P L RAJ UPSC MONTHLY MAGAZINE – COMPILATION

DECEMBER 2025

Index

1. Infrastructure- India on the Fast Track to Viksit Bharat@2047

GS Paper III- Economic Development

Topic

1. Infrastructure- Energy, Ports, Roads, Airports, Railways, etc.
2. Investment Models.
3. Indian Economy and issues relating to planning, mobilization of resources, growth, development, and employment.

Introduction

Infrastructure acts as the backbone of productivity and competitiveness, serving as the primary engine for India's transition toward Viksit Bharat @ 2047. Through sustained public investment and integrated planning over the last decade, India has shifted from a fragmented approach to a holistic, technology-driven infrastructure ecosystem.

1. Economic Impact & Progress Indicators

Surge in Capital Expenditure (Capex)- Public investment has witnessed a massive jump from Rs 2 lakh crore (2014–15) to Rs 11.21 lakh crore (2025–26).

Global Competitiveness- India's rank in the World Bank's Logistics Performance Index (LPI) improved significantly from 44 (2018) to 38 (2023).

Economic Growth- Infrastructure spending supports India's status as the fastest-growing major economy, with a GDP growth projection of 6.5–6.6% for 2024–25.

2. Bharatmala Pariyojana (The Highway Revolution)

Overview- Launched in 2017 with an investment of Rs 8.5 lakh crore, it is India's largest highway program aimed at optimizing freight movement.

Targets vs. Achievements (Phase-I)

1. Target- 34,800 km.
2. Awarded- 26,425 km.
3. Completed (mid-2025)- 20,770 km.

Network Expansion

National Highways (NH)- Expanded by ~60%, growing from 91,287 km (2014) to 1,46,342 km (2025).

Construction Pace- Accelerated from 12 km/day (2014–15) to a robust 29–34 km/day post-2020.

Key Components

1. Development of Economic Corridors (8,737 km).
2. Construction of Expressways (2,422 km).
3. Border & International connectivity roads (1,619 km).
4. Port/Coastal connectivity roads.

Outcome- Logistics costs have declined from 16% to ~10% of GDP, moving closer to global benchmarks.

3. Expressways & Strategic Infrastructure

Greenfield Expressways- Focus on high-speed corridors to improve freight efficiency.

Status (2025)- 25 expressways announced (10,000 km); 6,669 km awarded; 4,610 km completed.

Beneficiary States- Maharashtra, Rajasthan, Uttar Pradesh, and Madhya Pradesh (promoting regional integration).

Strategic & Border Security- Dual-use infrastructure serving both economic development and strategic defense.

Iconic Projects

1. Atal Tunnel & Sona-marg Tunnel (Himalayan connectivity).
2. Bogibeel Bridge (Assam-Arunachal).
3. Maitri Setu (India-Bangladesh).

4. Sudarshan Setu (Gujarat).

4. Financing & Implementation Reforms

Core Challenges

1. Land acquisition delays.
2. Environmental clearances.
3. Funding gaps and contractor capacity issues.

Digital Interventions (Reforms)

1. Bhoomi Rashi Portal- Digitized and expedited land acquisition.
2. Parivesh Portal- Streamlined environmental clearances.
3. Adoption of online approvals and better inter-state coordination.

Innovative Financing

Asset Monetization- NHAI plans to raise funds through public InvITs (Infrastructure Investment Trusts).
Revenue Potential- Targeted revenue generation of Rs 15 lakh crore through asset monetization to bridge funding gaps.

5. Employment & Structural Transformation

Job Creation

1. Current employment in logistics- 22 million.
2. Projected additional jobs by 2027- 10 million.

Qualitative Shift- Focus on formalization, digitalization, and skilling to enhance productivity and leverage India's demographic dividend.

6. PM Gati-Shakti National Master Plan (2021)

Objective- Coordinated planning and execution of infrastructure projects to bring down logistics costs.

Mechanism

1. Integrates 57 ministries and 36 States/UTs.
2. Utilizes a GIS-based platform with 1,700+ data layers.

Six Guiding Principles

1. Integrated development.
2. Connectivity improvement.
3. Reduced ecological impact.
4. Expedited clearances.
5. Allied infrastructure planning.
6. Faster land acquisition.

Network Planning Group (NPG)

1. Conducted 100 meetings (till Oct 2025).
2. Evaluated 293 projects worth Rs 13.59 lakh crore to ensure multimodal connectivity.

7. National Logistics Policy (NLP), 2022

Role- Complements PM Gati-Shakti by focusing on "soft infrastructure" (process reforms, digitization, policy) rather than just physical construction.

Digital Platforms

1. ULIP (Unified Logistics Interface Platform)- For data integration.
2. LDB (Logistics Data Bank)- For tracking EXIM (Export-Import) cargo.

Vision- Create a trusted, resilient, cost-efficient, and technologically enabled logistics ecosystem.

Operational Framework

1. Executed through CLAP (Comprehensive Logistics Action Plan).
2. Focus areas- Regulatory reform, standardization, skilling, and performance monitoring.

8. Multi-Modal Logistics Parks (MMLPs)

Status- 35 MMLPs approved under Bharatmala.
Key Locations- Chennai, Nagpur, Indore, Bengaluru.

Goal- 5 operational by 2027; aimed at improving warehousing efficiency and enabling seamless modal shifts (Road-Rail-Water).
SMILE Programme (with ADB)- Focuses on "Integrated State and City Logistics Plans" to reduce costs at the local level.

9. Key Challenges in Logistics Sector

Modal Imbalance (Skewed Mix)

1. Roads- Carry 70–71% of freight (High cost/congestion).
2. Railways- Carry only ~18% (NITI Aayog, 2021).

MSME Burden- High logistics costs erode the profit margins and global competitiveness of MSMEs.
Unorganized Sector Dominance- 90% of logistics players are small/informal (KPMG, 2022), preventing economies of scale.
Digital Divide- Low tech adoption among small operators, especially in rural areas.
Regulatory Complexity- Issues with overlapping Centre–State rules and GST inconsistencies.
Skill Deficit- Lack of trained manpower for modern warehousing and multimodal operations.

10. The Way Forward

Rebalancing Modal Mix- Shift freight from road to rail and waterways to lower costs and carbon footprint.
Technological Integration

1. Use of automation (IoT, scanners).
2. End-to-end data integration via ULIP.
3. Adoption of app-based, on-demand warehousing.

New Business Models- Support for Omnichannel retail, Quick Commerce, and BOPIS (Buy Online, Pick-up In-Store).
Promote PPPs- Encouraging collaboration between startups and small fleet owners.
Case Study- Rivigo's AI-based route optimization reduced fuel use and travel time.
Regulatory Harmonization- Simplify licensing and ensure GST consistency across states.
Green Logistics- Push for energy-efficient fleets and sustainable warehousing to meet climate goals.

2. Indian Industries- Issues, Challenges and Opportunities

GS Paper III- Economic Development
Topic- Indian Economy and issues relating to planning, mobilization of resources, growth, development and employment.
Sub-Topic- Changes in industrial policy and their effects on industrial growth.

Introduction

India's industrial sector has undergone a massive structural shift since Independence. It has evolved from a base of small-scale handicrafts and textiles (pre-1947) to State-led industrialization (post-1950), and finally to Liberalization, Privatization, and Globalization (LPG) after 1991. Today, the sector spans diverse fields like electronics, defense, and renewable energy, and is increasingly integrated into global value chains.

1. Structural Profile of Indian Industry

GDP Contribution
Industry- Consistently contributes 28–30% of GDP.
Manufacturing- Accounts for 14–16%.
Construction- Accounts for 8–10%.
Sectoral Shift- Agriculture's share has dropped from ~50% to ~15%, while the Services sector now dominates employment and output.
Global Standing- India's share in global manufacturing remains below 2%, missing the 25% of GDP target set by the National Manufacturing Policy (2011).

Regional Disparity- Industrial growth is uneven across different states and regions, hindering inclusive development.

2. Post-1991 Reforms & Outcomes

The 1991 Policy- Abolished licensing, encouraged private players, and opened sectors to Foreign Direct Investment (FDI).

Positive Outcomes

1. Increased efficiency, modernization, and domestic competition.
2. Growth in capital-intensive and import-intensive industries.
3. Expansion of exports and integration with global supply chains.

Persistent Concerns

High Import Intensity- Exports often rely heavily on imported components.

Jobless Growth- Manufacturing has seen a decline in labor intensity.

Sectoral Skew- Over-reliance on specific sectors (e.g., Automobiles alone contribute nearly 50% of manufacturing output).

3. Key Challenges Facing Indian Industry

A. Fragmented Structure

MSME Dominance- 7 crore MSMEs make up ~99% of enterprises.

The Problem- While this aids entrepreneurship, it leads to small-scale, poor-quality control, and weak global competitiveness.

Dilemma- Balancing the need for large-scale production vs. preserving employment in small units.

B. Infrastructure & Logistics

High Cost- Logistics costs are ~14% of GDP (vs. 8–10% in developed nations).

Bottlenecks- Power shortages, transport delays, and unreliable supply chains reduce competitiveness.

C. Regulatory & Governance Issues

Complexity- No "one-size-fits-all" regulation exists due to the diversity of enterprises.

Ghost Companies- Nearly 1/3rd of 29 lakh registered companies is inactive, complicating oversight.

D. Cross-Subsidization Burden

Railways- High freight tariffs are used to subsidize cheap passenger fares.

Power- High industrial power tariffs subsidize agriculture and households.

Result- Industries shift freight to roads and build captive power plants, reducing efficiency.

E. Environmental & Social Constraints

Closures- Plants often face closure due to environmental violations (e.g., Sterlite Copper).

Pharma Gap- Closure of Pharma PSUs has increased dependence on imported bulk drugs (APIs).

F. Employment & Informality

Unorganized Sector- Employ Over 85% of the workforce, leaving them without social security.

G. Technology Gaps

Industry 4.0- Adoption requires high capital and skilled labor, which is difficult for MSMEs to afford.

4. Emerging Opportunities

Demographic Dividend- One of the world's youngest workforces ensures a large labor pool and strong domestic demand.

New Tech & Models (Industry 4.0- Use of AI, IoT, Robotics, and 3D printing. Shift from "product ownership" to "service-based" models.

Green Manufacturing- High growth potential in EVs, renewable energy, and battery storage, aligning with climate goals.

Policy Support

PLI Scheme (2020)- Covers 14 sectors; attracted Rs 1.76 lakh crore investment and created 12 lakh jobs.

Semiconductor Mission- Rs 76,000 crore support to boost electronics.

Defense- Rising manufacturing and exports are adding depth to the sector.

Infrastructure Push

Projects- National Infrastructure Pipeline (NIP), Bharatmala, Sagarmala, and Dedicated Freight Corridors (DFCs).

Corridors- Development of Industrial Corridors like Delhi-Mumbai Industrial Corridor (DMIC).

Port Capacity- Target expansion to 10,000 MTPA.

5. The Way Forward

1. Competitiveness- Focus on scale, standardization, and strict quality control.
2. Skilling- Align workforce skills with Industry 4.0 and automation.
3. Logistics- Reduce costs through multimodal transport (Rail-Road-Water integration).
4. Export Focus- Promote capital-intensive sectors like defense for exports.
5. Flexible Regulation- distinct regulations for small vs. large enterprises.
6. 'Brand India'- Establish India as a symbol of quality while allowing inefficient firms to exit naturally.

Conclusion

India is transitioning from a service-led, consumption-driven economy to a balanced industrial powerhouse. By leveraging the National Manufacturing Mission, robust policy support (PLI), and infrastructure upgrades, India aims to fix structural constraints. If successful, Indian industry will emerge as a resilient, globally competitive engine driving inclusive growth and the vision of Viksit Bharat.

3. Education for the Next Century

GS Paper II- Social Justice & Governance

Topic- Issues relating to development and management of Social Sector/Services relating to Health, Education, Human Resources.

Sub-Topic- Skill Development, National Education Policy (NEP) 2020, and Government Policies for development.

GS Paper III- Economic Development

Topic- Employment and Inclusive Growth.

Introduction

India sits on a historic demographic opportunity with a large working-age population and a low dependency ratio. However, the central challenge is converting this "demographic bulge" into a "dividend" by ensuring sustained employability and decent jobs, moving beyond simple enrolment numbers to actual skill acquisition.

1. The Changing Nature of Work

21st Century Reality- Characterized by rapid tech changes and shorter skill life-cycles.

New Requirements- High demand for soft skills and adaptability.

Paradigm Shift- The boundary between education and work is blurring; the focus has shifted from "front-loaded education" (learning only in youth) to "Lifelong Learning".

2. NEP 2020- The Conceptual Foundation

Core Philosophy- Focuses on "Learning how to learn" rather than rote memorization.

Removing Silos- Eliminates hard separations between

a) Arts and Sciences.
b) Vocational and Academic streams.
c) Curricular and Co-curricular activities.

Goal- To create a flexible skills ecosystem where adaptability is valued over static degrees.

3. National Credit Framework (NCF)

Unified System- Developed jointly by UGC, AICTE, and NCVET to integrate School, Higher Education, and Skilling.

Micro-Credentials- Recognizes short, focused certifications (e.g., a specific solar safety module) that align with industry needs.

Credit Accumulation- Allows students to "stack" these small credits to earn larger qualifications (Degrees/Diplomas) over time.
Benefit- Prevents fragmentation of learning; a technician can upgrade skills incrementally without restarting education.

4. Quality Assurance (NCVET)

Regulator- The National Council for Vocational Education and Training (NCVET) acts as the quality watchdog.
Standardization- Sets "National Occupational Standards" and guidelines for micro-credentials.
Credibility- Mandates industry validation and assessment norms to ensure certificates are a "trusted currency" for employers, addressing the issue of poor recognition (ILO, 2025).

5. Institutional Modernization- Upgrading ITIs

Transformation- Converting Industrial Training Institutes (ITIs) into "Centres of Excellence" with modern simulators and industry-aligned curriculum.
PMSETU Scheme (Approved May 2025)

a) Goal- Upgrade 1,000 Government ITIs.
b) Establish- 5 National Centres of Excellence for Skilling.
c) Funding- Enables multi-source financing and industry collaboration.

Impact- Improves placement wages and supports MSMEs with shared testing facilities.

6. Digital Public Infrastructure (Skill India Digital Hub)

Integration- A unified platform for courses, assessments, credentials, and job discovery.
Smart Features- Provides digitally verified, portable learner profiles. Offers Smart Career Guidance (e.g., guiding a machine operator to become a 3D printing technician).
Target Groups- Critical for women re-entering the workforce and workers transitioning to Green/Digital economy jobs.

7. Way Forward

Shift in Metrics- Move from counting "number of people trained" to measuring real outcomes

a) Skill acquisition levels.
b) Job placement rates.
c) Wage growth and productivity.

Execution- Ensure education aligns with real-world workplace experiences.

Conclusion

India is dismantling the traditional divide between "learning" and "earning" by integrating Micro-credentials, Modern Institutions (PMSETU), and Digital Infrastructure. These reforms are moving from intent to execution. If implemented effectively with a focus on outcomes, this ecosystem will secure India's demographic dividend, boost industrial productivity, and drive the transition to an innovation-led economy.

4. India's Quantum Leap in the Global Innovation Landscape

GS Paper III- Economic Development & Science and Technology
Topic-

1. Indian Economy and issues relating to planning, mobilization of resources, growth, development and employment.
2. Indigenization of technology and developing new technology.
3. Effects of liberalization on the economy.

Introduction

India has achieved a historic milestone in the global innovation landscape, jumping 42 positions in the Global Innovation Index (GII)—from Rank 81 (2015) to Rank 38 (2025). This makes India the fastest-

improving large economy, the top innovator in Central and Southern Asia, and an "innovation overperformer" relative to its GDP per capita.

1. Global Innovation Index (GII) Performance

Published by- WIPO, Cornell University, and INSEAD.
Metrics- Evaluates 139 economies on 80 indicators (Inputs vs. Outputs).
India's Strength- Ranks 22nd globally in "Knowledge and Technology Outputs," highlighting its efficiency in converting inputs into tangible results.

2. Policy Architecture & Startup Ecosystem

Startup India (2016)
Reforms- Single digital portal for ease of entry, tax exemptions for the first 3 profitable years, and a Rs 10,000 crore Fund of Funds.
Growth- Recognized startups grew from **~**500 (2016) to Over 1.61 lakh (2025).
Impact- Created ~17 lakh jobs.
Inclusivity- ~51% of new startups are from Tier-2 and Tier-3 cities.
Insolvency and Bankruptcy Code (IBC)- Improved the "exit mechanism," encouraging entrepreneurial risk-taking. Accounted for 48% of bank recoveries in FY24 with a recovery rate of 32–33%.

3. Digital Public Infrastructure (DPI) as Enabler

Foundation- The Digital India Mission (2015) built the "India Stack" (Aadhaar, UPI, Open APIs).
Democratization-
UPI- Processed Rs 24.9 lakh crore in transactions (Sept 2025).
ONDC- Enabling inclusive digital commerce.
Account Aggregators- Facilitating MSME lending.
Global Leadership- This digital backbone supports micro-entrepreneurs and has propelled India to Rank 1 globally in ICT services exports.

4. Manufacturing & R&D Integration (PLI Scheme)

PLI Scheme (2020)- Covers 14 sectors; mobilized Rs 1.76 lakh crore investment and created 12 lakh jobs.
Sectoral Success
Electronics- 146% surge (Rs 2.13 lakh Cr to Rs 5.25 lakh Cr).
Telecom- Achieved 60% import substitution.
Drones- Sector expanded seven-fold.
Strategic Shift- With PLI 2.0 and the Rs 1 lakh crore RDI Scheme, India is shifting focus from "Make in India" to "Design, Invent, and Make in India".

5. Education, Research & Knowledge Creation

NEP 2020- Promotes interdisciplinary, research-driven learning.
Funding- Anusandhan National Research Foundation (ANRF) established with Rs 50,000 crore.
Outcomes
Rank 3rd globally in research publications (Output up 142% since 2015).
PhD Enrolment- Doubled to 2.34 lakh.
Gender Parity- Female enrolment increased by 135.6%.
IP Awareness- Programs like KAPILA are aligning higher education with industry IP needs.

6. Institutional Capacity & IP Ecosystem

Infrastructure- Established 42 new Central Higher Educational Institutions since 2014. Rs 11,828 crore approved to expand 5 new IITs (adding 6,500 seats).
Atal Innovation Mission (AIM)- Set up 10,000 Atal Tinkering Labs in schools. Incubated 3,500+ startups, generating 32,000 jobs.
Intellectual Property (IP)- Rank 6th globally in patent filings (64,480 in 2023).
Indigenization- 55.2% of filings are now by domestic residents, signaling homegrown innovation.

7. Way Forward

R&D Spending- Increase Gross Expenditure on R&D (GERD) from 0.7% to 2% of GDP.
Collaboration- Deepen participation of the private sector and promote MNC-Startup-University co-innovation.
Decentralization- Expand innovation hubs to the district level and push DPI/ONDC to the hinterlands (Vocal for Local).
Commercialization- Accelerate the process of turning patents into marketable products.

Conclusion

India's ascent in the GII represents a structural transformation driven by coordinated reforms in Policy, Digital Infrastructure, and Education. By sustaining these investments and decentralizing the ecosystem, India is transitioning from a "technology adopter" to a "Global Innovation Originator," capable of shaping solutions for the 21st century.

5. NISAR- Science from Orbit, Impact on Earth

GS Paper III- Science and Technology
Topic

1. Awareness in the fields of Space, Computers, Robotics.
2. Indigenization of technology and developing new technology.
3. Disaster and Disaster Management.

Introduction

NISAR (NASA-ISRO Synthetic Aperture Radar) is a Low Earth Orbit (LEO) Earth-observing satellite. It represents the largest-ever civil space collaboration between ISRO and NASA. Launched on 30 July 2025 by GSLV Mk-II (F16), it is placed in a Sun Synchronous Polar Orbit (SSPO) at an altitude of 747 km.

1. Mission Capabilities

Global Mapping- Maps the entire globe every 12 days.
Data Consistency- Generates spatially and temporally consistent data.
Key Monitoring Areas- Ecosystems, ice mass, vegetation biomass, sea-level rise, groundwater, and natural hazards (earthquakes, tsunamis, volcanoes, floods, landslides).

2. Payload and Technological Innovation

Dual-Band SAR- Equipped with two radar frequencies for all-weather, day-night imaging (penetrates clouds/darkness)-
L-Band- Produced by NASA (Better for thick vegetation/forests).
S-Band- Produced by ISRO (Better for crop monitoring/soil moisture).
Sweep SAR Technology- First global mission to use this, enabling a massive swath of ~240 km while maintaining high resolution.
Hardware- Features a massive deployable 12-meter reflector and boom.
Spacecraft Bus- Uses ISRO's 13K bus with advanced power, thermal management, and High-Data-Rate downlink.
Protection- Includes an indigenously developed shield to protect the fuel tank from micrometeoroids and orbital debris.

3. Science Applications Over India

Given India's diverse topography and disaster vulnerability, NISAR provides specific benefits-
Disaster Management
Rapid Response- Capable of rescheduling observation within 24 hours and delivering data within 5 hours.
Flood/Inundation- Mapping at high resolution.
Cryosphere (Ice) Monitoring
Himalayas & Antarctica- Monitors deformation every 12 days at ~100m scale.

Specifics- Tracks glacier faces, wet snow cover, and sea-ice drift near Indian Antarctic stations.

Agriculture & Ecology

1. Crops- Monitors growth and soil moisture at 100m resolution.
2. Mangroves- Annual mapping of India's cover at 25m resolution.
3. Forests- Maps above-ground biomass and disturbances at hectare scale.

4. Joint Collaboration & System Integration

The mission is a perfect blend of capabilities

NASA Contribution- Boom-reflector system and L-Band Radar.

ISRO Contribution- Satellite Bus (UR Rao Satellite Centre) and S-Band Radar.

Joint Effort- The Integrated Radar Instrument (IRIS) was jointly developed by JPL (NASA) and SAC (ISRO).

Testing- involved four stages, harmonizing design philosophies and standards over a decade of cooperation.

5. In-Orbit Deployment and Operations

Post-Launch- Successfully deployed solar panels and established Earth-pointing orientation.

First Light- Achieved in August 2025 for both S-SAR and L-SAR.

Data Volume- Expected to generate ~80 TB of data during its science phase.

a) L-band data- Downlinked at NASA stations.
b) S-band data- Downlinked at ISRO stations.

6. Strategic and Governance Relevance

Resilience- Strengthens India's disaster preparedness and climate resilience.

Resource Management- Aids in water and agricultural planning.

Global Role- Enhances India's contribution to global climate monitoring and Sustainable Development Goals (SDGs).

Science Diplomacy- Positions India as a credible partner in high-end, complex space technologies.

Conclusion

NISAR marks a quantum leap in Earth observation by combining cutting-edge Sweep SAR technology with deep institutional collaboration. It translates orbital science into actionable insights for disaster management and climate action, showcasing the maturity of the ISRO–NASA partnership in solving global challenges.

KURUKSHETRA

1. Khadi- Innovation, Sustainability and India's Textile Renaissance

This chapter traces Khadi's journey from a historical symbol of resistance to a modern, eco-conscious textile.

Concept & Significance

Khadi is a hand-spun and handwoven fabric made from natural fibers like cotton, silk, or wool. It is characterized by breathability, thermal versatility (cool in summer, warm in winter), and an extremely low carbon footprint. Beyond a textile, it generates rural employment and empowers women artisans.

Historical Evolution

Ancient Roots- Archaeological findings at Mohenjo-Daro suggest early handwoven textiles. Chanakya's *Arthashastra* (Mauryan period) references organized textile production.

Freedom Struggle- Gained political significance in 1918 when Mahatma Gandhi launched the Khadi Movement to resist colonial economic exploitation. The *charkha* became a symbol of *Swadeshi* and self-reliance.

Institutional Framework

The Khadi and Village Industries Commission (KVIC) was established under the KVIC Act of 1956 to promote the sector. Its mandate includes supplying raw materials, improving techniques, quality control, and marketing.

Renaissance & Innovation

Designer Revival- In the late 1980s-90s, designers like Ritu Kumar repositioned Khadi as a premium, artisanal fabric.

Material Innovation- New blends with bamboo, hemp, Tencel, and silk improve durability and drape.

Tech Interventions- Solar-powered dyeing units and improved charkhas enhance productivity while preserving the handmade character.

Global Context- While the global fashion industry is water-intensive and polluting, Khadi offers a sustainable alternative with minimal electricity usage and a low carbon footprint.

2. Khadi- Strengthening the Rural Economy and India's Journey Towards Self-Reliance

This chapter focuses on the economic performance, employment generation, and government schemes supporting the sector.

Economic Milestones (2024-25)

Turnover- The sector achieved a historic turnover of ₹1.70 lakh crore.

Growth (Last Decade)

1. Production- Increased by 347% (from ₹26,109 crore in 2013-14 to ₹1,16,599 crore).
2. Sales- Increased by 447% (from ₹31,154 crore to ₹1.70 lakh crore).
3. Employment- Supports 1.94 crore people, reflecting a 49% growth over the decade.

Women Empowerment- Women constitute 80% of Khadi artisans. In training programs, 57.45% of the 7.43 lakh trainees were women. Artisan wages have increased by 275% in the last 11 years.

The "3P Approach"- The Ministry of MSME follows the Protect, Promote, and Propel strategy to modernize production and expand markets.

Key Government Schemes

1. PMEGP- Promotes micro-enterprises; established over 10 lakh units creating 90 lakh jobs.
2. SFURTI- Cluster-based regeneration of traditional industries.
3. Khadi Gramodyog Vikas Yojana (KGVY)- Provides budgetary support and infrastructure.
4. MMDA (Modified Market Development Assistance)- Deregulates pricing for market competitiveness.
5. ISEC- Offers concessional loans (4% interest) for working capital.

3. Khadi as a Driver of Sustainable Agriculture

This chapter connects Khadi to the agrarian economy, highlighting the "Farm-to-Fabric" linkage.

Farm-to-Fabric Linkage

Khadi sources raw materials directly from agriculture- Cotton (farms), Silk (sericulture), Wool (sheep rearing), and Jute. This creates an ecosystem that supports farmers, spinners, weavers, and allied workers.

Livelihood Security

Provides off-season employment to farmers, reducing vulnerability to crop failures and climatic shocks. It offers income diversification for small and marginal farmers.

Sustainability & Climate Action

Eco-friendly Practices- Uses organic cotton, natural dyes, and minimal water.

Net Zero- Aligns with India's Net Zero 2070 goals due to negligible carbon emissions from hand-spinning.

Millet **Mission-** Integration with the Millet Mission (Shree Anna) strengthens climate-smart livelihoods in dry regions.

Digital & Market Expansion

1. e-Khadi platforms enable direct artisan-to-consumer sales.
2. Solar Charkha Mission promotes renewable energy in production.
3. Global Reach- Khadi trademarks are registered in 15 countries; exports stood at ₹37.88 crore (2023-24).

4. Khadi- Eco-friendly Textile and Living Cultural Heritage

This chapter emphasizes the environmental benefits and the need to preserve Khadi as a living heritage.

Eco-Friendly Production

Low Energy- Manual production eliminates dependence on heavy machinery.
Biodegradable- Natural fibers avoid microplastic pollution, unlike synthetic fabrics.
Circular Economy- Follows zero-waste principles where fabric scraps are reused for paper and quilts.

Challenges in the Sector

Competition- From cheap, machine-made fabrics and fast fashion.
Authenticity- Threat from machine-made imitations; need for stricter "Khadi Mark" certification.
Skill Gap- Younger generations moving away from manual crafts.
Scalability- High production costs limit mass-market reach.

Way Forward

Design Modernization- Innovate designs while maintaining cultural integrity.
Heritage Tourism- Integrate Khadi craft villages into heritage tourism circuits.
Global Branding- Promote the "eco-friendly narrative" to appeal to conscious global consumers.
GS Paper- GS Paper I- History, Culture
GS Paper III- Economic Development, Agriculture, Environment
Topic
GS I- The Freedom Struggle (Swadeshi Movement); Indian Culture (Heriage Crafts).
GS III- Inclusive Growth; Major crops-cropping patterns; Food processing and related industries in India (scope and significance); Conservation and Environmental Pollution (Sustainable Development).
Sub-Topic- Khadi and Village Industries (KVI), Rural Economy, Sustainable Textiles, Women Empowerment, Government Schemes (PMEGP, SFURTI).

DOWN TO EARTH

1. Promise And Paradox of Rooftop Solar Power

Context

Despite the technological and environmental promise, the transition to rooftop solar has not scaled up as expected in India, because of the deep structural challenge of integrating solar energy into existing power systems.

Solar Power in India

India has an ambitious goal of achieving 500 GW of renewable energy capacity by 2030, with 280 GW expected from solar. Within this, rooftop solar (RTS) — decentralized power generated on residential and commercial buildings — emerges as both a promise and a paradox. It faces systemic hurdles that challenge its scalability, while it promises democratized energy access and reduced carbon footprint.

Promise- Democratizing Energy Generation

Decentralized Energy Access- According to the MNRE, rooftop solar installations empower consumers to become 'prosumers'—both producers and consumers of energy. It reduces transmission losses and strengthens grid resilience.

Environmental and Economic Benefits- A 1 kW rooftop solar system can offset around 1.2 tonnes of CO_2 per year, contributing substantially to India's Nationally Determined Contributions (NDCs). Furthermore, RTS offers long-term savings—reducing household electricity bills by 30–40%.

Job Creation and Local Economies- MNRE reports indicate that every megawatt of rooftop solar installed creates around 24 direct jobs—far higher than centralized coal or hydro projects. It includes opportunities for local technicians, electricians, and maintenance services.

Paradox- Potential vs. Reality

Lagging Behind Targets- Despite a target of 40 GW by 2022, as per Central Electricity Authority, only 11 GW has been achieved. The reasons are multifold—policy inconsistency, poor implementation, and limited consumer awareness.

Financial Barriers- Even with government subsidies under schemes like the Grid Connected Rooftop Solar Programme (Phase II), upfront installation costs remain prohibitive for middle-class households. Financial institutions often perceive RTS loans as high-risk, limiting credit flow.

Distribution Companies' (DISCOMs) Reluctance- DISCOMs view rooftop solar as a threat to revenue. Reduced electricity consumption from grid-connected customers affects their financial stability, leading to delays in net-metering approvals and cumbersome bureaucratic procedures**.**

Technological and Maintenance Challenges- Issues like poor panel quality, inefficient inverters, and lack of skilled maintenance services affect long-term system reliability—dampening public confidence in rooftop solar projects.

Integration Challenge- As per the CEA, India's power demand during evening hours (6 pm–11 pm) accounts for nearly 30% of daily consumption**,** precisely when solar power is unavailable. Without efficient storage or pricing mechanisms, this imbalance puts pressure on distribution companies (discoms).

Kerala's Case Study

The Kerala State Electricity Board (KSEB) has installed 1.5 GW of rooftop solar, covering 2% of households. It exposed the financial vulnerability of utilities while celebrated as a success. The Kerala State Electricity Regulatory Commission (KSERC) introduced new rules requiring mandatory battery storage for systems above 10 kW, scaling up over time to include smaller setups. It aims to ease grid pressure by encouraging local storage and peak-hour supply. However, it raises installation costs, potentially discouraging middle-class adoption. According to the International Energy Agency (IEA), distributed solar systems could meet up to 45% of global electricity demand by 2050—if integrated with smart grids and affordable storage. Without these, excess daytime generation and inadequate nighttime supply could destabilize national grids.

Building the Solar Future

India and other nations need to rethink how electricity systems are designed to make rooftop solar truly transformative. Some key steps include

Grid Modernization- Smart meters and dynamic pricing to reflect real-time demand.

Battery Incentives- Subsidies or tax rebates to reduce upfront storage costs.

Peer-to-Peer Trading- Allowing local power exchange between solar homes and businesses.

Decentralized Mini-Grids- Especially in rural areas without reliable grid connectivity.

Tariff Reforms- Encouraging power use during daylight and disincentivizing heavy nighttime consumption.

2. India's Climate Catastrophe- PLOS Climate

Context

A recent study published in PLOS Climate warns that India is on track for catastrophic climate events, with multiple systems — atmospheric, oceanic, and cryospheric — undergoing alarming transformations.

Key Findings

India's average temperature has risen by 0.9°C between 2015–2024, compared to the 1901–1930 baseline. The frequency and duration of heatwaves have increased significantly, with most regions now experiencing 5–10 more 'Warm Days' per decade. 2024 alone witnessed more than 200 heatwave days across India, with states like Rajasthan, Gujarat, and Uttar Pradesh recording temperatures above 47°C**.** Urban heat islands have further exacerbated local warming due to unplanned construction and dwindling green cover.

Monsoon in Disarray- The southwest monsoon, the backbone of Indian agriculture, is becoming erratic. Extreme precipitation events have intensified in central India and coastal Gujarat, while mean rainfall has declined across the Indo-Gangetic plains and the Northeast. 2023 saw record-breaking rainfall anomalies, with floods in Himachal Pradesh and droughts in Bihar within the same season — a paradox that reflects the growing instability of the monsoon system. Climate models now project a 6–8% rise in all-India mean monsoon rainfall by 2050, driven by increased moisture in a warmer atmosphere.

Warming Oceans- The tropical Indian Ocean, which plays a critical role in shaping India's climate, is heating at 0.12°C per decade — faster than the global average. The PLOS Climate paper projects that marine heatwaves could last for nearly 200 days annually by 2050, compared to just 20 days in the recent past. These heatwaves have already led to coral bleaching in the Lakshadweep and Andaman Islands and are disrupting monsoon circulation patterns.

Melting Himalayas- The Hindu Kush Himalaya is warming at 0.28°C per decade, nearly twice the global rate. The study projects a 30–50% reduction in glacier volume by 2100, even under moderate warming scenarios (1.5–2°C). It has grave implications for water security — rivers such as the Ganga, Brahmaputra, and Indus, which sustain over 700 million people, depend heavily on glacial melt.

Human and Economic Toll- India lost over 3,000 lives to extreme heat in the last five years, and the World Bank estimates climate-related losses could cost India up to 2.8% of its GDP annually by 2050. Urban centers face heat stress and air pollution, while rural communities grapple with crop failures and groundwater depletion. India's food security is at risk, with wheat and rice yields projected to decline by 10–15% under current warming trends.

Way Forward

An integrated approach combining climate-resilient agriculture, early warning systems, urban green planning, and renewable energy expansion. India's updated National Action Plan on Climate Change (NAPCC) must prioritize local adaptation, not just mitigation. Community-led water management and afforestation efforts — as seen in parts of Maharashtra and Rajasthan — show promise, but scaling them nationally remains a challenge.

3. India's Draft Seeds Bill, 2025

Context

Recently, the Union government's Draft Seeds Bill, 2025 seeks to 'modernize and digitize' the seed sector, while farmer groups and seed keepers see it as a threat to traditional practices and community rights.

Background- Policy Context

The Bill revises the long-pending Seeds Bill, 2019, which itself was meant to replace the Seeds Act of 1966. The 2025 draft aligns with the Centre's push toward digital governance and agri-standardization, complementing schemes like Digital Agriculture Mission and PM Kisan Samriddhi Yojana. However, it is argued that such policies prioritize market efficiency over seed sovereignty and agrobiodiversity.

Key Provisions of the Bill

Mandatory Seed Registration- All seed varieties—domestic or imported—must be registered with the Centre, except farmers' traditional varieties and seeds produced exclusively for export.

Value for Cultivation and Use (VCU) Testing- Only varieties passing VCU tests, which assess performance, yield, and adaptability, can be approved for sale. The bill mandates minimum standards for germination, purity, and seed quality.

Dealer Registration- Seed dealers, producers, and distributors must obtain a state-issued registration certificate before engaging in seed trade, import, or export.

Digital Traceability- Every seed container must carry a QR code generated through the Centre's Seed Traceability Portal, ensuring end-to-end tracking and verification.

Concerns from the Ground

Threat to Community Seed Systems- Farmer organizations warn that the Bill categorizes community seed groups, including Farmer Producer Organisations (FPOs) and women's seed collectives, as commercial entities, bringing them under the same regulatory obligations as corporate seed firms.

Bias Toward Hybrid Varieties- VCU trials often favour uniform, high-input hybrid varieties typically produced by large agribusinesses. It marginalizes indigenous, open-pollinated, and climate-resilient varieties, which may perform well in diverse local conditions but not under standardized testing.

Digital Divide and Compliance Burden- Mandatory digital reporting through the Seed Traceability Portal poses challenges for smallholder farmers and rural seed keepers with limited internet access or digital literacy. Rural seed producers fear exclusion from the formal system due to 'digital-heavy compliance norms.

Lack of Farmer Representation- The Bill does not clearly specify mechanisms for farmer participation in the registration or testing process. Farmer unions demand local-level consultation and the inclusion of traditional knowledge holders in decision-making.

Environmental and Economic Implications- India's informal seed sector—dominated by farmer-to-farmer exchanges—supplies nearly 60% of all seeds used. Overregulation could disrupt these informal networks, potentially increasing dependence on commercial seed companies and narrowing the genetic base of cultivated crops. Moreover, the shift to centralized digital systems raises questions about data privacy, seed patenting, and corporate control over agricultural information.

Public Consultation and the Way Forward

The Bill is open for public comment until December 11, 2025. Civil society organizations urge the government to Exempt smallholder and community seed exchanges from licensing. Create region-specific VCU criteria for diverse agro-climatic conditions. Ensure digital inclusion through local-language interfaces and offline mechanisms. Establish a National Farmers' Advisory Council to oversee seed governance.

4. Global Rise and Risks of Ultra-Processed Foods

Context

According to a three-part series in The Lancet published recently, the ultra-processed food (UPF) corporations have embedded themselves deeply into scientific research, policy-making, and public health narratives—often under the guise of 'stakeholders.

Ultra-Processed Foods (UPFs)

UPFs are industrial formulations made from cheap food-derived ingredients, additives, and preservatives. These include chips, biscuits, carbonated drinks, and ready-to-eat meals, often engineered for hyper-palatability and long shelf life. UPFs are designed to replace traditional diets and maximize profit margins, unlike minimally processed foods Such products dominate global markets due to aggressive marketing, convenience, and affordability, especially in low- and middle-income countries.

Health Consequences

Scientific consensus increasingly links UPF consumption to chronic non-communicable diseases (NCDs), including

1. Obesity and Type 2 Diabetes;
2. Hypertension and Cardiovascular Diseases;
3. Chronic kidney disease;
4. Gastrointestinal and metabolic disorders;

   Regular consumption of UPFs contributes to gut microbiome imbalance, promoting inflammation and metabolic dysfunction. Moreover, the hidden sugar, salt, and fat content often exceeds WHO-recommended limits.

India's Emerging Challenge

In India, UPFs are gaining rapid market share, particularly among urban and adolescent populations. About 68% rise in packaged snack consumption between 2011 and 2021, correlating with an increase in childhood obesity and early-onset diabetes. Experts warn that UPF industries are replicating tobacco-style tactics—funding misleading studies, sponsoring sporting events, and rebranding products as 'healthier alternatives.

Policy and Global Health Implications

Independent research funding free from corporate influence; Front-of-pack warning labels for UPFs; Stricter regulation of food marketing to children; Fiscal policies (taxes/subsidies) to promote fresh foods; Governments need to resist industry lobbying and prioritize public health over profit to prevent UPFs from overwhelming food systems worldwide.

5. Reclaiming the Ravines- Chambal's Badlands

Context

The ravines of the Chambal River—spanning Rajasthan, Madhya Pradesh, and Uttar Pradesh are reshaping both the landscape and its fragile ecosystems.

Overview- Chambal Ravines

The Chambal Ravines are a unique geomorphological feature formed by severe gully erosion along the Chambal River basin (a tributary of the Yamuna). The process is largely anthropo-geomorphic—human activity has intensified natural erosive forces. The ravines are a natural consequence of the semi-arid region's geomorphology formed by centuries of water and wind erosion. From soil erosion due to unscientific agricultural practices, deforestation, and natural weathering of the alluvial plains. Steep slopes and the semi-arid climate accelerate runoff erosion, cutting deep gullies into the terrain.

Ecological Significance

The ravines host patches of dry deciduous forest, grassland, and scrub habitats supporting Indian gazelle (chinkara), Indian fox, and mugger crocodiles near the riverine tracts. The National Chambal Sanctuary (est. 1979) protects species like the gharial, Gangetic dolphin, Indian Skimmer and red-crowned roofed turtle.

Socio-Economic Impact

The ravines render large tracts unfit for cultivation, causing economic distress and migration among local communities. Historically, the Chambal valley was associated with dacoit activity, fostered by the rugged terrain and poor governance.

Government Initiatives

Ravine Reclamation Projects (since 1980s) – coordinated by the Central Soil and Water Conservation Research and Training Institute (CSWCRTI). NITI Aayog's 2020 Initiative – plan to convert ravines into productive agroforestry lands through a public-private partnership model. Madhya Pradesh Ravine Reclamation Project – aims to reclaim 60,000 hectares using bioengineering, check dams, and agroforestry.

Recent Developments (2020–2024)

ISRO and NRSC mapping initiatives have classified ravine severity for targeted land restoration. Pilot projects in Morena and Bhind districts demonstrate successful carbon sequestration via tree plantations.

Challenges

1. Continued illegal sand mining and deforestation.
2. Fragmented policy coordination between central and state agencies.
3. Lack of community participation in restoration programs.

6. India's Data Centre & Hidden Water Crisis

Context

India is setting up large-scale data centres in water-scarce regions as it races to expand its digital capabilities, raising alarms about the long-term sustainability of India's digital growth.

More About News

India is rapidly positioning itself as a global hub for data centres—the backbone infrastructure powering the world's digital operations. These facilities store and process vast amounts of data generated by online activities, artificial intelligence (AI) systems, and cloud services. However, behind this technological leap lies a pressing environmental challenge- the immense water requirement for cooling servers and maintaining system efficiency.

India's Emerging Data Centre Hub

The 1990s saw the birth of data centres, but the rise of cloud computing, internet penetration, and AI workloads has exponentially increased their demand. McKinsey & Company (2024) projects that by 2030, 70% of new data centre capacity will cater to AI-related operations. According to a Deloitte report (2025), India now hosts around 150 operational data centres across major Tier-1 cities, with a combined IT load capacity of 1,200–1,300 MW. The report predicts India will record the highest capacity addition in the Asia-Pacific region between 2024 and 2026, outpacing countries like Japan and Singapore. India's advantages—lower operational costs, skilled workforce, and strategic location—make it a global favourite. But these benefits mask a growing environmental cost.

Data Centres and Their Thirst for Water

A data centre houses high-performance servers, routers, and storage systems, all of which generate substantial heat during operation. Most facilities use water-based cooling systems, drawing from groundwater or surface water sources to prevent overheating. A 1 MW data centre with water-based cooling typically consumes about 26 million litres of water annually. Yotta's facility, with a capacity of 30 MW, could potentially use 780 million litres per year—enough to meet the annual domestic water needs of around 15,830 urban residents. Although Yotta claims to use air-based cooling technology, limiting water use to 6 million litres per year, its total approved limit stands at 43 million litres annually.

Hidden Cost- Water Stress and Environmental Impact

India ranks among the top 25 most water-stressed countries, as per the World Resources Institute's Aqueduct Water Risk Atlas. Their concentration in already water-stressed areas could exacerbate regional water crises, with data centres being heavy water consumers. A 2025 Planet Tracker analysis found that 50 data centres in India are located in 'extremely high' water-stressed regions, second only to Indonesia in Asia. The water footprint of these facilities varies by climate, size, and technology, but collectively, they pose a substantial risk to groundwater sustainability.

Environmental Clearance and Oversight Gaps

Data centre projects in Uttar Pradesh require environmental clearance from the State-level Environmental Impact Assessment Authority (SEIAA), based on recommendations from the State-level Expert Appraisal Committee (SEAC). Yotta received clearance in 2020, conditional upon obtaining groundwater extraction permission from the Central Ground Water Authority (CGWA). However, officials have not confirmed whether such permission was granted, and the company maintains that no borewells have been dug. Furthermore, Yotta has not published an Environmental, Social, and Governance (ESG) report, despite growing calls for corporate transparency in sustainability practices.

Local Impacts and the Road Ahead

Investigations in Bengaluru and Gautam Buddha Nagar, two of India's major IT hubs, reveal growing tensions between technological progress and local water security. Residents face the daily

reality of declining groundwater levels and insufficient water access, while companies highlight innovation and economic growth. India's digital expansion could deepen existing inequalities and environmental degradation, without stronger environmental regulation, transparency, and water-efficient technologies.

7. Reviving Punjab's Borewells for Flood Mitigation and Groundwater Replenishment

Context

The state of Punjab in India needs to shift from short-term recovery to long-term flood management, as it faced the worst flood in four decades due to the southwest monsoon in 2025.

Punjab's Borewells & Agricultural Role

It has 1.4 million abandoned borewells that became central to Punjab's agricultural landscape during the Green Revolution of the 1960s. The number of borewells multiplied rapidly—especially after 1997–98, when water tables stood around 12 metres, as farmers switched to groundwater irrigation. However, decades of over-extraction have since pushed groundwater levels down to depths of 150 metres or more, rendering many borewells defunct.

Turning a Threat into an Opportunity

Research by the ICAR–Indian Institute of Soil and Water Conservation (IISWC) demonstrates that abandoned borewells can be revived into effective underground recharge systems with minor modifications. It begins with a hydrogeological assessment to verify the borewell's depth, water quality, and structural condition. Once deemed safe, the borewell is cleaned, flushed, and refitted with slotted PVC pipes to facilitate filtration and infiltration.

Recharge Pit Design- A recharge shaft is then constructed following the Indian Standard IS 15797-2008. The shaft's filter media—a layered combination of coarse sand, gravel, and pebbles—ensures that only clean water percolates downward. A recharge pit surrounds the borewell, lined with brick, stone, or reinforced concrete. Rainwater runoff passes through a silt trap or settling chamber before entering the borewell, preventing clogging. The design includes safety features such as protective grills and annual disinfection. Routine maintenance—particularly desilting before each monsoon and cleaning the filter media every two to three years—ensures optimal performance.

Proven Models of Success- Case Studies

Gujarat- In Navagam village, Panchmahal district, ICAR-IISWC's installation of runoff filters (2017–20) increased the average groundwater table by 1.84 metres. The improved availability expanded the irrigated area by 12 hectares and enhanced crop yields—cotton productivity rose by 0.8 tonnes per hectare, and maize by 0.6 tonnes per hectare. Farmers' incomes increased by ₹16,000 per hectare, with return-to-cost ratios ranging between 1.65 and 2.89.

Karnataka- In Maramannahali village, Chitradurga district, a farmer transformed a low-yielding borewell into a recharge system and adopted drip irrigation. Annual income jumped from ₹53,500 in 2016–17 to ₹1.75 lakh in 2020–21, because of improved water availability and cultivation of high-yielding tomato and chilli varieties.

Blueprint for Punjab's Water Future

Punjab has the unique opportunity to turn a liability into a lifeline, with 1.4 million unused borewells. Large-scale conversion of abandoned borewells into recharge units could help-

Absorb floodwaters during heavy monsoons, reducing surface runoff. Replenish depleted aquifers, supporting long-term water security. Lower public spending on flood infrastructure and groundwater extraction. Enhance agricultural resilience by stabilizing irrigation sources. If implemented through village-level programs, with technical support from ICAR-IISWC and state agencies, this approach could redefine climate adaptation in the Punjab plains—turning every abandoned borewell into a portal of renewal.

8. Mission Food, Fodder, And Water (FFW) Project

Context

Kerala's forest department plants fruit and fodder trees to ease human-wildlife tensions.

About the Mission Food, Fodder, and Water (FFW) Project

It is envisioned as a multi-sectoral rural resilience initiative launched to address three interconnected crises—food insecurity, fodder scarcity, and water stress. It builds upon the Jal Shakti Abhiyan (2019), National Fodder Mission (2012–2018), and National Food Security Mission (NFSM), integrating their outcomes under a single operational vision of climate-adaptive resource management.

Key Objectives

Ensure Ecological Balance- Replenish natural food and water sources within forests and buffer zones.
Prevent Human-Wildlife Encroachment- Reduce crop raiding, livestock attacks, and resource competition.
Promote Coexistence- Support local communities through compensation and sustainable livelihood programs.
Restore Forest Ecology- Improve degraded forest patches to sustain native herbivores.

Components of the Mission

Food Security Component- Promotion of climate-resilient crops (millets, pulses, and oilseeds). Introduction of biofertilizers and micro-irrigation to boost yields. Integration of kitchen gardens and nutri-gardens in rural schools and Anganwadis.
Fodder Security Component- Expansion of fodder banks and silage units under cooperative models. Revival of common grazing lands through reseeding and rotational grazing. Linking livestock missions with dairy productivity and veterinary care**.**
Water Conservation Component- Construction of check dams, farm ponds, and percolation tanks. Revival of traditional water bodies like baolis, talabs, and johads. Emphasis on rainwater harvesting and aquifer recharge through community labour.

Policy Linkages

United Nations Sustainable Development Goals (SDGs)- SDG 2 (Zero Hunger), SDG 6 (Clean Water and Sanitation), SDG 13 (Climate Action), and SDG 15 (Life on Land).
India's National Action Plan on Climate Change (NAPCC)—specifically the National Mission for Sustainable Agriculture (NMSA) and National Water Mission (NWM).

9. Iceland Declares AMOC Collapse a National Security Threat

Context

Recently, Iceland declared the potential collapse of the Atlantic Meridional Overturning Circulation (AMOC) as a direct threat to its national security and existence.

About Atlantic Meridional Overturning Circulation (AMOC)

It is a large system of ocean currents that transports warm, salty water from the tropics northward and returns cooler, deeper water southward, often referred to as the 'climate engine' of the Atlantic Ocean. It governs the movement of warm and cold water across vast oceanic distances, influencing weather patterns, sea levels, and global temperatures. It is driven by differences in temperature (thermal) and salinity (haline) — hence the term thermohaline circulation. The most well-known component of the AMOC is the Gulf Stream, which carries warm water from the Gulf of Mexico across the North Atlantic toward Europe.

AMOC Matter

Regulate regional temperatures, particularly keeping northern Europe's climate milder. Distribute ocean nutrients, supporting marine ecosystems and fisheries. Stabilize weather patterns, reducing the frequency of extreme events. Control sea levels, especially along the eastern coast of North America.

Signs of Weakening

In recent decades, scientists have observed signs that the AMOC is slowing down. Key indicators include- Accelerating Greenland ice melt, which adds freshwater to the North Atlantic and disrupts salinity. Rising ocean temperatures, which alter density gradients and reduce water sinking. Shifts in Atlantic sea-surface patterns, observed through satellite and ocean buoy data. A study in Nature Climate Change (2021) suggested that the AMOC is now at its weakest point in over a millennium, signaling a potential tipping point.

Consequences of an AMOC Collapse

A complete or partial collapse of the AMOC could trigger severe and irreversible climate changes, including- Harsher winters and shorter growing seasons in Europe. Rising sea levels along the U.S. East Coast due to redistribution of ocean mass. Disruption of monsoon systems, affecting billions of people in Africa and Asia. Shifts in marine biodiversity and collapse of key fisheries. These cascading impacts could destabilize economies, ecosystems, and even geopolitical relations.

10. Urgent Need to Halt Biodiversity Loss

Context

The decline of species across the globe shows little sign of slowing, despite decades of awareness and action. Ecologists have warned of a sixth mass extinction, a crisis unlike any before, driven by aHomo sapiens, since the 1990s.

India's Biodiversity Loss

Humanity's footprint has disrupted every major ecosystem on Earth, from climate change and pollution to the relentless exploitation of land and oceans At least 680 vertebrate species have gone extinct since 1500, with extinction rates accelerating as global temperatures rise. India is a global biodiversity hotspot, harboring nearly 8% of plant species and 7.5% of animal species, many of them endemic, with just 2.4% of the world's land area. At the IUCN World Conservation Congress in Abu Dhabi (2024), India announced the National Red List Assessment Initiative to evaluate species conservation status and fulfill India's commitments under the Kunming-Montreal Global Biodiversity Framework (2030).

Findings from the Living Planet Report 2024

According to the World-Wide Fund for Nature (WWF) and the Zoological Society of London's 2024 Living Planet Report, the world's wildlife populations have declined by an average of 73% in just five decades.

1. Terrestrial Species- down by 69%
2. Marine Species- down by 56%
3. Freshwater Species- down by an alarming 85%

The report identifies habitat loss and degradation, driven largely by agricultural expansion, as the most widespread threats, followed by overexploitation, invasive species, and disease. These losses are not mere statistics; they are warning signals of collapsing ecosystems that sustain all life.

Declines- Taxonomic Bias

Lesser-known species like frogs, snakes, birds, and pollinators are quietly vanishing, undermining ecosystem stability. India's vulture species have declined dramatically- white-rumped vulture (-67%), Indian vulture (-48%), and slender-billed vulture (-89%). Native bee populations in Odisha have fallen by 80% since 2002, threatening pollination systems critical to agriculture. Knowledge gaps persist about key insects, flies, beetles, and butterflies—that underpin food security.

Alarming State of Global Biodiversity (UN 2024–2025 Reports)

The United Nations Environment Assembly (UNEA, 2024) reaffirmed that biodiversity loss has accelerated beyond prior projections. According to the latest UN System of Environmental Economic Accounting (SEEA, 2024), over 50% of assessed ecosystems are now degraded, with coral reefs, wetlands, and tropical forests experiencing the sharpest declines. The UNEP Global Biodiversity Outlook (2024) reported that species extinction rates are now 100–1,000 times higher than natural background levels, largely due to agricultural expansion, pollution, and climate-induced habitat shifts. The 2024 UN General Assembly report on the "Triple Planetary Crisis" underscored that biodiversity loss, alongside climate change and pollution, threatens to derail the 2030 SDGs.

Economic and Social Implications- Development–Nature Nexus

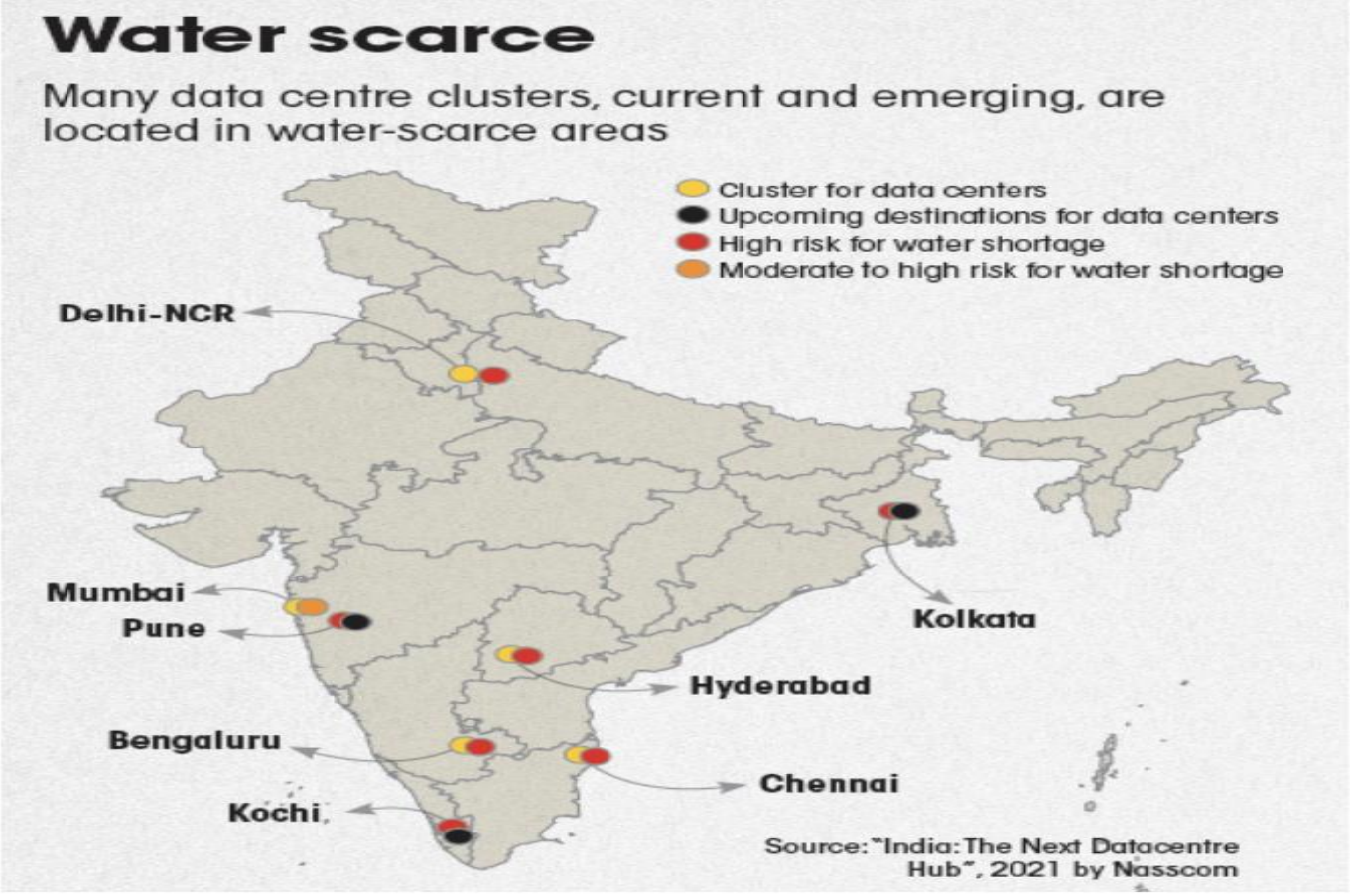
A UN DESA Working Paper revealed a staggering $300 billion annual biodiversity financing gap, with developing nations bearing 80% of ecosystem loss costs. At the same time, the degradation of mangroves and wetlands is directly reducing resilience against climate disasters, especially in South Asia. The UN's Financing for Development Report (2025) emphasizes that biodiversity loss could reduce global GDP by up to 10% by 2050 if current trends persist. The report calls for "nature-positive investment" as a fiscal strategy, not merely an environmental goal.

Flagship Successes- Tigers and Lions

Projects such as Project Tiger and Project Lion have become global success stories. Tiger populations are rebounding in Madhya Pradesh, Uttarakhand, and Maharashtra. The Asiatic lion population in Gujarat's Gir forest has increased from 674 (2020) to 891 (2025), prompting a change in its IUCN status from Endangered to Vulnerable.

Fresh Policy Initiatives- From Kunming to COP16

Building upon the Kunming-Montreal Global Biodiversity Framework (GBF) of 2022, COP16 (scheduled for 2025 in Colombia) aims to operationalize the 30x30 conservation goal—protecting 30% of land and oceans by 2030. UN policy briefs released in December 2024 stress that only 17% of global



terrestrial ecosystems and 8% of marine areas are currently under effective protection, revealing a serious implementation gap.

11. Species Demanding Conservation Attention in India

Mishmi Takin (Budorcas Taxicolor Taxicolor)

Habitat- It is found in Arunachal Pradesh of India (Mishmi Hills, Eastern Himalayas); also found in China and Myanmar. China is also home to two other subspecies- the Golden Takin (Budorcas Taxicolor Bedfordi) and the Sichuan Takin (Budorcas Taxicolor Tibetana). A fourth subspecies, the Bhutan Takin (Budorcas Taxicolor Whitei), as its name suggests, is found in Bhutan.

Conservation Status- Vulnerable under IUCN Red List Schedule I in WPA, 1972

Major Threats- Habitat loss due to logging, hunting, large infrastructure projects.

Sangai Deer (Rucervus Eldii Eldii)

It is endemic to south-east Asia and their range of distribution extends from Manipur in India to Burma, Thailand, Cambodia, Laos, Vietnam and Hainan. It is recognised as the State animal of Manipur, found in the Northern end of Keibul Lamjao National Park, Manipur. It lives on phumdis, floating biomass of vegetation which gives it a distinctive, graceful movement.

Conservation Status- Endangered under IUCN Red List Schedule I of the Wild Life (Protection) Act, 1972

Conservation Action Plan (2016–2025)- A joint initiative by the Wildlife Institute of India, Manipur Forest Department, and MoEFCC, funded by the National CAMPA.

Studbook Program- The Central Zoo Authority and WII maintain a national studbook to track captive populations and support breeding programs.

Major Threats- Inbreeding depression, habitat loss due to pollution, agricultural runoff.

Nilgiri Tahr (Nilgiritragus Hylocrius)

It is recognised as the State animal of Tamil Nadu, found in the Southern parts of Western and Eastern Ghats in Tamil Nadu and Kerala. In ancient Tamil Sangam literature the ungulate, called varayãdu or mountain goat.

Conservation Status- Endangered under IUCN Red List Schedule I under WPA, 1972

Major Threats- Habitat loss due to deforestation and invasive species, occasional hunting.

Kashmir Markhor (Capra Falconari Cashmiriensis)

It is recognised as the National animal of Pakistan, primarily found in Pakistan, Pakistan-Occupied Kashmir, Afghanistan and Jammu and Kashmir.

Conservation Status- Near Threatened under IUCN Red List; Schedule I of WPA, 1972 UNGA declared May 24 as the 'International Day of the Markhor'.

Major Threats- Unwise developmental activities, heavy livestock grazing, poaching.

Grey Slender Loris (Loris Lydekkerianus)

It is found in the Indian states of Tamil Nadu, Karnataka, Kerala and parts of Andhra Pradesh.

Conservation Status- Near Threatened under IUCN Red List Schedule I of the Wild Life (Protection) Act, 1972

Major Threats- Hunting for body parts, illegal pet trade, roadside captures

Nilgiri Langur (Trachypithecus Johnii)

It is found in high-altitude forests of Kerala, Tamil Nadu, and parts of Karnataka.

Conservation Status- Vulnerable under IUCN Red List; Schedule I of WPA, 1972

Major Threats- Poaching, habitat loss and road kill

Phayre's Leaf Monkey (Trachypithecus Phayrei)

It is found in Indian states of Assam, Tripura, Mizoram, and Bangladesh.

Conservation Status- Endangered under IUCN Red List; Schedule I of WPA, 1972

Major Threats- Habitat loss, forest fragmentation, hunting

Gee's Golden Langur (Trachypithecus Geei)

It is found in the Indian states of Assam.

Conservation Status- Endangered under IUCN Red List

Major Threats- Habitat loss, forest fragmentation and hunting

Western Hoolock Gibbon (Hoolock Hoolock)

It is recognised as the State animal of Arunachal Pradesh**,** primarily found in Indian states of Assam, Arunachal Pradesh, Meghalaya, Mizoram, Manipur, Nagaland and Tripura.

Conservation Status- Endangered under IUCN Red List

Major Threats- Habitat loss, forest fragmentation, hunting

Lion-Tailed Macaque (Macaca Silenus)

It is found in the Indian states of Kerala, Karnataka and Tamil Nadu.

Conservation Status- Endangered under IUCN Red List

Major Threats- Expanding plantations, fragmentation, tourism

Royle's Pika (Ochotona Roylei)

It is found in the Western Himalayas.

Conservation Status- Least Concern under IUCN Red List

Major Threats- Climate change, population isolation

Pygmy Hog (Porcula Salvania)

It is found in the grasslands of Assam's Manas National Park and Orang National Park.

Conservation Status- Endangered under IUCN Red List

Major Threats- Grassland degradation due to uncontrolled grass burning, illegal cattle grazing, rapid habitat succession

Madras Hedgehog (Paraechinus Nudiventris)

It is found in the Peninsular India, primarily across Tamil Nadu, Kerala, Andhra Pradesh and parts of Karnataka.

Conservation Status- Least Concern under IUCN Red List

Major Threats- Grassland degradation due to uncontrolled grass burning, illegal cattle grazing, rapid habitat succession

Fishing Cat (Prionailurus Viverrinus)

It is recognised as the State animal of West Bengal, primarily found in Indus basin; Ganga and Brahmaputra floodplains and delta of West Bengal and Bangladesh; Mahanadi, Godavari and Krishna basins.

Conservation Status- Vulnerable under IUCN Red List

Major Threats- Habitat loss due to degradation, destruction of wetlands

Blyth's Tragopan (Tragopan Blythii)

It is found in the Indian states of Arunachal Pradesh, Nagaland, Mizoram, and Manipur.

Conservation Status- Vulnerable under IUCN Red List

Major Threats- Small, fragmented population declining due to hunting, habitat loss.

Cheer Pheasant (Catreus Wallichii)

It is found in the Western Himalaya from northern Pakistan and Kashmir through Himachal Pradesh and Uttarakhand to central Nepal.

Conservation Status-Vulnerable under IUCN Red List Schedule I under WPA, 1972; Appendix I of CITES

Major Threats- Small, fragmented populations, increasing human and livestock pressures, hunting, changing land-use patterns.

Black-Necked Crane (Grus Nigricollis)

It is recognised as the State bird of Ladakh, primarily found in Ladakh and Arunachal Pradesh.

Conservation Status- Near Threatened under IUCN Red List Schedule I under WPA, 1972; and appears in Appendices I and II under CITES.

Major Threats- Changing agricultural practices, predation by free-ranging dogs, rapid and unregulated development around high-altitude wetlands

Western Tragopan (Tragopan Melanocephalus)

It is found in the Western Himalayas.

Conservation Status- Vulnerable under IUCN Red List

Major Threats- Forest loss, habitat degradation

Red-Crowned Roofed Turtle (Batagur Kachuga)

It is found in the Ganga river basin.

Conservation Status- Critically Endangered under IUCN Red List

Major Threats- Inbreeding depression

Bengal Florican (Houbaropsis Bengalensis)

It is found in the Terai region of Uttar Pradesh and Assam.

Conservation Status- Critically Endangered under IUCN Red List

Major Threats- Land-use change, expansion of agriculture, change of river course, invasive plant species, fire mismanagement

Indus River Dolphin (Platanista Minor)

It is recognised as the State aquatic animal of Punjab, primarily found in a 70-km stretch of the Beas, particularly between Beas bridge and Harike in Punjab, India; Indus River and tributaries in Pakistan.

Conservation Status- Endangered under IUCN Red List

Major Threats- Extensive fishing, bycatch, sedimentation, dams, river pollution

King Cobra (Ophiophagus Hannah)

It is recognised as the National Reptile of India, primarily found in South and Southeast Asia.

Conservation Status- Vulnerable as per IUCN (in revaluation)

Major Threats- Habitat destruction, human hostility

Mains Questions

1. "Khadi is not just a cloth, but a thought." Discuss how Khadi reflects Mahatma Gandhi's ideals of *Gram Swaraj* and dignity of labor, and assess its relevance in contemporary India's 'Aatmanirbhar Bharat' mission. *(250 words)*

2. The textile sector is often criticized for its environmental footprint. Analyze the potential of Khadi as a "climate-smart" alternative in contributing to India's circular economy and Net Zero 2070 commitments. *(250 words)*

3. Despite significant government support through schemes like SFURTI and PMEGP, the traditional artisan sector faces challenges from machine-made goods. Suggest measures to balance heritage preservation with economic viability for rural artisans. *(250 words)*

Essay Topics

1. "Khadi- Where heritage meets sustainability in India's development journey."
2. "From charkha to climate action- Reimagining Khadi for a green and inclusive future."