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DAILY ANSWER WRITING FOR
UPSC MAINS - 2025

GS 3

COMPILATION

Topics Covered

- Economics
- Agriculture
- Science & Technology
- Environment & Disaster Management
- Internal Security.

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Hope you're all doing well and staying on track. If you're writing Mains this year, please fill in the form linked below.

Like in previous years, we'll be providing solid support throughout this Mains phase — 1:1 Mentorship, Theme-Based Classes, Quick & Detailed Answer Evaluation, Ethics and Essay guidance and high-quality Value Addition materials (QnA-style notes, data banks, keyword docs, etc.)

A separate Telegram group would be formed for this purpose.

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DAY-22

Q.1) India's economy has been growing, but enough jobs aren't being created. What are the main reasons for this jobless growth, and how can it be addressed? (150 words, 10 marks)

Introduction

India's GDP grew at **7.2%** in 2022–23 and **8.2%** in 2023–24 **(MoSPI)**, yet unemployment remains high at **6.6% (PLFS, July 2024)**. With employment elasticity falling below 0.1, India faces a clear challenge of jobless growth.

Body

Key Reasons for Jobless Growth

1. **Capital-Intensive Growth Model**: Industries prefer automation over labour absorption.
2. **Low Manufacturing Share**: Employment fell from **51 mn** (2016–17) to **27.6 mn** (2020–21) (CMIE).
3. **Informal Sector Dominance**: Over **90%** of employment is informal (**Arjun Sengupta** Committee), leading to low-quality, insecure jobs.
4. **Skill Mismatch**: Fewer than **50%** of graduates are employable (**India Skills Report, 2023**).
5. **Technological Disruption**: **WEF's *Future of Jobs Report 2023*** estimates **69%** jobs in India face automation risk.
6. **Agrarian Overdependence & Low Female LFPR**: High disguised unemployment and care burdens.
7. **Lack of Credible Labour Data**: Prior to **PLFS (2017–18)**, estimates were irregular, hampering policy design.
8. **Pre-LPG Legacy & Service Sector Bias**: Earlier protectionist policies and post-1991 services-led growth failed to generate wide employment.

Solutions to the Problem of Jobless Growth

1. **Promote Labour-Intensive Sectors**: Focus on textiles, tourism, construction for mass employment.
2. **Modernise Skilling**: Align education with market needs—AI, robotics, data skills—as recommended by the **National Skill Development Corporation (NSDC)** and reflected in the **India Skills Report (2023)**.
3. **Ease of Doing Business for MSMEs**: Improve contract enforcement, credit access, tax incentives.
4. **Expand Urban Employment Schemes**: As suggested by ***Azim Premji University***'*s Urban Employment Guarantee Report* (2020).
5. **Accelerate Labour Law Reforms**: Implement the four labour codes uniformly to balance flexibility with worker security.
6. **Reform SEZs for Employment Generation**: Adopt the ***Baba Kalyani Committee's*** *3Es framework*—Employment, Economic activity, and Exports—for next-gen SEZs.
7. **Production Incentives with Job Linkage**: Align PLI with employment mandates and extend it to labour-intensive sectors.
8. **Implement New National Manufacturing Policy**: Target creation of **100 million jobs** and raise manufacturing share in GDP.

Steps Taken by the Government

1. **PMKVY & Skill India Mission**: Over **55 million** trained via **100,000+ centres (NSDC)**.
2. **NEP 2020**: Introduces skill-based curricula and vocational training in schools.

3. **PLI Scheme & Gati Shakti**: Incentivise manufacturing, infrastructure, and logistics sector employment.
4. **Skill India Digital Platform *(Union Budget 2024–25)***: Aims to train youth in emerging tech fields.
5. **Periodic Labour Force Survey (PLFS)**: Institutionalises regular employment data collection.
6. **Cabinet Committee on Employment & Economic Growth**: Coordinates multi-sector job creation efforts.

Conclusion

As emphasised by the **Economic Survey 2022–23,** sustainable job creation demands aligning growth with employment through sectoral diversification, manufacturing push, and skilling—ensuring India's **demographic dividend** translates into inclusive prosperity.

Q.2) NITI Aayog was established nearly a decade ago to promote cooperative federalism and long-term policy thinking. To what extent has it fulfilled its objectives? What challenges has it faced, and what reforms are needed to enhance its effectiveness? (150 words, 10 Marks)

Introduction

Established in **2015**, NITI Aayog replaced the Planning Commission as a **policy think tank** to foster **cooperative federalism** and long-term strategic planning, steering India toward evidence-based policymaking and **bottom-up development**.

Body

Core Objectives of NITI Aayog

1. **Inclusive Development**: Ensure equitable growth with a special focus on sections at risk of being left behind.
2. **Bottom-Up Planning**: Enable village-level credible plans through robust data and analysis.
3. **Cooperative Federalism**: Act as the **Team India Hub**—facilitating Centre–state collaboration and inter-sectoral coordination.
4. **Innovation & Entrepreneurship**: Promote an ecosystem that encourages innovation, enterprise, and tech upgrades.
5. **Knowledge Repository & Capacity Building**: Serve as a resource centre offering policy research and technical capacity enhancement.

Performance and Achievements

1. **Regional Equity**: **Aspirational Districts Programme** improved key indicators like health, education, and infrastructure in **112** backward districts.
2. **Federalism in Action**: Functioned as a **Team India Hub**, encouraging cooperative federalism through the Governing Council and promoting competitive federalism via state indices and rankings.
3. **Tech Foresight**: Formulated **strategies on AI, blockchain**, and **gig economy**, aligning India with global tech trends.
4. **Mission-Driven Innovation**: Led initiatives like **Atal Innovation Mission**, National Electric Mobility Mission, and One District One Product to boost entrepreneurship and local manufacturing.

5. **Crisis Coordination**: Acted as a nodal agency during **COVID-19**, ensuring Centre–state collaboration on supply chains and public health.
6. **Knowledge Reports**: Published evidence-based reports like **Strategy for New India @75**, Export Preparedness Index, and India Energy Outlook, guiding ministries and states on sectoral reforms and global competitiveness.

Key Challenges

1. **Lacks Fiscal Autonomy**: Without authority under **Article 275(1)**, it cannot allocate funds or grants to states.
2. **Limited Enforcement Power**: Lacks statutory backing; even flagship recommendations (e.g., Health Index reforms) are not binding.
3. **Centre–State Discontent**: States like **West Bengal and Punjab** have skipped meetings, citing over-centralisation and poor follow-up.
4. **Governance Gaps**: Only four Governing Council meetings were held in the first six years, reducing real-time consensus building.
5. **Exclusion from Inclusive Growth**: Despite focus on equity, lacks targeted strategies to reduce rising inequality (**Oxfam**: top **10%** own **77%** of wealth, **2023**).
6. **Uncritical of Government Policies**: Functions more as a platform for affirming government schemes rather than offering independent critique.

What Needs to Be Done

1. **Statutory & Fiscal Empowerment**: As the **15th Finance Commission** recommended, evolve into an institution with budget and grant authority.
2. **Strengthen Bottom-Up Planning**: Integrate Gram Panchayat data, enabling truly democratic development models.
3. **Boost Think Tank Capacity**: Attract domain experts, improve policy feedback loops, and align with ARC-II's call for inclusive governance.
4. **Implement NITI 2.0 Vision (Vijay Kelkar Recommendations)**:
   - **Rename NITI Aayog** as the Strategic and Knowledge Commission of India.
   - Empower it to **allocate capital and revenue grants** to states.
   - Allocate **1.5–2% of GDP** as dedicated funding.
   - Make Vice-Chair a **standing invitee to CCEA** for stronger Centre–state policy linkages.
   - Retain its **strategic role** but delink it from approving **annual state financial expenditure**.

Conclusion

NITI Aayog has laid the groundwork for a **21st-century governance** model. Empowering it with fiscal authority, deeper federal engagement, and strategic autonomy—as suggested by **Vijay Kelkar**—can make it India's true engine of transformation.

Q.3) What is capital expenditure? How is it being increasingly prioritized in recent Union Budgets? Discuss its implications for economic growth and employment in India. (150 words, 10 marks)

Introduction

Capital expenditure (Capex) refers to government spending on **long-term productive assets** like infrastructure and machinery. **Budget 2024–25** allocated **₹11.11 lakh crore** to Capex—a **16.9%** increase over FY24—underscoring its growing policy significance.

Body

Components of Capital Expenditure

1. Capital expenditure (Capex) is the money spent by the government on the development of machinery, equipment, building, health facilities, education, etc.
2. Capital expenditure includes money spent on the following:
   - Acquiring fixed and intangible assets
   - Upgrading an existing asset
   - Repairing an existing asset
   - Repayment of loan
3. Different from **revenue expenditure**, which includes recurring costs like salaries and subsidies and does not result in asset creation.

Prioritization of Capital Expenditure in Recent Budgets

1. **Rising Share in Total Expenditure:** Capex formed **19.2%** of government expenditure in FY25, up from **12.3%** in FY20. ***(Union Budget 2025)***
2. **Sustained Rapid Growth Trend:** Capex has grown at a **CAGR of 23%** from FY21 to FY25, outpacing revenue spending. ***(PRS data)***
3. **Strengthened Through Flagship Schemes:** Programs like **NIP**, **PM Gati Shakti**, and **PLI** are actively driving connectivity and industrial competitiveness.

Reasons for Emphasis on Capital Expenditure

1. **Crowds in Private Investment:** Public infrastructure lowers risks and attracts private investment into industrial and logistics zones.
   Example: Expressways, **multimodal parks** encourage private logistics and manufacturing clusters.
2. **Generates Large-Scale Employment:** Capex projects absorb both skilled and unskilled labour in multiple sectors.
   Example: Metro, **Bharatmala** and PMAY projects support lakhs of jobs.
3. **Promotes Inclusive Development:** Improves rural and backward region access to services, markets, and employment.
   Example: **PMGSY** improved rural market linkages and mobility.
4. **High Multiplier Effect:** Capital expenditure yields higher returns than revenue spending.
   Example: **NIPFP** estimates Capex multiplier at **₹2.25** in the same year and **₹4.80** over time, vs **₹0.98** for revenue spending.
5. **Acts as a Macroeconomic Stabiliser:** Capital expenditure helps drive **countercyclical fiscal stimulus**, especially during slowdowns.

Suggestions to Enhance Capex Impact

1. **Strengthen Monitoring and Coordination:** Use **PM Gati Shakti** for real-time project tracking and bottleneck resolution. ***(15th Finance Commission)***
2. **Empower States to Scale Up Capex:** Continue **50-year interest-free loans** for state capital projects. ***(Economic Survey 2023–24)***
3. **Balance Physical with Social Infrastructure:** Invest not just in roads and railways but also in health, education, and digital inclusion.
   Example: **South Korea's** balanced approach boosted long-term productivity.

4. **Encourage Private Capital Expenditure:** Improve ease of doing business, clearances, and financing options to stimulate private infra investment. **Economic Survey 2022–23** highlighted its importance for long-term growth.

Conclusion

Well-targeted capital expenditure can reshape India's growth trajectory—creating jobs, attracting investment, and improving infrastructure. As seen in **East Asia, Capex-led development** holds the potential to build a resilient, inclusive economy.

Q.4) Inclusive growth remains a key concern for India's development agenda. How can digital inclusion contribute to making growth more broad-based and equitable? Discuss the key challenges to digital inclusion and suggest measures to overcome them. (250 words, 15 marks)

Introduction

According to the **OECD**, *inclusive growth* is economic growth that creates **opportunities** for all and distributes the **dividends** fairly. In India, **digital inclusion** is key to bridging gaps and enabling broader, equitable participation in development.

Body

Inclusive Growth Remains a Key Concern in India

1. **High Income Inequality**: The top **10%** hold over **57%** of national income; the bottom **50%** get only 1**3%**. ***(World Inequality Report, 2022)***
2. **Rural–Urban Disparities**: Rural India, home to **65%** of the population, lags in infrastructure, investment, and opportunity.
3. **Low Digital Access**: Only **23.8%** of households had internet access in **2017–18**, with wide gender and regional gaps. ***(NSSO)***
4. **Jobless Growth**: Growth hasn't translated into proportional employment; youth unemployment remains high. ***(CMIE)***

Digital Inclusion's Contribution to Inclusive Growth

1. **Improved Access to Public Services**: Digitisation ensures targeted, efficient service delivery and reduces corruption.
   Example: **DBTs** through **JAM trinity** have improved welfare outcomes in rural India.
2. **Expansion of Education and Skilling**: Digital platforms democratise access to quality content, enhancing learning outcomes.
   Example: Initiatives like **DIKSHA** and **SWAYAM** enable remote learning across regions.
3. **Financial Empowerment and Inclusion**: Digital tools bring the unbanked into the formal financial system.
   Example: **UPI** and Jan Dhan-Aadhaar-Mobile platforms boost access for vendors and women.
4. **Market Linkages for Farmers and MSMEs**: Tech platforms help producers reach wider markets and get fair prices.
   Example: **eNAM** and **Agri-stack** reduce dependence on middlemen and improve income.
5. **Job Creation and Entrepreneurship Opportunities**: Digital ecosystems open up new livelihood streams and MSME growth.
   Example: Platforms like **ONDC** and **GeM** empower local entrepreneurs and gig workers.

Key Challenges to Digital Inclusion in India

1. **Rural–Urban Divide**: Rural internet penetration is just **37%** compared to **69%** in urban areas. ***(TRAI, 2022)***
2. **Affordability**: Devices and mobile data remain unaffordable for many low-income users. ***(Alliance for Affordable Internet)***
3. **Low Digital Literacy**: Only **20%** of the population can perform basic digital tasks. ***(NSO, 2021)***
4. **Gender Gap**: Women are **23%** less likely to own a mobile phone than men. ***(GSMA, 2022)***
5. **Weak Infrastructure**: Many regions still lack reliable internet and last-mile connectivity. ***(Parliamentary Standing Committee on IT, 2022)***

Measures to Overcome Challenges

1. **Expand Rural Connectivity**: Fast-track **BharatNet** Phase II to cover all Gram Panchayats.
2. **Make Devices and Data Affordable**: Strengthen **PM-WANI** and **USOF** to lower access costs, as recommended by the Parliamentary **Standing Committee on IT**.
3. **Boost Digital Literacy**: Expand and upgrade **PMGDISHA** with localised content and better tracking, per the **NITI Aayog Digital Strategy**.
4. **Bridge Gender Divide**: Implement NITI Aayog's Women Entrepreneurship Platform suggestions for equitable access.
5. **Foster Public-Private Partnerships**: Leverage **CSR funds** and tech firms for digital skilling and service delivery, supported by the **MeitY–NASSCOM Digital Skills Taskforce**.

Conclusion

Inclusive growth is vital to meeting **SDGs** and national goals. **Digital inclusion** enables access, reduces inequality, and ensures every citizen contributes to and benefits from India's developmental journey.

Q.5) The Union Budget has highlighted asset monetization as a key strategy to raise funds for infrastructure. What are the benefits and challenges of this approach? Suggest measures to improve its effectiveness. (250 words, 15 marks)

Introduction

Asset monetization refers to **unlocking the value** of public sector assets by leasing or transferring rights to private players for a fixed period. The **Union Budget 2024–25** reiterated its importance to mobilize resources for infrastructure development.

Body

Process of Asset Monetisation

- AM involves the **license/lease of a government-owned asset** to a private sector entity for a specific period.
- The transfer of rights in exchange for payments is governed by a **concession agreement** that facilitates balanced risk-sharing between the public authority and the private party.

Benefits of Asset Monetization

1. **Revenue Generation**: Unlocks capital tied in under-utilized public assets. *Example:* **NHAI** monetized over **1,700 km** of highways via **TOT** and **InvIT**, raising **₹26,366** crore. ***(Budget 2024–25)***

2. **Efficient Asset Utilization**: Private sector improves operational and financial efficiency. *Example:* Airports leased to private entities witnessed enhanced passenger services.
3. **Funding Infrastructure Without Debt**: Generates non-debt capital receipts. *Example:* **₹1.8 lakh crore** target under National Monetisation Pipeline **(NMP)** over **FY22–25**.
4. **Job Creation & Economic Boost**: Enhances logistics and industrial activity. *Example:* Monetization of **DFC corridors** can promote warehousing and logistics hubs.
5. **Public Asset Management**: Ensures transparent valuation, use, and maintenance. *Example:* Use of **InvITs** for transparency in power transmission monetization. ***(Budget 2024–25)***

Key Challenges to Asset Monetization in India

1. **Valuation Difficulties**: Inaccurate valuation discourages private interest. ***(CAG Report, 2021)***
2. **Regulatory and Policy Uncertainty**: Inconsistent policies reduce investor confidence.
3. **Public Opposition and Perception Issues**: Seen as backdoor privatization. ***(Economic Survey 2021–22)***
4. **Execution Bottlenecks**: Delays due to land, clearance, and coordination issues. *Example:* **Railways and Telecom departments** have struggled to meet monetization targets due to operational hurdles.

Recent Government Steps to Promote Monetization

- **National Monetization Pipeline (2021)**: **₹6 lakh crore** target across sectors by **FY26**.
- **Expansion of InvITs/REITs**: Used for highways, grids, and public housing; **Budget 2024–25** proposes widening their use.
- **Monetisation Dashboard**: Established in **Budget 2021–22** to monitor and coordinate NMP implementation.

Measures to Improve Effectiveness

1. **Transparent Valuation and Bidding**: Use independent agencies and digital auctions. *Example:* **NITI Aayog** recommends **uniform valuation norms** for core assets.
2. **Improved Risk-Sharing Models**: Draft clear concession agreements to balance risks. *Example:* **Kelkar Committee on PPPs** emphasized fair contractual frameworks.
3. **Stakeholder Engagement**: Sensitize public to distinguish monetization from privatization. *Example:* Awareness drives included in **NMP** communication strategy.
4. **Capacity Building in Departments**: Train ministries for asset mapping and pipeline creation. (Suggested in **Economic Survey 2021–22**).
5. **Private Sector Participation**: Encourage PPP models with long-term incentives. *The* **15th Finance Commission** recommended **crowding-in** private capital.

Conclusion

Asset monetization helps the government **raise funds** without increasing borrowing. It frees up resources for new projects and supports India's goal of becoming a **$5 trillion economy** while also contributing to **SDG 9** and **SDG 11**.

DAY-23

Q.1) How has the Pradhan Mantri Krishi Sinchayee Yojana promoted the adoption of micro-irrigation in India? Examine its role in improving water-use efficiency in agriculture. (150 words, 10 marks)

Introduction

Pradhan Mantri Krishi Sinchayee Yojana (PMKSY), launched in **2015**, is a centrally sponsored scheme that promotes **irrigation efficiency** and coverage through convergence of resources under **"Har Khet Ko Pani"** and **"More Crop Per Drop"**.

Body

Features of PMKSY

1. **Funding Pattern:** Centre–State share of **75:25** (**90:10** for NE and hill states).
2. **Major Components:** AIBP, Har Khet Ko Pani (HKKP), and Watershed Development.
3. **Amalgamated Approach:** Consolidates AIBP, IWMP, and On-Farm Water Management.
4. **Digital Monitoring:** Mobile app launched in **2020** for geo-tagging of project components.
5. **Farmer Inclusivity:** Aims to benefit **22 lakh farmers**, including SC and ST communities.

Role in Promoting Micro-Irrigation

1. **Incentivising Adoption:** PMKSY gives financial and technical help for drip and sprinkler systems, which helped bring over **72 lakh hectares** under micro-irrigation till **2023**.
2. **Convergence of Resources:** Micro-irrigation is supported through **district-level planning** linked to watershed projects under PMKSY.
3. **Enhancing Infrastructure:** PMKSY builds ponds, repairs canals and water bodies that make it easier for farmers to adopt micro-irrigation systems.
4. **Farmer Training and Awareness:** PMKSY trains farmers in **water-saving methods** using KVKs and on-field support, especially under the **Command Area Development program**.
5. **Precision Technology Promotion:** **NABARD's Micro Irrigation Fund** under PMKSY supports modern tools like sensors and timers for water-efficient farming.

Role in Improving Water-Use Efficiency

1. **Reduced Water Wastage:** Drip and sprinkler systems reduce runoff and water loss; in **Maharashtra**, sugarcane farms saved up to **40%** water.
2. **Enhanced Crop Yield:** Efficient watering under micro-irrigation raised crop yields by **20–25%** in states like **Karnataka**.
3. **Groundwater Recharge:** Structures like **check dams** and trenches under PMKSY help refill groundwater.
4. **Drought Resilience:** Micro-irrigation ensures crops survive dry spells, seen in drought-hit regions like **Vidarbha and Marathwada**.
5. **Urban Wastewater Reuse: Ministry of Jal Shakti** has created a framework for using treated wastewater in farming, though no PMKSY project has used it yet.

Challenges

1. **Implementation Gaps:** Delays at the **state level** in planning and using funds.
2. **Limited Awareness:** Many farmers, especially in **dry areas**, are still unaware of micro-irrigation benefits.

3. **Monitoring Shortfalls: Ministry of Jal Shakti (2023)** reported that **some states** missed targets due to **weak coordination**.

Way Forward

1. **Expand NABARD's Micro Irrigation Fund:** Make it easier for small farmers to access funds.
2. **Mandate Micro-Irrigation for Select Crops:** Promote drip and sprinkler use for water-heavy crops in dry areas.
3. **Swaminathan Commission:** Increase public spending on water projects and improve groundwater recharge.
4. **Dalwai Committee:** Focus on efficient irrigation and make micro-irrigation a core policy.

Conclusion

PMKSY has laid the foundation for **sustainable irrigation** and efficient water use, contributing significantly to the goal of **sustainable agriculture** and the achievement of **SDG-6** in India.

Q.2) Agricultural marketing in India faces structural challenges. How far has the e-NAM platform addressed these issues? Highlight its achievements and limitations. (150 words, 10 marks)

Introduction

Agricultural marketing includes **all activities that facilitate the movement of farm produce from producers to consumers**. In India, agriculture marketing faces several hurdles. The **e-NAM** platform, launched in **2016**, seeks to address these challenges digitally.

Body

Structural Challenges in Agricultural Marketing

1. **Fragmented Market Access:** Farmers sell mostly in local mandis, limiting price discovery; the **Dalwai Committee** noted this restricts competitive pricing.
2. **APMC Restrictions:** Interstate trade and private markets are limited due to state laws; the **2013 Agri Marketing Reforms Committee** flagged this as a major barrier.
3. **Middlemen Dominance:** Agents decide prices and extract commissions; **the Shanta Kumar Committee** highlighted their negative impact on farmer profits.
4. **Poor Infrastructure:** Many mandis lack storage, weighing and grading; **NITI Aayog** stressed modern infrastructure for better marketing.
5. **Low Digital Literacy:** Many farmers don't know how to use digital platforms; the CMs' Sub-Group (2015) pushed for digital training.
6. **Inadequate Market Information:** Real-time data on prices and buyers is missing; the DFI Committee (2017) recommended better ICT tools.

Key Features of e-NAM

1. **Online Trading Platform:** Connects APMC mandis for transparent online bidding and trading.
2. **Unified Licensing System:** Enables one license to trade in multiple mandis.

3. **Quality Assaying and Logistics Support:** Offers digital weighing, grading, and payment facilities.

How e-NAM Addresses Structural Issues

1. **Expands Market Reach:** Lets farmers sell across mandis and states, as supported by the **Dalwai Committee** for price discovery.
2. **Reduces Role of Middlemen:** Direct farmer-trader links improve prices, in line with **Shanta Kumar panel's** recommendations.
3. **Improves Transparency:** Real-time price updates and online payments reduce manipulation.
4. **Boosts Infrastructure Use:** Promotes grading, assaying, and better logistics through digital tools.

Achievements of e-NAM

1. **Wider Integration:** Over **1,300** mandis and **1.75 crore** farmers onboarded by **2023**.
2. **Digital Payment Push:** Nearly **65%** of trades settled through online payments.
3. **Increased Price Realisation:** Farmers report **15–20%** higher returns in e-NAM mandis.

Limitations of e-NAM

1. **Partial State Participation:** Some states haven't reformed APMC laws fully for e-NAM rollout.
2. **Inadequate Infrastructure:** Many mandis still lack labs, internet, and trained staff.
3. **Low Farmer Usage:** Many farmers prefer old methods due to habit and lack of trust.

Way Forward

1. **Full APMC Reform:** States must amend laws to allow open trade, as advised by the **Model APMC Act** and **Dalwai Committee**.
2. **Farmer Training and Incentives:** Improve awareness and reward digital platform use.
3. **PPP in Mandi Infrastructure:** Private investment should improve logistics and quality checks, as **NITI Aayog** suggests.

Conclusion

While **e-NAM** has improved **transparency and market access**, structural reforms like the now-repealed **farm laws are essential** to make agricultural marketing truly farmer-centric and future-ready.

Q.3) How can digitisation and e-technology transform Indian agriculture? Discuss their role in enhancing farmers' income along with key challenges and recent initiatives. (150 words, 10 marks)

Introduction

Digital agriculture, as per **FAO**, uses digital technologies to **enhance productivity** and **sustainability**. The **WEF** highlights its potential to double farmer incomes. In India, it can transform agriculture through efficiency, better access, and resilience.

Body

Role in Enhancing Farmers' Income through Digitisation and E-Technology

1. **Input Optimisation:** Technologies like **AI and IoT** help farmers use fertilizers, water, and seeds efficiently, reducing costs and increasing returns.
   Example: AI-based sowing advisory systems by **Microsoft and ICRISAT**.
2. **Precision Farming:** Satellite imagery, GIS, and drone monitoring allow for timely interventions and improved crop health.
   Example: **YES-TECH system** for yield estimation at Gram Panchayat level.
3. **Better Access to Credit and Insurance:** Digital platforms integrate farmer databases with banks and insurance providers for faster services.
   Example: **Kisan Rin Portal** ensures streamlined loan and subsidy tracking.
4. **Improved Market Linkages:** Platforms like **e-NAM** help farmers get better prices through wider reach and transparency.
5. **Climate Resilience:** Real-time weather data and early warnings help farmers adapt quickly to weather shocks.
   Example: **WINDS system** provides actionable weather insights.
6. **Empowered Governance:** Frameworks like **IDEA** help create integrated databases for targeted delivery of welfare schemes.

Key Challenges in Digital Agriculture

1. **Digital Illiteracy and Fraud:** Many farmers lack digital literacy and fear online fraud, leading to hesitancy in adoption.
2. **High Initial Cost:** Advanced tools require capital investments, making them inaccessible to small and marginal farmers.
3. **Fragmented Landholdings:** Smaller farm sizes make implementation and scalability of technologies difficult.
   Note: As per **Agriculture Census**, average holding shrank from **2.28 ha (1970–71)** to **1.08 ha (2015–16)**.
4. **Nascent Agri-Tech Ecosystem:** India has **less than 1%** Agri-Tech start up penetration, limiting innovation and outreach.
5. **Infrastructural Deficits:** Rural areas often lack reliable electricity, internet, and service support systems.
6. **Poor Content Design:** Lack of local language options, simple UI, and granular farmer-level datasets reduce effectiveness.

Recent Government Initiatives

1. **Advanced Data Platforms:** Unified Portal for Agricultural Statistics **(UPAg)** enables crop and land data management.

2. **Credit and Subsidy Integration: Kisan Rin Portal (KRP)** links banks, farmers, and government for seamless service delivery.
3. **Weather Intelligence: WINDS system** provides weather-based farming advisories for better preparedness.
4. **Digital Public Infrastructure:** In the **Union Budget 2023–24**, the government announced creation of an open-source digital public infrastructure to support crop planning, credit, insurance, and market intelligence.
5. **Digital Extension Services:** National e-Governance Plan in Agriculture (**NeGP-A)** promotes ICT-based agricultural service delivery.

Way Forward

1. **Affordable and Inclusive Innovation:** Encourage plug-and-play tools and shared models for cost-effective access to technology.
2. **Capacity Building:** Train farmers in using e-tools and protect them from digital frauds through awareness campaigns.
3. **Agri-Tech Ecosystem Support:** Facilitate incubators, funding, and **PPPs** to promote scalable Agri-Tech Start-ups and regional solutions.

Conclusion

Digitisation, as reaffirmed in the **G20 Delhi Declaration**, is key to inclusive farm growth. Along with enabling policies and reforms like the repealed farm laws, digital tech can redefine Indian agriculture for the better.

Q.4) Indian agriculture faces a dual challenge of boosting productivity while ensuring sustainability. In this context, discuss the need for crop diversification and the policy support required to promote it. (250 words, 15 marks)

Introduction

India's agriculture must increase productivity while conserving natural resources. The **FAO** notes that **unsustainable practices** threaten long-term output. In this context, crop diversification offers a path toward balanced, **climate-resilient growth**.

Body

Dual Challenge of Productivity and Sustainability

1. **Stagnant Yields in Staples:** Yield gains in rice and wheat are plateauing despite input intensification. **Economic Survey (2020–21)** notes declining marginal returns in Green Revolution areas.
2. **Soil and Water Degradation:** Excessive fertilizer and water use degrades soil health and depletes groundwater.
   Example: **Punjab** reports **85%** blocks as over-exploited by **Central Ground Water Board.**
3. **Climate-Induced Losses:** Extreme weather events affect crop output and income stability.
   Case: Unseasonal rains in **Maharashtra (2023)** caused widespread crop losses in sugarcane and **soybean**.

4. **Nutritional Deficits and Dietary Imbalance:** Overproduction of cereals leads to poor dietary diversity. **NITI Aayog** advocates shift towards nutrient-dense crops to tackle hidden hunger.

Role of Crop Diversification

1. **Enhances Climate Resilience:** Millets and pulses are better suited for variable rainfall and rising temperatures.
   Case: **Odisha's millet mission** led to both income and climate benefits.
2. **Improves Soil Health and Water Use:** Legumes fix nitrogen; diversified patterns reduce groundwater dependence.
   Example: Crop rotation with **pulses in MP** restored soil fertility.
3. **Boosts Farmer Income:** Horticulture, spices, and floriculture offer better returns and export opportunities.
   Case: **Sikkim's shift to organic horticulture** increased farmer profitability.
4. **Promotes Dietary Diversity:** Diversified food baskets lead to better community nutrition. **NFHS-5** highlights improved dietary indicators in states promoting coarse grains and vegetables.

Policy Support Required

1. **Price and Procurement Reforms:** Expand MSP and assured procurement beyond rice and wheat. **Shanta Kumar Committee** suggested restructuring MSP and diversifying procurement.
2. **Agro-Climatic Zoning:** Promote location-specific crops based on land and water suitability. **CACP** urged agro-ecological zoning for better crop planning.
3. **Infrastructure and Market Linkage:** Invest in cold chains, storage, and processing for perishable high-value crops. **Agriculture Infrastructure Fund (AIF)** supports such investments.
4. **Research, Training, and Extension:** Strengthen **ICAR and KVKs** for capacity-building and farmer advisories.
   Example: **ICAR's All India Coordinated Research Projects** promote diversified cropping.
5. **Credit and Insurance Access:** Improve credit for non-traditional crops and expand PMFBY coverage.
   Case: **Odisha** included millets in **state-level insurance pilot schemes**.
6. **Awareness and Behavioural Change:** Launch mass campaigns on ecological and economic benefits of diversification. **National Mission on Sustainable Agriculture (NMSA)** promotes awareness and adoption.

Conclusion

Swaminathan envisaged an **"evergreen revolution"**—productive agriculture without ecological harm. Crop diversification, backed by strategic policies, remains essential for sustainable, resilient, and inclusive farming.

Q.5) Evaluate the key constraints in the storage and transportation of agricultural produce in India. How do these affect farmers' income, and what measures have been taken to address them? (250 words, 15 marks)

Introduction

As per **ICAR**, post-harvest losses due to **inefficient storage and transport systems** account for nearly **6-7% of total** agricultural output. These inefficiencies directly impact farmers' incomes and the nation's food security.

Body

Key Constraints in Storage and Transportation

1. **Unscientific storage:** Around **80%** of handling and warehousing facilities are not mechanized, leading to frequent spoilage and quality degradation.
2. **Limited storage capacity:** With food grain production at **311 MMT** and available storage capacity at **145 MMT**, India faces a storage deficit of **166 MMT**.
3. **Surplus buffer stock: FCI** has been maintaining food stocks well beyond the buffer norms, congesting storage infrastructure and reducing space for fresh procurement.
4. **Post-harvest losses:** Traditional storage methods fail to prevent losses due to pests, moisture, or theft, affecting both quantity and marketable quality of produce.
5. **Lack of private investment in warehousing:** Scarcity of land and regulatory hurdles deter private sector participation in modern storage infrastructure.
6. **Inadequate cold-chain and transport linkage:** Lack of reefer vans and multi-modal transport affects perishables, with **ICRISAT** estimating **20-25% loss** in horticultural produce annually.

Impact on Farmers' Income

1. **Distress sales:** Without access to reliable storage, farmers are forced to sell immediately after harvest, often at lower prices.
2. **Increased logistics cost:** Poor infrastructure increases transport costs, reducing net earnings, especially for small and marginal farmers.
3. **Quality-based price reduction:** Without cold storage or packaging, produce quality deteriorates, fetching lower prices at mandis or export hubs.
4. **Missed market opportunities:** Time-sensitive produce misses optimal market windows, affecting profitability and bargaining power.

Measures Taken

1. **Grain Storage Plan in Cooperative Sector:** The Prime Minister recently inaugurated a pilot of the **World's Largest Grain Storage Plan** for **11 PACS** across **11 states** to strengthen decentralized warehousing.
2. **Operation Greens:** Focuses on reducing price volatility of **tomato, onion, and potato** by improving cold-chain logistics and value addition.
3. **e-NAM integration with logistics:** Promotes inter-market connectivity and quality-based online trade, with better access to transport and storage service providers.
4. **PM Gati Shakti Scheme:** Develops **multi-modal infrastructure**, including agriculture-specific warehousing zones, under a digitally integrated platform.
5. **Rural Infrastructure Development Fund (RIDF):** Supports construction of storage godowns and rural roads in underdeveloped regions.
6. **Warehousing (Development and Regulation) Act, 2007:** Promotes scientific warehousing practices and negotiable warehouse receipts for formal credit access.

Committee Recommendations

1. **Shanta Kumar Committee:** Suggested **reducing buffer stock norms** and promoting **decentralized procurement** to free up storage.
2. **Dalwai Committee:** Recommended integrated cold chain development through **PPP** and **viability gap funding**.
3. **NITI Aayog Task Force:** Advocated strengthening rural logistics through digital platforms and aggregation models.

Conclusion

Adopting a **"farm-to-fork" approach**, as advocated by the **National Commission on Agriculture**, ensures sustainable agri-logistics, reduces post-harvest losses, and enhances farmer income by integrating production with efficient market access.

DAY-24

Q.1) "The demand for legal guarantee to MSP reflects deeper anxieties about market volatility and rural distress." Critically analyse the implications of legalizing MSP in India. (150 words, 10 marks)

Introduction

Minimum Support Price (MSP) is a **government-declared price** that protects farmers from market fluctuations. As noted by the **Shanta Kumar Committee**, only **6%** of farmers benefit from MSP procurement—triggering continued protests in **2020**, demanding a legal guarantee.

Body

Rationale Behind Demand for Legal MSP

1. **Market volatility and price crashes:** Non-MSP crops like pulses often sell below cost, forcing distress sales. MSP acts as a floor price against such shocks.
2. **Rising input costs:** High prices for diesel, seeds and fertilisers make farming unsustainable. A guaranteed MSP offers financial stability.
3. **Uneven procurement: FCI** procurement is concentrated in states like **Punjab**. This excludes most farmers and deepens regional disparities.
4. **Lack of income alternatives:** Schemes like **PM-KISAN** and **Rythu Bandhu** exist. But they aren't enough to counter market failures.
5. **Rural economic distress:** Events like **COVID-19** and **demonetisation** hurt rural incomes. Legal MSP could boost consumption and demand.

Arguments in favour of Legal Guarantee to MSP

1. **Income security and risk protection:** Legal MSP provides stable income. It shields farmers from climate shocks and price crashes.

2. **Rural distress alleviation:** It boosts rural purchasing power. This reduces financial vulnerability in times of crisis.
3. **Benchmark price for the market:** MSP signals a minimum price to the market. This ensures traders do not exploit farmers during gluts.
4. **Crop diversification and sustainability:** With assured returns, farmers may diversify. This could promote millets and pulses.

Arguments Against Legalising MSP

1. **Huge fiscal burden:** Universal MSP procurement may cost over **₹5 lakh crore** annually. This could worsen fiscal health.
2. **Market distortion and storage issues:** Government may be forced to procure even unwanted crops. This would worsen warehousing woes.
3. **Inflationary pressure:** Higher procurement costs could raise food inflation. This affects poor and middle-income consumers.
4. **WTO concerns and export competitiveness:** Legal MSP risks violating **WTO norms**. It may hurt India's farm exports.
5. **Demand spill over effect:** Allied sectors like **dairy** and **horticulture** may also demand MSP. This strains policy capacity.
6. **Regional imbalance in production:** Farmers may grow MSP-covered crops unsuited to their ecology. This distorts cropping patterns.
7. **Political and administrative complexity:** Enforcing legal MSP across **22+ crops** is difficult. It needs massive institutional capacity.

Way Forward

1. **Price Deficiency Payment Schemes:** As recommended by **NITI Aayog** and the **Economic Survey**, compensate for price gaps without enforcing procurement.
2. **Strengthen FPOs and cooperatives:** Empower farmer collectives to boost bargaining power and market presence.
3. **Gradual MSP crop expansion:** Widen MSP coverage gradually to ensure balance and promote diversification.
4. **Invest in market and storage infrastructure:** Build mandis, logistics, and storage to reduce distress selling.

Conclusion

Rather than blanket legalisation of MSP, a **farm-to-market approach** grounded in the **National Commission on Farmers** vision of income assurance and market support would better address rural distress sustainably.

Q.2) India's agricultural subsidy system is often criticised for being inefficient, inequitable, and fiscally unsustainable. Examine how Direct Benefit Transfer (DBT) can address these concerns while highlighting the challenges it may face in effective implementation. (150 words, 10 marks)

Introduction

India's agriculture subsidies, amounting to over **₹4 lakh crore** annually **(Budget 2024),** are riddled with leakages and misallocation. Therefore, Direct Benefit Transfer (DBT) is being increasingly promoted to offer direct subsidy, reduce inefficiencies, and empower farmers.

Body

Present Issues with Subsidy System

1. **Leakages and ghost beneficiaries: CAG (2023)** flagged fertiliser diversion to industries and ghost beneficiaries in PDS due to poor targeting.
2. **Regional and crop bias:** Subsidies are concentrated in crops like **rice and wheat** and in states like **Punjab,** skewing resource distribution.
3. **Input-based distortion:** Subsidies on fertiliser and electricity encourage overuse, harming soil health and water tables **(NITI Aayog, 2021)**.
4. **Fiscal burden and inefficiency: Economic Survey 2022** highlighted ballooning subsidy bills crowding out investment in rural infrastructure and R&D.

How DBT Can Address These Issues

1. **Targeted benefit delivery:** DBT ensures subsidies reach genuine beneficiaries, cutting down leakages and corruption in delivery.
2. **Farmer autonomy and efficiency:** Direct cash transfers give farmers flexibility to buy best-suited inputs based on local conditions.
3. **Neutral input usage:** DBT discourages overuse of fertilisers and electricity by delinking subsidy from physical input use.
4. **Administrative transparency:** Digitised DBT platforms enhance accountability through Aadhaar seeding, **GPS tagging**, and real-time tracking.

5. **WTO-compliant structure:** Direct income transfers are permissible under **WTO "green box,"** unlike price-distorting input subsidies.

Challenges in Implementation of DBT

1. **Land ownership complexity:** Majority of tenant and sharecroppers lack formal land titles, excluding them from DBT eligibility.
2. **Digital and banking divide:** In remote areas, lack of connectivity and banking access hinders timely and inclusive transfer.
3. **Resistance from stakeholders:** Fertiliser and power lobbies, along with state governments, resist DBT due to loss of control and revenue.
4. **Risk of exclusion and errors:** Issues in Aadhaar-linking or data mismatch can exclude deserving farmers and delay benefits.
5. **Price volatility exposure:** Without subsidised inputs, farmers face market fluctuations unless DBT is accompanied by other support measures.

Way Forward

1. **Update land records and include tenants:** Adopt recommendations of the **DILRMP** and **Bhoomi Project (Karnataka)** to digitise land records and include actual cultivators.
2. **Strengthen rural banking and digital access:** Follow **Jharkhand's DBT-enabled fertiliser pilot** and expand banking correspondents in remote areas.
3. **Phase-wise implementation: NITI Aayog** recommends a calibrated, region-wise DBT rollout, starting with inputs like fertilisers.
4. **Combine with advisory services:** Madhya Pradesh's **"Krishi Upaj Mandi" model** shows how advisory + income support can guide optimal farm investments.
5. **Centre–State coordination:** As per the **15th Finance Commission**, cooperative federalism is vital for effective subsidy reforms like DBT.
6. **Use DBT-linked data analytics: NITI's 2023 report** suggests leveraging DBT data for policy targeting, grievance redressal, and course correction.

Conclusion

A well-designed DBT model ensures subsidy efficiency, farmer empowerment, and fiscal prudence while aligning with **WTO rules**. It is time India transitions to this sustainable and inclusive alternative.

Q.3) Livestock rearing in India is a vital livelihood source for rural communities. Examine the economic potential and challenges of promoting animal husbandry as a sustainable livelihood option. (150 words, 10 marks)

Introduction

According to the **20th Livestock Census (2019)**, India has over **535 million livestock**, supporting millions of rural households. Leveraging this sector sustainably offers immense potential for economic security and inclusive rural growth.

Body

Livestock as a Vital Livelihood Source for Rural Communities

1. **Supplementary income and risk buffer: NSSO 77th round** show over **70%** of rural households engaged in livestock; it cushions against crop failure and seasonal unemployment.
2. **Women empowerment and inclusive growth: 70%** of livestock care is done by women **(FAO)**, giving them financial agency and decision-making power.
3. **Smallholder-friendly enterprise: 87%** of livestock farmers own less than two hectares, making it accessible and scalable for marginal farmers.
4. **Region-specific models: Amul** dairy cooperatives in Gujarat and **Kudumbashree's** goat-rearing in Kerala show successful decentralised rural livelihoods.

Economic Potential of Animal Husbandry

1. **High value output:** Livestock contributes over **30%** to the **agricultural GVA (2022-23)**, growing faster than crop sectors.
2. **Export earnings:** India is the world's largest milk producer and a top exporter of buffalo meat, earning over **$3 billion annually (APEDA)**.
3. **All-season income flow:** Unlike crops, dairy, poultry, and goatery offer daily/weekly cash flows, reducing rural credit dependency.
4. **Agro-industrial linkages:** Growth in sectors like leather, feed, cold chains, and vet services creates employment and rural industrialisation.

Challenges in Promoting Animal Husbandry

1. **Low productivity and breed quality:** India's milk yield is half of global average **(FAO, 2022)**, with limited AI and selective breeding coverage.

2. **Disease outbreaks and vet gaps:** Only **one vet per 5,000 animals** (against **WHO** norm of **1:400**), making disease control difficult.
3. **Feed and fodder shortage:** National Dairy Development Board **(NDDB)** notes a **35%** green fodder deficit and overdependence on crop residues.
4. **Climate vulnerability:** Heatwaves and floods impact livestock health, water availability, and increase disease risks in climate-sensitive zones.

Government Initiatives

1. **Rashtriya Gokul Mission:** Promotes indigenous breeds and genetic improvement through **AI** and **IVF**.
2. **Animal Husbandry Infrastructure Development Fund (AHIDF):** Encourages private investment in dairy processing and meat value chains.
3. **National Livestock Mission (NLM):** Supports entrepreneurship in poultry, sheep, and fodder cultivation.
4. **Budget 2024 allocation: ₹10,000 crore** set aside to boost livestock health infrastructure and disease surveillance.

Way Forward

1. **Breed improvement and research:** Adopt recommendations from **NITI Aayog's 2023** Livestock Sector Roadmap to enhance genetic potential and resilience.
2. **Veterinary outreach and digitisation:** Expand e-Vet services and rural mobile clinics as piloted in **Haryana and Karnataka**.
3. **Fodder and feed innovation:** Promote hydroponic fodder, dual-purpose crops, and enforce **Fodder Development Programme (2018)**.
4. **Inclusive cooperatives and FPOs:** As suggested by **Ashok Dalwai Committee**, scale up women-led dairy and poultry collectives with credit and training.

Conclusion

As per the **Ashok Dalwai Committee**, **doubling farmers' income** needs strong livestock integration. With inclusive reforms and rural investment, animal husbandry can transform into a sustainable and resilient livelihood pillar for millions.

Q.4) "The public Distribution System (PDS) is a lifeline for the poor but suffers from substantial leakages and inefficiencies." Examine the objectives, structural flaws, and digital solutions required to overhaul the PDS. (250 words, 15 marks)

Introduction

India's Public Distribution System (PDS) distributes over **60 million tonnes** of food grains annually to nearly **80 crore** people. Despite its wide reach, it remains plagued by leakages, diversion, and exclusion errors, demanding urgent systemic reforms.

Body

Objectives of the Public Distribution System

1. **Food security for the poor**: PDS ensures nutritional access for vulnerable groups, particularly under the **National Food Security Act, 2013 (NFSA)**.
2. **Price stabilisation**: Helps regulate food grain prices in the open market and curb inflation during shortages.
3. **Buffer stock management**: Supports offtake from **FCI** warehouses and helps maintain food reserves.
4. **Social justice**: Acts as a welfare mechanism by ensuring entitlement-based delivery to marginalised communities.

Structural Flaws in the PDS

1. **Leakages and diversion**: **Economic Survey 2020-21** estimated over **36%** of PDS grains do not reach beneficiaries due to pilferage and corruption.
2. **Exclusion and inclusion errors**: **NITI Aayog (2022)** noted crores of eligible poor excluded due to flawed databases; many ineligible continue to receive rations.
3. **Poor targeting and duplication**: Ghost cards, duplicate entries, and **fake beneficiaries** weaken the system's credibility and efficiency.
4. **Lack of transparency and accountability**: Manual records and weak grievance redressal foster non-transparency and reduce public trust.

Digital Solutions to Strengthen PDS

1. **Aadhaar-based authentication**: As per **UIDAI** and **Ministry of Consumer Affairs**, over **95%** of ration cards are now seeded with Aadhaar, reducing identity fraud.
2. **One Nation One Ration Card (ONORC)**: Enables portability across states; covers over **100 crore** people, aiding migrant workers.

3. **End-to-end digitisation (Annavitran Portal)**: Tracks grain movement, enabling real-time monitoring and reducing diversion at every level.
4. **ePoS machines**: Installed in over **95% FPSs**, enabling biometric verification, real-time updates, and stock transparency.

Government Initiatives

1. **NFSA, 2013**: Covers **67%** of population, ensures legal entitlement to food grains at subsidised prices.
2. **ONORC Scheme**: Launched in **2019**, ensures seamless ration portability across India.
3. **IM-PDS Project**: Strengthens interstate portability, and data sharing among states.
4. **Digitisation drive**: Under **Digital India**, most states have completed beneficiary and supply chain digitisation.

Way Forward

1. **Targeted subsidy via DBT**: Adopt pilot models from **Chandigarh** and **Puducherry**, where cash transfer for food ensures choice and efficiency.
2. **Strengthen grievance redressal**: As suggested by **Shanta Kumar Committee (2015)**, set up independent social audit units and toll-free help centres.
3. **Periodic beneficiary updating**: Regular deletion of ineligible names and inclusion drives using **Socio Economic Caste Census (SECC)** data.
4. **Integrate supply chain tech**: Use **blockchain pilots** from states like **Andhra Pradesh** to ensure tamper-proof tracking of food grains.

Conclusion

To transform PDS into a **modern, transparent, and inclusive food safety net**, digital reform must align with beneficiary empowerment. Effective use of technology and targeted delivery can convert **PDS from a leaky lifeline into a resilient system**.

Q.5) The food processing sector plays a critical role in enhancing farmer incomes and reducing post-harvest losses. Elaborate on its significance and examine the major upstream and downstream challenges in developing an efficient supply chain ecosystem. (250 words, 15 marks)

Introduction

India's food processing industry, contributing over **12% of manufacturing GDP**, is a **sunrise sector** with immense export potential. It links **farm to fork**, enhances value addition, and supports income diversification for millions of farmers.

Body

Role and Significance of Food Processing Sector

1. **Enhances farmer income:** Increases value realization through grading, packaging, and branding of produce. The **Ashok Dalwai Committee** recommends value chain strengthening for doubling farmers' income.
2. **Reduces post-harvest losses:** As per **MOFPI** and **NITI Aayog**, India loses over **₹90,000 crore** annually due to wastage; processing curtails this.
3. **Boosts employment:** According to the **Economic Survey**, the sector generates **1.77 times** more jobs per investment than general manufacturing.
4. **Promotes crop diversification:** Ensures markets for perishables like fruits and vegetables, encouraging farmers to move away from cereal-dominated patterns, as noted in the **Committee on Doubling Farmers' Income**.
5. **Enhances export competitiveness:** Processed foods help tap global markets; India's agri-exports stood at **$53 billion** in **2022–23**, with processed foods forming a growing share (**APEDA Report**).

Supply Chain Challenges in Food Processing

Upstream Challenges

1. **Fragmented farm production:** Small landholdings limit economies of scale and consistency in raw material supply, a concern raised by the **Ramesh Chand Committee** on Agricultural Marketing.
2. **Poor pre-harvest infrastructure:** Lack of cold storage at farm-gates leads to spoilage, especially for perishables.
3. **Weak farmer-industry linkages:** Limited contract farming and **FPO** involvement restrict market integration and backward linkages.

Downstream Challenges

1. **Inadequate logistics and cold chains:** Only **15%** of produce moves via cold chains; leading to nutrient and value losses (**ICRIER Report, 2023**).
2. **Regulatory bottlenecks:** Multiple food safety norms **(FSSAI)** create compliance burdens for MSMEs.
3. **Low processing levels:** India processes only **10%** of its agro-produce vs. **40–60%** in countries like China and Thailand (**MOFPI data**).

Solutions

1. **Cluster-based approach:** Adopt **Mega Food Parks** and Agro-Processing Clusters to integrate infrastructure and reduce logistic costs, as recommended by **Shanta Kumar Committee (2015)**.
2. **Strengthen farmer-FPO linkages:** Implement **Model Contract Farming Act** to ensure price assurance and steady raw material.
3. **Technology adoption:** Use **AI and blockchain** for supply chain monitoring, grading, and demand forecasting to cut waste and improve quality.
4. **Ease of business reforms:** Streamline approvals through single-window clearance and reduce **GST** on processed food items.

Government Measures

1. **PM Formalisation of Micro Food Enterprises (PM-FME): ₹10,000 crore** scheme to assist **2 lakh** units through credit and capacity building.
2. **PLI Scheme (2021): ₹10,900 crore** to incentivize branding, innovation, and global market access.
3. **Operation Greens:** Extends price stabilization and value chain support for perishables beyond tomato, onion, and potato **(TOP) crops**.
4. **Budget 2024–25 push:** Allocation for cold chain and food labs **increased by 25%**, emphasising quality exports and rural infrastructure.

Conclusion

Food processing is pivotal to making agriculture a **profitable enterprise**, as envisioned by **M.S. Swaminathan**. Building robust **farm-to-fork systems** can ensure that agriculture becomes a source of dignity, stability, and higher incomes for rural India.

DAY-25

Q.1) "MSMEs are key to employment generation and inclusive growth yet face persistent structural challenges." Discuss the major bottlenecks faced by MSMEs in India and examine the effectiveness of recent policy interventions aimed at addressing them. (150 words, 10 marks)

Introduction

MSMEs are growth engines of the Indian economy, contributing **30% to GDP**, **49% to exports**, and employing over **11 crore people** (Annual Report, Ministry of MSME, 2022–23). They are crucial for **equitable growth, grassroots entrepreneurship, and regional development**.

Body

Key to Employment Generation and Inclusive Growth

1. **Labour-Intensive Sector**: MSMEs create **four times** more jobs per unit of capital than large enterprises **(Economic Survey 2020–21)**.
2. **Geographic Spread**: Promote **balanced regional development**, especially in semi-urban and rural areas.
3. **Women and SC/ST Empowerment**: Schemes like **Stand-Up India** encourage underrepresented groups in entrepreneurship.
4. **Support to Informal Sector**: MSMEs offer livelihood to a large informal workforce, aiding in **poverty reduction and inclusion**.

Major Bottlenecks Faced by MSMEs

1. **Credit Crunch**: The credit gap is **₹25 lakh crore (IFC Report, 2018)**; banks perceive MSMEs as high-risk.
2. **Delayed Payments**: Over **₹10,000 crore** in dues remain unpaid by PSUs and large firms **(CII Report, 2022)**.
3. **Low Formalisation**: Only around **1.3 crore** MSMEs are registered under **Udyam** out of **~6 crore** total.
4. **Technology and Skill Gaps**: Outdated machinery and unskilled labour reduce global competitiveness.
5. **Prevalence of Dwarf MSMEs**: As per **Economic Survey 2018–19**, firms older than **10 years** with low productivity dominate the sector, blocking growth and job creation.

Recent Policy Interventions

1. **Emergency Credit Line Guarantee Scheme (ECLGS)**: Disbursed over **₹3.6 lakh crore** to **1.2 crore** MSMEs post-COVID.
2. **Udyam Portal**: Seamless, Aadhaar-based registration has led to over **2 crore** MSMEs being formalised **(2024)**.
3. **RAMP Scheme (2022–27)**: **₹6,000 crore World Bank**-supported initiative for productivity and export readiness.
4. **Trade Receivables Discounting System (TReDS)**: Enables quicker invoice settlement through fintech-led platforms.
5. **MSME Act Reforms**: Proposals to decriminalise minor offences and introduce **time-bound payment enforcement** aim to ease compliance and protect working capital.

Successes So Far

1. **Enhanced Formal Credit Access**: Share of institutional lending to MSMEs has increased post-**ECLGS**.
2. **Improved Registration and Data**: **Udyam** has helped build a real-time MSME database for targeted policy.
3. **Boost to Digital Adoption**: Over **1.5 lakh MSMEs** onboarded on **Government e-Marketplace (GeM)**, increasing public procurement access.
4. **Increased Participation in Exports**: MSME share in exports rose from **48.5% in 2020** to **49.5% in 2023 (DGFT data)**.

Way Forward

1. **Implement Payment Enforcement Mechanisms**: Strengthen the **SAMADHAAN portal** and introduce statutory penalties for delayed payments to MSMEs.
2. **Adopt Cluster-Based Strategy**: As per **U K Sinha Committee (2019)**, promote credit, technology, and skill development through cluster models.
3. **Improve Access to Formal Credit**: Deepen fintech-banking partnerships and expand **CGTMSE** coverage to high-risk but viable MSMEs.
4. **Upgrade Technology and Productivity**: Provide targeted incentives for **Industry 4.0** adoption and enhance tool room support in manufacturing hubs.
5. **Build Integrated Policy Architecture**: Establish a unified MSME digital platform for registration, compliance, finance, skilling, and export facilitation **(Economic Survey 2020–21)**.

Conclusion

MSMEs hold the key to sustainable and inclusive growth, but require continued reforms in **finance, regulation, and technology**. A dynamic, digitally integrated MSME ecosystem is essential for India's **$5 trillion economy** vision.

Q.2) "Public-Private Partnerships (PPP) have been promoted as a viable model to modernize Indian Railways." Evaluate the potential and limitations of PPP in railway station redevelopment and infrastructure upgradation. (150 words, 10 marks)

Introduction

Indian Railways, the **fourth-largest railway network globally**, serves over **8 billion passengers annually**. With rising capacity constraints and modernisation needs, PPP has emerged as a vital model to infuse private capital, technology, and operational efficiency.

Body

Potential of PPP in Railways

1. **Resource Mobilisation**: PPP reduces the financial burden on Indian Railways, which needs over **₹50 lakh crore** in investments by 2030 **(NRP Vision 2030)**.
2. **Operational Efficiency**: Private partners bring advanced tech, timely project delivery, and better asset utilisation.
3. **Station Redevelopment**: Projects like **Habibganj and Gandhinagar** stations showcase world-class designs and better commuter experience.
4. **Modernisation of Infrastructure**: PPP is being used in high-speed corridors **(Mumbai–Ahmedabad bullet train)**, and private freight terminals.

Limitations of PPP Model

1. **Lack of Bankable Projects**: Private investors find limited commercial viability in smaller stations with low footfall.
2. **Land and Clearances**: Delays due to unclear land titles and cumbersome approval processes hinder PPP rollout.
3. **Revenue Model Challenges**: Monetisation from real estate or commercial activities often falls short, making ROI unattractive.

4. **Past Project Failures**: BOT station redevelopment attempts under **2009 policy** saw poor response and minimal execution.
5. **Risk Aversion**: Long gestation periods and regulatory uncertainty dissuade serious private players.

Recent Policy Interventions

1. **Station Redevelopment Policy 2020**: Shifts to **EPC + O&M model** with assured returns and transparent bidding norms.
2. **Railways Infrastructure for Future Initiative**: **Budget 2023** allocated **₹2.4 lakh crore**, with PPP in capex-heavy areas like rolling stock, terminals.
3. **Asset Monetisation Pipeline**: Railways identified **400+ stations and land parcels** under NMP to attract private investment.
4. **Gati Shakti and PM Gati Shakti Cargo Terminals**: Integrated logistics with private participation and faster clearances.

Way Forward

1. **Streamline Approval Process**: Create a **single-window clearance** mechanism with fixed timelines.
2. **Ensure Viable Revenue Models**: Provide long-term leases and allow dynamic pricing and real estate monetisation.
3. **Risk Sharing and Policy Clarity**: As advised by the **Kelkar Committee (2015),** adopt balanced risk allocation and restructuring of Railways to separate policy, operations, and regulation.
4. **Capacity Building in Railways**: Train officials in PPP appraisal, monitoring, and stakeholder engagement.
5. **Strengthen Accountability and Regulatory Oversight**: Establish independent dispute resolution and performance review bodies.

Conclusion

Guided by the **Bibek Debroy Committee's** reform vision, PPPs can make Indian **Railways future-ready** by integrating private capital with public planning to deliver efficient, modern, and commuter-friendly infrastructure aligned with national growth priorities.

Q.3) "India's renewable energy ambitions are high, but implementation faces multiple hurdles." Critically assess India's progress in the sector and outline key challenges that need urgent policy focus. (150 words, 10 marks)

Introduction

India is the world's **4th-largest** renewable energy producer with over **180 GW installed capacity (MNRE, 2024)**. Despite global praise and ambitious goals under **UNFCCC and Panchamrit**, implementation gaps persist, demanding a realistic policy rethink.

Body

India's High Renewable Energy Ambitions

1. **500 GW by 2030 Target**: India aims for **500 GW** non-fossil fuel capacity by **2030**, announced at **COP26**.
2. **Energy Transition Leadership**: Under **ISA** and **CDRI**, India positions itself as a global renewable's leader.
3. **'Panchamrit' Commitments**: Net-zero by **2070**, with **50%** power from renewables by **2030**.
4. **Green Hydrogen Mission**: **Budget 2023-24** allocated **₹19,744 crore** to promote green hydrogen and domestic manufacturing.

Progress Made

1. **Rapid Solar Growth**: Solar capacity grew from **2.6 GW in 2014 to 75+ GW** by **2024 (MNRE)**.
2. **Falling Tariffs**: Solar tariffs dropped to **INR 2.14/unit**, making renewables more competitive than coal.
3. **International Partnerships**: Collaborations with EU, UAE, and Japan support FDI and R&D.
4. **Rooftop and Off-grid Initiatives**: Over **11 GW roof-top solar** installed; **Saubhagya** electrified **2.8 crore** homes.
5. **Energy Storage Push**: **Budget 2023** supports Battery Energy Storage Systems (BESS) of **4,000 MWh** via Viability Gap Funding.

Challenges in Implementation

1. **Land Acquisition & Transmission Bottlenecks**: Solar parks face delays due to land and grid unavailability.
2. **DISCOM Financial Stress**: Poor payment records disincentivise private developers.
3. **Policy Uncertainty**: Frequent changes in import duties and PPA renegotiations deter investment.
4. **Slow Storage Capacity Growth**: Lack of viable storage hampers round-the-clock renewable supply.
5. **Manufacturing Dependence**: Over **80% of solar modules** still imported, mostly from **China.**

Initiatives and Policy Measures

1. **Production Linked Incentive (PLI) Scheme**: **₹76,000 crore** to boost solar PV and component manufacturing.
2. **Green Energy Corridor**: Strengthening interstate transmission for renewables evacuation.
3. **National Hydrogen Mission**: Promotes electrolyser production, green hydrogen hubs, and export ecosystem.
4. **PM-KUSUM**: Aims to solarise **30.8 lakh pumps** and encourage farmer participation in RE.
5. **Budget 2024**: Emphasised **offshore wind**, pumped hydro, and grid-scale storage development.

Way Forward

1. **Strengthen DISCOMs**: Implement **UDAY 2.0** with strict compliance and loss-reduction mandates.
2. **Ease Land & Forest Clearances**: Create **RE zones** with pre-cleared land and simplified processes.
3. **Stable Policy Environment**: Ensure long-term certainty in tariffs, duties, and open access norms.

4. **Invest in Storage and Grid Tech**: Scale up **BESS**, pumped hydro and smart grid projects with PPP support.
5. **Foster Domestic Manufacturing**: Fast-track PLI rollouts and reduce import dependency in line with **Atmanirbhar Bharat**.

Conclusion

India's renewable journey reflects vision but faces executional strain. Achieving **Panchamrit** targets requires aligning PPP, domestic manufacturing, and fiscal policy with ground realities to create a **resilient, green, and inclusive energy** future.

Q.4) "India's Production-Linked Incentive (PLI) scheme is an attempt to transform the manufacturing ecosystem and reduce import dependence." Discuss the rationale behind the PLI scheme and critically analyze its impact on industrial growth, innovation, and job creation. (250 words, 15 marks)

Introduction

Launched in **2020**, the PLI scheme aims to make India a **global manufacturing hub** by reducing import dependence—especially in **electronics**, **APIs**, and **renewables** where over **70–90%** components are imported—while boosting exports, jobs, and innovation.

Body

Features of the PLI Scheme

1. **Financial Incentives**: Offers financial rewards to domestic and foreign manufacturers based on incremental sales over a base year.
2. **Sectoral Coverage**: Initially launched for 3 sectors—electronics, electrical components, and medical devices—now extended to **14 sectors** including drones, **EVs, pharma, and solar**.
3. **Import Substitution**: Targets domestic capability in key sectors like **APIs** and **electronics** to reduce over-reliance on imports.
4. **Performance Metrics**: In sectors like ACC batteries and drones, incentives are based on sales, performance, and local value addition over five years.
5. **Focus on R&D**: Encourages companies to invest in R&D to maintain global competitiveness and create intellectual property in India.

Rationale Behind the PLI Scheme

1. **Reviving Manufacturing's GDP Share**: With manufacturing stagnant at **~16% of GDP,** PLI aims to push this toward **25%** through targeted interventions.
2. **Global Value Chain Integration**: Seeks to position India as a **China+1 destination** by attracting global supply chains and enhancing export competitiveness.
3. **Strategic Sectoral Independence**: Reduces vulnerability in essential sectors like pharma, solar, and electronics by encouraging local production.

Impact of the PLI Scheme

1. **Boost to Electronics Manufacturing**: Mobile exports have doubled to **₹90,000 crore by FY24**; India is now among the top 5 global smartphone exporters.
2. **Employment Generation**: Estimated creation of over **60 lakh direct and indirect jobs**, especially in emerging and **labor intensive** sectors.
3. **Capital Investment Surge**: Approved firms have committed **₹3.5 lakh+ crore** in investments, bolstering industrial infrastructure and supply chains.
4. **Innovation Ecosystem Growth**: R&D and design-led manufacturing in EVs, pharma, and renewable sectors have gained traction.
5. **Recent Budget Initiatives**: **Budget 2023** allocated **₹19,500 crore for solar PLI**; **Budget 2024** extended PLI to green hydrogen and semiconductors, promoting next-gen industrial capacity.

Challenges in Implementation

1. **Assembly vs. Value Addition**: Incentives often reward final assembly rather than deep domestic manufacturing; most high-value components still imported.
2. **WTO Constraints on Local Sourcing**: Global trade rules restrict linking incentives to local content, impeding full value chain development.
3. **Vague Disbursal Criteria**: Lack of transparent, uniform criteria across ministries leads to opaqueness and implementation inconsistency.
4. **Lack of Centralized Monitoring**: Absence of a unified database hinders tracking of outputs like job creation or incremental exports.
5. **Limited MSME Inclusion**: High qualification thresholds exclude MSMEs, reducing the scheme's penetration in grassroots manufacturing.

Way Forward

1. **Enable MSME Participation**: Design low-barrier PLIs tailored to MSMEs and industrial clusters for broader inclusion.
2. **Deepen Domestic Supply Chains**: Focus on upstream ecosystem development—components, raw materials, and tooling capacities.
3. **Link Incentives to Innovation**: Introduce a **Research-Linked Incentive (RLI) model** to encourage IP creation and product design.
4. **Implement Committee Recommendations**: As per **EAC-PM**, align PLIs with skill development and state industrial strategies for comprehensive impact.

Conclusion

To fulfil the objectives of the **National Manufacturing Policy** and realize the vision of **Atmanirbhar Bharat**, the PLI scheme must evolve from an assembly-driven approach into a long-term strategy fostering innovation, self-reliance, and sustainable industrial development.

Q.5) "Efficient logistics is the backbone of economic competitiveness." Examine the current challenges in India's logistics sector and evaluate the significance of the PM Gati Shakti scheme and National Logistics Policy in overcoming them. (250 words, 15 marks)

Introduction

India's logistics sector—comprising transport, warehousing, freight, and inventory management—contributes around **14% to GDP**. As per the **World Bank,** inefficiencies hamper competitiveness, necessitating reforms like PM Gati Shakti and the National Logistics Policy.

Body

Challenges in India's Logistics Sector

1. **High Logistics Cost:** Costs at **14–18% of GDP**, much higher than global benchmarks of **~8%**, reducing competitiveness.
2. **Road-Heavy Modal Share:** Over **60% freight** by road creates congestion, emissions, and inefficiencies.
3. **Fragmented Infrastructure Planning: Silos** across ministries lead to duplication and delays.
4. **Weak Multimodal Integration:** Scarcity of rail/port linkage limits economies of scale.
5. **Last-Mile Delivery Bottlenecks:** Poor warehousing and clearances block urban logistics.
6. **Low Tech Adoption: IoT/RFID** uptake remains restricted to a few players.
7. **State-Level Disparities:** Uneven logistics efficiency across states.
8. The **National Transport Development Policy Committee (NTDPC) 2014** advocated integrated multimodal planning and a **unified transport ministry**, which remains partly unimplemented.

Significance of PM Gati Shakti Scheme

1. **Integrated Planning Platform:** GIS portal links **16 ministries** to reduce duplication.
2. **Multimodal Connectivity:** Enables MMLPs, economic zones, and freight corridor alignment.
3. **Real-Time Monitoring:** Tracks project timelines and costs to prevent overruns.
4. **GIS-Based Mapping:** Uses satellite data to identify gaps in connectivity.
5. **Economic Survey 2022–23:** Recognized **PM Gati Shakti** as pivotal in boosting capital formation and reducing logistics inefficiencies.

Role of National Logistics Policy (NLP), 2022

1. **Cost Reduction Goal:** Targets cut logistics costs to **~8% of GDP by 2030**.
2. **Unified Digital Interface (ULIP):** Links **30+ digital systems** for real-time cargo tracking.
3. **Standardization & Skilling:** Advocates warehousing norms and logistics certification.
4. **LEADS Index:** Facilitates inter-state benchmarking and policy improvement.
5. **Committee Input: DPIIT's Logistics Development Committee** emphasized digitization and private-sector integration in NLP formulation.

Progress Achieved So Far

1. **World Bank Logistics Index:** India's rank improved from **44 (2018) to 38 (2023).**
2. **National Master Plan Projects:** Over **1000+ projects** are live on **PM Gati Shakti portal**, enabling quicker approvals.

3. **Dedicated Freight Corridors: Western and Eastern DFCs** nearing completion; transit time cut by **~40–50%**.
4. **Multimodal Logistics Parks: 35 MMLPs** are under development in locations like **Nagpur**, **Chennai**, and **Guwahati** to enhance freight movement.

Way Forward

1. **Modal Shift to Rail & Waterways: NITI Aayog** recommends increasing rail freight share to **45%** and reviving inland waterways for cost-efficient, low-carbon transport.
2. **Adopt Green and Smart Logistics:** Encourage electric freight fleets, solar-powered warehouses, and end-to-end digital integration.
3. **Build Regional Logistics Hubs:** Promote state-level logistics policies and infrastructure clusters to bridge regional disparities and improve last-mile connectivity.

Conclusion

A robust logistics ecosystem will enhance ease of doing business, support **Make in India**, and help achieve the **$5 trillion economy** vision. **Gati Shakti** and **NLP**, if effectively implemented, can transform India into a **global logistics powerhouse**.

DAY-26

Q.1) Considering the recent earthquakes in Nepal and north eastern India, examine India's preparedness to handle high-intensity earthquakes, especially in seismically active zones. (150 words, 10 marks)

Introduction

According to **NDMA** and the **UNDRR**, over **60%** of India's landmass is vulnerable to moderate-to-severe seismic activity. Recent quakes underscore the urgent need for resilient infrastructure and community preparedness in **seismic zones III–V**.

Body

Recent Earthquakes and Their Implications

1. **Nepal Earthquake, November 2023:** A **6.4** magnitude quake in **Jajarkot** claimed over **150 lives** and shook parts of northern India, including Delhi and UP.
2. **Assam Earthquake, March 2024:** A **5.2** magnitude tremor hit **Sonitpur district**, exposing structural vulnerabilities in Northeast India's urban hubs.

India's Current Earthquake Preparedness

1. **Seismic Monitoring Network Expansion:** The National Centre for Seismology runs over **115** observatories that relay real-time earthquake data to national and state disaster agencies.
2. **Seismic Micro zonation and Risk Mapping:** Cities with populations over **5 lakh** are micro-zoned for seismic risk, helping in quake-resistant planning and safer construction practices.

3. **National Earthquake Risk Mitigation Project (NERMP):** NDMA's flagship program in **Zones IV and V** focuses on legal reforms, institutional training, and community-level disaster awareness.
4. **Awareness and Communication Drives:** NDMA conducts multi-platform campaigns promoting **"Drop, Cover, Hold"** and retrofitting awareness, especially in high-risk states.
5. **Earthquake Disaster Risk Index: NDMA**'s index helps quantify risks in cities across Zones IV and V, guiding priority interventions and preparedness investments.

Challenges and Limitations in Preparedness

1. **Weak Implementation of BIS Codes:** Despite **BIS 1893 guidelines**, most Tier-2 and Tier-3 cities show poor adherence, as noted in the **CAG report (2020)**.
2. **Outdated Urban Planning Norms:** Many municipal bodies still operate under town planning acts that don't incorporate seismic risk zoning.
3. **Lack of Early Warning Systems:** India lacks an earthquake early warning system, unlike **Japan** or **Mexico**; IMD alerts are issued only post-event.
4. **Poor Community Awareness:** Surveys by NDMA show only **30%** awareness of **"Drop, Cover, Hold" drills** even in quake-prone states like **Uttarakhand.**
5. **Slow Pace of Retrofitting:** Of **5,000** vulnerable schools identified in Himachal and Assam, less than **25%** have been structurally upgraded.

Way Forward

1. **Strengthen Compliance Mechanisms:** Make **BIS seismic codes** legally binding across states; enforce penalties for non-compliance in high-risk zones.
2. **Develop Earthquake Early Warning Systems:** Build real-time alerts leveraging AI and sensors, in collaboration with global best practices (e.g., **Japan's EEWS**).
3. **Mainstream DRR in Urban Planning:** Integrate **Sendai Framework principles** into master plans—risk-informed land use, zoning, and resilient infrastructure.
4. **Boost Community Preparedness:** Promote mass-scale public drills and education, in line with **Hyogo Framework's "Build Back Better"** doctrine.
5. **Global Collaboration and Knowledge Sharing:** Expand **CDRI's role** in facilitating tech transfer, seismic modelling, and regional quake resilience cooperation.

Conclusion

Enhancing seismic resilience is essential for building long-term disaster resistance. Aligning with the **Sendai Framework** and **fostering local-global synergy** can transform India's earthquake risk landscape while safeguarding lives and development gains.

Q.2) The recurring landslides in Himachal Pradesh and Sikkim have exposed gaps in development planning. Critically examine the role of unplanned infrastructure and deforestation in increasing landslide vulnerability. Suggest solutions. (150 words, 10 marks)

Introduction

According to the **Geological Survey of India (GSI)**, nearly **12.6%** of India's landmass is prone to landslides. The **2023** landslides in **Himachal** and the **2024** events in **Sikkim** reveal how deforestation and haphazard construction aggravate this risk.

Body

Recent Landslide Incidents and Their Impacts

1. **Himachal Pradesh, July–August 2023:** Over **400 people lost lives** due to landslides triggered by torrential rain, worsened by slope-cutting for roads and buildings.
2. **Sikkim, May 2024:** Flash floods and landslides disrupted **NH-10** and damaged key infrastructure, showcasing the compound impact of glacial melt, deforestation, and ill-planned roads.

Unplanned Infrastructure and Its Contribution to Vulnerability

1. **Slope Destabilization due to Road Cutting:** Roads are carved out using vertical cuts with no retaining walls, disrupting slope equilibrium and causing collapses during heavy rainfall. Example: **Kalka-Shimla r**oad damage in **2023.**
2. **Urban Expansion Without Hazard Zonation:** Rapid urban growth on fragile slopes like in **Shimla** lacks integration of hazard zonation maps into bylaws, inviting construction in high-risk zones — as seen in Summer Hill collapse.
3. **Hydropower Projects and Blasting:** Projects such as **Teesta and Parbati** employ uncontrolled blasting and tunnelling, altering geophysical stress and triggering landslides in weak zones.
4. **Poor Drainage and Runoff Management:** Inadequate stormwater management systems near roads and settlements increase waterlogging and lead to saturation-induced landslides — evident along **NH-707 in Uttarakhand**.
5. **Tourism-Driven Infrastructure Boom:** Hotels and homestays are often built violating slope angle guidelines, overwhelming natural resilience — such as unregulated **homestay clusters in Manali**.

Role of Deforestation in Triggering Landslides

1. **Loss of Natural Slope Binders:** Tree roots act as natural reinforcements; deforestation loosens topsoil, especially during the monsoon, making slopes prone to failure.
2. **Shifting Cultivation in North East:** Slash-and-burn practices in **Sikkim** and nearby regions reduce vegetative cover and natural water retention, amplifying erosion.
3. **Unregulated Logging and Plantation:** Forest cover loss for agriculture and timber in **Himachal's Kullu and Mandi valleys** has been directly linked with slope weakening.
4. **Failure to Implement CAMPA Funds:** Delays in compensatory afforestation under the **CAMPA** scheme have meant ecological restoration hasn't kept pace with deforestation.
5. **Encroachment into Forest Land:** Expansion of settlements and roads into designated forest zones violates the **Forest Conservation Act** and removes stabilising green cover.

Steps Taken by the Government

1. **Landslide Hazard Zonation Mapping by GSI:** The Geological Survey of India has mapped **85%** of vulnerable hill regions and shared this data with states to incorporate into town planning.
2. **National Landslide Risk Management Strategy (2020):** This strategy aims at institutional capacity building, risk zoning, landslide monitoring, and promoting community-based disaster risk reduction.
3. **Installation of Early Warning Systems:** Pilot projects in **Uttarakhand and Sikkim** include rainfall thresholds and sensors to issue alerts before slope failures.

4. **Eco-sensitive Development Norms in Hill States:** Draft guidelines by the **MoEFCC** promote low-impact construction, waste management, and slope-sensitive architecture in eco-sensitive zones.

Solutions Needed

1. **Mandatory Landslide Hazard Mapping:** Enforce **GSI-led zonation maps** in urban masterplans; restrict high-risk slope construction as per **NDMA guidelines**.
2. **Eco-sensitive Infrastructure Codes:** Promote stilt-based structures, terracing techniques, and deep drainage norms specific to hill regions in building bye-laws.
3. **Reforestation and Slope Bioengineering:** Launch intensive slope-stabilisation projects using vetiver grass, willow trees, and **bio-nets**, especially in landslide-prone districts.
4. **Institutional Coordination and Capacity Building:** Strengthen disaster cells in municipalities; improve convergence among PWD, Forest Dept, and NHAI under State DM Plans.
5. **Incorporate Global Best Practices:** Draw from **Japan's Sabo engineering techniques** to integrate resilience into hill development models.

Conclusion

Addressing landslide risk demands compliance with **NDMA's landslide mitigation guidelines**, integrating environmental safeguards with planning. Only then can we build resilient mountain regions that balance development with safety and ecological stability

Q.3) Disaster preparedness is the first step in any disaster management process. Explain how hazard zonation mapping will help in disaster mitigation in the case of floods. (150 words, 10 marks)

Introduction

Disaster preparedness, the first phase of the **UNDRR** disaster management cycle, focuses on reducing impact before disasters strike. As per the **Sendai Framework** and India's **2009 DM Policy,** preparedness is critical to flood mitigation.

Body

Why Preparedness Is the First Step

1. **Risk Awareness and Education**: Pre-disaster campaigns, school drills, and local training boost readiness.
   Example: Coastal villages in **Odisha** conduct **mock drills** under the **GoI-UNDP Disaster Risk Reduction Programme.**
2. **Infrastructure and Resource Prepositioning**: Boats, shelters, food, and medicines are stocked in high-risk zones pre-monsoon.
   Example: **Assam and Bihar** use prepositioning strategies in flood-prone blocks.
3. **Evacuation Planning**: Includes hazard route mapping, identification of vulnerable populations, and shelter designation. Mandated under **NDMA's Flood Management Guidelines (2008)**.
4. **Forecasting and Early Warning Systems**: Real-time alerts from IMD and CWC aid in timely evacuation.
   Example: India's Flood Forecasting Network covers over **330 stations**.

5. **Institutional Capacity Building**: Training SDRFs, panchayats, and local bodies improves coordinated response.
   Example: The **National DM Plan (2019)** emphasizes multi-tier capacity development.

Hazard Zonation Mapping

Hazard zonation mapping classifies areas based on flood risk using hydrological data, satellite imagery, and GIS (NRSC, CWC).
Example: The **National Flood Hazard Atlas** maps all flood-prone districts in India.

How It Helps in Floods

1. **Guided Land Use Planning**: Prevents construction in low-lying floodplains and preserves buffer zones.
   Example: **Post-2015 Chennai floods**, urban land-use plans were revised.
2. **Targeted Infrastructure Design**: Facilitates flood-resilient structures such as stilt houses and elevated roads.
   Example: Stilted buildings in **Assam's Kaziranga** region follow zonation inputs.
3. **Efficient Resource Allocation**: Prioritizes SDRF, boats, and relief camp deployment based on flood-prone zones.
   Example: Assam's district-wise flood preparedness plans use zonation maps.
4. **Insurance and Risk Transfer Mechanisms**: Zonation helps assess flood risk and set premiums for insured assets.
   Example: Crop risk assessments under **PMFBY** rely on flood hazard data.
5. **Data-Driven Community Preparedness**: Empowers local bodies to organize drills and public safety campaigns.
   Example: **Kuttanad basin in Kerala** uses zonation for community response planning.

Steps Taken by the Government

1. **National Flood Hazard Atlas (NRSC)**: Uses satellite data to map historical flood frequency across India.
2. **Urban Flood Management Guidelines (NDMA, 2010)**: Mandate hazard mapping integration in urban drainage and city planning.
3. **Real-Time Flood Forecasting (CWC + IMD)**: Over **330 telemetry-based stations** issue flood alerts nationwide.
4. **Amrit Sarovar Mission (2022)**: Aims to rejuvenate water bodies to reduce surface runoff in flood-prone areas.

Way Forward

1. **Implement Mihir Shah Committee Recommendations**: Suggests integrating river basin planning with flood hazard mapping for sustainable water and disaster governance.
2. **Digital Elevation Mapping (ISRO + NRSC)**: Accelerate use of high-resolution satellite imagery and LIDAR-based elevation models to improve micro-zonation of flood risks.
3. **Deploy IFLOWS/CFLOWS Systems**: Expand AI-based flood forecasting models like **Mumbai's IFLOWS** and **Chennai's CFLOWS** to other urban flood hotspots.
4. **Adopt Sponge City Principles**: Learn from **China's model** by integrating permeable pavements, urban wetlands, and rain gardens to absorb excess water.

Conclusion

Preparedness, aligned with the Sendai Framework, ensures resilience through early warning and hazard mapping. **Zonation-integrated planning** is key to meeting India's **sustainable disaster risk reduction** and climate adaptation goals.

Q.4) With record-breaking heatwaves affecting large parts of India in 2024–25, examine the socio-economic and health impacts of extreme heat. Evaluate the effectiveness of Heat Action Plans in building long-term resilience. (250 words, 15 marks)

Introduction

A heatwave, as per **IMD**, is declared when the maximum temperature exceeds **40°C** in plains, **37°C** in coastal areas, or **30°C** in hilly regions, with deviations of **4.5°C** or more. India witnessed record-breaking heat in **2024–25**, affecting health, livelihoods, and productivity.

Body

IMD Classification of Heatwaves

1. **Heatwave**: Departure of **4.5°C to 6.4°C** above normal or temperature **≥ 45°C**.
2. **Severe Heatwave**: Departure **≥ 6.5°C** or temperature **≥ 47°C**.

Rising Frequency and Intensity

1. **Increased Incidence**: India recorded over **200 heatwave** days in the summer of **2024**, with states like **Rajasthan and Bihar** facing **>45°C** for extended periods.
   Example: **Phalodi, Rajasthan** touched **51°C** — India's highest ever.

Socio-Economic and Health Impacts

1. **Health Stress and Mortality**: Heat strokes and cardiovascular strain have increased, especially among elderly and outdoor workers.
   Example: Over **100** confirmed heat-related deaths in **Odisha (May 2024).**
2. **Reduced Labour Productivity**: **MGNREGA** and construction workers saw reduced work hours, lowering earnings.
   Example: **ILO** estimates India lost **5.8%** of working hours in **2023 due to heat**.
3. **Agricultural Losses**: Heat reduces crop yields and increases evapotranspiration.
   Example: **Wheat** production in **Punjab** declined by **10%** due to March heat spells.
4. **Water and Power Demand Surge**: Sharp rise in AC and pump use stresses grids and depletes groundwater.
   Example: **Delhi** faced 8-hour outages and **42%** power demand rise **(May 2024)**.
5. **Urban Poor Most Vulnerable**: Slum dwellers face unbearable indoor heat due to tin roofs, poor ventilation, and Urban Heat Island effects.
   Example: **Mumbai's** informal settlements recorded indoor temperatures **6–7°C** above ambient levels.

Heat Action Plans (HAPs): Effectiveness

1. **Localized Planning and Coordination**: Cities like **Ahmedabad** pioneered **India's first HAP** in **2013**, involving IMD, health departments, and urban bodies.

2. **Mortality Reduction**: **Ahmedabad** saw a **61%** drop in heat-related deaths over **five years** post-HAP implementation.
3. **Awareness and Behavioural Change**: SMS alerts, water stations, and public education reduced vulnerability in cities like **Nagpur and Bhubaneswar**.
4. **Still Limited in Coverage**: Only **23 of 100 smart cities** have functional HAPs. Implementation remains urban-centric and seasonal.
5. **Lack of Integration with Climate Policy**: HAPs often remain stand-alone documents, not linked with city masterplans or state disaster management strategies.

Government Interventions

1. **National Plan for Heatwave Action (2023)**: **NDMA**'s revised guidelines promote state-wise HAPs with focus on early warning systems, healthcare capacity, and inter-agency coordination.
2. **India Cooling Action Plan (ICAP)**: Launched by **MoEFCC** in **2019**, **ICAP** targets sustainable cooling and heat resilience with a **20–25%** reduction in cooling demand by **2037–38**.
3. **Early Warning Dissemination**: IMD issues color-coded heat alerts, reaching millions via **Doordarshan**, mobile apps, and district administrations.
4. **Amrit Dharohar and MISHTI Schemes**: Launched in **Union Budget 2023–24** to conserve wetlands and mangroves, enhancing natural cooling in urban peripheries.

Way Forward

1. **Strengthen Early Warning and Communication**: Use mobile alerts, local radio, and community workers for real-time advisories.
2. **Expand Cool Roofs**: Prioritize reflective materials in low-income housing clusters. Example: **Ahmedabad's Cool Roof Program** now covers **3 lakh sqm**.
3. **Adopt Global Best Practices**: Localize cooling models like **LA's cool pavements** and Singapore's vertical gardens.
4. **Integrate Urban Heat Mapping**: Use **IMD–ISRO** data to target zoning, shade infrastructure, and greening in high-risk areas.
5. **Learn from Seville, Spain**: First city to name and rank heatwaves, triggering faster response and public awareness.

Conclusion

Extreme heat events will intensify under climate change. Mainstreaming heat resilience in urban planning, guided by the **Sendai Framework** and **India Cooling Action Plan**, is essential to safeguard health, equity, and sustainable growth.

Q.5) India's approach to disaster management is evolving from a reactive, relief-centric model to one focused on proactive resilience-building. Discuss the progress and challenges in achieving this shift. Also suggest measures to strengthen this transformation. (250 words, 15 marks)

Introduction

As per **UNDRR, Disaster Management** involves organized planning to reduce hazard impact. India is shifting from reactive relief measures to **proactive resilience-building** — a vital transformation for sustainable development in a disaster-prone country.

Body

Earlier Relief-Centric Approach

1. **Post-Disaster Focus**: Major policies centered on relief distribution and temporary rehabilitation after events rather than prevention or risk reduction.
2. **Revenue Department Control**: Disaster response was traditionally led by revenue officials, lacking multi-sectoral coordination and scientific input.
3. **Ad-Hoc Financing**: Funding was mostly routed through the **Calamity Relief Fund**, with little investment in preparedness or mitigation. (Replaced by **SDRF and NDRF in 2010***)*
4. **Lack of Dedicated Institutions**: Until **2005**, there was no central legislation or agency specifically mandated to address disaster risk reduction.

Shift to Proactive Resilience Approach

1. **DM Act, 2005**: Established **NDMA, SDMAs, and DDMAs**, institutionalizing prevention, preparedness, and mitigation strategies.
2. **Mainstreaming DRR in Development**: Planning Commission guidelines (2010) and later **NITI Aayog** emphasized integrating risk reduction into all sectoral plans.
3. **Early Warning Infrastructure**: **IMD**, **INCOIS**, and **BIS** enhanced forecasting systems for cyclones, tsunamis, and earthquakes.
   Example: Accurate prediction of **Cyclone Yaas (2021)** minimized casualties.
4. **Community Participation**: **CBDRR initiatives** involve locals in hazard mapping, mock drills, and preparedness activities.
   Example: **Odisha's cyclone shelters** managed by community volunteers.
5. **Global Leadership via CDRI**: India launched the Coalition for Disaster Resilient Infrastructure **(CDRI) in 2019** to promote global collaboration on resilient infrastructure systems.

Progress Achieved

1. **Urban Resilience Measures**: **AMRUT and Smart Cities** include climate-resilient infrastructure planning.
   Example: **Surat** integrated flood-resilient stormwater systems.
2. **Technological Platforms**: **Bhuvan (ISRO) and GEM (NDMA)** support vulnerability mapping and structural safety audits.
3. **Policy Recognition**: The **National Disaster Management Plan 2019**, updated in **2023**, aligns with the **Sendai Framework** and **SDGs**.
4. **Institutional Strengthening**: **NDMA guidelines** issued for schools, hospitals, and heritage sites improved sectoral disaster preparedness.

Challenges in Achieving the Shift

1. **Persistence of Relief Orientation**: Many states still emphasize ex-post compensation, ignoring long-term risk reduction investments.
2. **Limited Local Capacities**: Panchayats and ULBs lack funds, training, and autonomy to implement DRR plans.
3. **Poor Enforcement of Regulations**: Building code violations, CRZ breaches, and unsafe hill construction continue unchecked.
   Example: Land instability in **Joshimath, 2023**. The **Ravi Chopra Committee (2021)** had warned against unchecked infrastructure in the fragile Himalayan region.
4. **Slow Adoption of Science-Based Planning**: Recommendations of the **E. Parthasarathy Committee (2006)** on incorporating disaster risk assessments into environmental clearances and development planning remain under-implemented.

Measures to Strengthen the Transformation

1. **Legislate Local DRR Mandates**: Make **Local Disaster Management Plans** legally binding with performance audits.
2. **Incentivize Risk Reduction**: Encourage DRR investments through tax benefits, CSR obligations, and insurance discounts.
3. **Private Sector & PPP Models**: Engage corporates in resilience infrastructure, emergency logistics, and insurance products.
4. **Adopt Global Best Practices**: Follow **Japan's school preparedness model**—mandating regular drills, disaster education, and evacuation routes in every institution.
5. **Capacity Building of First Responders**: Regular training and provisioning of modern equipment to **NDRF, SDRFs**, and local volunteers must be prioritized for quick and effective response.

Conclusion

India must fully embrace the **Build Back Better** vision of **UNDRR**, shifting decisively from relief to resilience. This transformation will safeguard lives, infrastructure, and economic development from future disaster shocks.

DAYY-27

Q.1) With cities like Delhi turning into seasonal "gas chambers," urban air pollution in India has become a chronic public health and governance crisis. Discuss. (150 words, 10 marks)

Introduction

According to **WHO (2023)**, **39** of the world's **50** most polluted cities are in India. As per **CPCB**, **131** Indian cities exceed national air quality standards. Urban smog, particularly in Delhi, reflects a chronic governance and public health crisis.

Body

Why Cities Like Delhi Are Turning into "Gas Chambers"

1. **Crop Residue Burning**: Satellite data shows stubble burning in **Punjab** and **Haryana** contributes up to **40%** of Delhi's **PM2.5** levels in winter.
2. **Meteorological Trapping**: Winter temperature inversion and low wind speeds trap pollutants, preventing their dispersion and leading to choking smog.
3. **Vehicular Emissions**: Delhi has over **1.2 crore** registered vehicles—a major source of NOx, PM, and ozone precursors, especially from diesel engines.
4. **Dust and Construction**: Unregulated construction, road dust, and open dumping generate high coarse **PM10** levels year-round, compounding seasonal spikes.

Health Impacts of Urban Air Pollution

1. **Public Health Emergency**: As per the **Lancet (2020)**, air pollution contributed to **1.67 million** deaths in India in **2019** alone.
2. **Respiratory Illnesses**: Surge in asthma, bronchitis, lung cancer, and reduced lung function—especially among children and the elderly.
3. **Cognitive and Maternal Risks**: Studies show links to cognitive decline, low birth weight, and premature deliveries.
4. **Economic Costs**: The **World Bank** estimates air pollution cost India **~8.5% of GDP** through health burden and lost productivity.

Why It Has Become a Governance Crisis

1. **Fragmented Jurisdiction**: Overlapping responsibilities between Centre, State, ULBs, and pollution control boards lead to policy paralysis.
   Example: **Delhi's Graded Response Action Plan (GRAP)** is often poorly coordinated across NCR.
2. **Seasonal Politicisation**: Air pollution is treated as a winter issue, with blame-shifting over stubble burning, ignoring systemic year-round sources like vehicular and industrial pollution.
3. **Weak Enforcement**: Despite the **Air (Prevention and Control of Pollution) Act, 1981,** compliance is poor. Polluters often go unpunished due to weak regulatory capacity.
4. **Lack of Data Transparency**: Real-time air quality monitoring is patchy. Many cities lack continuous air monitoring stations.
5. **Inadequate Urban Planning**: Dense construction, shrinking green spaces, and high vehicular dependency worsen urban air quality.

Example: The **IIT Kanpur study** on Delhi's pollution found secondary particles and vehicular exhaust as top contributors.

Steps Taken So Far

1. **Commission for Air Quality Management (CAQM)**: Established in **2020** to coordinate air quality management in the NCR region. However, its impact remains limited by jurisdictional challenges.
2. **Faster Adoption of Clean Fuels**: India leapfrogged to **BS-VI fuel in 2020.** Promotion of EVs through **FAME** schemes is ongoing.
3. **National Clean Air Programme (NCAP)**: Launched in **2019** with a target of **40%** PM reduction in **131 cities by 2026**. However, progress is uneven.
4. **Technological Interventions**: Use of smog towers, bio-decomposer sprays, and **SAFAR** (System of Air Quality and Weather Forecasting and Research) for real-time forecasting and public awareness.

Measures to Address the Crisis Holistically

1. **Legal Accountability**: Make clean air a **legally enforceable** right under the Air Act, with penalties for non-compliance by agencies and polluters.
2. **Air-Shed Management**: Move from city-centric to regional pollution control, with cross-state coordination (especially in **Indo-Gangetic plain**).
3. **Sustainable Urban Mobility**: Invest in mass public transport, cycle lanes, walkability, and disincentives for private car use.
4. **Decentralised Monitoring and Citizen Science**: Promote **community-owned AQI sensors** and real-time pollution data for greater transparency.
5. **Green Urban Design**: Mandate green building codes, vertical gardens, and urban forestry in all **smart city and AMRUT plans**.
6. **Adopt Global Best Practices**: Emulate cities like **London (ULEZ congestion pricing)**, **Beijing (industrial relocation), and Seoul (eco-zone transformation)** to design context-sensitive Indian solutions.

Conclusion

With air pollution costing **~8.5% of India's GDP (World Bank)**, inaction threatens both health and economic stability. Urgent, coordinated, and sustained efforts are essential to secure urban futures and national development.

Q.2) India's biodiversity hotspots are under threat from developmental pressures and invasive species. How does this dual challenge complicate conservation efforts? (150 words, 10 marks)

Introduction

Norman Myers defined biodiversity hotspots as regions rich in endemic species but under threat. India has **four**: Himalayas, Indo-Burma, Western Ghats–Sri Lanka, and Sundaland. These ecologically sensitive areas face mounting anthropogenic and biological stressors.

Body

Developmental Pressures on Biodiversity Hotspots

1. **Infrastructure Expansion**: Linear projects like roads, railways, and hydropower in the Himalayas and Western Ghats fragment habitats.
   Example: **Char Dham highway project** threatens alpine biodiversity and triggers landslides.
2. **Mining and Quarrying**: Unsustainable extraction for limestone, coal, and bauxite disrupts ecosystems.
   Example: Biodiversity loss in **Meghalaya's Indo-Burma hotspot** due to rat-hole mining.
3. **Tourism and Urbanisation**: Ecotourism often turns exploitative, with poorly planned resorts and waste dumping.
   Example: Overtourism in **Munnar** affecting **Nilgiri Tahr** habitats.
4. **Agricultural Encroachment**: Forest-to-farm conversions for tea, coffee, or areca plantations reduce natural forest cover.
   Example: Expansion in Western Ghats causes loss of native tree species (Western Ghats Ecology Expert Panel – **Gadgil Report, 2011**).

Threat from Invasive Alien Species (IAS)

1. **Habitat Displacement**: IAS outcompete native flora and fauna for resources. Example: **Lantana camara** has taken over large tracts of Western Ghats forest understorey
2. **Food Chain Disruption**: Species like **Prosopis juliflora** reduce availability of native fodder.
3. **Ecosystem Function Loss**: IAS can change soil chemistry, hydrology, and fire regimes. Example: **Eichhornia** in wetlands causes eutrophication **(CPCB Report 2020)**
4. **Compounding Climate Stress**: IAS thrive in warmer, disturbed habitats, accelerating spread.

Solutions to Address the Dual Challenge

1. **Ecologically Informed Development**: Apply the **'no-go' principle** in critical habitats and enforce eco-sensitive zone rules.
2. **Invasive Species Control Programs**: Create IAS task forces for mapping, monitoring, and biological control. (Suggested by **National Biodiversity Authority**, **2023**).
3. **Community-Based Conservation**: Empower locals via eco-restoration and **Biodiversity Management Committees** under the **Biological Diversity Act, 2002**.
4. **Strict EIA and Environmental Governance**: Use science-based assessments in hotspot regions. **(T.S.R. Subramanian Committee, 2014)**.
5. **Research and Restoration Ecology**: Support habitat restoration through **CAMPA funds**.

Conclusion

Safeguarding India's biodiversity hotspots is vital to achieving **UNCBD targets** on conservation and restoration. A balanced, science-backed strategy will secure both ecological integrity and long-term sustainable development

Q.3) The rapid melting of Arctic ice is no longer a remote environmental concern. Analyze its cascading effects on global climate patterns and India's environmental security.

Introduction

According to **IPCC AR6 (2023)**, Arctic sea ice has declined by over **40%** since **1979**. This ongoing crisis has far-reaching consequences, disrupting global climate systems and posing direct risks to India's environment and long-term security.

Body

Cascading Effects on Global Climate Patterns

1. **Jet Stream Distortion**: Arctic warming weakens the polar jet stream, leading to extreme weather shifts across continents.

   Example: **2021 Texas cold wave**, **2022 European heatwave** – **WMO** reports.
2. **Acceleration of Warming**: Melting ice reduces the Earth's albedo, amplifying global heat absorption and feedback loops.

   (**NASA, 2021**: Arctic reflects **80%** less sunlight than before)

3. **Disruption of Ocean Currents**: Meltwater may slow the Atlantic Meridional Overturning Circulation (AMOC), altering global rainfall and temperatures.
   (IPCC, 2019: Disruption is threat to thermohaline balance)
4. **Methane Emissions from Permafrost**: Thawing tundra is releasing methane, a potent greenhouse gas accelerating global warming.
   (UNEP, 2020: Tundra stores 1,500 billion tons of carbon)

Implications for India's Environmental Security

1. **Monsoon Disruptions**: Arctic-induced circulation changes impact the strength and timing of Indian monsoons.
   Example: **2022 monsoon** onset delays and uneven rainfall **(IITM, Pune)**.
2. **Coastal Threats from Sea-Level Rise**: Rising seas endanger low-lying regions and ecosystems like the **Sundarbans**.
   Example: Frequent saline ingress in coastal **West Bengal (CWC, 2021)**.
3. **Glacial Retreat in Himalayas**: Teleconnections from Arctic shifts destabilize Himalayan cryosphere.
   Example: Rapid melt in **Gangotri and Zemu** glaciers.
4. **Increase in Extreme Events**: Warmer oceans increase frequency and intensity of cyclones, floods, and heatwaves.
   Example: **Cyclone Amphan (2020)** intensified by elevated Bay of Bengal SSTs **(IMD)**.

Steps Taken So Far

1. **Observer Status in Arctic Council**: India has been an observer since **2013**, enhancing diplomatic and research presence.
2. **National Arctic Policy (2022)**: Lays out vision for scientific research, climate impact study, and strategic engagement.
3. **Himadri Research Station**: India's permanent base in **Svalbard, Norway**, conducts vital polar climate research.
4. **International Collaborations**: Working with **WMO, IPCC, SAON** for Arctic data integration and climate modelling.

Recommendations

1. **Strengthen Arctic Research Capacity**: Expand NCPOR funding, launch indigenous polar expeditions, and link findings to domestic climate models.

2. **Integrate Arctic Signals in National Plans**: Ensure Arctic impacts are reflected in SAPCCs, coastal regulations, and disaster planning.
3. **Enhance Coastal Resilience**: Invest in climate-resilient infrastructure, early warning systems, and mangrove restoration.
4. **Public Education and Policy Awareness**: Introduce polar climate modules in higher education and government training programs.
5. **Adopt Global Best Practices**: Learn from **Norway's Arctic preparedness planning** and **Canada's Indigenous-led environmental monitoring**.

Conclusion

Arctic ice loss contributes to unpredictable weather, rising seas, and glacier retreat, threatening India's environmental security. Urgent response to this **cryosphere crisis** is essential to align with **UNFCCC** goals and protect our ecological and economic future.

Q.4) Wetlands serve as ecological sentinels, yet they remain among the most threatened ecosystems in India. Examine the socio-economic and ecological importance of wetlands, and critically assess the gaps in policy and enforcement that hinder their protection. (250 words, 15 marks)

Introduction

According to the Ramsar Convention, wetlands are areas of marsh, fen, peatland, or water that support biodiversity and regulate water regimes. As of **2025**, India has **89 Ramsar sites** covering over **1.33 million hectares** yet faces alarming degradation.

Body

Why Wetlands Remain the Most Threatened Ecosystems

1. **Rapid Urbanization and Land Conversion:** India lost over **30%** of its natural wetlands between **1970 and 2014** due to infrastructure and real estate expansion **(ISRO)**.
2. **Pollution and Waste Dumping: 75%** of urban and peri-urban wetlands are contaminated by sewage, plastic, and industrial effluents **(CPCB, 2021)**.
3. **Climate Change Vulnerability:** Rising temperatures and erratic rainfall are shrinking wetland water levels and disrupting seasonal cycles.

Ecological and Socio-Economic Importance of Wetlands

1. **Biodiversity Hotspots:** Wetlands provide habitats for migratory birds and rare aquatic species. **Keoladeo** and **Chilika** support over **100 bird species**.
2. **Natural Purifiers and Recharge Zones:** Wetlands filter pollutants and recharge aquifers. **East Kolkata Wetlands** save around **Rs 500 million** annually.
3. **Flood Control and Climate Buffer:** Wetlands reduce flood impacts and sequester carbon. **Sunderbans** alone store **~4.15 billion tons of CO_2**.
4. **Livelihood and Food Security:** They support fishing, grazing, agriculture, and tourism. **Loktak Lake** sustains about **1 lakh fishers** in **Manipur.**
5. **Cultural and Religious Significance:** Many wetlands like **Pushkar Lake and Loktak** are deeply rooted in local traditions and religious practices.
6. **Research and Education Value:** Wetlands serve as open laboratories for ecological research, environmental awareness, and student field learning.

Policy and Enforcement Gaps Hindering Protection

1. **Fragmented Governance Framework:** Multiple ministries overlap, causing inaction. The **Ritesh Kumar Committee** recommended a unified wetland authority for coordinated efforts.
2. **Ineffective Wetlands Rules 2017:** Rules exclude man-made wetlands and lack enforcement. Only **13 states** have notified authorities **(CAG 2020)**.
3. **Encroachments from Urban Expansion:** Wetlands are drained for infrastructure. **Bengaluru lost 40%** of its wetlands since **1973.**
4. **Inadequate Monitoring Systems:** Less than **5% of wetlands** are geo-tagged. NWCP lacks updated inventories and real-time tracking.

Recommendations

1. **Enforce Wetlands Rules Effectively:** Ensure all states form and empower State Wetland Authorities with technical capacity.
2. **Technology-Driven Monitoring:** Use **ISRO's Bhuvan and AI tools** for satellite-based tracking and timely alerts.
3. **Community-Led Conservation Models:** Adopt co-management practices like **Chilika Development Authority** involving local stakeholders.
4. **Integrate in Urban Planning:** Include wetlands in master plans and climate infrastructure projects to ensure ecological buffers.

5. **Leverage Existing Schemes and Best Practices:** Integrate wetlands restoration with programs like the **Amrit Dharodhar Scheme** to rejuvenate water bodies and adopt global models like **USA's Clean Water Act** and **Australia's Ramsar zoning**.

Conclusion

Wetlands play a vital role in water security and climate resilience. Protecting them strengthens India's path toward **CBD and Ramsar targets** while safeguarding GDP-linked ecosystem services worth billions annually.

Q.5) The Environmental Impact Assessment (EIA) process in India is often seen as weak and ineffective. In the context of recent clearances for large projects, examine the key problems in the EIA system. What reforms are needed to make it more transparent, participatory, and environmentally sound? (250 words, 15 marks)

Introduction

Environmental Impact Assessment (EIA), notified under the **Environment (Protection) Act, 1986**, is a crucial tool to evaluate environmental consequences of development projects. Yet, implementation challenges have made it ineffective in safeguarding ecological interests.

Body

EIA Process in India

1. **Screening:** Determines if a project requires EIA based on type, scale, and location.
2. **Scoping:** Sets Terms of Reference for the EIA report.
3. **Impact Assessment & Mitigation:** Identifies likely impacts and mitigation measures.
4. **Public Consultation:** Involves local stakeholders through hearings and written responses.
5. **Appraisal & Decision-making:** Expert Appraisal Committees review the report and recommend clearance or rejection.
6. **Monitoring:** Project implementation is monitored for compliance with environmental conditions.

Recent Concerns

- **Dilutions and Clearances: Draft EIA 2020** included post-facto approvals and reduced hearing windows; projects like **Dibang Dam** and **Great Nicobar** were cleared despite environmental risks.

Key Problems in the EIA System

1. **Conflict of Interest:** Project proponents select consultants, reducing objectivity; **CAG** highlighted this in **2016**.

2. **Token Public Hearings:** Poorly advertised and inaccessible; the **2014 Subramanian Committee** noted this procedural weakness.
3. **Poor Quality Reports:** Reports like **Vedanta's Niyamgiri** case have contained falsified or outdated data.
4. **Weak Monitoring & Compliance: CAG** found only **6%** of cleared projects had compliance checks.
5. **Routine Exemptions: Draft EIA 2020** institutionalised exemptions for linear and strategic projects, weakening environmental oversight.

Reforms Needed

1. **Independent Accreditation:** Set up an **autonomous body** to accredit and audit EIA consultants.
2. **Digitised Transparency:** Use **PARIVESH portal** to publish all EIA documents in regional languages.
3. **Strengthen Public Consultation:** Expand outreach, extend consultation windows, and improve access.
4. **Post-clearance Accountability:** Implement mandatory compliance audits and enforce penalties.
5. **Judicial Reinforcement of Safeguards:** In ***Noble M. Paikada v. Union of India*** **(2024),** the Supreme Court upheld the need for rigorous environmental review by striking down blanket exemptions for linear projects.

Conclusion

Reforming the EIA process is crucial to align development with environmental sustainability. A robust EIA system contributes directly to achieving **SDG Goals 13 (Climate Action), 15 (Life on Land), and 16 (Institutional Justice)**.

DAY- 50

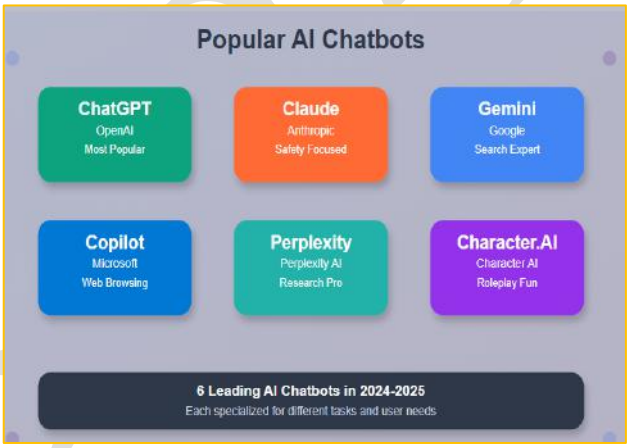
Q.1) What are Generative Pre-trained Transformers (GPTs)? Discuss how tools like ChatGPT are transforming education, governance, and the future of work. (150 words, 10 marks)

Introduction

Generative Pre-trained Transformers (GPTs) are revolutionizing digital landscapes. Tools like ChatGPT are reshaping how we learn, govern, and work, making systems more efficient, inclusive, and innovative through advanced AI-driven language understanding.

Body

What are GPTs?



1. **Transformer-based AI models:** GPTs are deep learning models based on the transformer architecture, designed to understand and generate human-like text with remarkable fluency and coherence.
2. **Pre-trained on vast datasets:** They are trained on large corpora of text from books, websites, and articles, enabling them to grasp language patterns, facts, and contexts efficiently.
3. **Generative in nature:** Unlike traditional models, GPTs can generate new content such as essays, code, stories, and summaries based on prompts, not just classify or translate text.
4. **Context-aware responses:** GPTs process and retain contextual information across multiple sentences or conversations, allowing them to maintain coherent and relevant dialogues.

Applications of ChatGPT-like Tools in Key Domains

Education

1. **Personalized tutoring:** ChatGPT helps students understand difficult concepts in subjects like math and science.
   Example: **Khan Academy's Khanmigo**, powered by GPT-4, serves as an AI tutor that helps students across subjects with interactive, step-by-step learning.
2. **Language and writing support:** It assists in improving writing skills by suggesting edits, grammar corrections, and content structuring.
   Example: **Microsoft Copilot** (based on GPT-4) helps students enhance essays and presentations directly within Word and PowerPoint.
3. **Content creation for educators:** Teachers can generate lesson plans, quizzes, and summaries instantly.

Example: Teachers are using **ChatGPT and Claude** (Anthropic's GPT-based model) to develop curriculum-aligned teaching material efficiently.

Governance

1. **Citizen services automation:** Governments can deploy GPTs for answering public queries in multiple languages.
   Example: The Indian Ministry of Electronics and IT has explored using **Bhashini** to improve multilingual public access to government schemes.
2. **Policy analysis and drafting:** AI can assist in summarizing large policy documents and suggesting drafts.
   Example: Researchers and government consultants in the **EU** have used GPT-4 to draft preliminary versions of climate policy recommendations.
3. **Public grievance redressal:** ChatGPT-like tools can triage complaints and route them to the correct departments.
   Example: In the **U.S. local councils** are experimenting with GPT-powered assistants to log citizen issues and provide real-time updates on resolution status.

Future of Work

1. **Productivity enhancement:** GPTs automate tasks like report writing and email drafting.
   Example: **Deloitte** integrates GPT-based copilots in internal systems to generate meeting summaries, client reports, and strategy briefs.
2. **Upskilling and learning:** Professionals use ChatGPT for self-paced learning.
   Example: **Duolingo Max**, powered by GPT-4, enables learners to practice language skills with AI-driven conversations and explanations.
3. **Creative and technical collaboration:** Writers and developers use GPTs for brainstorming and prototyping.
   Example: **Replit** uses Ghostwriter (GPT-powered) to help developers generate and debug code in real time.

Conclusion

GPTs are transforming how we learn, govern, and work—fueling efficiency, accessibility, and creativity. India's push toward **Digital India and AI-in-governance** aligns with this global wave, promoting inclusive, tech-driven growth across sectors.

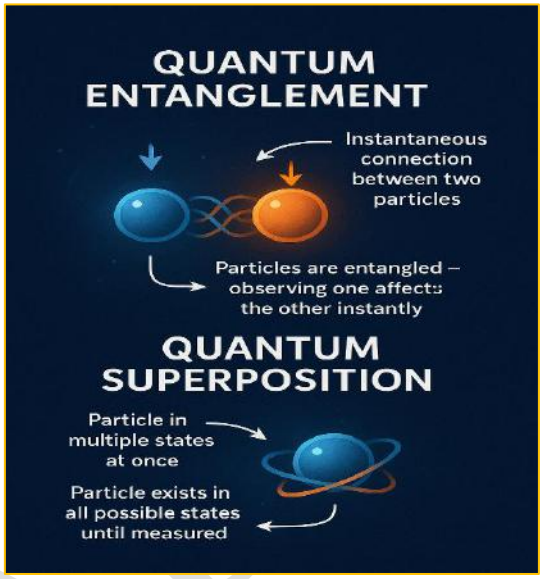
Q.2) What is quantum technology? Examine its potential applications and outline the steps taken by India to harness its benefits. (150 words, 10 marks)

Introduction

Quantum technology uses the rules of quantum physics—like particles being in two states at once—to build powerful tools for computing, communication, and sensing. It is set to transform science, industry, and governance.

Body

What is Quantum Technology?



1. **Based on quantum mechanics:** It operates on the laws of quantum physics, which govern the behavior of particles at atomic and subatomic scales.
2. **Superposition and entanglement:** It exploits quantum properties—**superposition** (being in multiple states at once) and **entanglement** (instant connection between particles)—for superior performance over classical systems.
3. **Beyond classical limitations:** Quantum devices can process vast computations simultaneously, detect minute changes in the environment, and ensure ultra-secure communication.
4. **Emerging interdisciplinary field:** It combines physics, engineering, mathematics, and computer science to build next-gen technologies like quantum computers, sensors, and networks.

Potential Applications of Quantum Technology

1. **Quantum Computing:** Solves complex problems in seconds that classical computers would take years to process.
   Example: Drug discovery simulations by **Google**'s quantum computer promise breakthroughs in medicine.
2. **Quantum Communication:** Enables ultra-secure data transfer using quantum key distribution (QKD).
   Example: **China's Micius satellite** demonstrated QKD-based quantum-encrypted communication between ground stations.
3. **Quantum Sensing:** Offers ultra-precise measurements of time, gravity, and magnetic fields.
   Example: **Quantum sensors** are being tested for underground mineral detection and early earthquake prediction.
4. **Quantum Cryptography:** Revolutionizes cybersecurity by creating unbreakable encryption methods.
   Example: Companies like **ID Quantique** in Switzerland offer commercial quantum encryption solutions for banks.
5. **Material Science & Chemistry:** Simulates molecular interactions with high accuracy for designing advanced materials.
   Example: **IBM's quantum simulations** help in developing better catalysts and battery technologies.
6. **Financial Modeling & Optimization:** Handles vast datasets for risk analysis and optimization in real-time.

Example: **JPMorgan Chase** is experimenting with quantum algorithms to improve investment strategies.

Steps Taken by India to Harness Quantum Technology

1. National Quantum Mission (NQM): Launched in **2023 with ₹6,003 crore** outlay to develop quantum computers, sensors, and secure communication networks over 8 years.
2. Centre for Quantum Technologies: Institutions like **IISc Bengaluru and IIT Madras** are setting up quantum research hubs and laboratories.
3. International Collaborations: India has partnered with global leaders like the US, Israel, and **France** to enhance quantum R&D and exchange expertise.
4. Quantum Communication Projects: DRDO successfully demonstrated secure quantum communication over 100+ km between **two labs in 2020**.
5. Quantum Education Initiatives: IITs and **IISERs** are introducing quantum engineering and computing courses to build a skilled workforce.
6. Industry Participation: Indian startups like **QNu Labs** are building indigenous quantum encryption tools, while **TCS and Infosys** are investing in quantum research.

Conclusion

Quantum technology holds the key to future breakthroughs in computing, security, and sensing. The **2022 Nobel Prize in Physics**, awarded for **quantum entanglement** research, highlights its global importance.

Q.3) Srinivasa Ramanujan made extraordinary contributions to mathematics with little formal training. Discuss the significance of his work and its relevance to modern science and technology. (150 words, 10 marks)

Introduction

Srinivasa Ramanujan, a self-taught mathematical genius from India, made groundbreaking contributions to **number theory, infinite series, and mathematical analysis**. Despite minimal formal training, his work continues to influence modern science, technology, and theoretical research.

Body

Significance of Ramanujan's Work

1. Contributions to Number Theory: Ramanujan's work on partitions, highly composite numbers, and modular forms expanded the foundations of number theory.
2. Discovery of Mock Theta Functions: These mysterious functions, introduced in his final letters, puzzled mathematicians for decades.
3. Infinite Series and Continued Fractions: He developed elegant formulas for π and other constants using unconventional infinite series.
4. Modular Forms and q-Series: His work laid groundwork for the modern theory of modular forms.

5. Ramanujan Prime and Tau Function: He introduced new functions and patterns in prime numbers and integer partitions.
6. Intuition over Formal Proofs: He arrived at deep truths through intuition and pattern recognition, challenging conventional methods of mathematical discovery.

Relevance to Modern Science and Technology

1. **Cryptography and Cybersecurity:** Ramanujan's theories on prime numbers and modular forms underpin encryption algorithms used in secure communication.
2. **Theoretical Physics:** Concepts like mock theta functions and modularity are applied in string theory, quantum gravity, and the study of black holes.
3. **Computer Science:** His formulas for rapidly converging series are used in algorithm development for symbolic computation and data processing.
4. **Artificial Intelligence:** His ability to identify patterns in complex data inspires modern approaches to machine learning and intuitive problem-solving.
5. **Space Science:** NASA scientists have used Ramanujan's equations in orbital mechanics and signal processing.
6. **Pure Mathematics Research:** His notebooks continue to be a source of unsolved problems and insights for mathematicians worldwide.

Conclusion

Ramanujan's legacy proves that genius can thrive beyond formal education. His intuition-driven discoveries not only reshaped mathematics but also continue to influence cutting-edge research in physics, computer science, and cryptography in the 21st century.

Q.4) Indigenization of technology is key to achieving strategic autonomy and reducing external dependence. Examine India's efforts towards indigenization in the fields of defence, space, and digital infrastructure. (250 words, 15 marks)

Introduction

Indigenization of technology refers to the development and production of critical systems, tools, and knowledge within the country. For India, it is essential to achieve strategic autonomy, ensure national security, and reduce reliance on foreign technology.

Body

India's Efforts Towards Indigenization

Defence

1. **Make in India – Defence:** The government launched initiatives to promote domestic manufacturing of weapons and platforms.
   Example: HAL's **Tejas** Light Combat Aircraft (LCA) is an indigenous fighter jet developed for the Indian Air Force.
2. **Defence Acquisition Reforms:** Restrictions on imports of various defence items to encourage local development.

Example: Defence Ministry released a **"positive indigenization list"** banning import of over 400 weapon systems and components.

3. **Private Sector Participation:** Indian startups and private firms are now key players in defence R&D.
   Example: **Bharat Forge** and **Larsen & Toubro** are involved in building artillery systems and naval platforms.

Space

1. **ISRO's Indigenous Missions:** ISRO has built launch vehicles and satellites using homegrown technologies.
   Example: The **GSLV Mk III** launch vehicle and Chandrayaan-3 mission were developed indigenously.
2. **Private Sector Collaboration:** India opened the space sector to private firms for innovation and manufacturing.
   Example: **Skyroot Aerospace**, an Indian startup, launched India's first private rocket, **Vikram-S**, in 2022.
3. **Satellite Navigation Systems:** India developed its own regional satellite navigation system.
   Example: **NAVIC** (Navigation with Indian Constellation) provides India with strategic independence from GPS.

Digital Infrastructure

1. **Digital India Mission:** A flagship program to promote self-reliance in digital services and infrastructure.
   Example: Development of **BharatNet** to connect rural India with high-speed internet.
2. **Indigenous Platforms and Technologies:** Efforts to reduce dependence on foreign software and tools.
   Example: **UPI** (Unified Payments Interface), developed by NPCI, has revolutionized digital payments in India.
3. **Cybersecurity and Data Sovereignty:** Focus on developing native cybersecurity frameworks and data storage norms.
   Example: CERT-In and MeitY have launched initiatives for indigenous **cybersecurity tools** and data localization.

Challenges in Indigenization

1. Technological Gaps: India still imports **60–70%** of its defence equipment due to the lack of advanced technology and R&D capabilities.
2. Limited Private Sector Ecosystem: The domestic private sector is still nascent in high-end tech domains like semiconductors and advanced aerospace systems.
3. Dependence on Foreign Components: Even indigenous platforms often rely on imported critical components like engines, sensors, and chips.
Example: The **Tejas LCA** uses an American-made GE engine.

4. Funding and Bureaucratic Hurdles: Slow project approvals and limited R&D funding restrict innovation and timely execution.
Example: Defence R&D budget has hovered around just **6–7%** of the total defence budget.

Way Forward

1. Strengthen R&D Ecosystem: Increase public and private investment in frontier research, with dedicated funding for innovation hubs.
2. Foster Public-Private Collaboration: Encourage joint ventures, tech transfers, and incubation programs to boost indigenous tech development.
3. Streamline Regulatory Frameworks: Simplify procurement procedures, ensure faster clearances, and reduce red tape to promote indigenous production.

Conclusion

India's push for indigenization in defence, space, and digital sectors reflects its strategic vision of ***Atmanirbhar Bharat***. These efforts not only strengthen national security and economic resilience but also position India as a global technology leader.

Q.5) India participated in the private Axiom Mission 4 through one of its trained astronauts. What is the significance of such collaborations for India's human spaceflight programme? And also Highlight the challenges. (250 words, 15 marks)

Introduction

India's participation in **Axiom Mission 4**, a private spaceflight to the International Space Station **(ISS)**, through **Group Captain Shubhanshu Shukla**, marks a significant milestone. It showcases India's growing global presence in human space exploration.

Body

Significance of Such Collaborations for India's Human Spaceflight Programme

1. **Exposure to International Spaceflight Operations:** Collaborating with private space missions like Axiom offers Indian astronauts hands-on experience in operating within the ISS environment.
2. **Accelerating Gaganyaan Mission Readiness:** Insights and training from international missions help ISRO refine its human spaceflight strategies, safety procedures, and life support systems.
3. **Enhancing Global Partnerships:** Such collaborations build diplomatic and technological ties with global space agencies and private firms.
4. **Skill Development and Capacity Building:** Participation fosters knowledge transfer in astronaut training, mission simulation, and biomedical monitoring in space.
5. **Promoting Private Sector Involvement:** India's entry into commercial spaceflight signals confidence in combining public research with private innovation.
6. **Boosting India's Global Image in Space Technology:** Taking part in such international missions elevates India's standing as an emerging leader in space technology.

Challenges

1. **High Cost of Human Spaceflight:** Human missions are far more expensive than satellite launches. Example: Gaganyaan's budget exceeds ₹10,000 crore.
2. **Limited Indigenous Infrastructure:** India currently lacks a fully operational human-rated launch system. Example: The GSLV Mk III is still undergoing human-rating upgrades.
3. **Space Medicine and Life Support Gaps:** Advanced systems for long-duration life support and space medicine are underdeveloped. Example: India relies on global partners for astronaut health tech.
4. **Low Private Sector Participation in Manned Missions:** Private firms are more engaged in satellite services than human spaceflight. Example: Few Indian companies have ventured into crewed module development.

Way Forward

1. **Strengthen Astronaut Training Ecosystem:** Develop indigenous astronaut training facilities with international standards to reduce reliance on foreign agencies.
2. **Encourage Public-Private Partnerships:** Enable Indian private space firms to collaborate with **ISRO** on human spaceflight modules, tech systems, and crew support.
3. **Establish a Human Spaceflight Research Hub:** Create a dedicated R&D institution focusing on long-duration spaceflight, microgravity experiments, and space medicine.
4. **Promote International Cooperation:** Foster long-term collaborations with **NASA, ESA, Roscosmos,** and private players like **SpaceX and Blue Origin**.

Conclusion

India's role in Axiom Mission 4 is a strategic leap toward building a robust **human spaceflight ecosystem**. It not only supports the but also aligns with India's vision of becoming a key global player in space exploration.

DAY- 51

Q.1) "Discuss the applications of nanotechnology in agriculture and healthcare. Highlight the key challenges in its widespread adoption in India." (150 words, 10 marks)

Introduction

Nanotechnology refers to the manipulation of matter at the atomic and molecular scale, typically below **100 nanometers**. It offers transformative applications in sectors like agriculture and healthcare, promising higher efficiency and smarter solutions.

Body

Applications in Agriculture

1. **Nano-fertilizers:** Increase nutrient use efficiency and reduce wastage. Example: **ICAR**-developed **zinc nano-fertilizers** enhance crop yield with minimal environmental impact.

2. **Nano-pesticides:** Enable **targeted delivery** and reduce chemical load on soil. Example: **IIT-Kharagpur** created **nano-formulations** to combat fungal infections in crops.
3. **Soil Health Monitoring:** Nano-sensors detect nutrient deficiencies and pH levels in real time. Example: **Portable nano-sensors** help farmers make timely soil amendment decisions.
4. **Food Packaging and Preservation:** Nano-coatings prevent microbial contamination and extend shelf life. Example: **Nano-silver** embedded packaging materials preserve perishable items.
5. **Water Purification for Irrigation:** Nano-filters remove toxins and heavy metals from irrigation water. Example: **Nano-iron particles** used to clean arsenic-contaminated water in Bengal.

Applications in Healthcare

1. **Targeted Drug Delivery:** Nanoparticles deliver drugs directly to affected cells, minimizing side effects. Example: **Liposomal doxorubicin** used in breast cancer therapy.
2. **Early Disease Diagnosis:** Nano-biosensors detect diseases at molecular levels. Example: **Gold nanoparticle**-based kits for TB and cancer screening.
3. **Nano-imaging and Theranostics:** Combines diagnostics and therapy in a single nanodevice. Example: **Quantum dots** used in imaging cancer cells.
4. **Antimicrobial Coatings:** Nano-silver and copper coatings reduce hospital-acquired infections. Example: AIIMS used **nano-coatings** on medical instruments during COVID-19.
5. **Regenerative Medicine:** Nanomaterials aid tissue repair and wound healing. Example: **Nano-hydroxyapatite scaffolds** in bone regeneration.

Challenges in Widespread Adoption in India

1. **High Cost and Limited Access:** Nanotech products are expensive and unaffordable for small farmers and rural clinics. Example: Nano-fertilizers cost significantly more than conventional ones.
2. **Regulatory Gaps and Safety Concerns:** Lack of standardized safety protocols for nanomaterials. Example: No comprehensive Indian regulation for nano-pesticide residue limits.
3. **Limited R&D Infrastructure:** Few dedicated nanotech labs for agriculture or public healthcare. Example: Most innovations limited to premier institutes like IITs and CSIR labs.
4. **Low Awareness and Skill Deficit:** Farmers and healthcare workers lack training in nanotech applications. Example: Few extension programs include nano-based agricultural solutions.

Way Forward

1. **Dedicated National Mission:** Implement a comprehensive National Mission on Nano-Bio Applications in Agriculture and Health under the Department of Science & Technology.
2. **Regulatory Framework:** Strengthen the guidelines under the **Food Safety and Standards Authority of India (FSSAI)** and Central Insecticides Board to cover nanomaterials.
3. **Capacity Building:** Expand training and outreach through **Krishi Vigyan Kendras** and Ayushman Bharat to raise awareness and build local capacity.

4. **Government Incentives:** Promote startups and public-private partnerships through schemes like the **National Nanotechnology Mission** and Make in India.

Conclusion

Nanotechnology holds immense potential for revolutionizing agriculture and healthcare in India. Overcoming infrastructural, regulatory, and financial hurdles is crucial to realize its benefits and ensure inclusive, safe, and sustainable deployment across the nation.

Q.2) Balancing the protection of intellectual property rights with the larger public interest remains a key policy challenge in developing countries. Examine in the Indian context. (150 words, 10 marks)

Introduction

Intellectual Property Rights (IPRs) incentivize innovation, yet excessive protection can hinder public access. In a developing country like India, balancing **innovation and social equity** remains a persistent and nuanced policy challenge.

Body

Importance of Balancing IPR and Public Interest in India

1. **Access to Affordable Medicines:** Excessive patent protection can limit access to life-saving drugs. Example: India allowed **Natco** to produce a low-cost generic version of **Nexavar** in 2012.
2. **Encouraging Indigenous Innovation:** Strong but flexible IPR regime supports local R&D without stifling competition. Example: Startup India helps new firms with IP filings and awareness.
3. **Agricultural Sustainability:** Over-patenting of seeds can hurt farmers' rights and food security. Example: **PPVFR Act** lets farmers reuse and share seeds legally.
4. **Educational and Research Access:** Strict copyright laws can hinder academic sharing in resource-poor settings. Example: **DU photocopy case** highlighted fair use in education.
5. **Traditional Knowledge Protection:** Global patents on indigenous knowledge can lead to biopiracy. Example: **TKDL** prevents misappropriation of Ayurveda formulations.
6. **Digital Innovation vs. Monopoly:** Tech patents can restrict the growth of startups in AI and software. Example: India excludes software patents to support open innovation.

Challenges in Striking the Balance

1. **International Pressure:** Trade agreements push India to adopt stricter patent regimes. Example: India is targeted in the **U.S. Special 301 Report**.
2. **Judicial Ambiguity:** Courts vary in interpreting the scope of compulsory licenses and public interest. Example: Inconsistent rulings create legal uncertainty.
3. **Enforcement Issues:** Weak IPR enforcement deters foreign investment and local innovators alike. Example: India ranks low on the Global Innovation Index.
4. **Lack of Public Awareness:** Many startups and grassroots innovators remain unaware of IPR protections. Example: **MSMEs** underuse patent filing schemes.

Way Forward

1. **Strengthen Legal Clarity:** Streamline judicial guidelines for interpreting public interest in IPR cases.
2. **Expand Compulsory Licensing:** Use it judiciously in health, agriculture, and environmental sectors.
3. **Boost IP Literacy:** Integrate IPR awareness in higher education, R&D institutions, and startup incubators.

Conclusion

India's IPR policy seeks to balance innovation incentives with inclusive access. **The National IPR Policy 2016** promotes this balance through legal reform, education, and traditional knowledge protection—key to ensuring both development and equity.

Q.3) Despite a visible decline in Left-Wing Extremist violence in recent years, the underlying issues of underdevelopment and alienation persist in affected regions. Analyse in the context of recent developments. (150 words, 10 marks)

Introduction

Left-Wing Extremism (LWE), rooted in Maoist ideology, began in **Naxalbari in 1967** as a peasant revolt. Though violence has declined recently, core issues like tribal alienation and underdevelopment still persist in affected regions.

Body

Indicators of Declining Violence

1. **Decline in Violence:** Security operations and development efforts have reduced LWE-related incidents. Example: MHA data shows a **77% drop** in LWE violence between **2010 and 2023**.
2. **Enhanced Security Infrastructure:** More Forward Operating Bases (FOBs) and road projects have improved force mobility. Example: Over **500 km of roads** built under the Road Requirement Plan-I in affected districts.
3. **Surrender and Rehabilitation:** Many extremists have surrendered due to pressure and incentives. Example: **Jharkhand and Chhattisgarh** report hundreds of surrenders in recent years.

Persistent Issues of Alienation and Underdevelopment

1. **Lack of Basic Services:** Many LWE-affected areas still lack health, education, and clean drinking water. Example: Several districts in **Odisha and Jharkhand** have poor access to PHCs and schools.
2. **Weak Local Governance:** Shortage of officers and weak panchayats limit development and trust in state institutions. Example: Administrative posts remain vacant in parts of **Chhattisgarh and Bihar**.

3. **Land and Forest Disputes:** Delay in recognising tribal land rights continues to fuel anger and unrest. Example: Poor implementation of **Forest Rights Act** leaves many without legal land ownership.
4. **Poor Execution of Welfare Schemes:** Leakages and corruption reduce the impact of government programmes. Example: **MGNREGA payments** are often delayed or siphoned off in remote villages.
5. **Digital and Financial Exclusion:** Many people in LWE zones lack internet access or bank accounts. Example: **DBT** benefits often don't reach remote areas in Maharashtra and Andhra Pradesh.
6. **Fear and Mistrust:** People fear both security forces and extremists, making cooperation difficult. Example: Civilians avoid reporting Maoist activity due to fear of retaliation.

Way Forward

1. **Inclusive Governance:** Strengthen local administration through the **Aspirational Districts Programme and Mission Karmayogi** to improve delivery and capacity.
2. **Land and Forest Rights Implementation:** Speed up implementation of **FRA and PESA Acts** with support from schemes like **Van Dhan Yojana**.
3. **Skill and Employment Generation:** Promote livelihoods through schemes like RSETI, NRLM, and PM Vishwakarma Yojana in tribal belts.
4. **Build Trust Through Dialogue:** Use Jan Samvad campaigns and community policing initiatives like **"Aastha" in Chhattisgarh** to build confidence and reduce fear.
5. **Use of Integrated Strategy:** Effectively apply the **SAMADHAN strategy** that combines leadership, technology, intelligence, and development efforts to tackle extremism from all angles.

Conclusion

Despite operational success, sustainable peace demands addressing structural causes of LWE. Recent moves like the **Aspirational Districts Programme** and revamped surrender policies must be complemented by deeper reforms to ensure inclusive and lasting development.

Q.4) Biotechnology is playing an increasingly important role in Indian agriculture. Discuss its major applications and examine the environmental and regulatory concerns associated with its use. Suggest measures to ensure its safe and sustainable deployment. (250 words, 15 marks)

Introduction

Biotechnology uses biological processes and organisms to develop useful products. In Indian agriculture, it is increasingly applied to improve crop yield, nutrition, and sustainability—making it vital to food security and climate resilience.

Body

Major Applications of Agricultural Biotechnology in India

1. **Genetically Modified (GM) Crops:** Enhance yield, pest resistance, and reduce pesticide usage. Example: **Bt cotton** led to a sharp decline in pesticide use and improved farmer incomes.
2. **Biofertilizers and Biopesticides:** Promote soil health and reduce chemical input dependence. Example: **Use of Rhizobium and Azotobacter** as nitrogen-fixing biofertilizers in legume farming.
3. **Tissue Culture:** Enables mass propagation of disease-free, high-yielding plant varieties. Example: **Banana and sugarcane** are widely propagated through tissue culture in Maharashtra and Tamil Nadu.
4. **Molecular Breeding:** Speeds up development of stress-resistant crop varieties using gene markers. Example: Development of **drought-resistant rice** under the ICAR's marker-assisted selection programs.
5. **Genetic Diagnostics:** Helps detect plant pathogens early to prevent spread. Example: **PCR-based tools** are used to detect viruses in **chillies and tomato crops**.
6. **Animal Biotechnology:** Improves livestock health and productivity through vaccines and diagnostics. Example: Development of FMD **(Foot-and-Mouth Disease) vaccines** for cattle.

Environmental and Regulatory Concerns

1. **Biodiversity Loss:** GM crops may impact natural genetic diversity by crossbreeding with wild relatives. Example: Concerns raised about **Bt cotton**'s impact on non-target insects and local varieties.
2. **Emergence of Superweeds/Pests:** Prolonged use may lead to resistance among pests or weeds. Example: **Bollworm resistance to Bt toxins** has been reported in some regions of Gujarat.
3. **Soil and Water Health:** Over-reliance on biotech inputs might affect soil microbial life and groundwater. Example: Intensive Bt cotton cultivation linked with falling soil fertility in parts of Punjab.
4. **Biosafety Risks:** Lack of comprehensive field trials and impact assessments can pose risks. Example: Controversy over **GM mustard** due to concerns over long-term ecological impacts.
5. **Weak Regulatory Oversight:** Gaps in coordination between agencies and lack of public engagement. Example: **GEAC** decisions often face criticism for inadequate transparency.

Measures for Safe and Sustainable Deployment

1. **Strengthen Regulatory Framework:** Make GEAC more transparent, autonomous, and inclusive of public feedback. Example: Include civil society and farmers' representatives in decision-making processes.
2. **Encourage Non-GM Biotech Alternatives:** Promote molecular breeding and bio-inputs over GM crops where feasible.
3. **Conduct Long-Term Environmental Assessments:** Ensure thorough field testing, ecological studies, and post-release monitoring.
4. **Promote Farmer Awareness and Training:** Equip farmers with knowledge about safe use, risks, and benefits.
5. **Develop Region-Specific Strategies:** Tailor biotech applications to agro-climatic zones and cropping patterns to prevent overuse.

6. **Strengthen IP and Benefit-Sharing Mechanisms:** Protect farmers' rights under the Protection of Plant Varieties and Farmers' Rights **(PPVFR) Act**.

Conclusion

Biotechnology can boost Indian agriculture if used responsibly. A strong **Biotechnology Regulatory Authority** is needed, along with the **National Biotechnology Development Strategy**, to ensure safety, farmer welfare, and environmental sustainability in its future adoption.

Q.5) In light of the recent Pahalgam terror attack on pilgrims in Jammu & Kashmir, examine the evolving nature of terrorism in the region. How can India strengthen its intelligence, coordination, and preventive response to such targeted civilian attacks? (250 words, 15 marks)

Introduction

The recent Pahalgam terror attack on pilgrims highlights the changing face of terrorism in Jammu & Kashmir, where civilians and soft targets are increasingly in focus. It raises urgent concerns about security preparedness and coordination.

Body

Evolving Nature of Terrorism in J&K

1. **Shift to Soft Targets:** Terror groups now focus more on unarmed civilians, tourists, and pilgrims to instill fear and attract media attention. Example: The attack on **Amarnath pilgrims in 2017** and the recent Pahalgam incident.
2. **Proxy and Hybrid Militancy:** Locals with minimal training are recruited for single operations, blurring the line between civilians and terrorists. Example: **Lone-wolf** or part-time militants with no known terror background.
3. **Use of Technology:** Encrypted communication, drones for arms delivery, and digital propaganda are rising. Example: **Drone-dropped weapons** recovered near border districts in Jammu region.
4. **Cross-border Support:** Despite tighter borders, Pakistan-backed groups continue infiltration and support via sleeper cells and logistics. Example: Recovery of arms caches with Pakistani markings.

Strengthening India's Response

1. **Intelligence Fusion:** Establish real-time coordination through Multi-Agency Centres and use AI to track movement patterns. Example: Integration of IB, RAW, and local police inputs through **NATGRID.**
2. **Tech-Enabled Surveillance:** Expand drone monitoring, facial recognition, and CCTV coverage across highways and religious sites. Example: Drone surveillance successfully foiled a terror attempt in Samba (2022).
3. **Community Policing & Early Warning:** Empower locals to report suspicious activity using mobile apps and reward systems. Example: Jammu Police's community informant network has helped track potential threats early.

4. **Pilgrim Protection Protocols:** Upgrade SOPs for Yatra routes with RFID tracking, quick response teams, and air surveillance. Example: The Amarnath Yatra security grid post-2017 includes RFID tags and 24/7 monitoring.
5. **Counter-Radicalisation Measures:** Run targeted de-radicalisation programs, online monitoring, and educational outreach in vulnerable communities. Example: **J&K Police's "Taameer" initiative** for youth engagement in Pulwama and Shopian.
6. **Crisis Response Drills:** Conduct regular mock drills and inter-agency coordination exercises for high-risk events and locations. Example: Annual mock evacuation drills conducted along the **Amarnath Yatra route**.

Steps Already Taken by India

1. **Revocation of Article 370:** Enabled better central control and coordination of security operations in J&K.
2. **Modernisation of Police Forces:** Under the MPF Scheme, J&K police have been equipped with bulletproof vehicles, body cameras, and surveillance tools.
3. **Increased Border Security:** Deployment of anti-drone systems and underground detection sensors along the Line of Control (LoC).
4. **Intelligence Infrastructure Expansion:** Strengthening **NATGRID** and establishing more Intelligence Fusion Centres in border areas.
5. **Operation Sindoor:** Launched after the **Pahalgam attack** to secure pilgrimage routes and neutralize terror threats through area domination and aerial surveillance.

Conclusion

The nature of terrorism in J&K is evolving, demanding **proactive adaptation** in **India's counter-terror strategy**. Enhanced coordination, tech integration, and community involvement will be key to preventing future attacks and securing civilian lives.

DAY- 52

Q.1) How can social media influencers become a threat to India's national security? What laws and rules help the government deal with these risks? (150 words, 10 marks)

Introduction

With their vast online reach, social media influencers can significantly **shape public opinion**. **In 2023**, an influencer from **Punjab used Instagram and YouTube** to promote **pro-Khalistan** views, highlighting the potential threats influencers pose to national security.

Body

How Influencers Can Threaten National Security

1. **Spreading Misinformation:** Fake news about communal issues, military operations, or natural disasters can trigger panic or violence. Example: During **COVID-19**, some promoted fake cures, causing panic buying.

2. **Propaganda and Radicalization:** Foreign-sponsored influencers may promote anti-India narratives or extremist ideologies. Example: Pro-Khalistan accounts incited unrest during the **Amritpal Singh** crackdown.
3. **Cyber Espionage:** Influencers sharing sensitive geolocation or troop data can compromise secrecy. Example: In 2020, some YouTubers shared troop movements during the **Galwan** standoff.
4. **Economic Disruption:** Promoting scams or crypto schemes can destabilize trust. Example: The **'Morris Coin' scam** duped many investors.
5. **Undermining Democratic Institutions:** Fake election-related content can erode trust in democratic processes.
6. **Deepfake Technology:** Influencers using AI impersonations can mislead the public and authorities.

Legal and Regulatory Measures

1. **Information Technology (IT) Rules, 2021:** Mandates due diligence for social media platforms and empowers flagging of fake or harmful content.
2. **Bharatiya Nyaya Sanhita (BNS):** Sections on sedition, promoting enmity, and public mischief apply to harmful online acts.
3. **Unlawful Activities (Prevention) Act (UAPA):** Allows action against influencers promoting terrorism or anti-national content.
4. **Broadcasting Services (Regulation) Bill (proposed):** Aims to regulate OTT and digital content, including influencers.
5. **Digital Personal Data Protection Act, 2023:** Prevents misuse of personal data by influencers and platforms.
6. **FEMA & FCRA:** Used to monitor foreign funding or business deals that may affect national interests.

Way Forward

1. **Stronger Vetting and Monitoring:** Set up AI-driven monitoring cells to detect coordinated harmful content early, especially during sensitive events like elections or crises.
2. **Influencer Code of Conduct:** Introduce mandatory training and certification for influencers on responsible content creation and national security awareness.
3. **Collaborative Fact-Checking Framework:** Encourage collaboration between government, civil society, and platforms to flag and counter disinformation rapidly.

Conclusion

India must strengthen enforcement and digital literacy. Adopting global models like the **EU's Digital Services Act** can help build accountability while ensuring free expression remains protected and national security safeguarded.

Q.2) The UN Convention on Cybercrime marks a major step in global efforts to combat cyber threats. Highlight its key provisions and analyze its significance for India in addressing cross-border cybercrime challenges. (150 words, 10 marks)

Introduction

The UN Convention on Cybercrime, adopted by the UN General Assembly **in 2024**, provides the first legally binding global framework to address cybercrime through cooperation, jurisdiction, and procedural tools—vital for digitally expanding nations like India.

Body

Key Provisions of the Convention

1. **Criminalisation of Core Cyber-Offences:** Establishes offences such as hacking, identity theft, fraud, child exploitation and ransomware as crimes.
2. **Procedural Tools for Investigation:** Enables preservation of electronic evidence, real-time data interception orders, and expedited search and seizure.
3. **International Cooperation Mechanisms:** Mandates mutual legal assistance, designation of 24/7 contact points, data sharing, and joint cross-border investigations.
4. **Human Rights Safeguards:** Includes privacy protections, respect for due process, and limits on surveillance powers.
5. **Capacity Building for Developing States:** Promotes technical assistance, training, and resource sharing, especially for developing countries.

Significance for India

1. **Bridging Jurisdictional Gaps:** Facilitates action against cybercrimes originating abroad, including phishing and ransomware affecting Indian users.
2. **Strengthening Law Enforcement Agencies :** Supports Indian agencies like **CERT-In, NCIIPC, and NIA** in gathering and sharing digital evidence internationally.
3. **Legal Harmonisation:** Pushes reform of the **IT Act, 2000** and aligned laws to meet global standards and obligations under the convention.
4. **Enhancing Citizen Trust:** Strengthens protections for digital payments, personal data, and public infrastructure security.
5. **Global Leadership Role:** Shows India's willingness to lead in crafting a trusted, secure global digital order.

Way Forward

1. **Amend Domestic Laws:** Revise the IT Act and allied legislation to reflect provisions of the Convention.

2. **Build Institutional Capacity:** Train law enforcement, judiciary, and cyber investigators in new cross-border procedures.
3. **Deepen International Links:** Participate in bilateral and multilateral initiatives, including with **CBI's Bharatpol and I4C** under MHA.
4. **Public Awareness and Collaboration:** Raise citizen awareness on cyber hygiene and encourage reporting of cybercrime.

Conclusion

India's involvement in the **UN Cybercrime Convention** enables it to close jurisdictional gaps, enhance LEA capacities, and modernise cyber laws. Effective ratification and coordination will be critical to combat global cyber threats.

Q.3) What is the Integrated Theatre Command (ITC) system? Critically evaluate its need and challenges in the Indian context. (150 words, 10 marks)

Introduction

Recommended by the **Shekatkar Committee**, the Integrated Theatre Command (ITC) aims to integrate the Army, Navy, and Air Force under a **unified command structure** for better synergy in planning and execution of operations.

Body

Need for ITC in the Indian Context

1. **Operational Efficiency:** Helps in joint planning and resource optimization, especially crucial in a two-front war scenario.
2. **Cost-effectiveness:** Avoids duplication of assets across services, ensuring optimal use of budget and resources.
3. **Quicker Decision-making:** A unified command facilitates faster response to emerging threats.
4. **Global Practice:** Countries like the **USA and China** have adopted integrated commands, showcasing its strategic relevance.

Challenges in Implementation

1. **Inter-service Rivalry:** Lack of consensus among services regarding structure and command hierarchy.
2. **Theatre Demarcation:** Geographical and functional boundaries for theatres remain contentious.
3. **Human Resource Integration:** Aligning training, culture, and promotional pathways is a complex task.
4. **Lack of Doctrine:** Absence of a comprehensive joint doctrine for integrated operations.

Way Forward

1. **Clear Legislative Mandate:** Define the roles and responsibilities of ITC through proper legislative backing.
2. **Capacity Building:** Invest in joint training and shared infrastructure to facilitate integration.
3. **Consensus Building:** Encourage dialogue among services to resolve disagreements.
4. **Phased Implementation:** Start with pilot commands and scale gradually based on learnings.

Conclusion

With 2025 declared the **"Year of Reforms,"** empowering the **CDS to issue joint orders** marks a pivotal step toward integration and strengthens India's path to establishing functional Integrated Theatre Commands (ITCs).

Q.4) What are the new methods used for money laundering and terrorist financing as highlighted in FATF's 2025 update? How can India improve its efforts to tackle these threats at both national and global levels? (250 words, 15 marks)

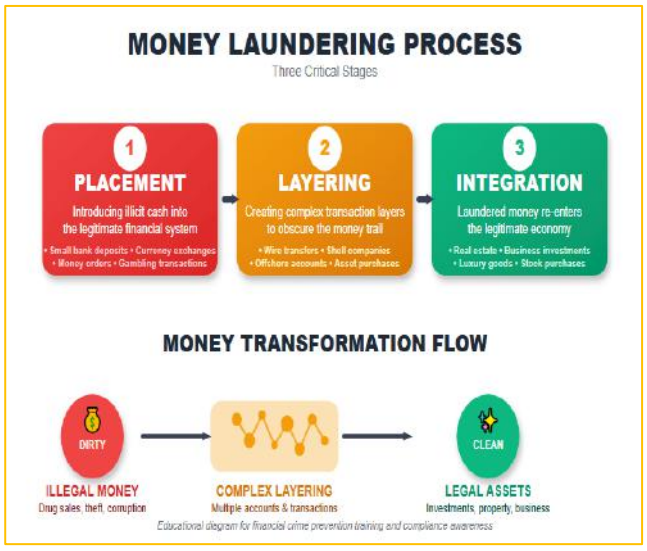
Introduction

Money laundering is the process of **making illegal proceeds appear lega**l. As per FATF's 2025 update, evolving technologies and globalized finance are enabling new laundering and terrorist financing methods, challenging India's national and international enforcement systems.

Body

New Methods Identified by FATF (2025)

1. **Use of Cryptocurrencies and Virtual Assets:** Terror groups use virtual currencies for anonymous cross-border transfers.
2. **Trade-Based Money Laundering (TBML):** Mis-invoicing and over/under-invoicing in international trade hide illicit funds.
3. **Crowdfunding Platforms:** Misused for raising funds under humanitarian pretexts.
4. **Shell Companies and Complex Ownership Structures:** Layering ownership across jurisdictions to obscure sources.
5. **Smurfing via Digital Wallets:** Splitting transactions into small amounts through mobile wallets or prepaid cards.



India's National Efforts to Tackle These Threats

1. **Strengthening Enforcement Directorate under PMLA:** Empowering the ED to track, seize and prosecute laundered assets.

2. **FIU-IND Monitoring:** Financial Intelligence Unit analyses suspicious transaction reports from banks and financial institutions.
3. **Digital KYC and Aadhaar Integration:** Ensures customer due diligence across platforms.
4. **Crackdown on Illicit Crypto Exchanges:** Recent ED actions against unregulated exchanges show rising vigilance.
5. **Amendments to Unlawful Activities (Prevention) Act (UAPA):** Enables designation of individuals and freezing of assets linked to terrorism.

India's Global Engagements and Cooperation

1. **Active FATF Participation:** India supports global standards and regularly updates compliance frameworks.
2. **Bilateral Treaties and Information Exchange:** Agreements with nations to trace and repatriate black money.
3. **Membership in Egmont Group:** Enhances global cooperation among FIUs for intelligence sharing.

Conclusion

India must combine strict laws like **PMLA** with global coordination and technological surveillance. As global norms evolve, India's proactive participation and adaptive enforcement will be key to countering financial crimes.

Q.5) What is hybrid warfare? Discuss the emerging threats it poses to India's national security and suggest measures to strengthen India's preparedness against such challenges. (250 words, 15 marks)

Introduction

Hybrid warfare refers to a blend of conventional warfare, irregular tactics, cyber operations, disinformation campaigns, and economic coercion. It exploits a nation's vulnerabilities across **multiple domains**, posing **new-age threats** to India's national security.

Body

Emerging Hybrid Warfare Threats to India

1. **Cyber Attacks on Critical Infrastructure:** Attacks have targeted power grids and health systems.
   Example: Malware attack on Maharashtra's grid (2020); AIIMS cyber breach (2022).
2. **Disinformation & Influence Operations:** Social media used to polarize and spread fake narratives.
   Example: Disinformation during Delhi riots (2020); Manipur unrest (2023).
3. **Terrorism and Insurgency with Cross-Border Support:** Drones used to smuggle arms and aid terror groups. **Example:** Drone arms drops in Punjab (2022); Reasi attack on pilgrims (2024).

4. **Economic and Trade-Based Pressure:** Disrupting supply chains to create dependence. **Example:** API supply shocks during COVID; EV disruptions due to lithium issues (2024).
5. **Maritime and Grey-Zone Tactics:** Civilian vessels used for surveillance in Indian waters. **Example:** Chinese ships near Andamans (2022).

Measures to Strengthen India's Preparedness

1. **Integrated Cyber Defence Framework:** Strengthen CERT-In, military-civilian coordination, and real-time threat sharing.
2. **Strategic Communication Units:** Establish agencies to counter disinformation and fake news.
3. **Modernization of Armed Forces with Jointness:** Roll out Theatre Commands and invest in AI, drones, EW.
4. **Public Awareness and Digital Literacy:** Educate citizens on digital hygiene and misinformation.
5. **Multi-Domain Task Forces:** Civil-military teams for hybrid threat response.
6. **Enhanced Maritime Surveillance:** Expand radar networks and ship tracking capabilities.

Steps Already Taken by India

1. **Creation of Defence Cyber Agency:** Protects military assets from cyber threats.
2. **Banning of Hostile-Origin Apps:** Chinese-origin apps banned over data and influence risks.
3. **New IT Rules and Fact-Check Units:** Counter misinformation online.
4. **Induction of Advanced Technologies:** Use of **AI and drones** on sensitive borders.

Way Forward

1. **Formulate a National Hybrid Warfare Strategy:** Define roles for civil, military, and intelligence agencies.
2. **Strengthen Global Partnerships:** Collaborate with like-minded countries on cyber norms and maritime security.
3. **Capacity Building and Red-Teaming:** Regular drills **simulating hybrid attacks** across sectors.

Conclusion

Hybrid warfare demands proactive defence. India must adopt a **whole-of-nation approach**—blending **technology, coordination, and foresight**—to protect its sovereignty and democratic institutions from emerging multi-domain threats.