Q.1) Examine the key drivers and challenges of India's manufacturing sector. Comment on the government policies in this regard. (150 Words, 10 Marks)

Introduction

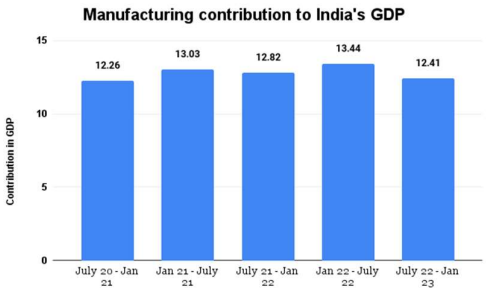
India's manufacturing sector contributes ~14% to GDP (2025) and is vital for employment, exports, and economic self-reliance. Despite major reforms, structural bottlenecks hinder achieving the target of 25% GDP share.

Body

Key Drivers

- **Demographic Advantage:** A large working-age population (~565 million) provides abundant labor supply for manufacturing industries.
- **Foreign Investments:** FDI inflows grew 57% (2014–24), supported by Make in India and PLI incentives.
- **Export Opportunities:** Global supply-chain diversification and high PMI (59.1 in 2025) signal robust demand and export growth.
- **Emerging Sectors:** Expansion in electronics, EVs, semiconductors, and drones strengthens high-value manufacturing.
- **Infrastructure Development:** PM Gati Shakti and industrial corridors reduce logistics costs and enhance competitiveness.

Challenges



- **Low GDP Share:** Manufacturing's share declined to ~14%, far from the 25% target.
- **Skill Deficiency:** Only a small fraction of workers are vocationally trained, affecting productivity.
- **Logistics Inefficiencies:** High transport costs and weak MSME infrastructure hinder scale.
- **Limited R&D:** Low R&D investment (~0.7% of GDP) limits technological innovation and vertical integration.
- **Trade Barriers:** Tariffs and global trade uncertainties challenge competitiveness and export stability.

Government Policy Initiatives

- **Make in India:** Launched in 2014 to attract investments across 25 sectors, aiming to increase manufacturing's GDP share to 25% and create 100 million jobs.
- **Production Linked Incentive (PLI) Scheme:** Covers 14 sectors, offering incentives worth ₹2 lakh crore to boost domestic production and reduce import dependence.
- **National Manufacturing Policy (NMP):** Promotes National Investment and Manufacturing Zones (NIMZs) to create large-scale industrial hubs with fiscal incentives.

- **Ease of Doing Business Reforms:** Implementation of GST, IBC, online single-window clearances, and labor code reforms improved India's global ranking from 142 (2014) to 63 (2020).

- **Skill Development Programs:** Initiatives like Skill India, PM Kaushal Vikas Yojana, and Atal Innovation Mission focus on skilling workers and fostering innovation.
- **FDI Liberalization:** 100% FDI permitted under automatic routes in several manufacturing sectors to attract foreign capital and technology transfer.
- **Digital and Infrastructure Push:** PM Gati Shakti, Digital India, and industrial corridors are improving logistics and reducing operational costs.
- **Sector-Specific Incentives:** Mega Textile Parks, Electronics Manufacturing Clusters, and National Solar Mission support competitive sectoral growth.
- **Green Manufacturing:** Zero Effect Zero Defect (ZED) Certification and renewable energy incentives promote sustainable and energy-efficient industrial practices.

Conclusion

Bridging skill gaps, enhancing R&D, and easing regulations are crucial to make India a global manufacturing hub. Sustained reforms can accelerate industrial growth and move India toward its $5 trillion economy goal.

Q.2) 'Data is the new oil, but unlike oil, its utility is limitless.' Analyse this statement in the context of monopolistic practices of Big Tech firms and suggest policy reforms for India's digital economy. (150 Words, 10 Marks)

Introduction

Data, termed as the "new oil," drives innovation and economic value in the digital era. Unlike finite oil, data's non-rivalrous nature allows limitless reuse, raising concerns over Big Tech monopolies in India's digital economy.

Body

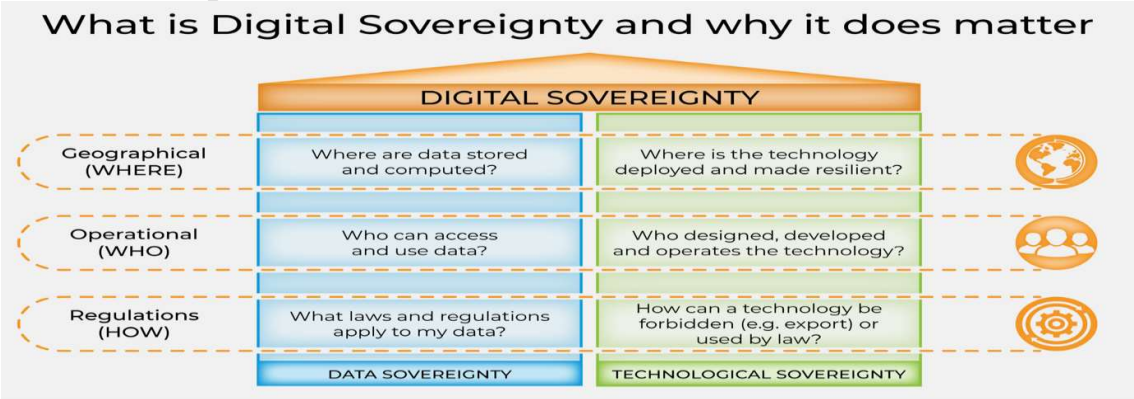
Monopolistic Practices of Big Tech

- **Market Concentration:** Google controls **~95% of India's search engine market**, Amazon and Flipkart together hold **~60% of e-commerce**, and Meta owns leading social platforms (WhatsApp, Instagram, Facebook), reducing competition.
- **Data Hoarding:** Big Tech companies collect and store massive user data—Google processes over **20 petabytes daily**—enabling strong network effects and consumer lock-in.

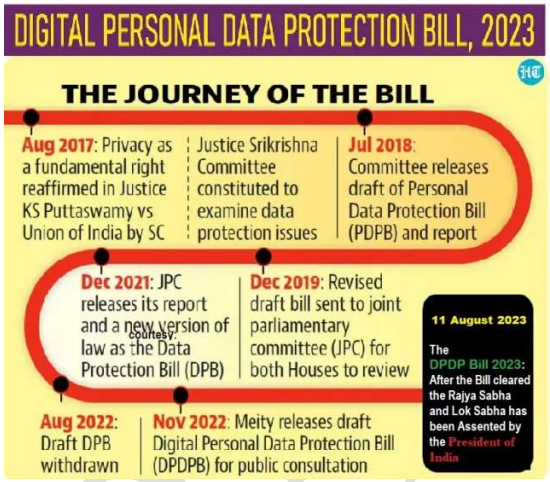
- **Predatory Pricing:** Amazon and Flipkart have offered **70–80% discounts** during major sales, pushing many small online retailers out of business.
- **Platform Gatekeeping:** Apple and Google levy **up to 30% commissions** on in-app payments, limiting smaller developers' access to markets.
- **Opaque Algorithms:** Lack of algorithm transparency has caused issues like **fake news amplification on Facebook** and biased product visibility on e-commerce sites.

Implications for Digital Economy

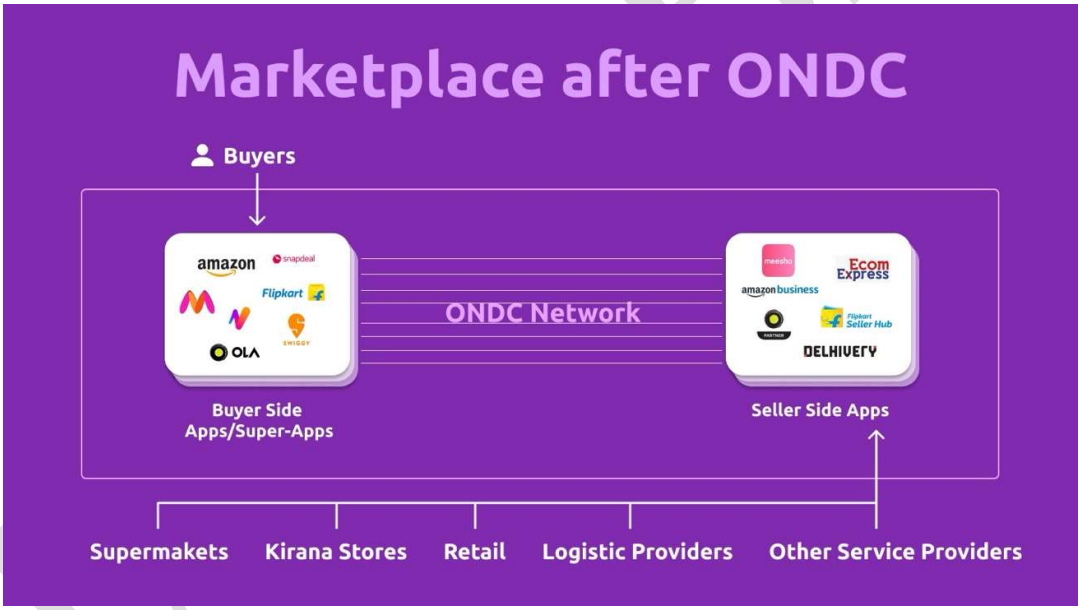
- **Reduced Innovation:** Dominance discourages startups—India's app ecosystem sees **fewer than 10% of new apps** reaching scale due to entry barriers.
- **Privacy Concerns:** Data breaches like **Facebook–Cambridge Analytica** exposed millions of users' personal data, risking misuse and surveillance.
- **Economic Inequality:** Google and Meta account for **~80% of India's digital ad revenue**, leaving smaller firms with limited monetization opportunities.
- **Digital Sovereignty Risks:** Heavy reliance on foreign cloud services means **70% of India's data is stored abroad**, reducing national control over critical infrastructure.
- **Regulatory Challenges:** Rapid tech evolution outpaces laws; India's Competition Commission struggled for years to address **Google Play Store billing disputes**.



Policy Reforms for India



- **Data Protection Law:** Implement the **Digital Personal Data Protection Act (2023)** fully to regulate data usage and penalize misuse.
- **Ex-ante Competition Regulation:** Empower regulators to proactively investigate anti-competitive behavior (similar to EU's **Digital Markets Act**).
- **Data Localization:** Mandate local storage of sensitive financial and personal data to strengthen security (e.g., RBI's directive for payment companies).
- **Open Digital Ecosystems:** Scale **UPI** and **ONDC** to provide low-cost, interoperable platforms, reducing dependence on single private gateways.



- **Digital Antitrust Framework:** Introduce rules for algorithmic transparency and mandatory data-sharing with startups, modeled on **Australia's News Media Bargaining Code.**

Conclusion

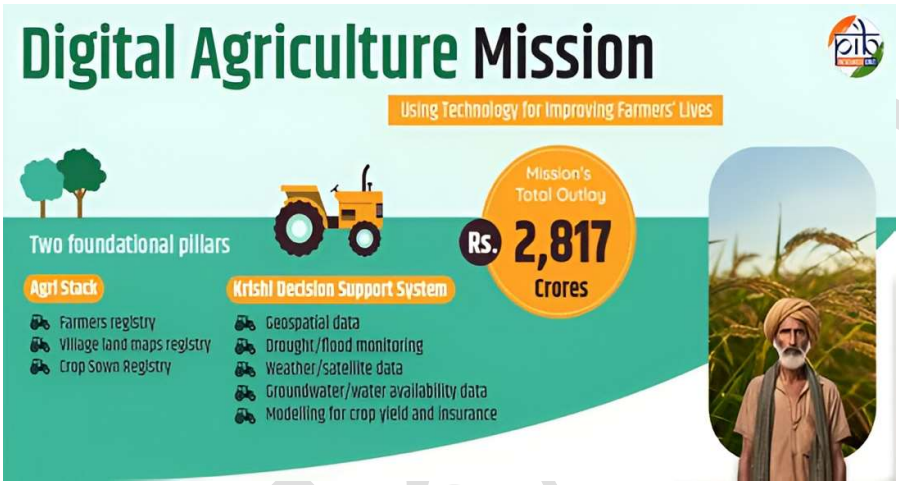
With limitless potential, data can fuel inclusive digital growth if monopolistic control is checked. Strengthening privacy, competition, and open ecosystems can make India's digital economy fair, innovative, and globally competitive.

Q.3) Discuss the objectives and expected outcomes of India's Digital Agriculture Mission. How can digitisation transform agricultural productivity and farmers' livelihoods? (150 Words, 10 Marks)

Introduction

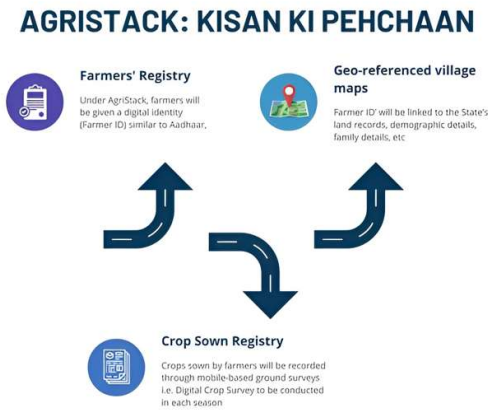
India's Digital Agriculture Mission (DAM), launched in 2021, aims to harness emerging technologies like AI, IoT, drones, and blockchain to modernize agriculture. It envisions data-driven, efficient, and sustainable farming for enhanced farmer incomes.

Body



Objectives of Digital Agriculture Mission

- **Unified Farmer Database:** A federated registry aims to cover **over 140 million farmers**, ensuring targeted subsidies, Kisan Credit Cards, and welfare delivery without duplication.
- **Technology Integration:** AI-based tools and **over 500 drones deployed under Digital Sky platform** support precision farming and pest control.
- **Smart Advisory Services:** Apps like **Kisan Suvidha** provide weather forecasts, pest alerts, and crop planning guidance to millions of farmers.



- **Improved Market Access:** Platforms like **eNAM (1,260 mandis integrated)** facilitate transparent trading; ONDC pilots are connecting farmers directly with buyers.
- **Public-Private Partnerships:** Collaboration with firms like **Microsoft and IBM** for farm data analytics and scalable agri-solutions.

Expected Outcomes

- **Enhanced Productivity:** Precision farming using AI and sensors has shown **15–20% yield improvement** in pilot states like Andhra Pradesh.
- **Efficient Resource Use:** Smart irrigation reduces water usage by **30–40%** (PMKSY micro-irrigation schemes).
- **Financial Inclusion: Over 12 crore PM-Kisan beneficiaries** receive direct income transfers through digital platforms.
- **Increased Farmer Income:** Digital marketplaces and reduced intermediaries increase returns by **10–15%**, as seen in Karnataka's Unified Market Platform.
- **Resilient Agriculture:** Real-time satellite data under **Bhuvan and FASAL** projects aids climate adaptation and disaster risk management.

Role of Digitisation in Transforming Agriculture

- **Precision Farming:** IoT soil sensors and AI-based advisory tools help farmers optimize inputs, boosting profits by **up to 25%**.
- **Drone Technology:** Used for rapid soil mapping, fertilizer spraying; in 2023, **100,000 hectares** were monitored with drones under pilot schemes.
- **Digital Marketplaces:** eNAM and ONDC initiatives connect farmers to national buyers, reducing reliance on traditional mandis.
- **Blockchain Traceability:** Adopted in spice exports from Kerala to ensure quality and traceability, boosting overseas market access.
- **Knowledge Dissemination:** Mobile apps like **AgriApp and mKisan** deliver scientific practices and market updates to **30 million+ farmers**.

Digitisation Area	Example / Application
1. AI Crop Advisory	1. FASAL, Kisan Suvidha – satellite-based and AI-driven crop guidance
2. Weather Alerts	2. IMD dashboards, SMS alerts
3. Digital Market Access	3. e-NAM, AgriStack,
4. Credit & Insurance	4. PMFBY portal, Aadhaar-linked DBT
5. Logistics Tracking	5. GPS, RFID, blockchain – efficient transport, reduced post-harvest losses
6. Extension Services	6. mKisan portal, Kisan Call Centres
7. Input Management	7. DBT for fertilizers, drones
8. Land Records	8. Bhoomi, Bhulekh, SVAMITVA
9. Data-Driven Governance	9. AgriStack, AI dashboards – targeted policymaking, scheme monitoring
10. Agritech Innovation	10. DeHaat, Ninjacart, digital sandboxes

Applications of Digitisation in Agriculture

Conclusion

The Digital Agriculture Mission can succeed only if farmers use it. For this, India's tech-savvy youth must take interest in farming and help bring technology to fields, making agriculture smarter and more inclusive.

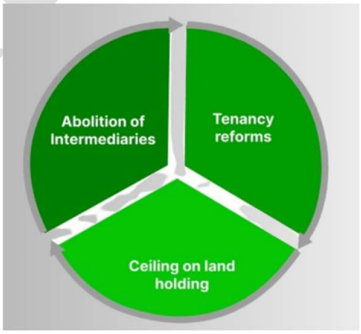
Q.4) Land reforms in India remain an unfinished agenda. Critically evaluate the objectives, implementation, and outcomes of land reforms since independence. Why have these reforms succeeded only in limited regions? (150 Words, 10 Marks)

Introduction

Land reforms in India aimed to dismantle feudal structures, redistribute land to the landless, and boost productivity. Despite multiple reform phases, only partial success has been achieved, leaving land equity an unfinished agenda.

Body

Objectives of Land Reforms



- **Abolition of Intermediaries:** Over 20 million tenants received ownership rights post-zamindari abolition (1950s), but landlords retained significant holdings through compensation provisions.
- **Tenancy Reforms:** States like Kerala (1970 Land Reforms Act) and West Bengal's Operation Barga (1978) legalized sharecroppers, improving farm incomes by 20–30%.
- **Land Ceiling:** Of 7.3 million hectares identified as surplus land nationwide, only 2.6 million hectares were redistributed, benefiting 5.6 million families (2023).
- **Consolidation of Holdings:** Achieved ~80% success in Punjab and Haryana, enabling mechanization and contributing to cereal yields rising from 1 ton/hectare (1960) to 3 tons/hectare (1980).
- **Modernization and Equity:** Cooperative farming initiatives and institutional credit access improved smallholder participation, particularly in Green Revolution regions.

Implementation and Outcomes

- **Zamindari Abolition:** Completed by 1956, legally eliminating intermediaries but creating new large landowners.
- **Tenancy Reforms:** Successful in Kerala and West Bengal, with 1.5 million sharecroppers gaining rights; largely ineffective in states like Bihar and UP.
- **Ceiling Redistribution:** States like Maharashtra distributed 48% of their surplus land; Odisha less than 20%, highlighting uneven implementation.
- **Consolidation:** Incomplete in eastern India; fragmented holdings still average 1.1 hectares nationally (2021).
- **Productivity Impact:** Effective reform states saw higher agricultural growth (e.g., Punjab 5% CAGR), while eastern states lagged below 2%.

Reasons for Success in Limited regions

- **Political Will and Ideology**: Success in **West Bengal** (Operation Barga) and **Kerala** due to committed Left regimes. In contrast, **UP**, **Bihar**, and **Rajasthan** saw reforms diluted by landlord-dominated politics.
- **Mass Peasant Mobilisation**: Movements like *Tebhaga* (Bengal), *Telangana Rebellion* (Hyderabad), and *Ezhava uplift movements* (Kerala) created bottom-up pressure. Absence of such mobilisation in **MP**, **Gujarat**, and **Odisha** led to weak implementation.
- **Legal and Administrative Effectiveness**: **Punjab**, **Haryana**, and **West Bengal** had relatively better land records and survey infrastructure. In **Bihar** and **Jharkhand**, poor land mapping, outdated records, and slow courts hindered reform.
- **Caste and Class Power Structures**: In **Hindi heartland states**, dominant agrarian castes (e.g., Yadavs, Jats, Rajputs) captured the political apparatus and resisted land redistribution.
- **Elite Bureaucratic Resistance**: In several states, revenue officials belonged to landed classes or aligned with them, weakening field-level enforcement of ceilings and tenancy protection.
- **Loopholes in Legislation**: States like **Maharashtra** and **Andhra Pradesh** had poorly drafted ceiling laws, allowing evasion through benami transfers, partitioning, and land under 'religious' or 'educational' trusts.
- **Green Revolution Priorities**: **Punjab** and **Haryana** prioritized productivity over redistribution; reforms were sidelined in favour of high-input agriculture that benefitted large landowners.
- **Lack of Tribal Integration**: In **Chhattisgarh**, **Jharkhand**, and **North-East**, customary land rights and shifting cultivation were poorly addressed by standard reform laws, leaving tribal populations vulnerable.
- **Urban Bias and Economic Shifts**: As the economy urbanized, political focus shifted to urban middle classes and industrial development, reducing reform urgency in agrarian regions.

Conclusion

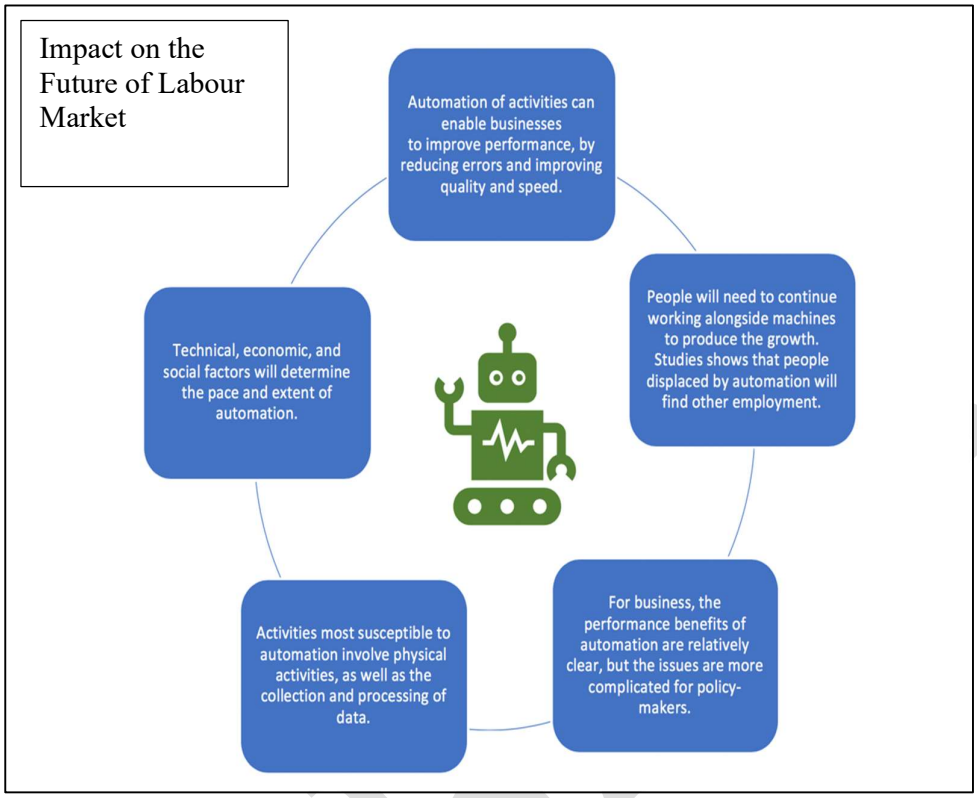
Land reforms achieved limited success due to political resistance, weak implementation, and social inequities. For true agrarian justice, renewed focus on digitisation, tribal rights, and equitable land access is essential in today's evolving economy.

Q.5) Discuss the opportunities and challenges posed by Artificial Intelligence (AI) for labour markets in India. How can inclusive institutions help manage technological disruption and ensure equitable outcomes? (150 Words, 10 Marks)

Introduction

Artificial Intelligence (AI) is rapidly transforming labor markets globally, with India projected to add $500 billion to its economy through AI by 2025 (NASSCOM). While it creates opportunities in innovation and productivity, it poses challenges of job displacement and inequality.

Body

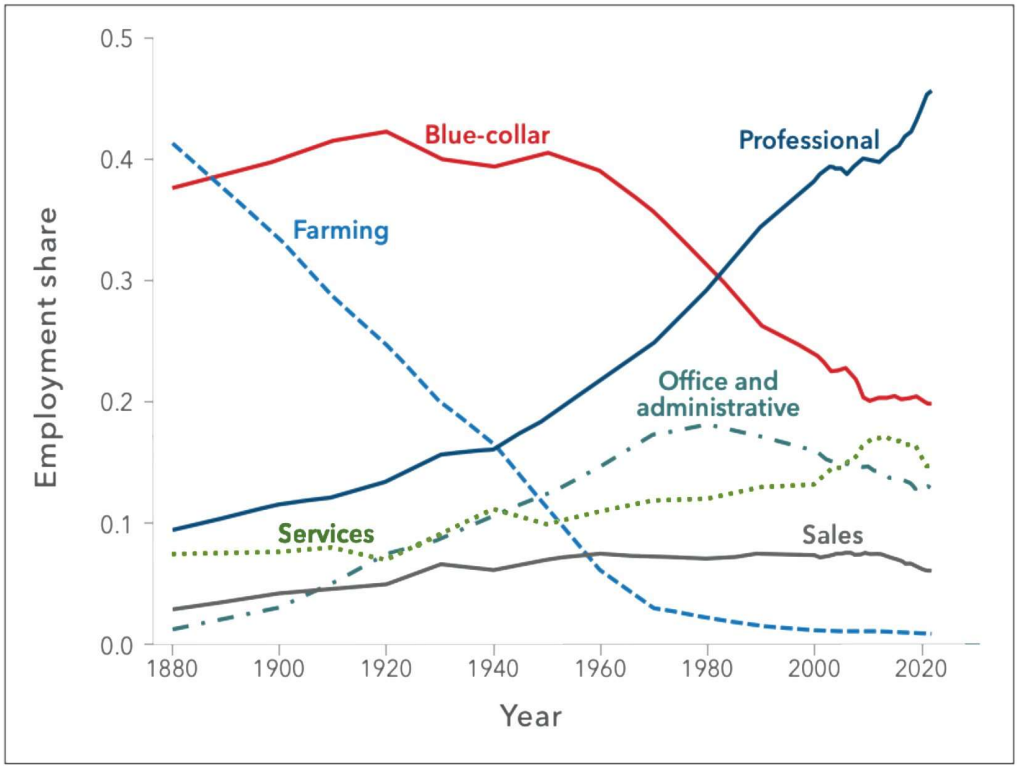


Opportunities from AI

- **Productivity Gains:** AI-driven automation can boost manufacturing efficiency by 15–20%, improving global competitiveness.
- **New Job Creation:** Sectors like AI development, data science, cybersecurity, and robotics may generate over 1 million jobs by 2030.
- **Enhanced Services:** AI in healthcare (e.g., AI-assisted diagnostics) and education (adaptive learning platforms) can expand access and service quality.
- **Agricultural Modernization:** AI tools for crop health monitoring and smart irrigation can raise yields by 25–30%.
- **Global Outsourcing Advantage:** India's IT sector can leverage AI to lead in global tech outsourcing markets, adding $90 billion to exports.

Challenges to Labor Markets

- **Job Displacement:** Automation threatens low- and mid-skill jobs in manufacturing and services; studies estimate 9% of current jobs are at risk.
- **Skill Mismatch:** Only ~4.7% of India's workforce is formally skilled, creating a gap for AI-related jobs.
- **Wage Inequality:** High demand for AI skills inflates wages for few, widening income disparities.



- **Informal Sector Vulnerability:** Gig workers face algorithmic control without adequate social security or bargaining power.
- **Regional Divide:** Tech adoption is concentrated in urban hubs, leaving rural labor markets lagging.

Role of Inclusive Institutions

- **Reskilling Initiatives:** Programs like PM Kaushal Vikas Yojana 4.0 and Skill India must scale up AI and digital literacy training for workers.
- **Social Safety Nets:** Universal social security and unemployment benefits can cushion job transitions.
- **Regulatory Frameworks:** Data protection and labor laws need updates to ensure fair use of AI and protection against algorithmic bias.
- **Public-Private Collaboration:** Industry partnerships in Digital Public Infrastructure (e.g., ONDC) can democratize access to AI tools.
- **Regional AI Hubs:** Incentivizing AI-based startups and research centers in smaller cities can balance opportunities geographically.

Skill Demand over the years

Conclusion

AI may affect over 69% of jobs in India by 2030. To benefit everyone, India must reskill workers, support the 80% in informal jobs, and build fair systems that help all access AI opportunities.

Q.6) Digital technology and Artificial Intelligence are transforming preventive medicine. Examine their role and potential challenges in combating lifestyle diseases in India. (150 Words, 10 Marks)

Introduction

Lifestyle diseases like diabetes, cardiovascular ailments, and hypertension account for nearly 60% of deaths in India (WHO, 2023). Digital health technology and Artificial Intelligence (AI) offer transformative potential in preventive medicine by enabling early detection, personalized care, and health monitoring.

Body

Role in Preventive Medicine

- **Remote Health Monitoring:** Wearables and IoT devices like **Fitbit and GOQii** track heart rate, glucose levels, and sleep patterns. A study (ICMR 2023) showed **20% early detection improvement** for diabetes and hypertension patients using these tools.
- **Predictive Analytics:** AI models analyzing electronic health records under the **Ayushman Bharat Digital Mission (ABDM)** predict risks of chronic diseases. For example, AI-driven cancer detection tools in Tata Memorial Hospital improved early diagnosis rates by **15%**.

- **Telemedicine Services:** Platforms like **eSanjeevani** have conducted **over 14 crore teleconsultations** (2024), enabling rural populations to access preventive advice without traveling to cities.
- **Personalized Health Plans:** Apps like **HealthifyMe** and **Practo** use AI to offer tailored diet and fitness plans, reducing obesity risks by **10–12%** among urban users.
- **Population Health Management:** Big data analytics from the **National Health Digital Ecosystem (NDHE)** help policymakers identify high-risk regions for diseases like tuberculosis and allocate resources effectively.

Potential Challenges

- **Digital Divide:** Only **44% of rural households** have internet access (NFHS-5, 2023), limiting digital preventive care adoption.
- **Data Privacy and Security:** In 2023, India witnessed **over 7 million health data records breached**, underlining weak cybersecurity in healthcare.
- **Algorithmic Bias:** AI tools trained on urban datasets misdiagnose rural patients; for example, diabetes risk models underperform for tribal populations.
- **Low Health Literacy:** A WHO report (2023) highlighted that **less than 40% of Indians** understand digital health apps' usage, reducing preventive effectiveness.
- **Integration with Public Health:** Lack of interoperability between private hospitals and ABDM slows unified preventive care implementation.

Way Forward

- **Strengthen Ayushman Bharat Digital Mission:** Expand **ABDM**, aiming for **100% digital health ID coverage by 2025**, enabling universal digital health records.
- **Health Literacy Campaigns:** Launch **"Swasth Digital Bharat"** campaign to educate citizens on using wearables, health apps, and telemedicine for prevention.
- **Public-Private Partnerships:** Encourage AI innovations through collaborations like **NITI Aayog's Health AI initiative** with Microsoft and Apollo Hospitals for early disease detection.

Conclusion

Digital health technology and AI can revolutionize preventive medicine in India by enabling proactive management of lifestyle diseases. Bridging digital gaps, securing data, and integrating these tools into public health systems will ensure equitable and effective outcomes.

Q.7) Landslides in India cause loss of life, infrastructure damage, and environmental degradation. Analyze key causes and suggest mitigation measures with recent examples. (150 Words, 10 Marks)

Introduction

India, accounting for 12.6% of global landslides (UNDRR, 2023), experiences frequent incidents causing loss of lives, infrastructure damage, and environmental harm. The Himalayan and Western Ghats regions are particularly vulnerable due to complex terrain and climatic factors.

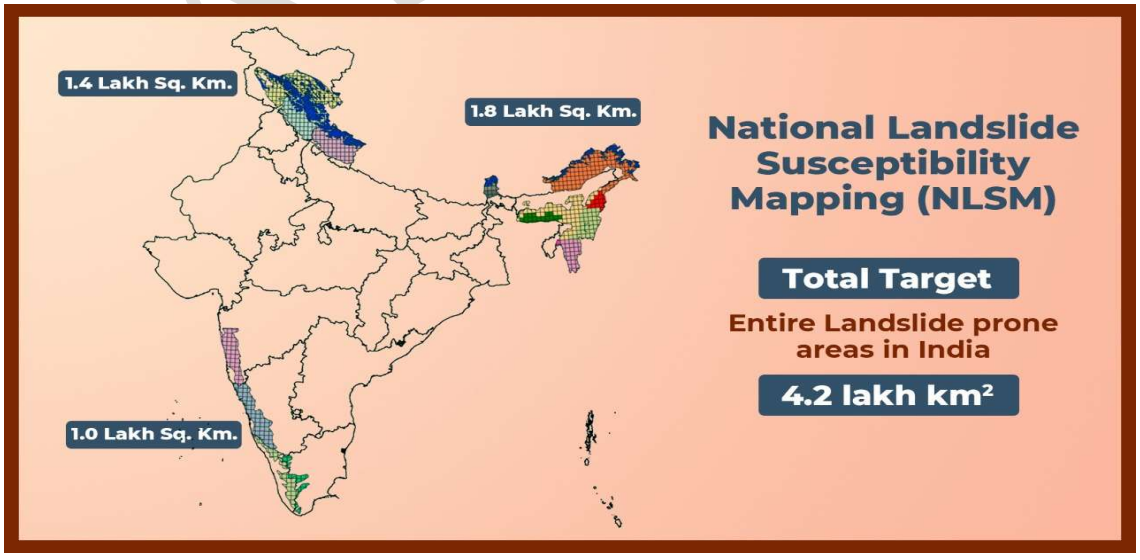
Body

Primary Causes of Landslides

- **Geological Factors:** Steep slopes, fragile lithology, and tectonic activity make regions like Uttarakhand and Himachal Pradesh prone to slope failure.
- **Intense Rainfall:** Extreme monsoons and cloudbursts, such as in Sikkim (2023), rapidly saturate soil, triggering landslides.
- **Deforestation and Land-Use Change:** Unregulated construction and mining in Western Ghats disturb natural slope stability.
- **Seismic Activity:** Earthquakes in Himalayan states (e.g., Nepal quake impact on Indian hills, 2015) exacerbate landslide risks.
- **Infrastructure Development:** Road widening and hydropower projects (e.g., Joshimath subsidence, 2023) destabilize mountain slopes.

Mitigation Measures

- **Hazard Zonation Mapping:** ISRO's Landslide Susceptibility Mapping (2023) identifies high-risk zones for targeted interventions.



- **Eco-Sensitive Planning:** Enforcing buffer zones and regulated construction in landslide-prone regions reduces anthropogenic triggers.

- **Slope Stabilization Techniques:** Retaining walls, bio-engineering methods, and afforestation strengthen hill slopes (applied in Kerala post-2018 floods).
- **Early Warning Systems:** The Geological Survey of India's Landslide Early Warning System in Darjeeling and Nilgiris helps timely evacuation.
- **Disaster-Resilient Infrastructure:** Use of tunneling and climate-resilient engineering in roads and dams reduces structural failures during landslides.

Conclusion

Reducing landslide risks in India needs early warnings, eco-sensitive planning, and resilient infrastructure—aligned with the Sendai Framework's goals of minimizing disaster losses through risk reduction, better land use, and protecting vulnerable communities and ecosystems.

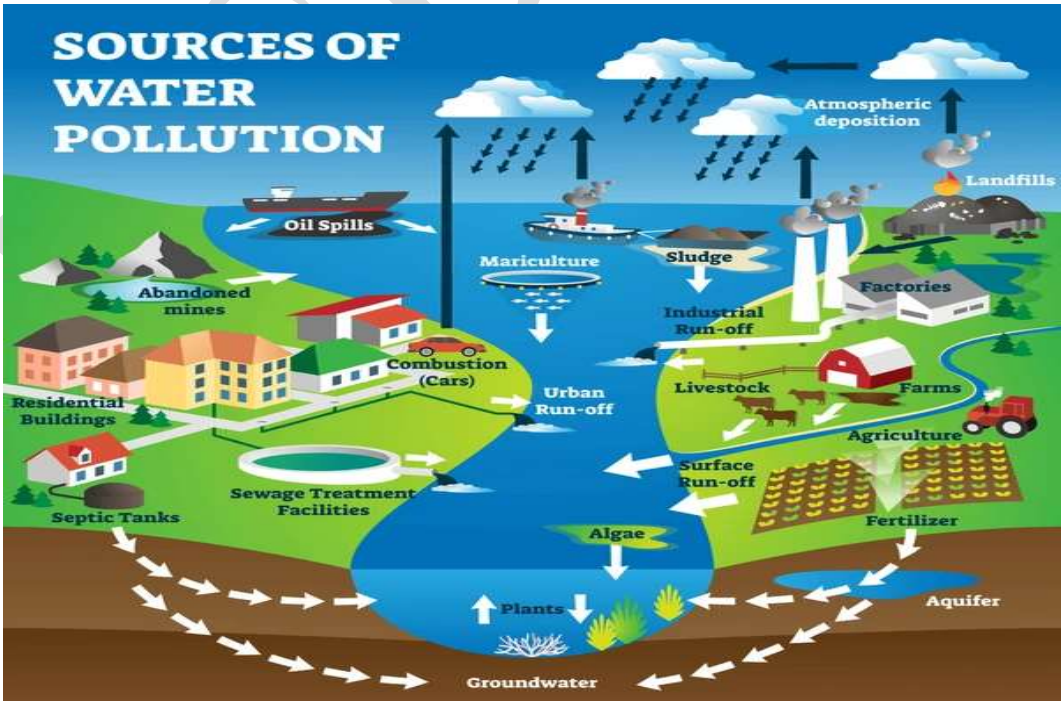
Q.8) Define water pollution. What are its major causes and impacts on aquatic ecosystems. Why is water pollution a particularly critical challenge for a country like India? (150 Words, 10 Marks)

Introduction

Water pollution refers to the contamination of water bodies by harmful substances that degrade water quality and threaten aquatic life. In India, over **70% of surface water is polluted (NITI Aayog, 2023)**, making it a critical environmental challenge.

Body

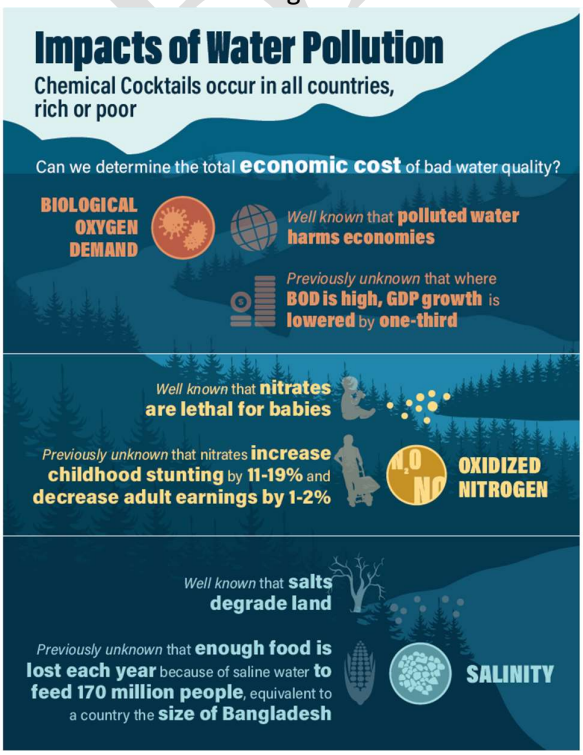
Major Causes of Water Pollution



- **Industrial Effluents:** Approximately **13% of India's rivers are polluted by industrial waste**; for example, leather tanneries in Kanpur discharge chromium into the Ganga.
- **Agricultural Runoff:** Excessive fertilizer use (India consumes **~55 kg/ha of fertilizers**, FAO 2023) causes nutrient leaching and eutrophication in lakes like Vembanad.
- **Domestic Sewage:** India generates **~72,368 MLD of sewage daily**, but only **28% is treated** (CPCB, 2023), contaminating rivers like Yamuna where **up to 80% of pollution** comes from untreated sewage.
- **Plastic and Solid Waste:** India produces **~3.5 million tonnes of plastic waste annually**, much of which ends up in rivers, harming species like the endangered Ganga river dolphin.
- **Mining Activities:** Illegal sand mining in rivers of Goa and coal mining in Jharkhand pollute groundwater with heavy metals and siltation.

Impacts on Aquatic Ecosystems

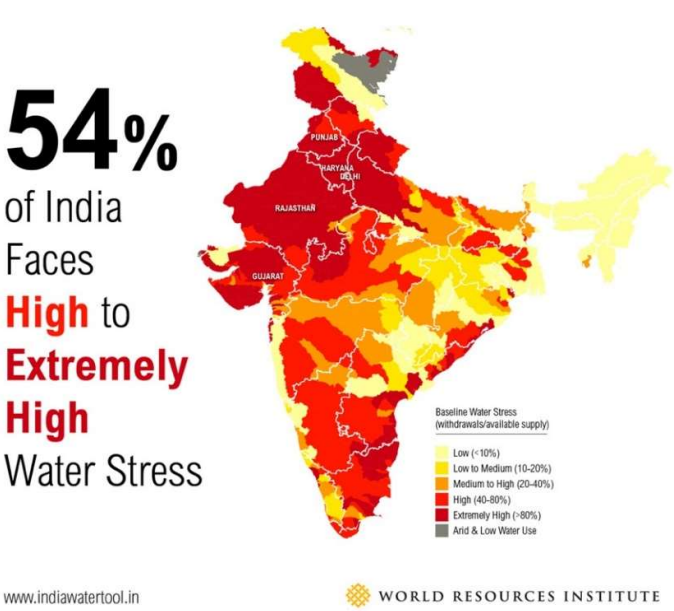
- **Loss of Biodiversity:** A WWF report (2023) notes a **76% decline in freshwater species** in South Asia since 1970 due to pollution and habitat degradation.
- **Algal Blooms:** Nutrient pollution in Bengaluru's Bellandur Lake causes frothing and toxic algal blooms, killing fish populations.
- **Bioaccumulation:** Mercury contamination in Kerala's Periyar River has led to toxic fish, impacting local fishing communities.
- **Habitat Destruction:** Sedimentation in Brahmaputra River disrupts spawning grounds for indigenous fish.
- **Health Hazards:** Waterborne diseases like cholera and diarrhea affect **~38 million Indians annually**, often linked to polluted drinking water sources.



Critical Challenge for India

- **High Dependence: Over 80% of rural households** rely on untreated groundwater, with arsenic contamination affecting **20 million people** in Bihar and West Bengal.
- **Population Pressure:** India's **1.4 billion population** strains water resources, making pollution more severe.

- **Riverine Economy:** Ganga supports **400 million people**, and pollution threatens agriculture, fisheries, and tourism.
- **Urbanization:** Cities like Delhi and Mumbai have wastewater treatment capacities lagging behind **by over 40%**, worsening river health.
- **Climate Stress:** Rising temperatures and droughts lower river flows, concentrating pollutants (e.g., Godavari in summer months).



Conclusion

Water pollution severely impacts India's ecosystems and public health. Strengthening sewage treatment, enforcing zero liquid discharge norms for industries, scaling up Namami Gange, and promoting sustainable farming practices are crucial for restoring clean and resilient water systems.

Q.9) Evaluate the role of the Public Distribution System (PDS) in advancing food security in India. What reforms are needed to enhance its efficiency and coverage? (150 Words, 10 Marks)

Introduction

The Public Distribution System (PDS) is a critical pillar of India's food security architecture, aiming to provide subsidized food grains to the poor. It supports the National Food Security Act (NFSA), 2013, which legally guarantees food access to ~80 crore beneficiaries.

Body

Role of PDS in Advancing Food Security

- **Improved Access:** PDS distributes **rice, wheat, and coarse grains** at subsidized rates to priority households, ensuring basic caloric needs and preventing hunger.
- **Buffer Against Price Volatility:** By stabilizing prices during inflation and crises (e.g., **COVID-19 lockdowns**, when free grains were given under **PMGKAY**), PDS acts as a social safety net.
- **Support to Agricultural System:** PDS creates assured demand for grains, incentivizing farmers through **Minimum Support Price (MSP)** procurement, especially in rice- and wheat-producing states.
- **Reduction in Malnutrition:** Supplementary schemes like **Mid-Day Meal** and **Integrated Child Development Services (ICDS)** are linked with PDS, improving nutrition for children and mothers.

- **Promotion of Equity:** By targeting disadvantaged groups (SCs, STs, women-headed households), PDS promotes social justice and inclusive growth.

Reforms to Enhance Efficiency and Coverage

- **Digitization and Portability:** Expansion of **One Nation One Ration Card (ONORC)** to enable portability for migrant workers.
- **End-to-End Transparency:** Use of **Aadhaar-based biometric authentication**, **GPS tracking**, and **e-PoS** to reduce leakages.
- **Diversification of Food Basket:** Inclusion of **pulses, oil, and millets** to improve nutrition and reflect changing consumption patterns.
- **Decentralized Procurement:** Encouraging local procurement to promote **climate-resilient crops** and reduce transportation losses.
- **Targeting and Exclusion Errors:** Periodic updating of beneficiary lists to remove ineligible households and include newly eligible poor.

Conclusion

While the PDS has significantly advanced food and livelihood security, systemic reforms—especially through e-PDS for transparency, better targeting, and diversified nutrition—are essential to make it leak-proof, equitable, and aligned with SDG-2 (Zero Hunger).

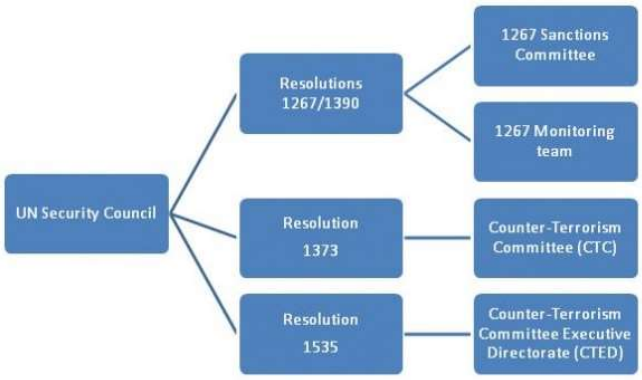
Q.10) Analyze the global counter-terrorism framework and discuss why it falls short in addressing India's concerns. Suggest key reforms to strengthen its effectiveness. (150 Words, 10 Marks)

Introduction

The global counter-terrorism framework, led by the UN since 2006, lacks teeth against India's core concern—cross-border terrorism, especially from Pakistan. Despite over 7,000 terrorism-related deaths in India since 2000, major perpetrators often evade global sanctions or action.

Body

Key Elements of Global Framework



- **UN Security Council Resolutions:** UNSC Resolution 1373 (2001) mandated states to deny safe havens and financing to terrorists; Resolution 1566 (2004) strengthened sanctions regimes, including those against Al-Qaeda and ISIS.
- **Financial Action Task Force (FATF):** Established in 1989, with 39 members, it combats money laundering and terror financing; Pakistan remained on the "Grey List" from 2018 to 2022 for inadequate action.
- **International Conventions:** 19 sectoral conventions cover offenses like aircraft hijacking and terror financing but lack a unifying, binding definition of terrorism.
- **UN Office of Counter-Terrorism (UNOCT):** With a $140 million budget (2023), it supports capacity-building initiatives worldwide.
- **Global Cooperation Tools:** Interpol's databases, the Global Counterterrorism Forum (2011), and G20 statements promote intelligence sharing and joint strategies.

Why It Doesn't Address India's Concerns

- **State-Sponsored Terrorism:** No binding mechanism to hold states accountable; Pakistan-based groups like Lashkar-e-Taiba (responsible for 2008 Mumbai attacks) and Jaish-e-Mohammed (Pulwama attack 2019) operate despite FATF scrutiny.
- **Delayed Terrorist Designation:** Political vetoes in UNSC delayed blacklisting of Masood Azhar until 2019 despite India's repeated requests since 2009.
- **Non-Binding Commitments:** Many resolutions lack enforcement; only 22 out of 193 UN member states fully comply with Resolution 1373.
- **Focus on Global Networks:** ISIS and Al-Qaeda are primary targets, while South Asian outfits receive limited global action despite India facing over **600 cross-border infiltration incidents annually (MHA 2023)**.
- **Weak Financial Tracking:** Despite FATF oversight, hawala networks and misuse of charitable organizations continue funding terrorism in India, as highlighted in the 2022 UN Sanctions Monitoring Report.

Suggested Reforms

- **Adopt CCIT:** A legally binding treaty defining terrorism comprehensively would strengthen global legal action.

- **Accountability Tribunal:** Establish a UN-backed tribunal to prosecute state-sponsored terrorism cases.
- **Expanded FATF Powers:** Include stricter compliance checks and address cryptocurrency-based terror financing, which grew by 70% in 2022 globally.
- **Unified Intelligence Platform:** Develop a real-time, UN-supervised intelligence-sharing system to preempt attacks.
- **Regional Counter-Terror Cells:** UN-supported joint task forces under SAARC or QUAD can specifically target South Asia's cross-border terror networks.

Conclusion

India showed leadership in counter-terrorism during Operation Sindoor by safely evacuating citizens from a terror-hit area. It combined security and care, showing how India can lead global efforts against such threats.

Q.11) Rising cross-border drone use for arms and drug smuggling threatens internal security. Evaluate current countermeasures and suggest ways to strengthen border security. (250 Words, 15 Marks)

Introduction

Cross-border drone incursions for arms and drug smuggling have surged, particularly along India's western borders. Between 2019 and 2023, over 500 drone sightings were reported by BSF, posing significant internal security threats.

Body

Current Countermeasures

- **Drone Detection Systems:** Deployment of anti-drone radar and RF-based detection by BSF and DRDO; used effectively during the 2023 G20 summit.
- **Drone Policy Framework:** Directorate General of Civil Aviation (DGCA) and Ministry of Home Affairs (MHA) regulate drone usage under Drone Rules, 2021.
- **Integrated Border Management System (IBMS):** Use of thermal sensors, surveillance cameras, and laser fencing along Indo-Pak border.
- **Counter-Drone Technology:** DRDO's D-4 systems capable of neutralizing drones with jamming or hard kill measures; deployed in Jammu & Punjab sectors.

- **International Cooperation:** Joint talks with Pakistan under DG-level meetings of BSF and Punjab Rangers to curb drone-based smuggling.

➔ While these measures mark a significant step forward, gaps in detection capability, enforcement, and coordination continue to hamper effective response.

Challenges

- **Detection Gaps:** Low-altitude, small drones often bypass existing radar surveillance.
- **Technology Proliferation:** Easy access to high-range drones with payload capacity of 10–20 kg increases smuggling attempts.
- **Limited Manpower:** Vast border stretches (~3,300 km with Pakistan) hinder continuous monitoring.
- **Coordination Issues:** Multiple agencies (BSF, NIA, State Police) operate without fully integrated command structures.
- **Legal Loopholes:** Current drone policies primarily address civilian use, lacking strong enforcement for cross-border threats.

Suggested Measures

- **Advanced AI Surveillance:** Deploy AI-enabled sensors and electro-optical systems to improve night detection and real-time alerts.
- **Counter-Drone Units:** Create specialized BSF and NSG units equipped with kinetic interceptors and jamming guns along vulnerable zones.
- **Blockchain-based Tracking:** Use digital ledgers for tracking drones and their parts to prevent illegal modifications and misuse.
- **Cross-border Data Sharing:** Strengthen intelligence cooperation with neighboring countries and global agencies (Interpol, UNODC) for supply chain disruption.
- **Policy Reforms:** Amend Unlawful Activities (Prevention) Act (UAPA) to include drone-based smuggling as a specific offense with stringent penalties.

Conclusion

Combating drone-enabled cross-border threats requires a multi-layered approach blending advanced technology, trained personnel, and robust legal frameworks. Strengthened surveillance and regional cooperation can effectively safeguard India's borders against emerging aerial threats.

Q.12) Analyze the economic impact of election-driven freebies on fiscal discipline and developmental goals. Discuss measures to differentiate genuine welfare from populist spending. (250 Words, 15 Marks)

Introduction

Election-driven freebies, often non-merit subsidies, are rising across Indian states. As per RBI's 2023 report, they consume 2–2.5% of GSDP in some states, straining fiscal health and diverting resources from long-term developmental needs.

Body

Economic Consequences

- **Fiscal Stress:** States like Punjab spent **1.9% of GSDP** on free electricity (2022), while Andhra Pradesh allocated **₹17,000 crore** for loan waivers, worsening fiscal deficits.
- **Debt Burden:** Punjab's **debt-to-GSDP ratio reached 47% (2023)**; states like Rajasthan and Kerala also exceed 35%, largely due to populist spending.
- **Crowding Out Development:** Tamil Nadu spends **₹18,000 crore annually** on free power for farmers, diverting funds from infrastructure and health projects.
- **Distorted Incentives:** Free electricity and water schemes contribute to groundwater depletion in states like Punjab and Haryana, threatening agricultural sustainability.
- **Social Inequity:** Farm loan waivers worth **₹10 lakh crore nationally since 2008** benefited mostly medium and large farmers, leaving out sharecroppers and landless labourers.

Challenges to Fiscal Discipline

- **Election Cycle Pressures:** Ahead of 2024 elections, several states announced free public transport and increased subsidies without sustainable funding sources.
- **Weak Enforcement:** Despite FRBM Acts capping fiscal deficits at 3% of GSDP, **11 states breached this limit in FY 2022–23** (CAG report).
- **Off-Budget Borrowing:** Andhra Pradesh's guarantees for state-owned entities led to **hidden liabilities worth ₹1.1 lakh crore**.
- **Limited Transparency:** Few states conduct ex-ante fiscal impact assessments; Karnataka's 2023 guarantee scheme (₹52,000 crore annually) lacked independent scrutiny.

- **Centre-State Tensions:** The Union Finance Ministry's 2022 note warned of a "Sri Lanka-like crisis" if freebie culture continues unchecked.

Mechanisms to Distinguish Welfare from Populism

- **Statutory Oversight:** Supreme Court-appointed expert committee (2022) proposed mechanisms to audit poll promises for fiscal sustainability.
- **Independent Fiscal Councils:** Similar to the UK's Office for Budget Responsibility, councils can publish impact reports on welfare schemes.
- **Outcome-Based Budgeting:** Linking free inputs (e.g., seeds or fertilizers) to productivity gains rather than unconditional giveaways.
- **Targeted Transfers:** Aadhaar-enabled Direct Benefit Transfers (DBT) saved **₹2.7 lakh crore** (2014–2022) by reducing leakage in welfare schemes.
- **Cost-Benefit Analysis**: NITI Aayog suggests ex-ante evaluation to assess long-term economic returns and sustainability
- **Social Audits**: Mandated under MGNREGA, they help assess real beneficiary impact and reduce leakages.

Conclusion

The Supreme Court (2022) urged a distinction between genuine welfare and irrational freebies, advocating expert bodies to assess their impact. Aligning with this, India must ensure social equity without compromising fiscal sustainability through transparent, accountable welfare mechanisms.

Q.13) Discuss the role of women entrepreneurs in fostering inclusive economic growth in India with special reference to rural enterprises. (250 Words, 15 Marks)

Introduction

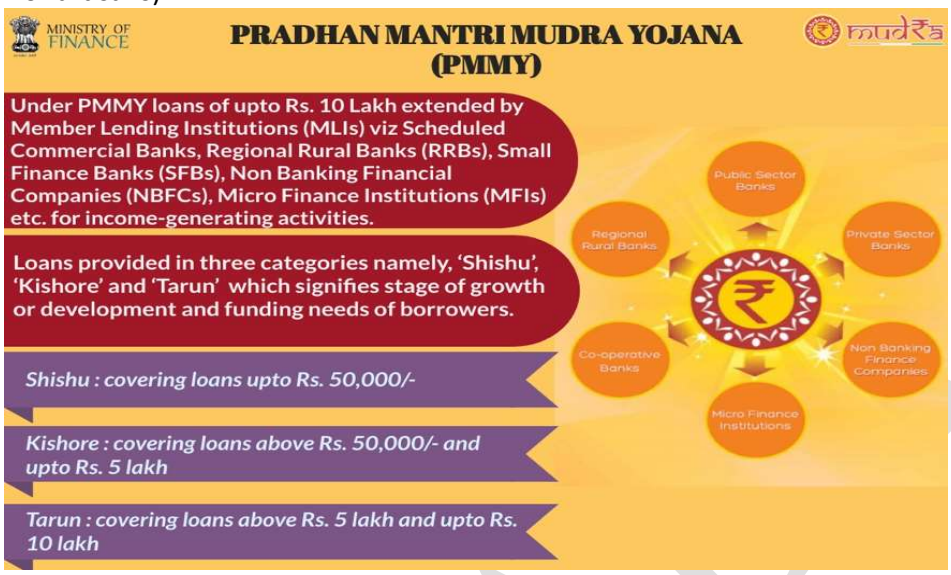
Women entrepreneurs are key drivers of inclusive growth in India, contributing to employment generation, poverty reduction, and gender equality. As per the 6th Economic Census, women constitute ~14% of total entrepreneurs, with a significant presence in rural enterprises that boost local economies.

Body

Role in Inclusive Economic Growth

- **Employment Generation:** Women-led MSMEs employ **over 13 million people**, particularly empowering rural women through self-help groups (SHGs).
- **Promoting Financial Inclusion:** Schemes like **Pradhan Mantri MUDRA Yojana** have disbursed **68% of loans to women entrepreneurs**, enabling access to credit for small businesses.
- **Social Impact:** Rural women entrepreneurs in dairy, handicrafts, and agri-based enterprises uplift community incomes and improve education and health indicators.

- **Innovation in Traditional Sectors:** Women in rural areas are modernizing crafts, food processing, and handlooms with digital marketing tools (e.g., e-commerce platforms for artisans).



- **Balanced Regional Development:** Initiatives like **Deendayal Antyodaya Yojana – National Rural Livelihoods Mission (DAY-NRLM)** have mobilized **8 crore women into SHGs**, fostering entrepreneurship in underserved regions.

Challenges Faced

- **Limited Access to Capital:** Only **27% of women have formal access to institutional credit**, restricting business expansion.
- **Skill Gaps:** Rural women often lack advanced technical and managerial skills, affecting competitiveness.
- **Socio-Cultural Barriers:** Patriarchal norms limit mobility and decision-making power for women entrepreneurs.
- **Digital Divide:** Low internet penetration hampers adoption of e-commerce and digital finance tools.
- **Market Linkage Issues:** Rural women struggle to access wider markets due to inadequate logistics and networking opportunities.

Government Initiatives Supporting Women Entrepreneurs

- **Stand-Up India Scheme:** Facilitates bank loans between ₹10 lakh–₹1 crore for women-led greenfield enterprises.
- **Mahila e-Haat:** A direct online marketing platform for women entrepreneurs launched by the Ministry of Women and Child Development.
- **Rural Livelihood Missions:** DAY-NRLM and **Cluster-Level Federations** provide training and microfinance support for sustainable rural businesses.
- **Skill Development Programs:** Schemes like PM Kaushal Vikas Yojana include women-centric training modules.
- **Digital Platforms:** Initiatives like ONDC and GeM support women-owned MSMEs to access national markets.

Conclusion

Women entrepreneurs in rural India boost inclusive growth. Self-Help Groups (SHGs) support them with loans, skills, and community backing. Stronger SHGs, better digital tools, and market access can help women lead local development.

Q.14) How has the Minimum Support Price (MSP) regime influenced cropping patterns in India, and what policy measures are needed to promote greater crop diversification? (250 Words, 15 Marks)

Introduction

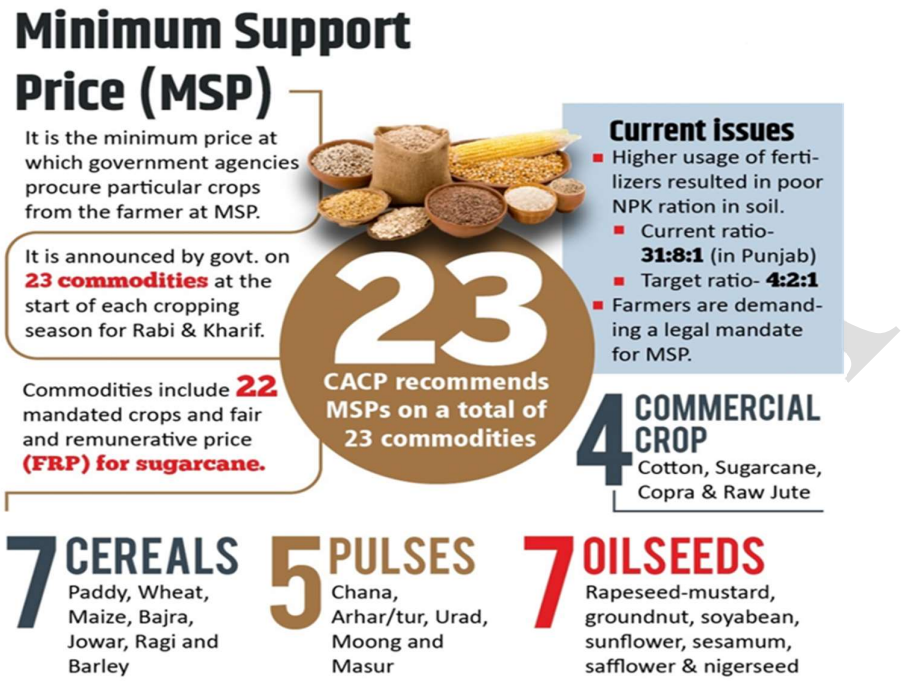
The Minimum Support Price (MSP) regime, introduced in 1966–67, aimed to ensure remunerative prices for farmers and food security for India. Over time, it has significantly influenced cropping patterns, particularly favoring water-intensive cereals, while limiting diversification.

Body

Influence of MSP on Cropping Patterns

- **Cereal Dominance:** MSP predominantly supports wheat and rice; these two crops account for **~85% of MSP procurement**, leading to monocropping in states like Punjab and Haryana.
- **Regional Imbalances:** Northern states shifted from pulses and oilseeds to wheat-paddy rotations, while eastern India remains underdeveloped in MSP procurement.

- **Water Resource Strain:** Water-guzzling crops like paddy expanded to semi-arid regions; Punjab's groundwater declined by **33% between 2000–2020** due to assured MSP returns.
- **Neglect of Nutri-Cereals:** MSP coverage for millets and pulses remains limited despite



being climate-resilient; coarse cereals' share in cropped area fell from **37% (1960s) to 15% (2020)**.

- **Fertilizer and Input Misuse:** High MSP-backed procurement encourages intensive fertilizer use and soil degradation, impacting long-term sustainability.

Policy Measures for Crop Diversification

- **Broaden MSP Coverage:** Strengthen procurement of pulses, oilseeds, and millets; link with **PM-AASHA** and **National Food Security Mission** to incentivize farmers.
- **Market Reforms:** Expand electronic platforms like **e-NAM** for better price discovery and alternative markets beyond cereals.
- **Agro-Ecological Zoning:** Implement region-specific cropping advisories to promote horticulture and less water-intensive crops.
- **Value Chain Development:** Invest in storage, processing, and marketing infrastructure for diversified crops like fruits and vegetables to ensure remunerative returns.
- **Direct Income Support:** Shift from price-based incentives to income support schemes (e.g., PM-KISAN) to reduce cereal bias and encourage sustainable diversification.

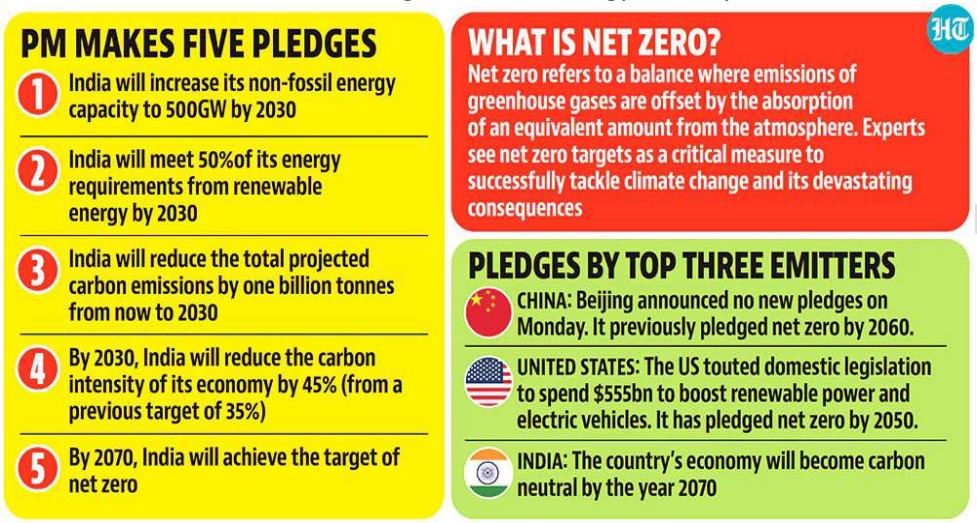
Conclusion

While MSP ensures income and food security, the Shanta Kumar Committee and NITI Aayog suggest limiting it to needy farmers and shifting focus to crop diversification, improved procurement, and market reforms for sustainable agriculture.

Q.15) Discuss the dual challenge India faces in achieving net-zero emissions by 2070 while sustaining high economic growth and energy security. (250 Words, 15 Marks)

Introduction

India's 2070 net-zero pledge at COP26 was a landmark move for a major developing economy, reflecting its commitment to climate leadership while balancing the dual demands of sustained economic growth and energy security.



Body

Balancing Decarbonization with Developmental Needs

- **Coal Dependence**: As of 2024, ~73% of electricity is generated from coal (CEA), making rapid decarbonisation risky for grid stability and employment.
- **Green Tech Affordability**: Green hydrogen costs ₹300–400/kg, unaffordable for MSMEs without subsidies (NITI Aayog).
- **Agricultural Emissions**: India's large agri sector contributes 18% of total GHGs (MoEFCC), yet reforms like low-emission irrigation or bio-fertilizers remain under-penetrated.
- **Urban Growth**: India's urban population will reach 600 million by 2036 (NUEPA), increasing demand for concrete, steel, and transport—carbon-intensive sectors.
- **Just Transition**: Coal-rich states like Jharkhand and Chhattisgarh rely on coal royalties (₹14,000 crore annually); alternatives must be economically viable.

Sustaining High Economic Growth

- **Manufacturing Push**: Sectors like cement and steel contribute ~25% to industrial emissions (IEA). Green transition here must not undermine Make in India goals.
- **Job Creation Needs**: India needs to generate 90 million new jobs by 2030 (McKinsey Global Institute); clean sectors must become job creators.
- **Service Sector Emissions**: Growing IT, digital, and fintech industries demand large data infrastructure, increasing electricity needs.
- **Energy Intensity**: India's energy intensity of GDP has declined by 33% since 2005 (UNFCCC), showing decoupling potential.

- **FDI and Trade**: Green compliance can make Indian exports competitive, especially under EU's Carbon Border Adjustment Mechanism (CBAM).

Ensuring Energy Security During Transition

- **High Import Dependence**: 85% of oil and 55% of gas are imported (PPAC 2024), exposing India to price shocks and supply disruptions.
- **Renewable Intermittency**: Solar and wind contribute ~22% to installed capacity, but storage remains inadequate for 24x7 energy needs.
- **Grid Modernisation**: India's Green Energy Corridor is underfunded and behind schedule, affecting renewable integration.
- **Strategic Reserves**: India has just ~9.5 days of crude reserves (as of 2023); transition plans must expand reserves and diversify sources.
- **Nuclear and Hydro**: Nuclear provides only 3.1% of capacity (CEA), yet offers base-load potential; projects face land and safety concerns.

Conclusion

As PM Modi stated at COP26, "This is not a promise made by India to the world… it is a promise made by 1.4 billion Indians to themselves" - marking a historic move for a developing nation balancing growth and climate justice.

Q.16) Discuss its core principles of Trumponomics and evaluate its potential impact on global trade dynamics, particularly with respect to India's export competitiveness. (250 Words, 15 Marks)

Introduction

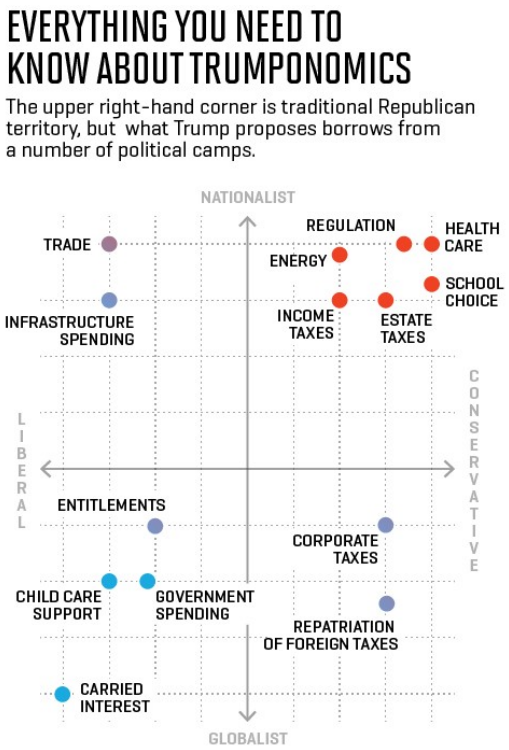
Trumponomics refers to the economic policies promoted during Donald Trump's presidency, characterized by protectionism, tax cuts, deregulation, and trade renegotiations. These principles aimed to prioritize domestic industry but disrupted global trade flows and multilateralism.

Body

Core Principles of Trumponomics

- **Protectionist Tariffs**: Imposed sweeping tariffs on over $360 billion worth of Chinese goods, initiating a prolonged trade war and reshaping global supply chains.
- **Corporate Tax Cuts**: Slashed U.S. corporate tax from 35% to 21%, boosting business investment; widened the tax competitiveness gap with emerging economies like India.
- **Bilateral Trade Focus**: Withdrew from multilateral deals like TPP and restructured NAFTA into USMCA, reinforcing a transactional, "America First" trade posture.
- **Aggressive Deregulation**: Rolled back over 800 federal rules, especially in energy and finance, aiming to reduce regulatory burdens and spur domestic investment.

- **Restrictive Immigration**: Tightened skilled visa norms, reducing H-1B approvals and restricting inflow of foreign talent, affecting tech-heavy economies like India.



Impact on Global Trade Dynamics

- **U.S.–China Decoupling**: China's share in U.S. imports fell from 22% (2018) to 14% (2023), reflecting tariff-led supply chain shifts and strategic diversification.
- **Rise in Bilateralism**: Weakening of WTO's multilateral dispute mechanism triggered a surge in bilateral trade deals and unilateral retaliatory tariffs.
- **Slowdown in Trade Growth**: Global trade volumes contracted by 1.2% in 2023; projected to recover modestly in 2024 (2.6%), reflecting persistent geopolitical uncertainty.
- **Regional Trade Blocs Rise**: Agreements like RCEP and CPTPP are reshaping trade flows; RCEP now accounts for ~30% of global GDP, without U.S. presence.
- **Fragmentation of Supply Chains**: Friend-shoring and near-shoring trends accelerated; ASEAN nations, especially Vietnam, gained as alternatives to China.

Implications for India's Export Competitiveness

- **China+1 Advantage**: Shift of U.S. importers away from China offers India a strategic opening; India's exports to the U.S. touched **$77 billion in FY23**, led by electronics and pharma.
- **Electronics and Textile Boost**: U.S. firms like **Apple and Foxconn** expanding Indian production aligns with Trumponomics' **China de-risking goals**, boosting manufacturing exports.
- **Threat to IT Services**: Stricter **H-1B visa regulations** may adversely impact India's **$260 billion IT-BPM sector**, which derives **60% of its revenue** from the U.S. market.
- **Pressure for Bilateral Deals**: With **GSP benefits still revoked since 2019**, India may face pressure to enter **bilateral trade negotiations** to secure market access.
- **Geopolitical Leverage**: Strategic convergence under the **Indo-Pacific** framework and **iCET** partnership may help India seek **selective exemptions or market access**.
- **Subsidy Disadvantages**: U.S. domestic acts like the **IRA and CHIPS Act** act as non-tariff barriers, undermining **India's green tech and electronics competitiveness** unless countered by **matching subsidies**.

Conclusion

India is taking a strong yet balanced approach to Trumponomics—calling out unfair trade practices, using WTO rules, launching a ₹20,000 crore export plan, and seeking fair trade deals to protect its economy and exports.

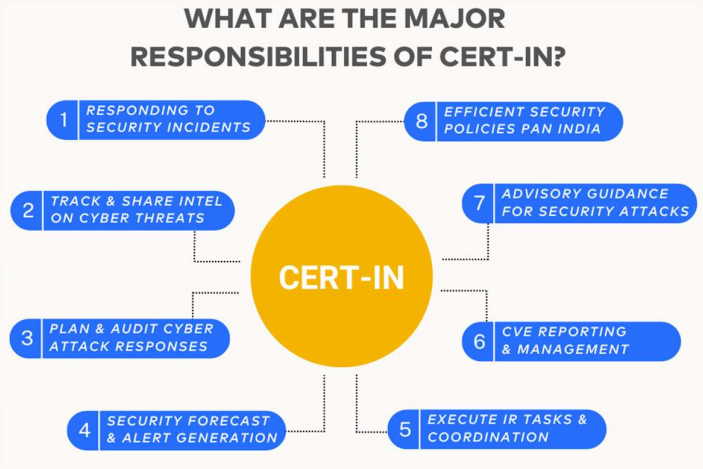
Q.17) Evaluate the role of CERT-In, National Cyber Coordination Centre (NCCC), and the Indian Cyber Crime Coordination Centre (I4C) in mitigating recent cyber threats. (250 Words, 15 Marks)

Introduction

Cyberattacks in India have surged over 30 times—from 71,780 cases in 2013 to more than 22 lakh in 2023—highlighting the vital role of CERT-In, NCCC, and I4C in national cyber defense.

Body

Role of CERT-In



- **Real-Time Alerts**: Issued over 4,000 security advisories in 2023, helping critical sectors pre-empt attacks (Source: CERT-In Annual Report).
- **Mandatory Reporting**: April 2022 guidelines require organizations to report breaches within 6 hours, enhancing response speed.
- **Ransomware Response**: Played a key role during the 2023 AIIMS ransomware attack by coordinating system recovery and forensic analysis.
- **Cyber Drills**: Conducts "Synergy" and "Cyber Shockwave" simulations with over 150 entities to test response capacity.
- **Global Cooperation**: MoUs with 7+ countries including Japan and the U.S. to exchange threat intelligence.

Role of National Cyber Coordination Centre

- **Traffic Analysis**: Monitors metadata from internet service providers and critical infrastructure to detect unusual patterns.
- **Real-Time Data Correlation**: Uses AI-driven analysis to detect coordinated attacks (e.g., phishing, DDoS, malware spread).
- **Policy Support**: Assists in shaping national cyber policies through threat pattern analytics.
- **Incident Correlation**: Mapped over 50,000 incident signatures in 2022 to detect emerging attack trends (Source: MHA).
- **Controversy and Oversight**: Faces scrutiny over surveillance concerns, requiring clearer legal frameworks.

Role of Indian Cyber Crime Coordination Centre

- **National Cybercrime Reporting Portal**: Received over 11 lakh complaints by mid-2024, aiding victim redressal.
- **Training Police Forces**: Trained over 25,000 police officials under Cyber Crime Investigation and Forensics modules.
- **State Coordination**: Facilitated establishment of cyber police stations and labs across all states.
- **Child and Women Protection**: Operates "Cyber Dost" platform for public awareness, especially targeting frauds and exploitation.
- **Crime Mapping Tools**: I4C has developed predictive analytics to track emerging cybercrime hotspots (e.g., financial fraud clusters in Tier 2 cities).

Challenges & Limitations

- **Coordination Gaps**: CERT-In, NCCC, and I4C often work in silos; **lack of a unified cyber command** reduces synergy.
- **Skilled Workforce Deficit**: India needs **over 1 million cybersecurity professionals** by 2030 (NASSCOM), indicating capacity constraints.
- **Jurisdictional Issues**: Cross-border cybercrime and absence of robust data-sharing treaties hinder legal enforcement.

Way Forward

- **Cybersecurity Law**: Enact a robust legal framework ensuring institutional accountability, privacy, and cyber deterrence.
- **Unified Cyber Command**: Set up a **National Cybersecurity Authority** to integrate CERT-In, NCCC, and I4C efforts.
- **Bilateral & Global Cooperation**: Leverage forums like **G20 Digital Economy Working Group** for cross-border cyber defence.

Conclusion

Adopting global best practices like Israel's layered cyber defense model, India must strengthen inter-agency coordination, invest in cyber forensics, and promote public-private collaboration to build a resilient digital ecosystem against evolving cyber threats

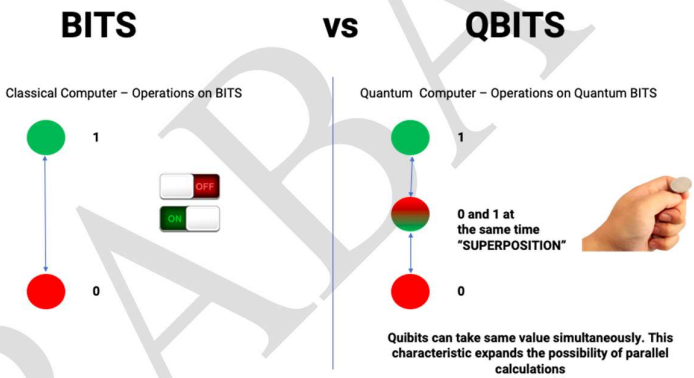
Q.18) Define Quantum Key Distribution (QKD) technology. Explain its working principle and evaluate its significance in enhancing cyber and national security amid emerging quantum computing threats. (250 Words, 15 Marks)

Introduction

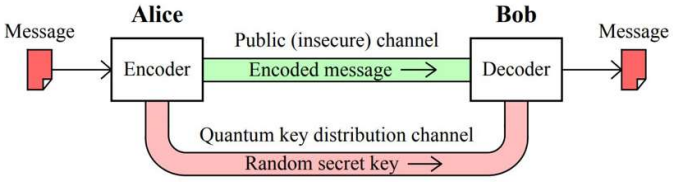
Quantum Key Distribution (QKD) is a secure communication method that uses quantum mechanics to encrypt data. By enabling tamper-proof key exchange, QKD offers next-generation protection against cyber threats, especially from powerful quantum computers.

Body

Working Principle of QKD



- **Quantum Superposition**: QKD uses photon polarization (e.g., vertical/horizontal) to represent qubits; any measurement alters the state, as demonstrated in the BB84 protocol and ISRO's 2021 trial over 300 meters.
- **Key Exchange Process**: Sender (Alice) and receiver (Bob) use random bases for encoding and decoding photons; China's Micius satellite (2017) enabled secure exchange over 1,200 km.
- **Error Checking**: A subset of bits is publicly compared to estimate Quantum Bit Error Rate (QBER); ISRO reported QBER <5%, ensuring acceptable levels for secure key generation.



- **Authentication**: Classical methods like digital signatures or hash-based authentication are used before QKD begins to prevent impersonation; this hybrid model strengthens trust in the system.
- **No-Cloning Theorem**: Qubits can't be copied without disturbing their state; TIFR experiments showed any eavesdropping raises QBER, making interception easily detectable and preventing key theft.

Emerging Quantum Computing Threats

- **Classical Encryption at Risk**: RSA-2048 and ECC can be broken by Shor's algorithm, threatening global digital security, including banking and defense systems.
- **Future Decryption Attacks**: "Store now, decrypt later" tactics are used to capture encrypted data now and break it once quantum computers scale.

- **Growth of Cyber Espionage**: Quantum-powered attackers may intercept classified government or corporate data without detection.
- **Blockchain Vulnerability**: Quantum computing can crack digital signatures (e.g., ECDSA), posing risks to cryptocurrencies and smart contracts.
- **Threat to Sovereignty**: National systems like nuclear command, power grids, and satellite links face serious breaches without quantum-safe protocols.

Significance in Cyber and National Security

- **Post-Quantum Security**: QKD provides unconditional security based on quantum laws, unlike RSA or ECC, which are vulnerable to Shor's algorithm in quantum computing.
- **Protection of Critical Infrastructure**: QKD secures communications for defense, banking, and nuclear sectors; DRDO's QKD trials in 2022 aimed to secure Army's strategic networks.
- **Long-Term Confidentiality**: Even if quantum computers decrypt today's encrypted data later (harvest now, decrypt later), QKD ensures future-proof confidentiality.
- **Secure Government Communication**: Countries like China use QKD for encrypted diplomatic links; e.g., Beijing-Shanghai quantum backbone for government and finance sectors.
- **Boost to Indigenous Tech**: India's National Mission on Quantum Technologies (₹6,000 crore outlay, 2020) supports QKD R&D, strengthening Atmanirbhar Bharat in cyber defence.

Conclusion

India must scale up investments in quantum R&D through initiatives like the National Mission on Quantum Technologies and Applications (NM-QTA), Defence Research and Development Organisation (DRDO) trials, and Centre for Development of Telematics (C-DOT) projects to secure future communication.

Q.19) Analyze the role of lifestyle changes envisaged under India's LiFE Mission in promoting climate mitigation and sustainable resource use. (250 Words, 15 Marks)

Introduction

India's LiFE (Lifestyle for Environment) Mission, launched at COP26, promotes simple eco-friendly habits in daily life. It aims to cut carbon emissions and save resources by encouraging mindful choices and sustainable living among citizens.

Body

Mission LiFE: India's Lifestyle for Environment Initiative

- **Global Launch**: Launched by PM Modi and UN Secretary-General in 2022 at Kevadia, Mission LiFE promotes sustainable living as a mass movement.

- **People-Centric Approach**: Focuses on nudging individuals and communities toward climate-conscious daily choices, avoiding over-reliance on state-led or tech-only solutions.
- **Global Recognition**: Endorsed at COP27 and G20, positioning India as a pioneer of demand-side climate action.
- **LIFE Global Call for Ideas**: Over 2 million ideas submitted globally; fosters citizen innovation for environment-friendly behaviour.
- **7 Themes of Action**: Includes energy saving, water saving, waste reduction, sustainable food, transport choices, eco-friendly consumption, and healthy lifestyles.

Climate Mitigation through Lifestyle Changes

- **Behavioural Shifts**: LiFE (Lifestyle for Environment) encourages individuals to adopt low-carbon habits like public transport, vegetarian diets, and energy conservation.
- **Emission Reductions**: UNEP estimates that widespread adoption of LiFE practices could reduce global CO_2 emissions by up to 20% by 2050.
- **Demand-Side Efficiency**: Promotes reduced demand for high-carbon goods—like single-use plastics—helping reduce industrial emissions.

- **Community-Driven Action**: Campaigns like "My LiFE Pledge" and "Mission Life Global Call" mobilize citizens to act collectively against climate change.
- **Influencing Global Narratives**: India's LiFE approach positions lifestyle as a fourth pillar of climate action alongside technology, finance, and policy.

Sustainable Resource Use through Lifestyle Change

- **Water Conservation**: Promotes rainwater harvesting, water-efficient fixtures, and behavioral nudges to reduce daily water consumption.
- **Energy Savings**: Encourages use of LEDs, efficient appliances, and reduced reliance on air conditioning—already saving 40 million tonnes of CO_2 annually (MoEFCC, 2023).
- **Waste Reduction**: Advocates for reuse and recycling habits, aligning with Swachh Bharat and circular economy models.
- **Sustainable Mobility**: Promotes walking, cycling, and EVs to lower fossil fuel demand—especially in urban settings.
- **Food Sustainability**: Encourages mindful consumption and waste reduction.

Conclusion

As the UNEP notes, "Climate change is a global challenge with local solutions." Mission LiFE bridges this gap by embedding sustainability into everyday habits, ensuring India's growth aligns with planetary boundaries and climate resilience.

Q.20) Analyze India's internal security challenges and discuss how technology-driven surveillance and intelligence systems are strengthening national security. (250 Words, 15 Marks)

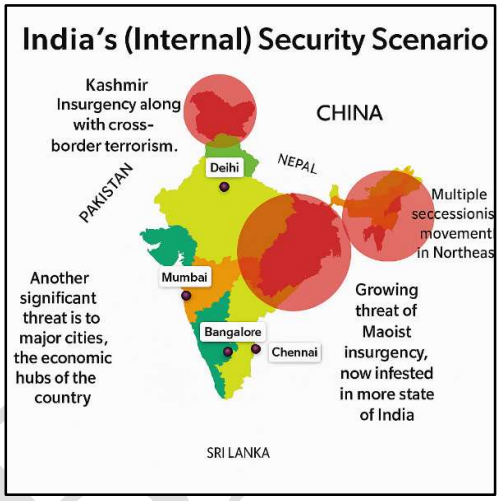
Introduction

India's internal security faces growing challenges such as terrorism, insurgency, organized crime, and cyber threats. These issues are becoming more complex and widespread, making it necessary to adopt technology-driven solutions to strengthen national security.

Body

India's Internal Security Challenges

- **Cross-Border Terrorism**: Over 100 infiltration attempts recorded annually in J&K; *JeM*'s involvement in Pulwama (2019) and drone drops of arms in Punjab show evolving tactics.
- **Left-Wing Extremism (LWE)**: Incidents dropped from 2,258 (2009) to 509 (2023), but Bastar, Sukma, and Gadchiroli still report high Maoist activity with ambushes and IED attacks.
- **Insurgency in Northeast**: Post-NSCN split, Manipur saw >140 deaths in 2023 ethnic clashes; porous 1,643 km border with Myanmar fuels arms and drug trafficking.
- **Cyber Threats**: India saw 1.4 million cybersecurity incidents in 2023 (CERT-IN); *AIIMS Delhi* ransomware attack (2022) exposed critical digital vulnerabilities.
- **Communal & Identity Conflicts**: Nuh violence (2023) and Delhi riots (2020) triggered by social media provocation; encrypted messaging apps complicate real-time response.



Technology-Driven Surveillance and Intelligence Systems

- **Integrated Intelligence Grids**: NATGRID connects data from 11 central agencies and 21 databases (e.g., railways, banks), enabling faster terror link tracing.
- **Facial Recognition & Biometrics**: Delhi Police used facial recognition to identify 1,100+ suspects during 2020 riots; Aadhaar aids verification in border regions.
- **Drone & Anti-Drone Tech**: BSF deployed drone surveillance along Punjab border; *DRDO's D-4 drone jammer* countered multiple arms-dropping attempts in 2023.
- **Satellite-Based Monitoring**: ISRO's *RISAT* and *CartoSAT* satellites assist in border mapping, Maoist tracking, and disaster-time troop deployment.
- **CCTV Expansion**: Delhi ranked world's most surveilled city (2022) with 1,826 cameras per sq. mile; helps crime prevention and crowd monitoring.
- **Cyber Surveillance Platforms**: I4C (Indian Cyber Crime Coordination Centre) analyzes data from 7 verticals to counter phishing, financial fraud, and dark web threats.
- **AI & Predictive Policing**: States like Telangana use AI to predict crime-prone zones; *TSCOP* app integrates facial recognition and FIR access.
- **Real-Time Information Sharing**: CCTNS and ICJS link 16,000+ police stations for seamless access to FIRs, case files, and criminal records across states.

Conclusion

India must adopt models like Germany's data safeguards and South Korea's smart surveillance, while empowering alert citizens and innovators to act as the first line of defense in preventing threats and strengthening internal security.