital deficits:** Gaps in education, health and skilling reduce long-term growth potential.  
**Eg: NITI Aayog Human Capital Index** highlights inter-state disparities in learning and health outcomes.
4. **Trade integration and competitiveness gaps:** Tariff complexity and non-tariff barriers weaken export competitiveness in global value chains.  
**Eg: WTO Trade Policy Review of India (2024)** notes persistence of tariff peaks and QCO-related frictions.
5. **Institutional and regulatory rigidities:** Delays in factor market reforms and contract enforcement deter private investment.  
**Eg: World Bank Doing Business legacy indicators** and **Economic Survey** underline contract enforcement delays.

## Priority reform areas to sustain growth structurally

1. **Labour-intensive growth strategy:** Reorient industrial policy towards sectors with high employment potential.  
**Eg: Labour Codes (2020)** aim to balance flexibility with worker protection, as recommended by the **Second National Commission on Labour**.
2. **Human capital mission mode reforms:** Strengthen education, skilling and health to raise productivity.  
**Eg: National Education Policy 2020** and **National Skill Development Mission** focus on employability enhancement.
3. **Trade and tariff rationalisation:** Simplify customs duties and integrate with global value chains.  
**Eg: Economic Survey 2024–25** reiterates that high tariffs act as implicit taxes on exports.
4. **Deepening private investment climate:** Improve contract enforcement, regulatory certainty and credit access.  
**Eg: Insolvency and Bankruptcy Code, 2016** has improved recovery rates, as per **IBBI data**.
5. **Strengthening cooperative federalism in reforms:** Align Centre–State incentives for sustained reform implementation.  
**Eg: Article 246 and GST Council framework** demonstrate institutionalised fiscal coordination.

### **Conclusion**

As cyclical supports lose potency, India's growth sustainability hinges on accelerating structural reforms that raise productivity, employment and competitiveness. A decisive shift towards human capital-driven, labour-intensive and globally integrated growth is essential to secure long-term economic resilience.

## **Q. "Strategic autonomy in the economy today depends as much on supply-chain integration as on domestic self-reliance". Discuss. (15 M)**

### **Introduction**

In a fragmented global economy marked by geopolitical shocks, supply disruptions and techno-nationalism, economic strength is no longer defined by insulation alone. Strategic autonomy today rests on a calibrated balance between domestic self-reliance and deep, diversified integration into global supply chains.

### **Body**

#### Strategic autonomy through supply-chain integration

1. **Risk diversification and shock absorption:** Integration across multiple supply chains reduces over-dependence on single geographies and enhances resilience during external shocks.  
**Eg: India's diversification of crude oil imports post-2022** cushioned energy security despite global price volatility and geopolitical disruptions.
2. **Technology access and upgrading:** Participation in global value chains enables access to advanced technologies, standards and managerial practices essential for competitiveness.  
**Eg: Electronics manufacturing ecosystems** leverage imported components and know-how to build domestic assembly and testing capacities.
3. **Export competitiveness and scale:** Integration allows firms to exploit comparative advantages and achieve scale economies beyond domestic demand constraints.

**Eg: Automobile and auto-component exports** benefit from cross-border supply networks linking India to global OEMs.

4. **Geopolitical leverage through interdependence:** Economic integration creates mutual stakes, reducing coercive vulnerabilities and enhancing strategic bargaining power.

**Eg: India's services exports** create reciprocal dependencies with advanced economies, strengthening economic diplomacy.

### Strategic autonomy through domestic self-reliance

1. **Core capacity building:** Self-reliance ensures domestic capabilities in critical sectors where external dependence can be strategically risky.

**Eg: Defence manufacturing indigenisation** aims to reduce vulnerability arising from import dependence in sensitive sectors.

2. **Supply continuity in crises:** Domestic production buffers against global disruptions, sanctions or export controls.

**Eg: Pharmaceutical manufacturing** ensured medicine availability during global supply bottlenecks.

3. **Employment and industrial depth:** Localised production strengthens industrial ecosystems and generates broad-based employment.

**Eg: Manufacturing clusters** create backward and forward linkages across MSMEs and large firms.

4. **Policy autonomy and fiscal stability:** Reduced import dependence lowers exposure to external price shocks and balance-of-payments stress.

**Eg: Domestic renewable energy capacity** reduces long-term vulnerability to fossil fuel price volatility.

### Challenges in balancing integration and self-reliance

1. **Geopolitical fragmentation:** Trade blocs, sanctions and export controls constrain seamless supply-chain integration.

**Eg: Technology export restrictions** complicate access to advanced semiconductors.

2. **Infrastructure and logistics gaps:** High logistics costs weaken India's ability to integrate efficiently into global value chains.

**Eg: Port and hinterland bottlenecks** raise transaction costs for exporters.

3. **Regulatory and policy uncertainty:** Frequent policy changes discourage long-term investment required for deep integration.

**Eg: Inconsistent tariff structures** affect firms planning supply-chain relocation.

4. **Capability gaps in high-tech sectors:** Limited domestic R&D and skill depth restrict movement up the value chain.

**Eg: Advanced manufacturing and precision engineering** remain constrained by skill shortages.

### Way forward

1. **Selective integration with strategic sectors:** Combine openness with strategic safeguards by prioritising trusted and diversified supply partners.

**Eg: Friend-shoring approaches** balance resilience with openness.

2. **Strengthening domestic industrial ecosystems:** Invest in skills, R&D, MSMEs and infrastructure to complement global integration.  
**Eg: Industrial corridor development** supports scale and efficiency.
3. **Stable and predictable trade policy:** Ensure policy consistency to attract long-term supply-chain investments.  
**Eg: Medium-term tariff roadmaps** reduce uncertainty for investors.
4. **Leveraging services and digital trade:** Use India's strengths in services and digital public infrastructure to integrate beyond manufacturing.  
**Eg: IT-enabled services exports** embed India deeply into global production networks.

## Conclusion

Strategic autonomy in the modern economy is neither isolation nor dependence, but intelligent interdependence. By aligning domestic capacity-building with diversified supply-chain integration, India can secure resilience, competitiveness and long-term economic sovereignty.

**Q. Analyse how India's goods trade deficit interacts with capital flow volatility to influence rupee stability. Suggest appropriate structural correctives to address this vulnerability. (10 M)**

## Introduction

India's exchange rate pressures persist despite strong growth and contained inflation, indicating that **external sector structure**, not macro fundamentals alone, shapes rupee stability. A persistent **goods trade deficit combined with volatile capital flows** creates recurring balance-of-payments stress for the rupee.

## Body

### Interaction between goods trade deficit and capital flow volatility

1. **Structural merchandise trade gap:** India consistently runs a large **goods trade deficit** due to high import dependence on crude oil, electronics and capital goods, creating a permanent foreign exchange demand.  
**Eg: Economic Survey 2025-26** notes that India's **net services surplus and remittances are insufficient to offset the merchandise deficit**, making the rupee structurally vulnerable.
2. **Financing deficit through capital inflows:** The goods deficit is largely financed by **foreign capital inflows**, especially FPIs, rather than stable export earnings, increasing exposure to global financial cycles.  
**Eg: RBI Balance of Payments data (FY25)** shows capital account inflows playing a decisive role in maintaining external balance amid a widening trade gap.
3. **Pro-cyclical FPI behaviour:** FPIs respond quickly to **global risk-off sentiment, US bond yields and currency expectations**, amplifying rupee volatility when outflows coincide with trade deficits.  
**Eg: Economic Survey 2025-26** reports sustained **FPI net outflows during 2025**, coinciding with renewed rupee depreciation pressures.
4. **Exchange rate–capital flow feedback loop:** A depreciating rupee raises currency risk perceptions, triggering further capital outflows and reinforcing exchange rate instability.  
**Eg: RBI Financial Stability Reports** have highlighted this **self-reinforcing loop** during periods of global monetary tightening.

5. **Limited shock-absorption capacity:** Unlike manufacturing-export-led economies, India lacks a strong **goods export buffer** to stabilise the currency during capital flow reversals.  
**Eg: Economic Survey 2025-26** notes that services exports, though stabilising, **cannot substitute for goods-based export ecosystems** in ensuring durable currency stability.

### Structural correctives to address this vulnerability

1. **Strengthening manufacturing export competitiveness:** Expanding labour-intensive and technology-driven manufacturing exports reduces reliance on volatile capital inflows.  
**Eg: PLI schemes and India-EU FTA (2024)** aim to integrate India into global manufacturing value chains, as highlighted in the **Economic Survey 2025-26**.
2. **Rebalancing capital flow composition:** Shifting from volatile FPIs to **stable FDI and long-term debt flows** enhances balance-of-payments resilience.  
**Eg: RBI and Economic Survey recommendations** emphasise improving ease of doing business and contract enforcement to attract durable foreign investment.
3. **Import-intensity reduction in key sectors:** Lowering import dependence through domestic capability creation moderates the structural goods deficit.  
**Eg: National Electronics Policy and energy diversification efforts** seek to reduce electronics and crude oil import exposure (Economic Survey 2025-26).
4. **Deepening domestic financial buffers:** Strong domestic institutional investors reduce excessive dependence on foreign portfolio flows during stress periods.  
**Eg: Economic Survey 2025-26** notes rising **DII ownership in NSE-listed equities**, which helped cushion FPI outflows.
5. **Prudent exchange rate management:** Allowing flexibility while preventing disorderly movements helps absorb shocks without eroding confidence.  
**Eg: RBI's managed-float framework**, repeatedly articulated in **Monetary Policy Statements**, aims to smooth volatility rather than defend a fixed level.

### **Conclusion**

Rupee stability ultimately depends on correcting **structural external imbalances**, not merely managing capital flows. A decisive shift towards **manufacturing-led exports and stable capital inflows** is essential for durable external and currency resilience.

## **Inclusive growth and issues arising from it.**

### **Government Budgeting.**

**Q. Identify the major non-farm uses of pesticides in India. Discuss why these uses pose higher exposure risks than agricultural applications. (10 M)**

#### Introduction

India's pesticide risk profile has shifted significantly from open agricultural fields to enclosed non-farm settings. This transition has created **continuous, involuntary and poorly regulated exposure**, directly affecting public health and food safety under **Article 21 of the Constitution**.

#### Body

##### Major non-farm uses of pesticides in India

1. **Domestic pest control in residential buildings:** Insecticides are widely applied indoors for termite, mosquito and cockroach control, often without adherence to safety or re-entry norms.  
**Eg: Chennai (2024)** incident where indoor pest control led to the death of **two children** following routine fumigation.
2. **Stored grain fumigation in households and warehouses:** Highly toxic fumigants are used to protect stored food grains, sometimes within living spaces.  
**Eg: Madhya Pradesh (July 2024)** case where inhalation of fumes from **aluminium phosphide-treated wheat** caused fatalities among children.
3. **Pesticidal paints and construction materials:** Paints containing micro-encapsulated insecticides release chemicals slowly over extended periods.  
**Eg: Recent housing contamination findings (2024)** detected **legacy pesticides such as heptachlor** in low-income residential units.
4. **Public and institutional spaces:** Pesticides are used in schools, temples, community kitchens and warehouses without sector-specific safety protocols.  
**Eg: Bihar Mid-Day Meal tragedy (2013)** involving **monocrotophos contamination** due to unsafe storage practices.
5. **Transport and aviation disinsection:** Insecticides are sprayed inside aircraft cabins to prevent vector transmission.  
**Eg: Mandatory in-flight spraying in India** continues under the **Insecticides Act, 1968**, despite documented occupational exposure concerns.

#### **Why non-farm uses pose higher exposure risks than agriculture**

1. **Enclosed exposure environments:** Homes, storage spaces and aircraft cabins trap toxic vapours, increasing inhalation exposure compared to open fields.  
**Eg:** Indoor fumigation cases show **higher acute toxicity risks** due to poor ventilation.
2. **Continuous and involuntary exposure:** Residents are exposed over long durations without informed consent or safety disclosures.  
**Eg: Pesticidal paints** releasing insecticides for **up to two years**, leading to prolonged low-dose exposure.
3. **Use by untrained and unlicensed applicators:** Non-farm pest control is often carried out without mandatory certification or supervision.  
**Eg: Urban pest control operations** functioning without standardised licensing or safety audits.
4. **Weak separation from food and water systems:** Domestic and institutional spaces lack enforced segregation between pesticides and consumables.  
**Eg: Temple prasad poisoning in Chamarajanagar (2018)** due to pesticide contamination.
5. **Absence of systematic poisoning surveillance:** Pesticide incidents are not captured through a central public health reporting system.  
**Eg:** Unlike vaccine-related adverse events, **pesticide poisoning lacks a national incident reporting framework**.

#### **Conclusion**

Non-farm pesticide applications transform everyday environments into **high-risk chemical exposure zones** due to enclosure, prolonged contact and weak safeguards. Addressing these risks requires recognising pesticide safety as a **public health imperative under Article 47**, rather than a farm-only concern.

## Major crops-cropping patterns in various parts of the country, - different types of irrigation and irrigation systems storage, transport and marketing of agricultural produce and issues and related constraints; e-technology in the aid of farmers.

**Q. Examine how rigid cropping patterns affect farm incomes. Analyse the role of market access in correcting these distortions. (10 M)**

### Introduction

Farm incomes in India are shaped not only by prices but also by production choices locked in by historical incentives. Rigid cropping patterns weaken income resilience, making market access a key economic lever for correcting these distortions.

### Body

#### How rigid cropping patterns affect farm incomes

- 1. Policy-induced monoculture dependence:** Assured procurement and price support encourage concentration in a few crops, reducing diversification and increasing exposure to price and climate risks.  
**Eg: Rice-wheat dominance in Punjab and Haryana** driven by **MSP-backed FCI procurement** has led to stagnant real farm incomes and rising input costs, as highlighted in the **Economic Survey 2023-24**.
- 2. Rising cost of cultivation and declining factor productivity:** Repetitive cropping raises fertiliser, irrigation, and pest-control intensity, eroding net returns per hectare.  
**Eg: Water-intensive paddy cultivation** in north-west India has caused **groundwater over-extraction and higher electricity consumption**, reducing profitability, noted by **NITI Aayog groundwater assessments**.
- 3. Heightened income volatility under climatic stress:** Rigid cropping restricts farmers' ability to shift crops in response to rainfall variability and demand shocks.  
**Eg: Rainfed regions continuing cereal cultivation** despite erratic monsoons have experienced higher yield and income fluctuations, observed in **ICAR climate impact studies**.
- 4. Missed gains from high-value agriculture:** Staple-centric cropping limits entry into horticulture and allied activities with higher income elasticity.  
**Eg: Cereal-dominated farm portfolios** persist despite horticulture contributing a rising share of agricultural GVA, as per **Ministry of Agriculture and Farmers Welfare data**.

#### Role of market access in correcting these distortions

- 1. Improved price discovery through integrated markets:** Wider market access allows cropping decisions to respond to competitive prices rather than local distortions.  
**Eg: e-NAM-linked APMC mandis** have enabled inter-state price comparison and informed crop choice decisions, reported by the **Ministry of Agriculture and Farmers Welfare**.
- 2. Demand-led incentives for diversification:** Access to processors, exporters, and organised buyers transmits demand signals for high-value crops.  
**Eg: Market linkages under the PM-FME Scheme** have encouraged farmers to diversify into fruits and vegetables aligned with processing demand.

- 3. Scale efficiencies through collective marketing:** Aggregation improves bargaining power, reduces transaction costs, and stabilises farm incomes.  
**Eg: Farmer Producer Organisations supported by NABARD** have enabled bulk marketing and better price realisation, as noted by the **Dalwai Committee (2016)**.
- 4. Reduction of procurement-driven regional lock-ins:** Competitive markets weaken over-dependence on MSP-centric crops and regions.  
**Eg: NITI Aayog crop diversification advisories** emphasise market access as a prerequisite for shifting away from water-intensive staples.

## **Conclusion**

Correcting rigid cropping patterns requires complementing price support with deep and reliable market access. Competitive, demand-driven markets can realign production choices, stabilise farm incomes, and improve long-term agricultural viability.

**Issues related to direct and indirect farm subsidies and minimum support prices; Public Distribution System-objectives, functioning, limitations, revamping; issues of buffer stocks and food security; Technology missions; economics of animal-rearing.**

**Food processing and related industries in India- scope' and significance, location, upstream and downstream requirements, supply chain management.**

**Land reforms in India.**

**Effects of liberalization on the economy, changes in industrial policy and their effects on industrial growth.**

**Infrastructure: Energy, Ports, Roads, Airports, Railways etc.**

**Q. With reference to the Draft National Electricity Policy 2026, describe the proposed changes in India's electricity generation mix. Analyse the rationale for greater reliance on nuclear power. Discuss the implications for long-term energy security. (15 M)**

### **Introduction**

India's electricity sector is at an inflection point where rising demand, decarbonisation goals and grid reliability concerns intersect. The Draft National Electricity Policy 2026 reflects this transition by recalibrating the generation mix and elevating nuclear power as a strategic pillar.

### **Body**

#### **Proposed changes in India's electricity generation mix under Draft NEP 2026**

- 1. Gradual rebalancing away from coal-centric generation:** The policy recognises coal's continued role but seeks to progressively reduce over-dependence by expanding low-carbon sources.

**Eg: Draft NEP 2026** explicitly states that **nuclear power will be promoted as a substitute for coal-based thermal generation**, especially for base-load and captive use.

2. **Scaling up nuclear capacity as a core pillar:** Nuclear power is envisaged as a long-term component of India's electricity mix.

**Eg: Draft NEP 2026**, read with government targets, aligns with India's ambition of reaching **100 GWe nuclear capacity by 2047**, compared to about **8.8 GWe installed currently** (DAE data).

3. **Promotion of advanced and smaller nuclear technologies:** The policy encourages deployment of modular and small-capacity reactors to enhance flexibility.

**Eg: Draft NEP 2026** proposes **Small Modular Reactors and Bharat Small Reactors**, particularly for industrial and captive applications.

4. **Renewable expansion with greater emphasis on system integration:** Renewable energy continues to expand but with focus on storage and flexibility.

**Eg: Draft NEP 2026** stresses **energy storage systems** to stabilise the grid as solar and wind penetration rises.

5. **Repurposing of existing thermal infrastructure:** The policy allows reuse of legacy assets to support cleaner generation.

**Eg: Draft NEP 2026** supports **repurposing retired coal plant sites for nuclear generation**, where feasible, to optimise land and grid connectivity.

### Rationale for greater reliance on nuclear power

1. **Reliable low-carbon base-load generation:** Nuclear power provides continuous electricity without carbon emissions.

**Eg: Draft NEP 2026** characterises nuclear energy as a **clean and reliable source**, complementing variable renewables.

2. **Support for climate commitments:** Nuclear energy aligns with India's emissions reduction trajectory.

**Eg: Draft NEP 2026** links power-sector choices to India's pledge to **reduce emissions intensity by 45% by 2030** and achieve **net-zero by 2070**.

3. **Decarbonisation of captive and industrial power:** Nuclear is proposed as an alternative to coal-based captive plants.

**Eg: NITI Aayog data (2023–24)** shows **coal dominates captive capacity**, which **Draft NEP 2026** seeks to progressively replace where feasible.

4. **Energy density and land efficiency advantages:** Nuclear requires far less land than renewables per unit of power.

**Eg: Government and IAEA assessments** consistently highlight **high energy density** as a strategic advantage of nuclear power.

5. **Grid flexibility through design innovations:** Future reactors are intended to support variable renewable integration.

**Eg: Draft NEP 2026** envisages **two-part tariff structures and flexible nuclear operations** to balance solar and wind variability.

### Implications for long-term energy security

1. **Reduced dependence on fossil fuel imports:** Nuclear power lowers exposure to coal and gas supply risks.

**Eg: Draft NEP 2026** positions nuclear as a contributor to **long-term energy security** through stable domestic generation.

2. **Improved resilience of the power system:** A diversified mix enhances reliability against shocks.

**Eg: CEA and MoP planning documents** emphasise diversification as key to grid resilience.

3. **Stabilisation of electricity supply for industry:** Reliable power supports manufacturing and logistics competitiveness.

**Eg: Draft NEP 2026** allows **direct nuclear power use by commercial and industrial consumers**.

4. **Strengthening of domestic technological ecosystem:** Nuclear expansion encourages indigenous capability and supply chains.

**Eg: Fleet-mode and standardisation approach in Draft NEP 2026** aims at cost optimisation and local manufacturing.

5. **Long-term alignment with sustainable growth:** Nuclear enables high electricity consumption growth without proportionate emissions.

**Eg: Draft NEP 2026** projects **per capita electricity consumption exceeding 4,000 kWh by 2047**, necessitating clean base-load sources.

## Conclusion

The Draft National Electricity Policy 2026 marks a strategic shift from incremental energy transition to structural transformation. By repositioning nuclear power within a diversified low-carbon mix, it seeks to anchor India's long-term energy security while advancing climate and development goals.

## **Investment models.**

**Q. Discuss the role of infrastructure investment in accelerating economic growth. Identify the challenges in improving capital efficiency and also outline measures to enhance returns. (15 M)**

### Introduction

Infrastructure investment expands the economy's productive base by lowering costs, improving connectivity and enabling scale. In India, public capital expenditure has emerged as a key growth driver amid global slowdown and private investment uncertainty.

### Body

#### Role of infrastructure investment in accelerating economic growth

1. **High output multiplier effect:** Infrastructure spending has strong backward and forward linkages across manufacturing and services, amplifying overall GDP growth.

**Eg: Capital expenditure has been shown to generate higher output multipliers than revenue expenditure**, strengthening growth momentum.

2. **Reduction in logistics and transaction costs:** Improved roads, ports and railways enhance supply chain efficiency and firm productivity.

**Eg: Bharatmala and Dedicated Freight Corridors** target reduction of logistics costs from around **13–14% of GDP** towards global benchmarks.

3. **Expansion of market access:** Infrastructure integrates regional markets, enabling scale, specialisation and inter-state trade.

**Eg: Sagarmala programme** improves port-led connectivity, boosting export competitiveness of coastal manufacturing clusters.

4. **Crowding-in of private investment:** Quality public infrastructure reduces risk and improves viability of private capital deployment.

**Eg:** Sustained public capex push since **Union Budget 2021–22** coincided with revival in private investment intentions.

5. **Employment and income generation:** Infrastructure construction generates large-scale direct and indirect employment.

**Eg: Railways and urban transport projects** act as major employment multipliers across allied sectors.

### **Challenges in improving capital efficiency**

1. **Time and cost overruns:** Delays inflate capital costs and reduce economic returns of projects.

**Eg:** Large infrastructure projects often face land acquisition and execution delays, affecting viability.

2. **Under-utilisation of created assets:** Infrastructure assets frequently operate below optimal capacity.

**Eg: Regional airports and ports** in certain areas show low traffic despite heavy capital deployment.

3. **Fragmented project planning:** Lack of integration across transport, energy and urban infrastructure weakens network benefits.

**Eg:** Misalignment between **industrial corridors and logistics infrastructure** reduces freight efficiency.

4. **Weak maintenance and asset management:** Poor upkeep shortens asset life and raises operating costs.

**Eg:** Inadequate road maintenance increases vehicle operating costs and logistics inefficiencies.

5. **Financing stress and leverage risks:** High capital intensity strains balance sheets of infrastructure developers.

**Eg:** Stress in power and road sectors has constrained fresh private investment.

### **Measures to enhance returns from infrastructure investment**

1. **Lifecycle-based project approach:** Integrating planning, construction, operation and maintenance improves long-term efficiency.

**Eg: PM Gati Shakti National Master Plan (2021)** promotes integrated and synchronised infrastructure planning.

2. **Asset monetisation and recycling:** Unlocking value from operational assets enables reinvestment without excessive fiscal burden.

**Eg: National Monetisation Pipeline** focuses on monetising brownfield assets for capital recycling.

3. **Prioritisation of high-impact sectors:** Targeting logistics, power transmission and urban infrastructure maximises productivity gains.

**Eg:** Increased capital allocation towards **railways and urban transport** in recent budgets.

4. **Improved project execution mechanisms:** Digital monitoring and standardised contracts reduce delays and cost escalation.

**Eg: Gati Shakti digital platforms** improve inter-sectoral coordination and execution tracking.

5. **Strengthening private participation:** Balanced risk-sharing improves private investment appetite.

**Eg: Hybrid Annuity Model in highways** improved project viability and investor confidence.

## Conclusion

Infrastructure investment accelerates growth only when capital is efficiently deployed and productively utilised. A strategic shift from asset creation to asset performance is essential for sustaining India's long-term economic expansion.

## Science and Technology- developments and their applications and effects in everyday life.

### Achievements of Indians in science & technology; indigenization of technology and developing new technology.

### Awareness in the fields of IT, Space, Computers, robotics, Nano-technology, bio-technology and issues relating to intellectual property rights.

**Q. "Cryptocurrencies challenge state regulation not merely due to anonymity but due to decentralised architecture". Explain the statement. Discuss its implications for India's financial system. (15 M)**

#### Introduction

The rise of cryptocurrencies marks a shift from state-mediated finance to protocol-driven financial systems. This challenges regulatory authority not at the level of user identity, but at the deeper level of sovereign control over money, transactions, and financial stability.

#### Body

##### Why decentralised architecture challenges state regulation

- 1. Absence of central authority:** Cryptocurrencies function on distributed ledger systems without a central issuer or administrator, limiting direct regulatory supervision and enforcement.  
**Eg: Bitcoin's decentralised blockchain**, maintained by globally distributed miners, operates outside the supervisory perimeter of the **Reserve Bank of India (RBI)** unlike regulated payment systems.
- 2. Jurisdictional fragmentation:** Decentralised networks span multiple jurisdictions simultaneously, weakening the applicability of domestic financial laws.  
**Eg: Offshore crypto exchanges** continue to service Indian users despite domestic restrictions, as highlighted in FATF's **Risk-Based Approach to Virtual Assets, 2023**.
- 3. Algorithmic monetary issuance:** Monetary supply is embedded in protocol code, restricting state discretion over money creation and liquidity management.  
**Eg: Bitcoin's fixed supply cap of 21 million**, determined by protocol rules, contrasts with RBI's flexible monetary tools under **Entry 36, Union List**.
- 4. Resistance to transaction censorship:** Decentralised validation prevents unilateral blocking, freezing, or reversal of transactions by authorities.  
**Eg: Blockchain immutability** makes transaction reversal impossible, unlike bank-mediated transfers regulated under the **Payment and Settlement Systems Act, 2007**.
- 5. Disintermediation of regulated entities:** Peer-to-peer architecture bypasses banks and regulated intermediaries, weakening KYC-based compliance frameworks.

**Eg: Self-custodial crypto wallets** enable direct transfers without regulated intermediaries, raising AML concerns flagged by **FATF, 2022**.

### Implications for India's financial system

- 1. Threat to monetary sovereignty:** Parallel digital currencies dilute the state's exclusive authority over currency issuance and monetary transmission.  
**Eg:** RBI has consistently warned that **private virtual currencies** undermine sovereign currency functions (RBI Annual Report **2022–23**).
- 2. Financial stability risks:** High volatility and speculative trading expose households and markets to abrupt wealth erosion.  
**Eg:** **Global crypto market crashes in 2022** triggered sharp retail losses, cited as systemic risk concerns in **RBI Financial Stability Report, June 2023**.
- 3. Taxation and compliance challenges:** Decentralised trading complicates income tracking and tax enforcement.  
**Eg:** Introduction of **30% tax on Virtual Digital Assets and 1% TDS in 2022** reflects India's effort to retain fiscal oversight (Finance Act, **2022**).
- 4. Illicit finance and security risks:** Pseudonymous transactions increase vulnerability to money laundering and terror financing.  
**Eg:** **Enforcement Directorate probes** into crypto-linked laundering cases echo risks identified by the **Inter-Ministerial Committee on Virtual Currencies, 2019**.
- 5. Innovation–regulation imbalance:** Over-regulation risks innovation flight, while under-regulation threatens systemic stability.  
**Eg:** **Supreme Court in Internet and Mobile Association of India vs RBI (2020)** stressed proportionality over blanket prohibitions.

### Way forward

- 1. Principle-based regulatory framework:** Move from prohibition to activity-based regulation focusing on risk outcomes rather than technology.  
**Eg:** **G20 New Delhi Declaration, 2023** endorsed coordinated global standards for crypto-asset regulation.
- 2. Strengthening AML–CFT compliance:** Mandate KYC, reporting, and travel-rule compliance for all VDA service providers operating in India.  
**Eg:** Inclusion of VDAs under **Prevention of Money Laundering Act, 2002 in 2023** strengthens enforcement architecture.
- 3. Global regulatory coordination:** Align domestic rules with international frameworks to address cross-border decentralisation.  
**Eg:** India's support for **FATF crypto standards** during its G20 presidency enhances regulatory coherence.
- 4. Promotion of sovereign digital currency:** Use state-backed digital alternatives to preserve monetary sovereignty and trust.  
**Eg:** **Digital Rupee pilot launched by RBI in 2022** provides a regulated, sovereign alternative to private cryptocurrencies.
- 5. Regulatory sandbox for innovation:** Encourage blockchain innovation within controlled environments to balance growth and risk.

**Eg: SEBI and RBI regulatory sandboxes** allow testing of blockchain applications without systemic exposure.

## Conclusion

Decentralised cryptocurrencies challenge the foundations of state financial authority rather than merely regulatory enforcement. India's response must blend **global coordination, proportionate regulation, and sovereign digital innovation** to secure stability without sacrificing technological progress.

## **Q. Analyse the role of paramilitary forces in India's internal security architecture. Examine coordination challenges with the armed forces. (10 M)**

### Introduction

India's internal security challenges range from **Left Wing Extremism, cross-border terrorism, to border management and disaster response**, requiring a layered security architecture. **Central Armed Police Forces (CAPFs)** act as the critical bridge between civil policing and the military, ensuring stability below the threshold of war.

### **Body**

#### Role of paramilitary forces

- Counter-insurgency and internal conflict management:** CAPFs, especially **CRPF** and its specialised units, form the backbone of counter-insurgency and counter-terror operations in disturbed areas, operating under civilian authority.  
**Eg: CRPF's CoBRA battalions** remain the primary force against **Left Wing Extremism** in Chhattisgarh and Jharkhand, significantly shrinking the LWE influence zone as noted in **MHA Annual Report 2023–24**.
- Border guarding and first-line defence in peacetime:** Forces like **BSF, ITBP and SSB** secure international borders during peacetime, preventing infiltration, smuggling and transnational crime, thereby reducing pressure on the armed forces.  
**Eg: BSF's integrated border management system** along the **India-Pakistan border** has helped curb cross-border infiltration and drone-based narcotics drops, as highlighted by **MHA 2023**.
- Maintenance of public order and election security:** CAPFs provide neutral and credible security during elections and major internal disturbances, reinforcing State police capacity.  
**Eg: Deployment of CAPFs during the 2024 General Elections** ensured peaceful polling in sensitive constituencies, acknowledged by the **Election Commission of India**.
- Disaster response and humanitarian assistance:** Certain paramilitary forces perform critical non-traditional security roles, strengthening internal resilience.  
**Eg: National Disaster Response Force (NDRF)** played a key role in rescue and relief operations during **Himachal Pradesh floods 2023**, as per **NDMA reports**.
- Aid to civil authorities under constitutional mandate:** CAPFs operationalise the Union's responsibility to protect States from internal disturbance.  
**Eg: Deployment of CAPFs under Article 355 of the Constitution** during communal or insurgency-related violence, coordinated through the **Ministry of Home Affairs**.

#### Coordination challenges with armed forces

1. **Overlapping operational domains:** In internal security theatres, CAPFs and the Army often operate in contiguous or overlapping spaces, creating command and role ambiguities.  
**Eg:** In **Jammu and Kashmir**, counter-terror operations involve both **Army Rashtriya Rifles** and **CRPF**, sometimes leading to duplication of effort, flagged by the **Kargil Review Committee**.
2. **Differences in command and control structures:** CAPFs operate under the **civilian control of MHA**, while the armed forces function under the **Ministry of Defence**, complicating unity of command.  
**Eg:** The **Naresh Chandra Task Force on National Security** highlighted the absence of permanent joint command mechanisms for internal security contingencies.
3. **Divergent training doctrines and equipment standards:** Variations in training intensity, operational doctrine and equipment interoperability affect seamless coordination.  
**Eg:** Army units trained for high-intensity combat differ from CAPFs trained for prolonged internal security duties, a gap noted in **2nd Administrative Reforms Commission reports on public order**.
4. **Intelligence sharing and real-time coordination gaps:** Institutional silos between military and CAPF intelligence systems can delay actionable inputs.  
**Eg:** Post-incident reviews of terror attacks have repeatedly stressed the need for tighter **multi-agency intelligence coordination**, as emphasised by **MHA and IB assessments**.

### Conclusion

Paramilitary forces remain indispensable to India's internal security by stabilising conflict zones and securing borders below the war threshold. Strengthening **joint training, interoperable communication systems and institutionalised civil-military coordination mechanisms** is essential to ensure a seamless and future-ready security architecture.

**Q. Solar energy expansion in India faces constraints that are structural rather than technological." Evaluate the structural constraints affecting large-scale solar deployment and their implications for India's long-term energy security. Suggest measures to overcome these constraints. (15 M)**

### **Introduction**

India's rapid solar capacity addition has demonstrated technological maturity and falling costs, yet deployment outcomes remain uneven. The binding constraints increasingly lie in institutional design, land-grid-finance linkages, and federal governance rather than panel efficiency or generation technology.

### **Body**

#### **Why constraints are structural, not technological**

1. **Mature technology and cost convergence:** Utility-scale solar in India has achieved global cost competitiveness, indicating that technology is no longer the primary bottleneck.  
**Eg:** **Record-low competitive tariffs discovered through SECI auctions** reflect learning curves and scale economies rather than technological scarcity.
2. **Policy and market frictions dominate outcomes:** Project delays and under-utilisation are driven by land, grid, and contractual risks, not by generation capability.

**Eg: Stalled solar parks despite ready modules** due to evacuation and land issues reported in multiple MNRE reviews.

### **Structural constraints affecting large-scale solar deployment**

1. **Land acquisition and spatial planning constraints:** Fragmented land records, competing land uses, and ecological sensitivities delay projects and raise costs.  
**Eg: Delays in solar parks in arid and semi-arid regions** owing to land aggregation challenges and wildlife clearance requirements (MNRE).
2. **Grid integration and evacuation bottlenecks:** Transmission planning lags behind capacity addition, especially for variable renewables concentrated in few states.  
**Eg: Green Energy Corridor phases** were conceived precisely to address evacuation delays highlighted by CEA assessments.
3. **DISCOM financial stress and offtake risk:** Weak balance sheets and payment delays raise counter-party risk, affecting bankability.  
**Eg: Payment delays by state DISCOMs**, acknowledged by MoP, necessitated escrow and payment security mechanisms in PPAs.
4. **Regulatory and contractual uncertainty:** Renegotiation risks, delayed approvals, and state-level policy reversals undermine investor confidence.  
**Eg: Attempts to reopen signed PPAs by some states**, flagged in sector consultations, increased risk premiums.
5. **Centre–State coordination gaps:** Electricity is a shared domain, leading to misalignment between national targets and state implementation capacity.  
**Eg: Electricity as a Concurrent List subject (Entry 38) under Article 246** creates coordination challenges in land, grid, and DISCOM reforms.
6. **Financing constraints for long-duration assets:** Access to low-cost, long-tenor finance remains limited for domestic developers.  
**Eg: Higher cost of capital for Indian renewable projects** compared to OECD markets, noted by RBI and multilateral lenders.

### **Implications for India’s long-term energy security**

1. **Reliability risks despite capacity growth:** Structural bottlenecks limit effective capacity utilisation and grid reliability.  
**Eg: Curtailment of solar generation during congestion periods**, reported by CEA, affects dependable supply.
2. **Regional concentration and vulnerability:** Over-reliance on a few solar-rich states increases systemic risk.  
**Eg: High concentration of capacity in Rajasthan and Gujarat** exposes the system to transmission and climatic shocks.
3. **Delayed decarbonisation and import exposure:** Slower deployment prolongs dependence on fossil fuels and energy imports.  
**Eg: Coal-based balancing during peak demand** persists where renewable integration is constrained (MoP).
4. **Investor confidence and technology spillovers:** Persistent structural risks deter scale and complementary investments.

**Eg: Cautious foreign investor participation** when PPA sanctity is questioned, as noted in sector reviews.

### Measures to overcome structural constraints

1. **Integrated land–grid planning:** Align solar parks with pre-approved land banks and transmission corridors.  
**Eg: Plug-and-play solar parks model under MNRE**, linking land and evacuation upfront.
2. **Accelerated transmission and flexibility:** Fast-track inter-state transmission, storage, and demand response.  
**Eg: Green Energy Corridor expansion and grid-scale storage pilots** supported by CEA planning.
3. **DISCOM reform and payment security:** Improve operational efficiency and enforce payment discipline.  
**Eg: Revamped Distribution Sector Scheme (2021)** targeting loss reduction and smart metering (MoP).
4. **Contract sanctity and regulatory certainty:** Standardise PPAs and strengthen dispute resolution.  
**Eg: SECI-backed PPAs with payment security mechanisms** improving bankability.
5. **Centre–State coordination mechanisms:** Institutionalise cooperative federalism for renewables.  
**Eg: Inter-State coordination through MoP–MNRE task forces**, consistent with the Concurrent List framework.
6. **Lower cost of capital:** Expand green finance instruments and multilateral support.  
**Eg: Sovereign green bonds and multilateral lines of credit** to extend tenors and reduce financing costs.

### **Conclusion**

India's solar challenge is now a governance and systems-integration problem. Resolving land, grid, finance, and federal coordination constraints can convert installed capacity into reliable power, anchoring a secure, low-carbon energy future.

### **Q. Explain the working principle of fuel cells. Discuss the major barriers to their large-scale adoption in India. (10 M)**

#### **Introduction**

Fuel cells represent a shift from combustion-based energy systems to **electrochemical conversion**, offering high efficiency and near-zero local emissions. Their relevance has increased with India's **net-zero 2070 commitment** and the launch of the **National Green Hydrogen Mission (2023)**.

#### **Body**

#### Working principle of fuel cells

1. **Electrochemical energy conversion:** Fuel cells generate electricity through an electrochemical reaction between **hydrogen and oxygen** across an electrolyte, producing electricity, heat and water without combustion.  
**Eg: Proton Exchange Membrane Fuel Cells (PEMFCs)** used in buses directly convert hydrogen into power, achieving efficiencies higher than internal combustion engines (IEA, 2023).

2. **Anode–cathode reaction mechanism:** At the anode, hydrogen splits into protons and electrons; electrons flow through an external circuit generating electricity, while protons migrate through the electrolyte to the cathode.  
**Eg: PEM fuel cells** demonstrated in Indian Railways’ hydrogen-powered coach prototypes use this principle for onboard power generation.
3. **Continuous power generation:** Unlike batteries, fuel cells continue to produce electricity as long as fuel is supplied, enabling long-duration and high-load applications.  
**Eg: Hydrogen fuel cell buses** piloted under India’s National Hydrogen Energy Roadmap enable extended driving ranges compared to battery-only systems.
4. **Low-emission by-product profile:** The primary by-product is **water vapour**, making fuel cells suitable for urban and environmentally sensitive regions.  
**Eg: Fuel-cell-based backup power systems** in hospitals and data centres are promoted globally for clean and silent operation (IRENA).

### **Barriers to large-scale adoption in India**

1. **High cost of hydrogen production and fuel cells:** Green hydrogen remains expensive due to high electrolyser and renewable energy costs, limiting commercial viability.  
**Eg: NITI Aayog (2022)** noted green hydrogen costs in India are still significantly higher than fossil-based alternatives, constraining fuel-cell deployment.
2. **Inadequate hydrogen infrastructure:** Lack of hydrogen production hubs, storage facilities and refuelling stations restricts scalability and market confidence.  
**Eg:** India currently has **very limited hydrogen refuelling stations**, confining fuel-cell pilots largely to controlled demonstrations under government programmes.
3. **Technology dependence and material constraints:** Fuel cells rely on critical materials like **platinum-group metals**, increasing import dependence and supply risks.  
**Eg: PEM fuel cells** depend on platinum catalysts, raising concerns over cost volatility and strategic mineral security (IEA Critical Minerals Report).
4. **Regulatory and safety ecosystem gaps:** Absence of comprehensive hydrogen safety codes, standards and skilled manpower slows adoption.  
**Eg: NITI Aayog’s Hydrogen Roadmap** highlights the need for harmonised safety standards and capacity-building before mass deployment.

### **Conclusion**

Fuel cells offer a clean and efficient pathway for India’s deep decarbonisation, especially in transport and industry. Addressing cost, infrastructure and regulatory gaps through **mission-mode implementation under the National Green Hydrogen Mission** can unlock their transformative potential.

### **Q. What role do advanced manufacturing technologies play in improving supply-chain resilience? Evaluate their strategic relevance. (10 M)**

#### **Introduction**

Modern supply chains are increasingly exposed to shocks from pandemics, geopolitical disruptions and climate events, making resilience a strategic economic priority. **Advanced manufacturing technologies** have emerged as a structural enabler to absorb shocks, adapt quickly and sustain production continuity.

## Body

### Role of advanced manufacturing technologies in improving supply-chain resilience

- Digital twins and real-time monitoring:** Advanced manufacturing integrates sensors, **IoT** and digital twins to track production and logistics in real time, enabling early detection of disruptions and rapid corrective action.  
**Eg: Siemens digital twin platforms**, cited by **World Economic Forum 2023**, helped manufacturers simulate supplier failures and re-route production during post-pandemic bottlenecks.
- Additive manufacturing and decentralised production: 3D printing** allows on-demand, localised production of components, reducing dependence on single foreign suppliers and long logistics chains.  
**Eg: During COVID-19 (2020–21), additive manufacturing hubs in India and Europe** rapidly produced medical components, a case highlighted by **NITI Aayog** as resilience through distributed manufacturing.
- Automation and robotics for continuity:** Robotics and advanced process automation ensure consistent output even during labour shortages, lockdowns or skill disruptions.  
**Eg: Automotive plants in Japan and South Korea**, documented by **OECD manufacturing outlook 2022**, maintained production stability using high robot density during workforce disruptions.
- Data-driven demand forecasting: AI-enabled manufacturing systems** integrate demand signals with production planning, reducing bullwhip effects and inventory shocks.  
**Eg: AI-based supply planning tools** adopted by global electronics firms, noted in **McKinsey Global Institute 2023**, improved forecast accuracy during semiconductor shortages.
- Flexibility through smart factories:** Reconfigurable manufacturing systems allow quick switching between products and suppliers, enhancing adaptive capacity.  
**Eg: Industry 4.0 smart factories in Germany**, supported by the **High-Tech Strategy 2025**, demonstrated rapid retooling amid energy and component supply disruptions.

### Strategic relevance of advanced manufacturing technologies

- Economic security and strategic autonomy:** Advanced manufacturing reduces critical import dependence, aligning with India's pursuit of resilient and self-reliant supply chains.  
**Eg: India Semiconductor Mission (2021)** aims to build domestic chip manufacturing capacity to mitigate global supply shocks, as outlined by **MeitY**.
- Global competitiveness and export resilience:** Firms with advanced manufacturing adapt faster to global disruptions, protecting export performance and market share.  
**Eg: South Korea's smart manufacturing push**, referenced in **World Bank 2022**, helped sustain electronics exports despite global logistics stress.
- National innovation ecosystem strengthening:** Adoption of frontier manufacturing technologies deepens R&D–industry linkages and skill ecosystems.  
**Eg: PM-STIAC recommendations (2022)** emphasised advanced manufacturing as a core pillar of India's national science and technology strategy.
- Alignment with constitutional values:** Promotion of scientific and technological advancement reflects **Article 51A(h)**, which enjoins citizens and institutions to develop **scientific temper**, underpinning long-term economic resilience.

**Eg:** Government support for **Industry 4.0 centres of excellence**, noted in **NITI Aayog policy papers**, operationalises this constitutional vision.

5. **Resilience against future systemic shocks:** Advanced manufacturing enhances preparedness against climate-induced disruptions and geopolitical fragmentation.

**Eg:** **WEF Global Supply Chain Barometer 2024** highlights smart manufacturing as a key buffer against climate and geopolitical risks.

## Conclusion

Advanced manufacturing technologies transform supply chains from fragile, linear systems into adaptive and resilient networks. For India, scaling such technologies is not only an economic imperative but a strategic pathway towards secure, competitive and future-ready industrial growth.

**Q. Analyse how advancements in robotics are transforming industrial labour processes. Examine their implications for skill formation. Assess policy challenges arising from this shift. (15 M)**

## Introduction

Robotics-driven automation is reshaping industrial labour by redefining task allocation, skill hierarchies and production logic. This transition raises critical questions not only about efficiency but also about workforce preparedness and policy responsiveness.

## Body

### How advancements in robotics are transforming industrial labour processes

1. **Automation of repetitive and hazardous shop-floor tasks:** Robots increasingly undertake high-risk and monotonous activities, improving workplace safety and production consistency.  
**Eg:** **Automotive welding and painting robots in Maruti Suzuki Manesar and Hyundai Sriperumbudur plants** reduce worker exposure to fumes and heat (Source: **International Federation of Robotics, World Robotics 2023**).
2. **Transition from labour-intensive to capital-intensive manufacturing:** Robotics enables higher output per worker, altering traditional labour-productivity relationships.  
**Eg:** **Electronics manufacturing units under PLI schemes use pick-and-place robotic arms**, scaling production without proportional labour expansion (Source: **NITI Aayog Manufacturing Competitiveness Reports**).
3. **Human-robot collaboration through cobots:** Collaborative robots assist rather than replace workers, redistributing tasks within production lines.  
**Eg:** **Cobots deployed in MSME clusters of Pune and Coimbatore** support material handling and quality checks (Source: **Ministry of MSME Technology Upgradation Programme**).
4. **Standardisation and precision in industrial processes:** Robotics ensures uniform quality and minimises human-induced variability in manufacturing.  
**Eg:** **CNC-integrated robotic systems in aerospace component manufacturing** ensure micron-level precision (Source: **DRDO and aerospace industry disclosures**).
5. **Continuous and round-the-clock production capability:** Robots allow 24×7 operations, reducing downtime and enhancing supply-chain reliability.  
**Eg:** **Automated logistics robots in large warehousing facilities** support uninterrupted manufacturing supply flows (Source: **Economic Survey 2022–23**).

## Implications for skill formation

1. **Rising demand for advanced technical and digital skills:** Robotics increases demand for programming, systems integration and diagnostics skills.  
**Eg: Mechatronics, robotics maintenance and PLC programming roles** identified as emerging skills in **India Skills Report 2024 (NSDC)**.
2. **Decline in demand for routine manual skills:** Low-skill repetitive jobs face displacement risks without timely reskilling.  
**Eg: ILO Global Employment Trends for Industry 2023** highlights vulnerability of assembly-line workers in automation-heavy sectors.
3. **Need for interdisciplinary skill sets:** Workers increasingly require combined knowledge of mechanics, electronics and software.  
**Eg: Industry 4.0 curricula** promoted under **Skill India Digital Platform (2023)** emphasise cross-domain competencies (Source: **MSDE**).
4. **Shortened skill life cycles demanding lifelong learning:** Rapid technological upgrades reduce the longevity of existing skills.  
**Eg: OECD Skills Outlook 2023** stresses continuous upskilling as a response to automation-driven skill obsolescence.
5. **Greater importance of on-the-job and modular training models:** Traditional long-duration training is inadequate for fast-changing robotic systems.  
**Eg: Apprenticeship reforms under National Apprenticeship Promotion Scheme (NAPS)** support industry-linked skilling (Source: **MSDE**).

## Policy challenges arising from this shift

1. **Managing labour displacement and livelihood security:** Automation-induced job transitions raise concerns linked to **Article 21 (Right to Livelihood)** as interpreted by the Supreme Court.  
**Eg: Economic Survey 2022–23** warns against automation without parallel workforce transition policies.
2. **Addressing skill mismatch between education and industry needs:** Formal education lags behind rapidly evolving industrial technologies.  
**Eg: Parliamentary Standing Committee on Labour (2021–22)** flagged weak industry–academia alignment in advanced manufacturing skills.
3. **Ensuring inclusive access to robotics for MSMEs:** High costs limit adoption by smaller firms, risking productivity divergence.  
**Eg: OECD Automation Policy Review 2023** recommends targeted fiscal and technical support for MSMEs.
4. **Updating labour regulations for human–robot workplaces:** Existing labour laws inadequately address safety, liability and work design in automated environments.  
**Eg: ILO Future of Work Reports** highlight regulatory gaps in automated production systems.
5. **Coordinating multi-ministerial governance of robotics adoption:** Robotics spans industry, labour, education and technology domains, requiring policy coherence.  
**Eg: NITI Aayog’s Industry 4.0 strategy discussions** emphasise whole-of-government coordination.

## Conclusion

Robotics is transforming labour rather than eliminating it, but the transition demands anticipatory skilling and adaptive regulation. Aligning automation with inclusive workforce policies will determine whether technological progress strengthens or fragments industrial growth.

**Q. What is regenerative medicine? Examine its significance for the future of disease treatment. Discuss the scientific and regulatory challenges involved. (15 M)**

**Introduction**

Modern medicine is increasingly shifting from disease control to biological restoration. Regenerative medicine embodies this transition by aiming to repair or replace damaged tissues, offering new possibilities for conditions once considered irreversible.

**Body**

**What is regenerative medicine**

1. **Cell-based tissue restoration:** Regenerative medicine focuses on repairing, replacing, or regenerating damaged cells, tissues, or organs using biological mechanisms rather than only alleviating symptoms.  
**Eg: Autologous stem-cell-based bone marrow transplantation** used in blood disorders demonstrates clinically proven regenerative capacity.
2. **Use of stem cells with differentiation ability:** It relies on stem cells that can self-renew and differentiate into specialised cells, enabling targeted tissue repair.  
**Eg: Hematopoietic stem cells differentiating into blood cells** in leukemia treatment.
3. **Combination of biology and engineering:** Regenerative medicine integrates cell biology with tissue engineering, biomaterials, and growth factors to recreate functional tissues.  
**Eg: Bioengineered skin grafts** used for severe burn management.
4. **Shift from replacement to regeneration:** Unlike prosthetics or organ replacement, it aims to restore native tissue function and structure.  
**Eg: Cartilage regeneration approaches** explored for early osteoarthritis to delay joint replacement.
5. **Personalised therapeutic approach:** Therapies are often patient-specific, reducing immunological rejection and improving compatibility.  
**Eg: Patient-derived cells** used in experimental cardiac tissue repair after myocardial injury.

**Significance for the future of disease treatment**

1. **Management of degenerative and chronic diseases:** Regenerative medicine offers potential solutions for conditions like spinal disc degeneration, neurodegenerative disorders, and arthritis where conventional therapies are limited.  
**Eg: Cell-based therapies explored for Parkinson's disease** to restore dopamine-producing neurons.
2. **Reduction in invasive surgeries:** Successful regeneration can reduce dependence on major surgical interventions and lifelong implants.  
**Eg: Biological cartilage repair techniques** reducing the need for early knee replacement.
3. **Improved quality of life and functional recovery:** Restoration of tissue function enhances long-term outcomes rather than temporary relief.  
**Eg: Stem-cell-supported wound healing** leading to faster recovery and reduced scarring.

4. **Advancement of precision medicine:** Regenerative approaches align with personalised medicine by tailoring therapies to individual biological profiles.  
**Eg: Patient-specific cell therapies** reducing graft rejection risks.
5. **Potential long-term cost efficiency:** Though initially expensive, effective regeneration may lower lifetime healthcare costs by preventing repeated treatments.  
**Eg: Curative stem cell transplants** eliminating the need for chronic transfusion therapy.

### Scientific and regulatory challenges involved

1. **Insufficient clinical evidence:** Many regenerative therapies lack large-scale, long-term clinical trials to establish safety and efficacy.  
**Eg: Variable outcomes in spinal disc stem-cell injections** across different patient profiles.
2. **Risk of uncontrolled cell behaviour:** Stem cells may cause abnormal growth, immune reactions, or tumor formation if not properly regulated.  
**Eg: Concerns over aberrant cell proliferation** at injection sites.
3. **Standardisation and reproducibility issues:** Variability in cell sources, processing methods, and delivery techniques complicates consistent outcomes.  
**Eg: Differences between laboratory-prepared and clinic-prepared cell products.**
4. **Regulatory approval and ethical oversight:** Absence of uniform global regulatory standards leads to premature clinical use of experimental therapies.  
**Eg: Medical tourism for unapproved regenerative treatments** exploiting regulatory gaps.
5. **High costs and access barriers:** Advanced infrastructure and expertise make therapies expensive, raising concerns of inequitable access.  
**Eg: High-priced cell therapies** remaining confined to elite healthcare settings.

### **Conclusion**

Regenerative medicine holds transformative potential to redefine disease treatment by restoring biological function rather than merely managing decline. Its future impact, however, depends on rigorous science, robust regulation, and ethical deployment to ensure safe, equitable, and evidence-based innovation.

### **Q. Describe the application of artificial intelligence in air pollution assessment. Highlight the challenges it faces in accounting for complex environmental interactions. (10 M)**

#### **Introduction**

Air pollution assessment increasingly requires high-resolution, real-time and predictive understanding of atmospheric processes that conventional monitoring alone cannot provide. Artificial intelligence has emerged as a critical scientific tool to enhance pollution measurement, interpretation and forecasting across spatial and temporal scales.

#### **Body**

#### Application of artificial intelligence in air pollution assessment

1. **High-resolution pollution mapping:** AI enables interpolation and downscaling of air quality data to generate fine-grained spatial pollution maps beyond sparse monitoring stations.  
**Eg: Machine learning models integrating CPCB monitoring data with satellite observations**

(ISRO, NASA) to estimate PM<sub>2.5</sub> concentrations at sub-district scales, as used in recent **WHO-supported exposure studies**.

- Predictive air quality forecasting:** AI models process historical pollution, meteorological and emissions data to forecast pollution levels in advance.  
**Eg: AI-based forecasting modules integrated into air quality early warning systems**, drawing on **CPCB SAFAR and AQI datasets**, to anticipate pollution episodes.
- Source apportionment support:** AI assists in identifying probable pollution sources by recognising complex patterns across datasets.  
**Eg: Data-driven source classification models** supplementing traditional receptor models in studies referenced by **CPCB and IIT-led research on emission attribution**.
- Sensor calibration and data validation:** AI improves reliability of low-cost sensors by correcting drift, noise and bias.  
**Eg: AI-enabled calibration of low-cost air quality sensors against reference-grade monitors**, highlighted in **UNEP and World Bank technical assessments**.
- Trend detection and long-term assessment:** AI helps detect subtle trends and anomalies in long-term air quality data.  
**Eg: Time-series machine learning applied to multi-year PM<sub>2.5</sub> datasets** to identify structural pollution trends, cited in **Global Burden of Disease air pollution analyses**.

#### **Challenges in accounting for complex environmental interactions**

- Non-linear atmospheric chemistry:** AI models struggle to fully capture complex chemical reactions among pollutants under varying climatic conditions.  
**Eg: Secondary pollutant formation like ground-level ozone**, which depends on non-linear interactions between NO<sub>x</sub>, VOCs and sunlight, as noted in **WHO air quality science reviews**.
- Data quality and representativeness issues:** Incomplete, uneven or biased datasets reduce model reliability.  
**Eg: Sparse rural and peri-urban monitoring data in India**, acknowledged by **CPCB**, limits AI generalisation across diverse environments.
- Limited interpretability of AI models:** Many AI systems function as black boxes, constraining scientific transparency.  
**Eg: Deep learning models producing accurate forecasts without clear causal explanation**, flagged as a concern in **IPCC AR6 discussions on model interpretability**.
- Sensitivity to changing climatic conditions:** AI models trained on historical data may underperform under altered climate regimes.  
**Eg: Changing monsoon patterns and heat extremes** affecting pollution dispersion, highlighted in **IPCC Sixth Assessment Report (2021–2023)**.
- Difficulty in integrating multi-scale interactions:** Environmental processes operate across local, regional and global scales that AI models may inadequately synchronise.  
**Eg: Transboundary pollution transport interacting with local emissions**, documented in **UNEP assessments on regional air pollution**.

#### **Conclusion**

Artificial intelligence significantly strengthens air pollution assessment by enhancing resolution, prediction and pattern recognition. However, its effectiveness depends on robust data, scientific integration and complementary physical understanding to address the inherent complexity of environmental systems.

## **Q. Distinguish between different levels of automation in robotic systems. Discuss why partial automation is often preferred in public applications. (10 M)**

### **Introduction**

Rapid advances in **robotics and artificial intelligence** have enabled machines to operate with varying degrees of autonomy across sectors such as transport, manufacturing and public services. However, the choice of automation level is shaped not only by technology but also by safety, accountability and public trust considerations.

### **Body**

#### **Different levels of automation in robotic systems**

1. **Manual and assisted automation:** Robots provide decision-support or physical assistance while humans retain full control and responsibility.  
**Eg: Robotic surgical assistance systems** where surgeons control every critical movement, as regulated under **medical device norms of CDSCO**, ensuring human oversight.
2. **Partial automation:** Robots perform specific tasks autonomously but require human supervision and intervention in complex situations.  
**Eg: Advanced Driver Assistance Systems (ADAS)** such as lane assist and adaptive cruise control, classified as **Level 2 automation by SAE International**, widely adopted globally.
3. **Conditional automation:** Systems can operate independently under defined conditions but expect humans to take over when limits are reached.  
**Eg: Pilot-assisted autopilot systems in aviation**, where automated navigation operates under standard conditions with pilots monitoring continuously, as per **ICAO safety standards**.
4. **High automation:** Robots handle most functions even in dynamic environments, with limited human involvement mainly for oversight.  
**Eg: Automated metro rail operations** such as **driverless metro corridors**, supervised from central control rooms for safety assurance.
5. **Full automation:** Systems operate without human intervention across all scenarios, assuming complete decision-making authority.  
**Eg: Fully autonomous vehicles (Level 5)** remain largely experimental, with regulatory concerns highlighted by **OECD AI Policy Observatory** due to safety and liability risks.

#### **Why partial automation is often preferred in public applications**

1. **Safety and risk management:** Human oversight reduces the probability of catastrophic failure in unpredictable public environments.  
**Eg: Civil aviation globally mandates human pilots** even with advanced automation, as reinforced by **ICAO safety management systems**.
2. **Accountability and legal clarity:** Retaining human control ensures clear responsibility in case of accidents or system failure.  
**Eg: NITI Aayog's Responsible AI framework (2021)** emphasises **human-in-the-loop systems** to maintain accountability.
3. **Technological limitations in real-world complexity:** AI systems still struggle with edge cases involving human behaviour and environmental uncertainty.

**Eg: Autonomous vehicle trials globally** have shown difficulties in handling mixed traffic conditions, as documented by **World Economic Forum AI governance reports**.

4. **Public trust and social acceptance:** Gradual automation builds confidence among users and reduces resistance to new technologies.

**Eg: Semi-automated public transport systems** have achieved higher acceptance than fully autonomous pilots in multiple cities worldwide.

5. **Cost-effectiveness and scalability:** Partial automation offers efficiency gains without the high costs and risks of full autonomy.

**Eg: Smart surveillance and robotic assistance in public infrastructure**, supported by MeitY's **AI adoption initiatives**, balance manpower optimisation with affordability.

## Conclusion

In public applications, **partial automation offers an optimal balance between efficiency, safety and accountability**. As technology matures and regulatory frameworks evolve, such hybrid models provide a pragmatic pathway for responsible adoption of robotics in society.

## **Conservation, environmental pollution and degradation, environmental impact assessment.**

**Q. Examine the role of Generative AI in addressing capacity constraints in healthcare systems. Discuss its limitations as a clinical support tool. (10 M)**

### **Introduction**

India's healthcare system is under sustained stress due to rising disease burden, workforce shortages and time-intensive service delivery. In this setting, Generative AI has emerged as a capacity-augmenting technology that expands functional reach without proportional expansion of physical resources.

### **Body**

#### **Role of Generative AI in addressing capacity constraints**

1. **Clinical documentation automation:** Generative AI significantly reduces the time doctors spend on electronic records, allowing scarce clinical hours to be redirected towards patient care.  
**Eg: AI-generated discharge summaries and progress notes** are now used in several large hospitals to cut documentation burden and improve doctor-patient interaction time.
2. **Diagnostic workload optimisation:** AI acts as a decision-support layer by pre-processing clinical data and images, helping specialists manage high patient volumes efficiently.  
**Eg: AI-assisted radiology triaging systems** flag high-risk scans in emergency settings, enabling faster prioritisation without replacing human interpretation.
3. **Scaling routine patient communication:** Generative AI handles repetitive, non-critical interactions such as appointment reminders and follow-ups, easing pressure on frontline staff.  
**Eg: Automated patient messaging systems** deployed in public health networks improved response times while maintaining continuity of care.
4. **Augmenting specialist reach in underserved areas:** AI enables limited specialists to support peripheral facilities through summarisation and clinical assistance tools.  
**Eg: AI-supported telemedicine platforms** assist primary doctors by structuring patient histories before specialist consultation.

5. **Accelerating biomedical research pipelines:** Generative AI reduces early-stage research bottlenecks, indirectly easing future system capacity constraints.  
**Eg: AI-driven molecule screening models** narrow down viable drug candidates before laboratory testing, shortening development timelines.

### **Limitations of Generative AI as a clinical support tool**

1. **Risk of confident but incorrect outputs:** Generative AI can produce plausible yet inaccurate medical suggestions, making unsupervised clinical use unsafe.  
**Eg: Instances of AI hallucination in clinical summaries** have highlighted the need for strict human validation in medical contexts.
2. **Data bias and representational gaps:** AI performance is constrained by the quality and diversity of training data, leading to uneven clinical reliability.  
**Eg: Models trained predominantly on urban hospital data** may underperform in rural or resource-limited healthcare settings.
3. **Absence of ethical and contextual reasoning:** AI lacks moral judgement and cannot account for nuanced patient values or socio-cultural factors.  
**Eg: End-of-life or consent-related decisions** require human empathy and ethical discretion beyond algorithmic capability.
4. **Accountability and legal responsibility constraints:** Clinical responsibility cannot be delegated to algorithms, limiting AI's autonomous role.  
**Eg: Medical negligence jurisprudence under Article 21** places the duty of care squarely on human practitioners, not technological tools.
5. **Institutional and regulatory readiness gaps:** Health systems often lack robust protocols for validation, audit and oversight of AI outputs.  
**Eg: Absence of standardised clinical AI audit mechanisms** increases the risk of inconsistent or unsafe deployment.

### **Conclusion**

Generative AI can meaningfully expand healthcare capacity by reducing friction and amplifying human effort, but its role must remain supportive and bounded. Sustainable adoption lies in preserving human judgement as the final authority while using AI as a reliable clinical assistant, not a substitute.

**Q. Explain the concept of carrying capacity in environmental planning. Analyse its relevance for urban and infrastructure development in India. Examine the consequences of exceeding carrying capacity for ecological sustainability and human well-being. (15 M)**

### **Introduction**

Urban India is entering a phase where ecological limits are colliding with accelerated infrastructure expansion. The concept of carrying capacity provides a scientific lens to reconcile development ambitions with the finite resilience of natural and urban ecosystems.

### **Body**

#### **Concept of carrying capacity in environmental planning**

1. **Ecological threshold concept:** Carrying capacity refers to the maximum level of population, activity, or infrastructure that an environment can sustain without irreversible degradation of natural resources and ecosystem functions.

**Eg:** The **Central pollution control board** applies river assimilative capacity limits to determine permissible pollution loads, recognising collapse of self-purification beyond thresholds.

2. **Systems-based planning tool:** It integrates limits of land, water, air, waste absorption, and energy into spatial planning instead of treating them as externalities.

**Eg:** The **National environmental policy, 2006 (MoEFCC)** explicitly identifies carrying capacity–based regional planning as a core governance principle.

3. **Preventive governance approach:** Carrying capacity operationalises the precautionary principle by restricting activities before ecological damage becomes irreversible.

**Eg:** In **Vellore citizens welfare forum v Union of India (1996)**, the **Supreme court** prioritised ecological limits over industrial growth.

### **Relevance for urban and infrastructure development in India**

1. **Urban water security and demand planning:** Cities exceeding hydrological carrying capacity face chronic scarcity despite supply-side expansion.

**Eg:** The **Niti Aayog composite water management index, 2018**, warned that **21 major cities** risk groundwater exhaustion due to planning beyond recharge limits.

2. **Transport growth and air quality regulation:** Atmospheric carrying capacity determines the sustainable scale of vehicular and infrastructure expansion.

**Eg:** **CPCB air quality status reports (2023)** show persistent non-attainment cities despite road expansion under the **National clean air programme**.

3. **Fragile landscape infrastructure control:** Hill and coastal regions have low geomorphological carrying capacity, requiring differentiated development norms.

**Eg:** The **Kasturirangan committee report, 2013**, recommended graded development in the **Western ghats** based on ecological sensitivity.

4. **Waste assimilation and land-use planning:** Exceeding waste absorption capacity converts cities into secondary pollution hotspots.

**Eg:** The **Solid waste management rules, 2016 (MoEFCC)** mandate capacity-based waste planning before township approvals.

### **Consequences of exceeding carrying capacity for ecological sustainability and human well-being**

1. **Collapse of ecosystem services:** Threshold breaches degrade flood regulation, groundwater recharge, and urban climate moderation.

**Eg:** **National institute of disaster management** linked the **Chennai floods, 2015** to large-scale wetland loss beyond urban carrying limits.

2. **Amplified disaster risks:** Overbuilt environments convert natural hazards into human disasters.

**Eg:** The **Supreme court–appointed expert body** on the **Uttarakhand disaster, 2013** flagged infrastructure pressure exceeding mountain capacity.

3. **Public health stress and social inequity:** Environmental overload disproportionately affects vulnerable populations through heat, pollution, and water stress.

**Eg:** The **Lancet countdown on health and climate change, 2023** highlighted rising heat-related mortality risks in Indian cities.

4. **Escalating governance and economic costs:** Ignoring capacity results in litigation, project delays, and post-clearance reversals.

**Eg: Parliamentary standing committee on environment reports** note repeated infrastructure disputes due to weak capacity assessment.

### **Way forward: Institutionalising carrying capacity-based development**

1. **Mandatory capacity assessments in urban planning:** Carrying capacity studies should be integrated into master plans and smart city proposals.  
**Eg:** The **15th finance commission** recommended outcome-linked urban funding, enabling capacity-based conditional transfers.
2. **Strengthening EIA and regional planning linkage:** Project-level EIA must be anchored within regional and basin-level capacity limits.  
**Eg: Supreme court jurisprudence** on cumulative impact assessment in infrastructure cases reinforces this integration.
3. **Use of geospatial and real-time data systems:** Dynamic monitoring of air, water, land, and mobility loads can guide adaptive planning.  
**Eg: ISRO's geospatial platforms** are increasingly used by **MoEFCC** for environmental monitoring and decision support.
4. **Decentralised governance and local accountability:** Urban local bodies must be empowered to regulate growth aligned with ecological limits.  
**Eg: Article 243W of the Constitution** enables municipalities to manage urban planning and environmental protection functions.

### **Conclusion**

Carrying capacity must evolve from an advisory concept to a binding planning principle. Embedding ecological limits into India's urban and infrastructure trajectory is essential for resilient growth that safeguards both nature and human well-being.

**Q. Discuss the need for aligning national sustainability reporting frameworks with evolving global climate disclosure standards. Examine the trade-offs involved for emerging economies like India. (10 M)**

### **Introduction**

Climate change has transformed sustainability reporting into a core instrument for managing economic risk, capital flows, and environmental accountability. For emerging economies, aligning national frameworks with global climate disclosure norms is increasingly tied to growth, resilience, and credibility.

### **Body**

#### **Need for aligning national sustainability reporting frameworks with global climate disclosure standards**

1. **Global capital compatibility:** Alignment ensures Indian companies remain comparable and credible for international investors increasingly guided by climate-aligned disclosure benchmarks.  
**Eg: Indian listed companies under BRSR** are increasingly evaluated by foreign investors against **ISSB-style climate disclosures**, influencing access to **green bonds and sustainability-linked finance**.

2. **Improved climate risk pricing:** Standardised disclosures allow consistent assessment of **physical and transition risks**, improving risk pricing across financial markets.  
**Eg: Extreme heat, flooding, and energy transition risks** are now factored into **credit appraisals by banks**, requiring reliable corporate climate data.
3. **Strengthening net-zero credibility:** Alignment links corporate disclosures with India's **net-zero by 2070** commitment, improving confidence in long-term decarbonisation pathways.  
**Eg: Hard-to-abate sectors like steel and cement** disclosing technology pathways such as **green hydrogen and CCUS** improve credibility of transition plans.
4. **Policy coherence and governance:** Harmonised standards help integrate climate considerations into **corporate governance, risk management, and capital allocation**.  
**Eg: Board-level climate oversight disclosures** enable better monitoring of climate risks within large Indian corporations.
5. **Integration with global value chains:** Alignment supports Indian firms' participation in climate-sensitive global supply chains.  
**Eg: Export-oriented manufacturers** increasingly face climate disclosure requirements from **European and global buyers**.

### **Trade-offs involved for emerging economies like India**

1. **Higher compliance costs:** Advanced climate disclosures impose financial and technical burdens, particularly on smaller firms.  
**Eg: MSMEs and tier-2 suppliers** face challenges in **emissions measurement, scenario analysis, and reporting capacity**.
2. **Developmental asymmetry:** Uniform global standards may insufficiently account for **development needs and energy poverty**.  
**Eg: Coal-dependent regions and thermal power utilities** face disclosure pressures despite limited short-term transition alternatives.
3. **Institutional capacity constraints:** Effective alignment requires strong data systems and regulatory capability, which are still evolving.  
**Eg: Fragmented climate data availability across sectors** weakens scenario modelling and disclosure accuracy.
4. **Risk of capital diversion:** Stricter disclosures may temporarily deter investment in transition-intensive sectors.  
**Eg: Infrastructure and heavy industry projects** may face higher financing costs during early transition phases.
5. **Policy sequencing challenges:** Premature alignment without phased implementation can reduce compliance quality.  
**Eg: Companies reporting high-level targets without credible transition levers** risk superficial disclosures.

### **Conclusion**

Aligning sustainability reporting with global climate standards is essential for India's financial competitiveness and climate credibility. A calibrated, phased approach that builds domestic capacity while preserving developmental flexibility can transform disclosure alignment into a catalyst for a just transition.

**Q. Discuss the statutory role of the National Board for Wildlife in India's conservation framework. Examine the challenges it faces in fulfilling this role. (10 M)**

**Introduction**

India's wildlife conservation architecture relies on statutory institutions to regulate human intervention in ecologically sensitive spaces. The National Board for Wildlife occupies a pivotal position in this framework by shaping how development interfaces with protected areas.

**Body**

**Statutory role of the National Board for Wildlife**

- 1. Apex statutory advisory body:** Established under the **Wildlife (Protection) Act, 1972**, NBWL advises the central government on wildlife conservation policy, giving operational meaning to **Article 48A** and **Article 51A(g)** of the Constitution.  
**Eg:** NBWL's policy guidance influences decisions on activities permitted within **national parks, wildlife sanctuaries and eco-sensitive zones**, shaping national conservation priorities.
- 2. Mandatory clearance authority for protected areas:** Approval of the **Standing Committee of NBWL** is a statutory prerequisite for projects located inside or affecting protected areas, making it a key regulatory gatekeeper.  
**Eg:** The **Kaziranga elevated corridor project** was cleared only after NBWL imposed multiple wildlife-specific conditions to regulate animal movement and disturbance.
- 3. Regulatory interface between development and conservation:** NBWL scrutinises linear infrastructure, mining and tourism projects to assess their compatibility with wildlife protection objectives.  
**Eg:** Road, railway and transmission line proposals passing through tiger reserves require NBWL clearance before execution.
- 4. Platform for integrating scientific expertise:** NBWL incorporates ecological inputs from expert bodies such as the **Wildlife Institute of India** and the **National Tiger Conservation Authority** into its decision-making process.  
**Eg:** Scientific studies on wildlife corridors and animal movement patterns are used to shape mitigation measures attached to project approvals.
- 5. Coordination across conservation institutions:** NBWL functions as a coordinating forum linking the Union government, state governments and statutory wildlife authorities to ensure coherence in conservation governance.  
**Eg:** State proposals affecting protected areas are examined at the national level to align them with broader wildlife conservation goals.

**Challenges in fulfilling its mandate**

- 1. Over-reliance on condition-based approvals:** NBWL increasingly permits projects with mitigation conditions instead of rejecting ecologically risky proposals, weakening the application of the **precautionary principle**.  
**Eg:** Infrastructure projects in sensitive habitats are often allowed subject to safeguards rather than avoidance of core wildlife areas.
- 2. Weak enforcement and compliance monitoring:** NBWL lacks an independent field-level mechanism to ensure effective implementation of the conditions it imposes.

**Eg:** Monitoring of wildlife crossings, speed limits and construction restrictions largely depends on capacity-constrained state forest departments.

3. **Institutional capacity constraints:** The Standing Committee handles a large volume of complex proposals, limiting the depth of ecological scrutiny for each project.

**Eg:** Multiple development proposals are frequently considered in single meetings, reducing time available for detailed evaluation.

4. **Developmental and political pressures:** Chaired by the **Prime Minister**, NBWL operates within a high-level policy environment where strategic and economic priorities can overshadow ecological caution.

**Eg:** Judicial observations in conservation-related cases have repeatedly stressed the need for stricter scrutiny of activities in protected areas.

5. **Fragmented post-clearance accountability:** Responsibility for implementing NBWL conditions is spread across multiple agencies, weakening accountability and consistency.

**Eg:** Wildlife mitigation measures are often shared between user agencies and state authorities, leading to uneven on-ground outcomes.

## Conclusion

The National Board for Wildlife remains central to India's conservation framework, but its effectiveness is constrained by capacity, compliance and governance challenges. Reinforcing precaution-based decision-making and strengthening independent monitoring are essential to safeguard the ecological integrity of protected areas in the long run.

**Q. "Climate change is transforming remote ecosystems into zones of intensified human pressure. Examine with reference to polar and mountain regions. Analyse the ecological consequences of such transformation. (10 M)**

## Introduction

Climate change is dismantling the natural isolation of polar and mountain ecosystems by shrinking ice, snow and permafrost barriers. This ecological opening has converted remote regions into active zones of human presence and pressure.

## Body

### Climate change is transforming remote ecosystems into zones of intensified human pressure

1. **Cryosphere retreat removing access barriers:** Rising temperatures are shrinking glaciers and sea ice, eliminating physical barriers that historically limited human entry.

**Eg: IPCC AR6 (2021–23)** confirms sustained **Arctic sea-ice decline**, extending seasonal navigability and human activity in polar waters.

2. **Climate-enabled economic access:** Reduced ice and snow cover is enabling tourism, mining and resource exploration in fragile regions.

**Eg: Alpine glacier retreat in Europe**, reported by **UNEP**, has expanded **high-altitude tourism and infrastructure footprint**.

3. **Infrastructure expansion into sensitive landscapes:** Improved accessibility has encouraged road, energy and military infrastructure in ecologically fragile zones.

**Eg: Himalayan road expansion flagged in MoEFCC and NITI Aayog reports** has increased anthropogenic pressure in sensitive mountain ecosystems.

4. **Growth of scientific and strategic human presence:** Climate change has increased the research and strategic relevance of polar regions, resulting in permanent human installations.

**Eg: Expansion of Antarctic research stations under the Antarctic Treaty System**, documented by SCAR, has increased local ecological disturbance.

5. **Climate-induced livelihood shifts increasing pressure:** Environmental stress alters traditional livelihoods, intensifying seasonal and permanent human use of fragile areas.

**Eg: IPCC Working Group II notes changing pastoral patterns in Himalayan regions**, increasing grazing pressure on alpine ecosystems.

### Ecological consequences of such transformation

1. **Fragile biodiversity disruption:** Human intrusion accelerates habitat fragmentation in ecosystems already stressed by warming.

**Eg: IUCN Red List assessments** highlight rising vulnerability of **cold-adapted alpine and polar species**.

2. **Hydrological regime alteration:** Infrastructure and land-use change disrupt natural meltwater-dependent hydrological cycles.

**Eg: IPCC AR6 reports glacial melt variability affecting Himalayan river systems**, impacting downstream freshwater ecosystems.

3. **Soil instability and land degradation:** Human activity on thawing permafrost and steep slopes increases erosion and slope failures.

**Eg: Permafrost thaw-related ground instability in the Arctic**, documented by IPCC, accelerates land degradation.

4. **Pollution accumulation in low-resilience ecosystems:** Increased human presence introduces persistent pollutants into ecosystems with slow recovery rates.

**Eg: UNEP-cited studies** have detected **microplastics in Arctic snow**, indicating anthropogenic contamination.

5. **Reduced ecosystem resilience to climate stress:** Multiple stressors together weaken the adaptive and recovery capacity of ecosystems.

**Eg: IPCC AR6** warns that combined **climate stress and human pressure** reduce long-term ecosystem resilience in polar and mountain regions.

### Conclusion

As climate change erodes natural isolation, polar and mountain ecosystems face compounded ecological stress from human intrusion. Safeguarding these regions demands climate-sensitive environmental governance anchored in **Article 48A** and **Article 51A(g)** of the Constitution.

### **Q. Examine how climate change alters the risk profile of long-gestation infrastructure projects. Discuss the implications for project viability assessment. (10 M)**

#### Introduction

India's long-gestation infrastructure projects are increasingly exposed to **non-linear and irreversible climate risks** that evolve over decades rather than years. This has fundamentally altered how risk, uncertainty and viability are assessed at the planning stage.

## Body

### How climate change alters the risk profile of long-gestation infrastructure projects

- 1. Climate hazard intensification risk:** Climate change increases the **frequency and severity of floods, cyclones, heatwaves and landslides**, raising physical damage risk over a project's lifetime.  
**Eg: Char Dham highway projects in Uttarakhand** have repeatedly suffered damage from **extreme rainfall and landslides**, increasing repair costs and downtime.
- 2. Temporal risk mismatch:** Long-gestation projects are designed using **historical climate baselines**, while climate impacts unfold progressively, making original assumptions obsolete.  
**Eg: Hydropower projects in the Himalayan region** face rising sedimentation and altered river flows, deviating from original design hydrology.
- 3. Asset concentration and cascading risk:** Climate change amplifies losses when **multiple high-value assets are clustered in hazard-prone regions**, increasing correlated failures.  
**Eg: Urban infrastructure in floodplains of Delhi and Chennai** has seen repeated disruptions due to intense rainfall events affecting roads, metros and drainage simultaneously.
- 4. Insurance and financing risk escalation:** Predictable climate risks lead to **higher insurance premiums, exclusions or withdrawal of cover**, transferring risk back to developers and the state.  
**Eg: Hydropower and coastal infrastructure projects** have faced rising insurance costs due to flood and cyclone exposure.
- 5. Regulatory and compliance risk:** Climate risks trigger **stricter environmental norms, redesign requirements and clearance delays**, affecting timelines and cost estimates.  
**Eg: Coastal and hill-area infrastructure projects** increasingly require design revisions to comply with environmental safeguards.

### Implications for project viability assessment

- 1. Distortion of cost–benefit analysis:** Climate damage, downtime and retrofitting costs inflate lifecycle costs, reducing **economic internal rate of return**.  
**Eg: Repeated post-disaster reconstruction of hill roads** raises long-term public expenditure beyond initial project appraisals.
- 2. Financing and bankability stress:** Heightened climate risk weakens **bankability**, as lenders factor in higher default and asset impairment risks.  
**Eg: Infrastructure assets exposed to floods and cyclones** face stricter lending conditions and higher risk premiums.
- 3. Insurance-linked viability constraints:** Projects may become unviable if insurance becomes unaffordable or unavailable, especially for long-duration assets.  
**Eg: Flood-prone hydropower projects** face premium loadings that affect financial closure.
- 4. Fiscal risk transfer to the state:** Under-insured losses are often absorbed through **disaster relief, reconstruction funding and guarantees**, affecting fiscal sustainability.  
**Eg: Post-flood rebuilding of national highways and urban assets** is largely financed through public funds.
- 5. Need for climate-adjusted appraisal frameworks:** Traditional appraisal tools fail to capture climate uncertainty, necessitating **risk-adjusted viability assessments**.  
**Eg: Climate-resilient infrastructure planning approaches** increasingly emphasise integrating climate risk screening at the DPR stage.

## Conclusion

Climate change has transformed long-gestation infrastructure from predictable assets into **dynamic risk-bearing systems**. Integrating climate risk into viability assessment is therefore essential to protect public finances and ensure sustainable infrastructure-led growth.

**Q. “India’s solid waste problem has evolved into a systemic environmental crisis.” Examine the nature of this crisis. Explain how the Solid Waste Management Rules, 2026 attempt to respond to it. Assess the environmental limitations of the current framework. (15 M)**

## Introduction

India’s solid waste challenge has moved beyond municipal inefficiency into a deep environmental stressor, affecting land, air, water and climate systems simultaneously. Rapid urbanisation, changing consumption patterns and weak waste processing have transformed waste from a local nuisance into a systemic ecological risk.

## Body

### Nature of India’s solid waste crisis as an environmental problem

- 1. Land and soil contamination:** Large volumes of mixed waste dumped in open landfills lead to long-term soil toxicity through heavy metals and persistent organic pollutants.  
**Eg: CPCB (2023)** noted leachate contamination around legacy dumpsites like **Ghazipur and Bhalswa**, with elevated **heavy metal levels** in surrounding soils.
- 2. Groundwater and surface water pollution:** Unlined dumpsites allow leachate to percolate into aquifers and nearby water bodies, degrading freshwater ecosystems.  
**Eg: NGT orders on Bellandur Lake, Bengaluru** linked frothing and eutrophication partly to untreated solid waste inflows and landfill runoff.
- 3. Air pollution and public health stress:** Open dumping and waste burning release particulate matter, dioxins and furans, worsening urban air quality.  
**Eg: CPCB air quality assessments (2022–24)** identified open waste burning as a recurrent contributor to **PM2.5 spikes** in North Indian cities.
- 4. Climate change externalities:** Decomposing organic waste in landfills emits methane, a high-global-warming-potential gas.  
**Eg: India’s Third Biennial Update Report to UNFCCC (2023)** highlighted landfills as a significant source of **urban methane emissions**.

### How the SWM Rules, 2026 attempt to respond to this crisis

- 1. Strengthening source segregation for pollution prevention:** The Rules mandate **four-way segregation** to prevent contamination of recyclables and organic waste.  
**Eg: SWM Rules, 2026**, notified by MoEFCC, explicitly include **sanitary and special care waste** to reduce health and environmental risks.
- 2. Reinforcing the waste hierarchy:** Priority is given to **reduction, recycling and processing**, with disposal positioned as a last resort.  
**Eg: The Rules** reiterate alignment with the **National Resource Efficiency Policy framework (NITI Aayog)** emphasising material recovery.

3. **Legacy waste remediation focus:** Scientific capping, bio-mining and environmental safeguards are clearly emphasised.  
**Eg: SBM-Urban 2.0 guidelines (MoHUA)** support remediation of old dumpsites using **bio-remediation and bio-mining techniques**.
4. **Regulated role for waste-to-energy:** Thermal processing is limited to **non-recyclable, high-calorific fractions** to reduce indiscriminate incineration.  
**Eg: CPCB emission standards** linked to WtE plants are cross-referenced to control air pollution risks.

### **Environmental limitations of the SWM Rules, 2026**

1. **Weak disincentives against landfilling:** The Rules discourage landfilling but do not impose explicit bans or ecological pricing on mixed waste disposal.  
**Eg: NITI Aayog (Circular Economy Discussion Papers)** note absence of **landfill taxation**, unlike EU environmental best practices.
2. **Technology bias risks persist:** Waste-to-energy remains permissible without mandatory proof of high segregation or recovery rates.  
**Eg: CAG audit observations on WtE plants** have earlier highlighted under-performance due to poor waste quality.
3. **Limited integration of climate objectives:** Methane mitigation is implicit but not directly linked to climate targets or carbon accounting.  
**Eg: India's Long-Term Low Emission Development Strategy (2022)** does not yet fully integrate municipal waste reforms.
4. **Marginal attention to informal recycling ecology:** Informal waste workers are acknowledged but not structurally integrated into environmental outcomes.  
**Eg: Planning Commission Task Force on Waste (2014)** had recommended formal inclusion of waste pickers to enhance recycling efficiency.

### **Conclusion**

The SWM Rules, 2026 mark a decisive environmental shift from disposal-centric waste handling to pollution prevention and resource recovery. However, without stronger ecological disincentives, climate integration and protection of recycling ecosystems, the framework risks under-delivering on its environmental promise.

## **Disaster and disaster management.**

**Q. Discuss the factors responsible for the rising frequency of climate-induced disasters in India. Examine their implications for disaster preparedness. (10 M)**

### **Introduction**

India's disaster profile is undergoing a structural shift, with extreme weather events becoming more frequent and intense due to interacting climatic and anthropogenic drivers. This transformation is stretching disaster management systems beyond episodic response towards continuous risk governance.

### **Body**

## Factors responsible for rising frequency of climate-induced disasters

1. **Anthropogenic climate change and warming trends:** Rising mean temperatures over the Indian subcontinent are intensifying the hydrological cycle, leading to more frequent heatwaves, extreme rainfall, and cyclonic intensification, consistent with **IPCC AR6 Synthesis Report (2023)** findings.  
**Eg: IMD data** shows a sharp rise in **extreme rainfall events over central India since the 1950s**, contributing to recurrent floods. Source: **IMD, IPCC**.
2. **Monsoon variability and cloudburst events:** Climate change has increased intra-seasonal monsoon variability, producing short-duration, high-intensity rainfall episodes that overwhelm local carrying capacity.  
**Eg: July 2023 Himachal Pradesh floods** driven by multiple cloudbursts caused widespread landslides and infrastructure collapse. Source: **IMD, NDMA post-disaster assessment**.
3. **Rapid and unplanned urbanisation:** Expansion into floodplains, wetlands, and coastal zones reduces natural buffers and amplifies disaster impacts, converting climatic hazards into human disasters.  
**Eg: Chennai floods (2015, recurring urban flooding later)** linked to loss of wetlands like **Pallikaranai marsh**. Source: **NDMA, CAG reports**.
4. **Coastal exposure and sea surface temperature rise:** Rising **sea surface temperatures in the Bay of Bengal** are increasing cyclone intensity, rainfall load, and storm surge risks along India's east coast.  
**Eg: Cyclone Remal (May 2024)** caused severe coastal flooding and wind damage in **West Bengal**, despite moderate wind speed classification. Source: **IMD cyclone reports**.
5. **Ecological degradation and land-use change:** Deforestation, hill cutting, and riverbed mining reduce slope stability and drainage resilience, increasing landslide and flood frequency.  
**Eg: Western Himalayan landslides** intensified by road-widening and deforestation, as highlighted in **NDMA Landslide Atlas**. Source: **NDMA**.

## Implications for disaster preparedness

1. **Shift from response-centric to risk-informed planning:** Rising disaster frequency necessitates mainstreaming **disaster risk reduction** into development planning, as mandated under the **Disaster Management Act, 2005**.  
**Eg: State Disaster Management Plans** now aligned with **Sendai Framework 2015–2030** priorities. Source: **NDMA, UNDRR**.
2. **Strengthening early warning and forecasting systems:** Preparedness must rely on high-resolution, impact-based forecasting rather than event prediction alone.  
**Eg: Expansion of IMD's impact-based cyclone and heatwave warnings** has reduced casualties despite higher event frequency. Source: **IMD annual reports**.
3. **Fiscal and institutional preparedness pressures:** Frequent disasters strain public finances and require predictable risk financing mechanisms rather than ad hoc relief.  
**Eg: Fifteenth Finance Commission** recommended **dedicated disaster risk management grants** to states for mitigation and preparedness. Source: **XV FC Report**.
4. **Need for climate-resilient infrastructure standards:** Infrastructure must be designed for future climate extremes, not historical averages, to avoid repeated losses.  
**Eg: NDMA guidelines on flood-resistant infrastructure** for roads and bridges in high-risk zones. Source: **NDMA guidelines**.

5. **Community-level preparedness and constitutional duty:** Effective preparedness increasingly depends on community awareness and participation, reflecting **Article 51A(g)** and **Article 48A** of the Constitution.

**Eg: Community-based disaster management programmes** in cyclone-prone Odisha have significantly reduced mortality. Source: **NDMA, Odisha SDMA**.

### **Conclusion**

The rising frequency of climate-induced disasters signals that preparedness can no longer be episodic or reactive. India's disaster governance must evolve into a climate-resilient development model anchored in science, institutions, and community participation.

## **Linkages between development and spread of extremism.**

**Q. What is Left-Wing Extremism? Analyse the structural and socio-economic conditions that sustain it in India. (10 M)**

### **Introduction**

Left-Wing Extremism represents a persistent internal security challenge rooted in unresolved social injustice and governance deficits rather than mere ideological deviation. It reflects the failure of development to reach India's most marginalised regions in a meaningful and participatory manner.

### **Body**

#### **What is Left-Wing Extremism**

1. **Ideological insurgency rejecting constitutional democracy:** Left-Wing Extremism is an armed movement inspired by **Marxism–Leninism–Maoism** that seeks to overthrow the Indian State through **protracted people's war**, rejecting electoral politics and constitutional means.  
**Eg:** The **Ministry of Home Affairs (MHA)** identifies **CPI (Maoist)** as the main LWE organisation pursuing armed struggle instead of democratic participation.
2. **Organised and violent challenge to State authority:** LWE involves systematic use of violence against security forces, public infrastructure and symbols of the State to establish parallel control.  
**Eg:** As per **MHA Annual Report 2023–24**, LWE groups continue to target **police stations, roads and communication infrastructure** to undermine State presence in affected districts.
3. **Region-specific insurgency rooted in marginalised geographies:** LWE is concentrated in forested, tribal-dominated and remote regions with weak administrative reach, commonly referred to as the **Red Corridor**.  
**Eg:** **Chhattisgarh, Jharkhand, Odisha and parts of Maharashtra** account for a majority of LWE-affected districts as per **MHA data**.

#### **Structural and socio-economic conditions sustaining LWE in India**

1. **Tribal alienation and land rights violations:** Systematic displacement and weak enforcement of protective laws in Scheduled Areas have deepened Adivasi mistrust of the State.  
**Eg:** The **Supreme Court in Samatha vs State of Andhra Pradesh (1997)** barred transfer of tribal land to non-tribals, yet continued mining-related alienation in tribal belts has been flagged by **MHA** as a driver of LWE mobilisation.

2. **Development deficit and service delivery gaps:** Poor access to health, education, roads and livelihoods reduces State legitimacy and creates fertile ground for extremist influence.  
**Eg:** MHA (2023) notes that many LWE districts overlap with **Aspirational Districts**, reflecting persistent human development deficits despite resource endowment.
3. **Weak local governance and administrative vacuum:** Limited presence of civil administration and ineffective Panchayati Raj institutions allow extremists to operate parallel systems of authority.  
**Eg:** The **Second Administrative Reforms Commission (2007)** observed that absence of responsive governance enables Maoists to position themselves as alternative justice and welfare providers.
4. **Displacement without effective rehabilitation:** Large infrastructure, mining and industrial projects have displaced local communities without adequate consent, compensation or livelihood security.  
**Eg:** The **Planning Commission Expert Group on Development Challenges in Extremist-Affected Areas (2008)** linked displacement in the **Dandakaranya region** to expansion of Maoist influence.
5. **Persistent poverty and economic exploitation:** Chronic unemployment, informal labour exploitation and indebtedness sustain resentment against State institutions.  
**Eg:** **MHA assessments** highlight that LWE-affected populations are largely **tribal and land-poor**, with limited integration into formal economic systems.

### Conclusion

Left-Wing Extremism endures where development, justice and governance remain extractive rather than inclusive. Its long-term resolution lies in synchronising **security measures with constitutional rights, participatory development and accountable local governance**, thereby restoring State legitimacy at the grassroots.

**Q. Trace the ideological and organisational evolution of Left-Wing Extremism in India. Analyse the reasons for its regional concentration. Evaluate recent policy initiatives to contain it. (15 M)**

### **Introduction**

Left-Wing Extremism (LWE) in India represents a protracted internal security challenge rooted in radical ideology, organisational adaptation, and deep regional socio-economic asymmetries. Its persistence reflects the intersection of ideological mobilisation with governance deficits in specific geographies.

### **Body**

#### **Ideological And organisational evolution of Left-Wing Extremism**

1. **Maoist ideological foundations and class struggle narrative:** LWE in India draws from **Marxism–Leninism–Maoism**, emphasising armed revolution, protracted people’s war, and capture of state power through rural mobilisation.  
**Eg:** **Charu Majumdar’s Naxalbari movement (1967, West Bengal)** articulated the strategy of agrarian revolution and annihilation of class enemies, directly inspired by **Mao Zedong’s Chinese revolution**.
2. **Organisational consolidation into CPI (Maoist):** Fragmented communist revolutionary groups gradually unified to enhance ideological coherence and operational capacity.

**Eg: Merger of CPI (ML) People's War and MCC in 2004** led to the formation of **CPI (Maoist)**, creating a centralised leadership structure with military, political, and mass organisation wings.

3. **Shift from urban intellectualism to forest-based guerrilla warfare:** Operational strategy evolved towards exploiting difficult terrain and weak state presence.

**Eg:** Expansion of **People's Liberation Guerrilla Army (PLGA)** bases in **Dandakaranya forests** across **Chhattisgarh–Odisha–Maharashtra**, enabling sustained guerrilla operations against security forces.

4. **Integration of tribal grievances into revolutionary mobilisation:** Ideology increasingly embedded local issues of land, forest rights, and displacement.

**Eg:** Maoist mobilisation around **forest access and opposition to mining projects** in **Bastar region**, framing state development as corporate exploitation.

### Reasons for regional concentration of LWE

1. **Historical land alienation and agrarian distress:** Regions with exploitative land relations and weak land reforms became fertile ground for mobilisation.

**Eg: Telangana and parts of Bihar** witnessed early Maoist influence due to **zamindari legacies** and ineffective tenancy reforms, noted by the **Planning Commission Expert Group (2008)**.

2. **Tribal marginalisation and Fifth Schedule governance gaps:** Failure to implement constitutional safeguards intensified alienation.

**Eg:** Weak enforcement of **Article 244 (Fifth Schedule)**, **PESA Act, 1996**, and **Forest Rights Act, 2006** in **central tribal belt** limited genuine self-governance, enabling Maoist parallel authority.

3. **Resource-rich but development-poor geography:** Mineral abundance without local benefit created conflict between state, corporations, and communities.

**Eg: Iron ore and bauxite belts of Chhattisgarh and Odisha** saw Maoist resistance to mining-linked displacement, as highlighted in **MHA LWE assessments**.

4. **Difficult terrain and limited state penetration:** Dense forests and poor connectivity constrained administration and security outreach.

**Eg: Abujmarh region (Chhattisgarh)** remained outside effective governance for decades, allowing Maoist dominance and training zones.

### Evaluation of recent policy initiatives to contain LWE

1. **Integrated security approach under SAMADHAN strategy:** Focus on intelligence, leadership targeting, and inter-state coordination strengthened counter-insurgency.

**Eg: SAMADHAN (2017)** framework led to improved coordination between **CRPF, CoBRA, state police**, contributing to decline in major incidents as per **MHA annual reports**.

2. **Development-centric interventions in affected districts:** Addressing root causes through targeted socio-economic programmes.

**Eg: Aspirational Districts Programme** improved health, nutrition, and infrastructure indicators in LWE districts like **Dantewada**, reducing local support for insurgents.

3. **Capacity enhancement of local forces and technology use:** Emphasis on local policing and modern surveillance reduced operational space for Maoists.

**Eg:** Deployment of **CoBRA battalions, UAV-based reconnaissance**, and **fortified police stations** in **Chhattisgarh–Jharkhand corridor** improved area domination.

4. **Rights-based governance and surrender-cum-rehabilitation policies:** Combining enforcement with reintegration weakened organisational strength.  
**Eg: State surrender policies in Chhattisgarh and Telangana,** offering skill training and financial support, encouraged cadre exit, as noted in **MHA and state home department data.**

## Conclusion

The trajectory of Left-Wing Extremism in India shows that ideological militancy thrives where governance, justice, and development deficits intersect. Sustained success lies in deepening constitutional decentralisation, rights-based development, and locally rooted governance alongside calibrated security action.

**Q. Guerrilla warfare allows asymmetric groups to convert local familiarity into strategic advantage.” Explain the nature of guerrilla warfare adopted by LWE groups. Analyse its implications for conventional counter-insurgency responses. (10 M)**

## Introduction

Guerrilla warfare has enabled Left-Wing Extremist groups to survive against a militarily superior state by embedding violence within local terrain, society, and time. By exploiting asymmetry rather than confronting the state directly, LWE has transformed familiarity with forests and communities into a strategic asset.

## Body

### Nature of guerrilla warfare adopted by LWE groups

1. **Terrain-based mobility and concealment:** LWE groups operate in dense forests, hilly terrain, and remote tribal belts to evade detection and ensure rapid dispersal after attacks.  
**Eg: Abujmad forests (Chhattisgarh)** continue to be used as safe zones due to limited road connectivity and difficult topography, as noted in **MHA Annual Report 2022–23.**
2. **Hit-and-run and ambush tactics:** Attacks are short, sudden, and aimed at inflicting maximum damage before security forces can respond.  
**Eg: Dantewada IED ambush (2019)** targeted a BJP convoy using pressure-triggered explosives, illustrating classic guerrilla surprise tactics highlighted by **CRPF after-action reports.**
3. **Decentralised command structure:** LWE groups function through small, semi-autonomous units to avoid leadership decapitation and intelligence penetration.  
**Eg: The People’s Liberation Guerrilla Army (PLGA)** operates in squads and platoons, reducing vulnerability to arrests, as documented by **MHA LWE Division.**
4. **Blending with civilian population:** Cadres rely on local support networks for shelter, logistics, and intelligence, blurring the line between combatants and civilians.  
**Eg: Use of Jan Militia networks** in Bastar region to gather movement information on security forces, cited in **ARC Report on Public Order.**

### Implications for conventional counter-insurgency responses

1. **Reduced effectiveness of force-heavy operations:** Large-scale search and cordon operations become predictable and less effective against mobile guerrilla units.  
**Eg: Early Salwa Judum-era operations (2005–2007)** faced setbacks due to static deployment

patterns, acknowledged by the **Supreme Court in Nandini Sundar vs State of Chhattisgarh (2011)**.

2. **Intelligence asymmetry against the state:** Human intelligence becomes difficult when insurgents enjoy community familiarity and fear-induced silence.  
**Eg: Intelligence gaps before Sukma attacks (2017–2018)** were highlighted in **MHA parliamentary replies**, stressing reliance on local informers.
3. **Higher vulnerability to IED-centric warfare:** Conventional patrols face disproportionate casualties due to low-cost, high-impact explosive devices.  
**Eg: IEDs accounted for a majority of security force casualties in LWE areas**, as per **SATP India LWE data 2023**.
4. **Need for integrated civil-security approach:** Purely kinetic responses fail without parallel governance and development measures to erode local support.  
**Eg: SAMADHAN doctrine (2017)** explicitly integrates security action with development and technology, reflecting lessons from guerrilla warfare dynamics.

### **Conclusion**

Guerrilla warfare compels the Indian state to move beyond conventional militarised responses toward intelligence-led, locally rooted, and governance-integrated counter-insurgency. Neutralising LWE's asymmetric advantage ultimately depends on shrinking its social and spatial operating space, not merely its armed capacity.

## **Role of external state and non-state actors in creating challenges to internal security.**

**Q. Militancy in Jammu and Kashmir is sustained as much by internal vulnerabilities as by external sponsorship. Enumerate the key internal factors behind militancy. Analyse the role of external state support in sustaining it. What measures are needed to curb the menace of militancy in the region? (15 M)**

### **Introduction**

Militancy in Jammu and Kashmir represents a layered internal security challenge where domestic governance deficits intersect with sustained external proxy warfare. Its endurance reflects not episodic violence but a structurally reinforced ecosystem spanning politics, economy, ideology, and geopolitics.

### **Body**

#### **Background**

1. **Interlocking internal and external drivers:** Internal alienation creates fertile ground, while external sponsorship converts grievances into organised violence.  
**Eg: MHA Annual Report 2023–24** notes decline in local recruitment alongside continued recovery of foreign-made weapons, underlining this interaction.
2. **Shift from mass insurgency to low-intensity proxy conflict:** Militancy has transitioned from mass participation in the 1990s to selective, externally guided strikes.  
**Eg: Security assessments post-Article 370 abrogation (2019)** indicate reduced street mobilisation but persistent targeted killings.

### **Key internal factors behind militancy**

1. **Political alienation and delayed normalisation:** Long phases of central rule and delayed electoral cycles weakened participatory politics.  
**Eg: Governor's rule between 2018–2020** coincided with a spike in radical propaganda exploiting democratic vacuum (Source: MHA).
2. **Youth unemployment and fragile economic base:** Conflict-induced disruption of tourism, horticulture, and MSMEs limits upward mobility.  
**Eg: PLFS 2022–23** shows youth unemployment in J&K consistently above the national average.
3. **Radicalisation through religious and digital narratives:** Local clerical influence combined with online extremist content accelerates ideological indoctrination.  
**Eg: NIA investigations (2020–2023)** reveal systematic use of encrypted platforms for indoctrination and handler communication.
4. **Overground worker (OGW) networks:** Civilian support structures provide logistics, intelligence, and safe houses to militants.  
**Eg: Operation All Out (post-2017)** identified OGWs as critical enablers of militancy
5. **Perceived human rights excesses and accountability gaps:** Civilian casualties and detentions occasionally fuel grievance narratives.  
**Eg: Supreme Court in EEVFAM vs Union of India (2016)** reaffirmed that **AFSPA does not override Article 21** protections.

### **Role of external state support in sustaining militancy**

1. **Cross-border infiltration and terror infrastructure:** Launch pads, training camps, and handlers across the LoC enable sustained violence.  
**Eg: Army Northern Command briefings (2022–24)** confirm existence of multiple active launch pads.
2. **Financial and logistical sustenance through terror funding:** Hawala routes, fake NGOs, and narcotics trade fund operations.  
**Eg: FATF grey-listing of Pakistan (2018–2022)** cited terror-financing deficiencies.
3. **Proxy war doctrine and strategic deniability:** Non-state actors are used to bleed India while avoiding direct conflict.  
**Eg: Parliamentary Standing Committee on Home Affairs (2021)** termed J&K militancy as “externally sponsored proxy war”.
4. **Information and psychological warfare:** Disinformation campaigns aim to internationalise the Kashmir issue.  
**Eg: EU DisinfoLab (2020)** exposed coordinated fake media networks targeting India on Kashmir.

### **Measures needed to curb militancy**

1. **Restoration of democratic normalcy and statehood:** Political empowerment reduces alienation and separatist appeal.  
**Eg: District Development Council elections (2020)** showed high grassroots participation (Source: ECI).

2. **Youth-focused economic integration:** Skill development, entrepreneurship, and tourism revival must be conflict-sensitive.  
**Eg: PM Development Package for J&K** prioritises infrastructure-led employment
3. **Disruption of OGW and terror-financing networks:** Coordinated action by **NIA, ED, and J&K Police** is essential.  
**Eg: NIA crackdowns in Srinagar (2022–23)** dismantled multiple terror-financing cells.
4. **Intelligence-led and technology-enabled security operations:** Precision operations minimise collateral damage and backlash.  
**Eg: Increased use of drones, SIGINT, and facial recognition by security forces**
5. **Balanced application of special laws with oversight:** Security laws must be periodically reviewed to retain legitimacy.  
**Eg: Justice Jeevan Reddy Committee (2005)** recommended review-based continuation of AFSPA.

### Conclusion

Lasting peace in Jammu and Kashmir demands synchronising security gains with democratic legitimacy, economic inclusion, and relentless disruption of external sponsorship. Only an integrated, rights-sensitive, and intelligence-driven approach can transform tactical stability into enduring normalcy.

### Q. Explain the objectives and powers granted under the Armed Forces (Special Powers) Act, 1958. Analyse the controversy surrounding its implementation. (10 M)

#### Introduction

Enacted during the early phase of post-independence insurgencies, the **Armed Forces (Special Powers) Act, 1958** was designed as an extraordinary security legislation for disturbed regions. Its prolonged use, however, has raised critical questions about the balance between **national security imperatives and constitutional liberties**.

#### Body

#### Objectives of AFSPA

1. **Restoration of public order in disturbed areas:** AFSPA aims to enable rapid stabilisation of areas where insurgency overwhelms civilian policing and governance capacities.  
**Eg: Notification of “disturbed areas” in Manipur and Nagaland under Section 3**, renewed periodically based on ground security assessment (Source: **Ministry of Home Affairs annual reports**).
2. **Legal framework for military aid to civil administration:** The Act provides statutory clarity for armed forces deployed in aid of civil power under the constitutional duty of the Union.  
**Eg: Supreme Court in Naga People’s Movement of Human Rights vs Union of India (1997)** linked AFSPA to the Centre’s obligation under **Article 355** to protect states from internal disturbance.
3. **Deterrence against organised armed insurgency:** AFSPA seeks to create a deterrent environment against militant groups by empowering forces to act swiftly without procedural delays.  
**Eg: Decline in organised insurgent violence in Tripura**, which enabled **complete repeal of AFSPA in 2015**, cited by **MHA** as a security success case.

#### Powers Granted Under AFSPA

1. **Use of force including lethal force: Section 4(a)** authorises armed forces to use force, even causing death, against armed insurgents violating prohibitory orders.  
**Eg: Counter-terror operations against heavily armed militants in Jammu and Kashmir prior to 2019**, conducted under notified prohibitory orders (Source: **MHA parliamentary replies**).
2. **Arrest without warrant and search authority: Sections 4(c) and 4(d)** empower arrest without warrant and search of premises on reasonable suspicion to disrupt insurgent networks.  
**Eg: Cordon-and-search operations in Assam and Manipur** leading to recovery of arms, IEDs, and communication devices (Source: **Assam Rifles operational briefings**).
3. **Immunity from prosecution without central sanction: Section 6** requires prior **Central Government sanction** before prosecuting armed forces personnel for acts done in exercise of AFSPA powers.  
**Eg: Justice Jeevan Reddy Committee (2005)** identified sanction denial as a major structural barrier to accountability (Source: **Committee report**).

### Controversy Surrounding Implementation

1. **Alleged violation of fundamental rights:** Critics argue AFSPA enables disproportionate force, impacting **Article 21 (Right to life)** and **Article 14 (Equality before law)**.  
**Eg: Supreme Court in EEVFAM vs Union of India (2016)** ruled that allegations of fake encounters in AFSPA areas must be independently investigated.
2. **Erosion of civilian trust and democratic legitimacy:** Prolonged militarisation under AFSPA has contributed to alienation and weakened state-citizen trust in conflict regions.  
**Eg: Partial withdrawal of AFSPA from multiple districts in Assam, Nagaland and Manipur since 2022**, acknowledging improved security and public sentiment (Source: **MHA notifications**).
3. **Demand for reform and replacement:** Multiple expert bodies have questioned AFSPA's compatibility with democratic governance in the long term.  
**Eg: Justice Jeevan Reddy Committee (2005)** recommended repeal and integration of necessary provisions into **Unlawful Activities (Prevention) Act**, while the **Second Administrative Reforms Commission** stressed enhanced accountability and grievance redressal.

### Conclusion

AFSPA remains a critical but controversial instrument of internal security management. Its continued relevance depends on **calibrated use, periodic review, and stronger accountability mechanisms** to ensure security objectives do not undermine constitutional values.

**Q. Examine the security challenges along India's borders with its neighbours. Analyse how geopolitical dynamics and non-state actors shape these challenges. Propose comprehensive policy responses to tackle this emerging threat. (15 M)**

### Introduction

India's borders lie at the intersection of unresolved geopolitics, fragile neighbourhoods, and active non-state threats. Contemporary border security challenges extend beyond territorial defence to managing hybrid threats rooted in politics, crime, and transnational networks.

### Body

## Security challenges along India's borders with neighbours

- 1. Unresolved boundary disputes:** Undemarcated and disputed borders create persistent military tension and crisis instability.  
**Eg: India–China LAC standoff since 2020**, following the **Galwan clash**, has led to sustained troop mobilisation and heightened risk of escalation despite disengagement talks.
- 2. Cross-border terrorism and infiltration:** Borders remain vulnerable to militant infiltration due to hostile external support and difficult terrain.  
**Eg: LoC infiltration attempts in Jammu and Kashmir by Pakistan-backed terror groups** continue despite multi-layered fencing and surveillance.
- 3. Porous borders and illegal movements:** Open or lightly regulated borders facilitate illegal migration, smuggling, and demographic pressures.  
**Eg: India–Bangladesh border** witnesses **illegal migration and cattle smuggling**, complicating internal security and social cohesion.
- 4. Difficult terrain and climatic extremes:** Mountains, rivers, deserts, and forests constrain surveillance and rapid force mobilisation.  
**Eg: High-altitude sectors of Arunachal Pradesh and Ladakh** face logistical constraints due to weather and limited last-mile connectivity.
- 5. Borderland alienation and weak state presence:** Underdevelopment and limited governance weaken security and intelligence depth.  
**Eg: Remote border villages in the Northeast** experience governance gaps that insurgent groups have historically exploited.

## Role of geopolitical dynamics and non-state actors

- 1. Great power rivalry and coercive posturing:** Borders are increasingly used for signalling and strategic pressure short of war.  
**Eg: China's infrastructure buildup and patrol face-offs along the LAC** reflect grey-zone coercion without formal conflict.
- 2. State-sponsored proxy warfare:** Non-state actors are used as instruments of foreign policy, blurring accountability.  
**Eg: Pakistan's sustained use of proxy militant groups** in Kashmir illustrates indirect conflict strategies.
- 3. Criminal–terror nexus:** Smuggling, narcotics, and arms trafficking finance extremist activities.  
**Eg: Narco-terrorism networks along the Punjab border** linked to **Golden Crescent drug routes** have funded radical modules.
- 4. Cross-border ethnic and insurgent linkages:** Shared ethnic identities across borders enable insurgent mobility and shelter.  
**Eg: Northeast insurgent groups** have historically exploited **India–Myanmar border ethnic continuities** for sanctuaries.
- 5. Technological diffusion to non-state actors:** Drones, encrypted communication, and cyber tools enhance non-state capabilities.  
**Eg: Drone-based arms and narcotics drops** along western borders have bypassed traditional border controls.

## Comprehensive policy responses

1. **Integrated border management architecture:** Unified command, intelligence sharing, and clear role demarcation are essential.  
**Eg:** Strengthening the **One Border One Force principle** reduces operational overlap and improves accountability.
2. **Technology-enabled surveillance systems:** Smart fencing, drones, and sensors enhance detection and deterrence.  
**Eg: Comprehensive Integrated Border Management System (CIBMS)** integrates radars, sensors, and command centres.
3. **Diplomatic pressure and international norm-building:** External support to terrorism must be countered multilaterally.  
**Eg:** India's push for **global terror financing accountability mechanisms** has constrained space for proxy actors.
4. **Border area development and population retention:** Security is strengthened by economic opportunity and civic integration.  
**Eg: Vibrant Villages Programme** focuses on infrastructure, livelihoods, and service delivery in border settlements.
5. **Legal and institutional capacity strengthening:** Laws must enable action while respecting constitutional safeguards.  
**Eg: Article 355 obligations** justify central assistance to states for maintaining security without undermining federal balance.

### Conclusion

India's border security challenges reflect a shift from conventional threats to hybrid and networked risks. A holistic approach combining geopolitics, development, technology, and institutional reform is essential for resilient and future-ready boundary management.

**Q6. Assess the strategic significance of coastal security for India. Discuss why maritime threats increasingly challenge traditional internal security frameworks. (10 M)**

### Introduction

India's coastline of over **7,500 km**, dense maritime trade routes, and proximity to volatile sea lanes make coastal security a strategic pillar of national security. The maritime domain has emerged as a preferred vector for asymmetric threats that bypass traditional land-centric security frameworks.

### Body

#### Strategic significance of coastal security for India

1. **Protection of economic lifelines:** Coastal security is critical for safeguarding trade, energy imports, ports, and the Blue Economy that sustain national growth.  
**Eg: Over 90% of India's trade by volume and 70% by value** moves through sea routes, making ports and sea lanes high-value strategic targets.
2. **Prevention of maritime terrorism:** Seas offer anonymity, mobility, and stealth, enabling terrorists to exploit weak coastal surveillance.  
**Eg: 26/11 Mumbai attacks (2008)** involved **sea-based infiltration**, fundamentally reshaping India's coastal security doctrine.

3. **Safeguarding offshore and coastal infrastructure:** Offshore assets are vulnerable to sabotage and disruption.  
**Eg: Offshore oil and gas installations in the Mumbai High region** require layered maritime and coastal protection.
4. **Strategic depth against external threats:** Coastal security complements naval deterrence by securing the hinterland against spillover threats.  
**Eg: Post-2008 establishment of the Indian Navy as lead agency** for maritime security strengthened coastal–naval integration.

### **Why maritime threats challenge traditional internal security frameworks**

1. **Porous and dynamic maritime domain:** Unlike land borders, seas lack visible barriers and fixed checkpoints.  
**Eg: Unregulated fishing craft and small boats** complicate identification and tracking in near-shore waters.
2. **Multiplicity of stakeholders and coordination gaps:** Maritime security involves central forces, states, and civilian agencies with overlapping roles.  
**Eg: Naresh Chandra Task Force on Coastal Security (2009)** highlighted fragmentation among Navy, Coast Guard, Marine Police, and port authorities.
3. **Blurring of crime–terror nexus at sea:** Smuggling, piracy, and trafficking seamlessly merge with security threats.  
**Eg: Drug and arms trafficking routes in the Arabian Sea** have been linked to terror financing networks.
4. **Technology asymmetry favoring non-state actors:** Low-cost technology empowers asymmetric actors faster than conventional policing adapts.  
**Eg: Use of GPS-enabled boats and encrypted communication** by maritime criminals challenges conventional coastal policing.

### **Conclusion**

Coastal security is no longer a peripheral concern but a frontline of India's internal security. Addressing maritime threats requires integrated institutions, technology-led surveillance, and seamless centre–state coordination to secure India's maritime frontier.

### **Challenges to internal security through communication networks, role of media and social networking sites in internal security challenges, basics of cyber security; money-laundering and its prevention.**

**Q. Discuss the need for a formal internal security doctrine for India. Identify its core components. Examine how such a doctrine can improve coordination between security and development agencies. (15 M)**

### **Introduction**

Internal security challenges in India have become increasingly complex due to the convergence of **extremism, organised crime, cyber threats, border-area vulnerabilities and development asymmetries.**

In this context, the absence of a **formal internal security doctrine** limits strategic coherence, inter-agency coordination and integration of security with development objectives.

## Body

### Need for a formal internal security doctrine

1. **Fragmented threat perception:** Internal security responsibilities are dispersed across Union, States and multiple agencies, often leading to divergent threat assessments.  
**Eg: Article 355 of the Constitution** mandates the Union to protect States against internal disturbance, yet operational interpretation varies widely across States as highlighted in **Second Administrative Reforms Commission (ARC), Report on Public Order**.
2. **Evolving nature of internal security threats:** Traditional law-and-order challenges now intersect with cyber space, finance, information warfare and cross-border linkages.  
**Eg: MHA Annual Report 2023–24** notes the growing role of **digital financing and encrypted communication** in terrorism and Left-Wing Extremism (LWE).
3. **Absence of a unified strategic framework:** Unlike external security, India lacks a publicly articulated doctrine guiding internal security responses.  
**Eg: Kargil Review Committee (1999)** explicitly recommended a comprehensive internal security framework to complement national security planning.
4. **Centre–State coordination challenges:** Internal security is a State subject, but threats often have inter-State and national dimensions.  
**Eg: Article 246 read with Seventh Schedule** creates functional overlap, evident in inter-State Maoist corridors across **Chhattisgarh–Odisha–Maharashtra**.
5. **Over-reliance on force-centric responses:** Without doctrinal clarity, security operations often precede governance and development interventions.  
**Eg: Second ARC** cautioned against excessive militarisation of internal security, advocating governance-led conflict resolution.

### Core components of an internal security doctrine

1. **Clear definition of internal security scope:** The doctrine must comprehensively cover **terrorism, insurgency, extremism, organised crime, cyber threats and urban security**.  
**Eg: UNODC Internal Security Frameworks** emphasise integrated threat categorisation to avoid institutional silos.
2. **Constitutional role clarity:** Explicit articulation of Union and State responsibilities grounded in constitutional provisions.  
**Eg: Articles 355, 256 and 21** together underline security as a prerequisite for constitutional governance and citizen rights.
3. **Intelligence-led policing architecture:** Emphasis on anticipatory intelligence rather than reactive enforcement.  
**Eg: MAC (Multi-Agency Centre)** mechanism under **IB** has improved intelligence sharing but lacks statutory backing, as noted by **Naresh Chandra Task Force**.
4. **Human rights–compliant security operations:** Doctrine must integrate rule of law and civil liberties to maintain legitimacy.

**Eg: Supreme Court in Nandini Sundar vs State of Chhattisgarh (2011)** stressed constitutional limits on security responses in LWE areas.

5. **Development–security integration framework:** Security planning must be institutionally linked with development delivery.

**Eg: SAMADHAN strategy for LWE** formally includes development, rights-based governance and financial inclusion as core pillars.

### **How a doctrine improves coordination between security and development agencies**

1. **Common operational priorities:** A doctrine enables shared goals between security forces and civil administration.

**Eg: Aspirational Districts Programme**, coordinated by **NITI Aayog**, aligns security stabilisation with health, education and livelihoods in fragile districts.

2. **Sequencing of interventions:** Security operations can be synchronised with governance and welfare rollout.

**Eg: Road Connectivity Projects under PMGSY** in LWE areas were executed alongside security grid expansion, as reported by **MHA 2023**.

3. **Institutionalised inter-departmental coordination:** Doctrine-backed mechanisms reduce ad-hoc coordination.

**Eg: Unified Command Structures** in LWE States bring police, CRPF and district administration onto a common platform.

4. **Trust-building with local communities:** Development agencies gain operational space when security actions are predictable and rights-sensitive.

**Eg: Forest Rights Act implementation in Bastar** improved community cooperation with security forces, documented by **MoTA reports**.

5. **Outcome-based accountability:** Doctrine allows measurable security–development outcomes rather than isolated metrics.

**Eg: Decline in LWE violence by over 70% between 2010–2023**, as per **MHA data**, reflects coordinated security and development action.

### **Conclusion**

A formal internal security doctrine can transform India’s response from reactive crisis management to **strategic, constitutional and development-oriented security governance**. By integrating security imperatives with inclusive development, such a doctrine can strengthen both **state authority and citizen trust** in the long run.

### **Q. Identify the major sources of money laundering in India. Explain the typical process through which illicit money is converted into legitimate assets. (10 M)**

#### **Introduction**

Illicit financial flows distort India’s financial system by converting proceeds of crime into apparently lawful wealth, undermining economic integrity and national security. Money laundering thus links everyday economic activity with organised crime, corruption and transnational networks.

#### **Body**

## Major sources of money laundering in India

1. **Corruption and abuse of public office:** Proceeds generated through bribery, kickbacks and rent-seeking in public procurement and regulation form a primary source of laundered money.  
**Eg: Enforcement Directorate (ED)** cases linked to infrastructure and mining contracts show laundering through **shell companies and benami accounts**, flagged in **FATF Mutual Evaluation of India (2024)**.
2. **Drug trafficking and organised crime:** Narcotics trade generates high-value cash flows that require laundering to enter the formal economy.  
**Eg: Narcotics Control Bureau–ED coordination** has revealed laundering via **hawala channels and cash-intensive businesses** in coastal and border states, cited in **MHA annual reports**.
3. **Tax evasion and black money:** Deliberate concealment of income and use of informal channels create large pools of unaccounted money.  
**Eg: Income Tax Department searches** post-GST have uncovered laundering through **fake invoicing and circular trading**, referenced in **CBDT annual reports**.
4. **Terror financing and cross-border crime:** Funds raised for extremist activities are laundered to mask origin and end-use.  
**Eg: Unlawful Activities (Prevention) Act cases** show use of **NGOs and digital wallets** as fronts, noted in **MHA and FATF typology reports**.

## Typical process of converting illicit money into legitimate assets

1. **Placement stage:** Illicit cash is first introduced into the financial system to reduce detection risk.  
**Eg:** Cash deposits split into small amounts through **multiple bank accounts and cash-heavy businesses**, a red flag under **PMLA, 2002**.
2. **Layering stage:** Complex transactions are used to obscure the audit trail and ownership.  
**Eg:** Transfers through **shell companies, offshore accounts and trade-based money laundering**, highlighted in **FATF typologies**.
3. **Integration stage:** Laundered money re-enters the economy as apparently lawful income or assets.  
**Eg:** Investment in **real estate, luxury goods and capital markets**, with proceeds shown as business income, examined by **ED under PMLA**.

## **Conclusion**

Money laundering in India stems from diverse criminal sources and follows a predictable yet adaptive process of placement, layering and integration. Strengthening financial intelligence, technology-driven monitoring and inter-agency coordination remains vital to protect economic governance and national security.

**Q. Examine the major cyber threats facing India, including cyber terrorism and cyber warfare. Analyse the challenges in attribution and deterrence. Outline measures to enhance national cyber security. (15 M)**

## Introduction

India's accelerated digital transformation has elevated cyber space into a critical domain of national security, where threats now range from non-state terrorism to state-sponsored cyber warfare. These threats operate in a legally ambiguous and technologically opaque environment, complicating attribution, deterrence, and response.

## Body

### Major cyber threats facing India

- Cyber terrorism and online radicalisation:** Terrorist organisations exploit cyberspace for propaganda dissemination, recruitment, financing, and operational coordination without physical presence.  
**Eg: ISIS-linked digital propaganda and encrypted messaging platforms**, highlighted in **UN Counter-Terrorism Committee reports and Indian intelligence assessments**, show how extremist networks leverage cyberspace to sustain transnational reach.
- State-sponsored cyber warfare and espionage:** Cyber operations are used by hostile states to infiltrate government systems, steal strategic data, and signal coercive intent without triggering armed conflict.  
**Eg: Intrusions into Indian power and government networks during India–China tensions**, reported by **Recorded Future (2022)** and referenced in **Parliamentary replies**, reflect cyber tools as instruments of hybrid warfare.
- Attacks on critical information infrastructure:** Power, telecom, banking, transport, and healthcare systems are increasingly targeted due to their cascading socio-economic impact.  
**Eg: The 2020 Mumbai power outage**, investigated by **CERT-In and Maharashtra authorities**, demonstrated the vulnerability of urban infrastructure to cyber disruption.
- Ransomware and financial cyber crimes:** Cyber criminals deploy ransomware, phishing, and malware to extort funds and disrupt financial systems, affecting economic confidence.  
**Eg: Ransomware attacks on Indian hospitals, municipal bodies, and MSMEs**, documented in **CERT-In Annual Reports**, exposed weaknesses in cyber hygiene and patch management.
- Supply-chain and software vulnerabilities:** Dependence on imported hardware, software, and cloud services introduces hidden vulnerabilities exploitable by malicious actors.  
**Eg: Global concerns flagged by the World Economic Forum on software supply-chain attacks**, increasingly reflected in **Indian cyber security advisories**, underline risks embedded deep within digital ecosystems.

### Challenges in attribution and deterrence

- Technical difficulty in attribution:** Use of spoofed IPs, proxy servers, botnets, and compromised third-party systems makes precise identification of attackers extremely complex.  
**Eg: CERT-In technical assessments and NATO cyber doctrine studies** note that technical attribution rarely provides courtroom-level certainty.
- Plausible deniability by state actors:** States often operate through non-state proxies or criminal groups, avoiding direct accountability under international law.  
**Eg: UN Group of Governmental Experts (GGE) reports** acknowledge that state responsibility in cyberspace remains difficult to legally establish.
- Absence of enforceable international norms:** Existing global cyber norms are voluntary and lack binding enforcement mechanisms, weakening deterrence.  
**Eg: UN GGE and Open-Ended Working Group (OEWG) frameworks** provide normative guidance but no sanctioning authority.
- Asymmetry between offence and defence:** Cyber attacks are low-cost and scalable, while defence demands continuous investment in skills, infrastructure, and coordination.

**Eg: MeitY discussions on the National Cyber Security Strategy** highlight persistent capability gaps vis-à-vis rapidly evolving attack techniques.

5. **Legal and proportionality constraints:** Democratic states face constitutional and legal limits on retaliatory cyber actions, constraining credible deterrence.

**Eg: Article 21 jurisprudence under Justice K.S. Puttaswamy (2017)** mandates legality, necessity, and proportionality in all state cyber actions.

### Measures to enhance national cyber security

1. **Strengthening institutional coordination:** Effective cyber defence requires seamless coordination between CERT-In, sectoral CERTs, NCIIPC, defence cyber agencies, and states.

**Eg: National Critical Information Infrastructure Protection Centre (NCIIPC)**, created under **Section 70A of the IT Act, 2000**, focuses on safeguarding strategic digital assets.

2. **Upgrading legal and regulatory frameworks:** Cyber laws must be updated to address emerging threats while preserving constitutional rights and due process.

**Eg: IT Act, 2000 read with CERT-In Directions (2022)** strengthens incident reporting while remaining subject to constitutional scrutiny.

3. **Human capital and cyber skill development:** Building a skilled cyber workforce is essential for threat detection, response, and resilience.

**Eg: National Cyber Security Policy initiatives and capacity-building programmes under MeitY**, aligned with **NASSCOM skill frameworks**, aim to bridge talent gaps.

4. **Public-private partnership in cyber defence:** Since most digital infrastructure is privately owned, collaboration with industry is critical.

**Eg: Sectoral CERTs in banking and telecom**, supported by **RBI and DoT advisories**, demonstrate shared responsibility for cyber resilience.

5. **International cooperation and norm shaping:** Cyber security is transnational and requires cooperation for intelligence sharing, capacity building, and norm development.

**Eg: India's engagement with Quad cyber initiatives, ITU frameworks, and UN cyber processes** reflects a move towards collective security.

### Conclusion

Cyber security has emerged as a foundational pillar of India's national security, economic stability, and constitutional governance. The path forward lies in resilient institutions, credible deterrence, rights-respecting laws, and sustained international cooperation in an increasingly contested cyber domain.

**Q5. Social media platforms have become force multipliers for internal security threats. Explain the features enabling this role. Discuss recent security challenges linked to them and also suggest comprehensive measures to tackle the issue. (15 M)**

### **Introduction**

The digital public sphere has collapsed the distance between speech, mobilisation and violence. In this environment, social media platforms do not merely transmit information but actively amplify, coordinate and accelerate internal security threats, turning isolated grievances into networked risks.

### **Body**

## Features of social media enabling internal security threats

1. **Algorithmic amplification and virality:** Platform algorithms prioritise engagement, often boosting sensational, polarising or misleading content that can rapidly escalate tensions and crowd behaviour.  
**Eg: Parliamentary Standing Committee on IT (2021–22)** flagged how recommendation systems amplify **fake news and hate speech**, increasing risks of mob mobilisation during sensitive law-and-order situations.
2. **Anonymity and encrypted ecosystems:** Pseudonymous accounts and end-to-end encryption reduce traceability, complicating attribution and real-time interdiction by security agencies.  
**Eg: Encrypted messaging platforms** have been repeatedly cited by **MHA annual reports** as facilitators for covert coordination by extremist and organised crime networks.
3. **Low-cost mass mobilisation and coordination:** Hashtags, live streams and closed groups enable instant mobilisation without hierarchical structures, overwhelming local security responses.  
**Eg: Real-time live streaming** during violent incidents has been used to signal locations and movements, as documented in **state police SIT reports** submitted to courts.
4. **Cross-border reach and influence operations:** Platforms allow hostile state and non-state actors to influence domestic narratives at scale, bypassing traditional gatekeepers.  
**Eg: MHA advisories** have warned of **foreign-origin disinformation campaigns** targeting internal fault lines through coordinated inauthentic behaviour.
5. **Deepfakes and synthetic media:** AI-generated audio–visual content erodes trust, enables impersonation and can trigger panic or targeted violence.  
**Eg: Election Commission of India advisories (2024)** cautioned against **AI deepfakes** distorting electoral discourse and public order, citing verified takedowns by platforms.

## Recent internal security challenges linked to social media

1. **Communal polarisation and flash violence:** Rapid spread of rumours and doctored visuals has precipitated sudden outbreaks of violence.  
**Eg: During Manipur violence (2023)**, authorities documented viral misinformation prompting **temporary internet suspensions**, later reviewed under judicially mandated proportionality standards.
2. **Online radicalisation and recruitment:** Extremist narratives exploit grievance framing and private groups to indoctrinate vulnerable users.  
**Eg: NIA charge sheets** have repeatedly cited **online propaganda and encrypted chats** in cases linked to transnational terror outfits.
3. **Cyber-enabled organised crime:** Fraud, extortion and narcotics coordination increasingly rely on social platforms for reach and anonymity.  
**Eg: NCRB Crime in India 2023** reported continued growth in **cybercrime**, with social engineering via platforms as a dominant vector.
4. **Information warfare during crises:** Disinformation during disasters and conflicts undermines state response and public trust.  
**Eg: Press Information Bureau Fact Check Unit** recorded spikes in **false advisories and panic-inducing claims** during emergencies, necessitating rapid debunking.
5. **Threats to electoral integrity:** Coordinated misinformation, micro-targeting and deepfakes threaten free and fair processes.

**Eg: ECI model code enforcement (2024)** involved coordinated takedowns with platforms for impersonation and manipulated media.

### Comprehensive measures to tackle the menace

- 1. Robust legal and regulatory enforcement:** Enforce due diligence, grievance redressal and takedown timelines under **IT Act, 2000** and **IT Rules, 2021 (amended 2023)** while ensuring safeguards.  
**Eg:** The **2023 amendments** mandate **prompt removal of unlawful content** and **platform accountability**, monitored by designated Grievance Appellate Committees.
- 2. Constitutionally balanced controls:** Any restriction must meet **Article 19(2)** tests and protect privacy under **Article 21**.  
**Eg: Shreya Singhal v. Union of India (2015)** struck down vague censorship, while **Anuradha Bhasin (2020)** laid proportionality standards for internet restrictions.
- 3. Platform design and transparency reforms:** Require risk assessments, algorithmic transparency and provenance labelling for synthetic media.  
**Eg: Global best practices** referenced by the **Standing Committee on IT** recommend **algorithmic audits** and **deepfake watermarking**.
- 4. Capacity building of security agencies:** Invest in digital forensics, OSINT, AI-assisted monitoring and inter-agency fusion centres.  
**Eg: MHA cybercrime coordination initiatives** and state **cyber labs** have improved detection and evidence quality in prosecutions.
- 5. Public resilience and media literacy:** Scale nationwide digital literacy to reduce susceptibility to misinformation.  
**Eg: MeitY and PIB fact-check campaigns** and **NCERT digital citizenship modules** aim to inoculate users against viral falsehoods.
- 6. Structured platform–state cooperation:** Institutionalise lawful data sharing, emergency escalation protocols and election-period codes.  
**Eg: ECI–platform coordination frameworks** during elections enabled rapid takedowns without blanket bans.

### **Conclusion**

Internal security in the digital age hinges on aligning platform accountability, constitutional safeguards and state capacity. A future-ready approach must hard-wire transparency, proportionality and societal resilience into the governance of social media ecosystems.

**Q. Explain why internal security threats increasingly demand anticipatory intelligence. Discuss the limitations of reactive security models. (10 M)**

### **Introduction**

Internal security threats in India have shifted from episodic violence to networked, technology-enabled and fast-moving risks. This transformation makes **anticipatory intelligence**, rather than post-incident response, the decisive determinant of prevention, deterrence and democratic stability.

### **Body**

#### Why internal security threats increasingly demand anticipatory intelligence

1. **Shift from organised hierarchies to decentralised networks:** Contemporary threats operate through loosely connected modules, making early pattern detection crucial before mobilisation and execution.  
**Eg: IS-inspired lone-actor plots in India (2022–24)** were disrupted through **pre-emptive intelligence inputs by state ATS units**, reflecting a move away from waiting for overt violence.
2. **Compression of threat timelines due to technology:** Digital platforms enable rapid radicalisation, financing and coordination, leaving minimal reaction windows once an attack phase begins.  
**Eg: Encrypted messaging platforms and online propaganda** flagged during **NIA-led investigations** enabled anticipatory arrests in **online radicalisation cases after 2021**.
3. **Blurring of internal–external security boundaries:** Cross-border linkages now fuse internal disturbances with external state and non-state actors, requiring foresight-based intelligence integration.  
**Eg: Drone-based arms and narcotics drops along the Punjab border since 2020** were intercepted through **predictive intelligence and pattern mapping**, not post-incident policing.
4. **Prevention mandate under constitutional governance:** The **Right to Life under Article 21** obligates the State to prevent foreseeable harm, not merely respond after casualties.  
**Eg: The Supreme Court in the Prakash Singh case (2006)** underlined proactive policing and intelligence-led law enforcement as part of constitutional responsibility.
5. **Escalating economic and social costs of failure:** Reactive responses address symptoms after irreversible damage to public trust, infrastructure and economic activity.  
**Eg: Sustained decline in Left-Wing Extremism after 2015** is linked to **intelligence-driven area domination and early warning mechanisms**, rather than reactive force deployment alone.

#### Limitations of reactive security models

1. **High human and collateral costs:** Reactive models intervene only after violence, resulting in avoidable civilian and personnel casualties.  
**Eg: Mumbai 26/11 attacks (2008)** exposed the catastrophic limits of response-centric security in the absence of prior actionable intelligence.
2. **Institutional overload and fatigue:** Continuous crisis response drains police and paramilitary capacity, reducing effectiveness over time.  
**Eg: Repeated law and order deployments during communal flare-ups** have shown how forces become overstretched without anticipatory threat assessment.
3. **Poor adaptability to low-visibility threats:** Reactive systems are designed for visible violence, not covert cyber, financial or informational subversion.  
**Eg: Terror financing through small-value digital transactions** often remains undetected until networks mature and operationalise.
4. **Fragmented intelligence–action linkage:** Post-incident focus weakens institutional incentives for data integration, predictive analytics and inter-agency coordination.  
**Eg: Post-incident reviews of major internal security lapses** have consistently highlighted missed early-warning signals across agencies.
5. **Erosion of public confidence:** Recurrent reactive failures create perceptions of state incapacity, indirectly strengthening hostile narratives.  
**Eg: Delayed responses despite local intelligence alerts in sporadic urban violence cases** have intensified trust deficits between citizens and the security apparatus.

## **Conclusion**

Internal security in the 21st century is won before violence manifests, not after it erupts. Embedding **anticipatory intelligence as the core of security governance** is essential to protect lives, preserve constitutional legitimacy and ensure long-term national resilience.

**Q. “Technological advancement has lowered entry barriers for internal security threats”. Analyse how emerging technologies are exploited by hostile actors. Assess India’s preparedness to counter them. (15 M)**

## **Introduction**

The rapid diffusion of digital technologies has altered the balance between state capacity and hostile actors by compressing cost, skill and scale. As a result, internal security threats today are no longer defined by size or resources, but by access to technology and speed of execution.

## **Body**

### **Technological advancement has lowered entry barriers**

1. **Democratisation of disruptive capabilities:** Advanced tools once monopolised by states are now cheaply accessible to individuals and small groups.  
**Eg: Commercial drones, encrypted messaging applications, and open-source cyber tools** are easily available to non-state actors.
2. **Reduction in skill and training thresholds:** Automation and pre-packaged software reduce dependence on specialised expertise.  
**Eg: Plug-and-play ransomware kits and AI-assisted phishing tools** enable low-skilled actors to conduct complex attacks.
3. **Anonymity and attribution evasion:** Digital technologies allow hostile actors to conceal identity, location and intent.  
**Eg: Use of VPNs, dark web platforms, and end-to-end encrypted channels** to evade surveillance and attribution.
4. **Speed and scalability of operations:** Technology enables rapid execution and mass impact without physical presence.  
**Eg: Viral misinformation campaigns** spreading nationwide within hours during sensitive law-and-order situations.
5. **Decentralised and leaderless threat structures:** Technology enables autonomous action without hierarchical command or coordination.  
**Eg: Self-radicalised lone actors** influenced by online extremist content without direct organisational control.

### **Exploitation of emerging technologies by hostile actors**

1. **Cyber attacks on critical and civilian infrastructure:** Digital systems are targeted to disrupt essential services and induce panic.  
**Eg: Ransomware attacks on hospitals, power utilities and municipal systems,** affecting service delivery and public trust.
2. **Social media driven radicalisation and misinformation:** Platforms are exploited to amplify extremist narratives and communal polarisation.

**Eg: Coordinated disinformation campaigns** during communal tensions using fake accounts and algorithmic amplification.

3. **Drone-enabled cross-border and internal operations:** Unmanned systems are used for surveillance, delivery and reconnaissance.

**Eg: Drone-based smuggling of arms, ammunition and narcotics** along sensitive border regions.

4. **Misuse of digital financial systems:** Technology enables covert movement and laundering of funds.

**Eg: Layered digital wallets and cryptocurrency transactions** used to obscure terror financing trails.

5. **Artificial intelligence based deception and fraud:** AI tools enhance realism and scale of impersonation and manipulation.

**Eg: Deepfake-based impersonation scams** targeting officials and institutions to extract information or funds.

### Assessment of India's preparedness to counter such threats

1. **Evolving legal and regulatory framework:** India has adapted laws and rules to address technology-enabled threats, though enforcement remains uneven.

**Eg: Mandatory cyber incident reporting norms** and enhanced digital platform compliance requirements.

2. **Dedicated institutional mechanisms:** Specialised bodies have been created to address cyber and technology-driven crimes.

**Eg: National-level cyber coordination and cybercrime response structures** supporting states and central agencies.

3. **Improved Centre–State coordination:** Digital platforms enable faster information sharing, but capacity varies across states.

**Eg: Centralised cybercrime reporting portals** assisting real-time case registration and inter-agency coordination.

4. **Human resource and skill gaps:** Rapid technological change has outpaced availability of trained investigators and analysts.

**Eg: Shortage of cyber forensic experts and AI-trained personnel** in state police forces.

5. **Preventive and awareness initiatives:** Efforts are underway to improve digital hygiene, though outreach remains limited.

**Eg: Capacity-building and cyber awareness programmes** for officials and citizens to reduce vulnerability.

### Conclusion

As emerging technologies continue to outpace institutional adaptation, India's internal security resilience will depend on anticipatory governance, continuous skill upgradation and deeper coordination across agencies. The challenge lies in ensuring that technological openness strengthens national security rather than eroding it.

## Security challenges and their management in border areas - linkages of organized crime with terrorism.

### Various Security forces and agencies and their mandate.

**Q. Discuss the mandate of specialised security forces involved in internal security management. Examine coordination challenges among them. (10 M)**

#### Introduction

Internal security management in India rests on a layered architecture of **specialised central armed police forces and elite units**, operating within a federal constitutional framework. Their effectiveness increasingly depends not only on mandate clarity but also on **inter-agency coordination** in complex, multi-domain threats.

#### Body

##### Mandate of specialised security forces involved in internal security management

- 1. CRPF and internal law-and-order support:** Central Reserve Police Force (CRPF) is the primary force for maintaining internal security and assisting states during serious law-and-order disturbances.  
**Eg:** CRPF-led operations under the Unified Command in Left Wing Extremism areas, as highlighted in MHA Annual Report 2023-24, show its central role in counter-insurgency support.
- 2. BSF and border-linked internal security:** Border Security Force (BSF) guards international borders and prevents infiltration, which has direct internal security implications.  
**Eg:** BSF's counter-infiltration grid along the India-Pakistan border, cited in MHA data, curbs cross-border terrorism with internal spillover effects.
- 3. ITBP and frontier stability:** Indo-Tibetan Border Police (ITBP) ensures security along the India-China border and assists civil administration in high-altitude internal contingencies.  
**Eg:** ITBP deployment for internal security support in border districts of Ladakh, reported in MHA 2022-23, reflects its dual external-internal mandate.
- 4. CISF and critical infrastructure security:** Central Industrial Security Force (CISF) protects critical infrastructure whose disruption can threaten internal security.  
**Eg:** CISF security cover to airports and nuclear installations, noted in MHA and CISF official releases, prevents high-impact internal security incidents.
- 5. NSG and counter-terror response:** National Security Guard (NSG) is a specialised force for counter-terrorism and hostage rescue in extreme internal security situations.  
**Eg:** NSG's role in urban counter-terror preparedness drills, referenced in MHA advisories, demonstrates its niche rapid-response mandate.

##### Coordination challenges among specialised security forces

- 1. Federal division of powers:** Police and public order under State List (Schedule VII, Article 246) often leads to operational friction between state police and central forces.  
**Eg:** Second Administrative Reforms Commission noted coordination gaps during central force deployment in states.

2. **Overlapping operational jurisdictions:** Multiple forces operate in the same theatre with differing command structures, creating role ambiguity.  
**Eg: CRPF and state police overlap in LWE districts**, flagged by the **MHA Standing Committee on Home Affairs (2023)**.
3. **Intelligence sharing deficits:** Fragmented intelligence flows weaken timely and coordinated response.  
**Eg: Kargil Review Committee (1999)** emphasised institutionalised intelligence coordination, a concern still echoed in internal security assessments.
4. **Divergent training doctrines:** Differences in training standards and operational culture reduce interoperability.  
**Eg: Padmanabhaiah Committee on Police Reforms (2000)** highlighted the need for common training frameworks for joint operations.

### **Conclusion**

While specialised security forces provide depth and flexibility to India's internal security framework, **effective coordination within the constitutional federal structure** remains the decisive factor. Strengthening institutional integration, joint command mechanisms, and intelligence sharing is essential for future-ready internal security governance.