P L RAJ UPSC MONTHLY MAGAZINE – COMPILATION

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1. Freedom to Innovate

This chapter explores the theme of innovation as a new dimension of freedom in India, tracing its historical roots, constitutional basis, recent policy boosts, and measurable global impact.

I. India's Historical & Constitutional Ethos of Innovation

Ancient Roots: India has a long civilisational history of innovation.

Scholars: Figures like Pingala, Brahmagupta, Aryabhata, and Bhaskara made significant advances in mathematics and astronomy.

Learning Hubs: Ancient universities like Nalanda, Vikram Shila, and Vallabha were interdisciplinary centres that nurtured fields like metallurgy, medicine, and architecture.

Resilience: This spirit of innovation endured through invasions and colonial rule, showing deep foundational strength.

Innovation as Modern Freedom: The vision of Viksit Bharat 2047 redefines freedom as the capacity to create, solve problems, and shape society.

Constitutional Links: This "freedom to innovate" is implicitly supported by fundamental rights and duties, including Article 14 (Equality), Article 21 (Life and Dignity), Article 21A (Education), and Article 51A (Duty to develop scientific temper).

Decentralisation: Innovation is spreading from metro cities to rural areas and from tech unicorns to self-help groups.

II. Strategic Policy Framework & Institutional Support

Union Budget 2025-26:

1. A dedicated ₹20,000 crore corpus was announced for R&D in strategic and emerging technologies like AI, quantum computing, biotechnology, and clean energy.
2. This budget supports the freedom to experiment, fail, and commercialise innovations.

Deep-Tech Financing:

1. The budget complements the ₹10,000 crore Deep-tech Fund of Funds (FoF) under SIDBI, with the government acting as an early-stage backer for high-risk, long-gestation projects.

Anusandhan National Research Foundation (ANRF):

1. Established by Parliament in 2023, the ANRF replaces SERB with a wider mandate.
2. It has a funding target of ₹50,000 crore for 2023-28, with ₹14,000 crore from the Central Government and the rest from PSUs, the private sector, and international bodies.

Research Development and Innovation (RDI) Scheme:

1. Approved on July 1, 2025, with a ₹1 lakh crore corpus.

2. It offers long-term financing at low or nil interest rates to encourage private sector investment in R&D, with strategic direction from ANRF.

III. Grassroots Innovation & Digital Platforms

National Innovation Foundation (NIF): An autonomous institute under the DST, NIF scouts and supports grassroots innovators from ~600 districts. It has filed over 1,400 patents and facilitated 120+ technology transfers.

Unnat Bharat Abhiyan: This Ministry of Education initiative connects academic institutions with rural India to develop contextual solutions.

Digital Public Infrastructure (DPI): Platforms like Aadhaar, UPI, and ONDC act as building blocks for innovation.

1. As of March 2025, ONDC had onboarded over 7 lakh sellers (mostly MSMEs) and recorded 20.4 crore transactions.

India Energy Stack (IES): This is a UPI-like digital infrastructure for the energy sector, designed to integrate renewables, improve DISCOM efficiency, and support Net Zero goals.

IV. Sectoral Deepening & Measurable Impact

Healthcare:

1. The Ayushman Bharat Digital Mission (ABDM) has registered over 5.23 lakh professionals and 3.49 lakh facilities, with over 20 crore ABHA accounts created.
2. The Pharmaceutical Research Incentive Program (PRIP) has a corpus of ₹25,000 crore to make India a global pharma R&D hub.

Agriculture (Agriculture 4.0): This sector, which employs ~42% of the workforce, is adopting drones, AI, and IoT for precision farming. Initiatives include **Drone Didi**, **Agri-India Hackathon**, and **Agri-Tech Innovation Hubs**.

Incubation & Frontier Tech:

1. **Atal Tinkering Labs (ATLs)** provide science equipment to thousands of schools.
2. **Atal Incubation Centres (AICs)** are being established in Tier-II and Tier-III areas. These align with missions like the National Quantum Mission (NQM).

Global Rankings:

Global Innovation Index 2024: India ranked 39th.

WIPO IP Filings Report 2023: India ranked 6th globally in patent filings.

Startup Ecosystem: India has over 1.57 lakh recognized startups and 100+ unicorns, with ~51% participation from Tier-II and Tier-III cities

2. People's Padma

This chapter celebrates grassroots cultural icons recognized with the Padma Shri, highlighting their contributions to preserving India's intangible heritage.

Shri Pandi Ram Mandavi - Tribal Instrument Maker:

From: Narayanpur, Chhattisgarh (Bastar region).

Art: Specializes in Gond wood crafts and making bamboo musical instruments, most iconically the 'Sulur' or 'Bastar flute'.

Legacy: Born into a family of woodworkers, he learned the craft from his father. He has mentored young artisans, formed a community to share skills, and acted as a guardian of Muria tribal heritage.

Dr. Venkappa Ambaji Sugatekar - Gondhal Folk Singer:

From: Bagalkot, Karnataka.

Art: A master of the Gondhal folk music tradition of Karnataka.

Legacy: Began training at age 10 and has mastered thousands of folk compositions by memory, including over 1,000 songs and 150 long-form mythological stories. He has trained over 1,000 students free of cost and, at age 82, remains an active cultural ambassador praised by the Prime Minister as a "Cultural Torch Bearer".

Significance of the 'People's Padma':

1. This recognition celebrates grassroots icons often overlooked by mainstream media.
2. It highlights the national importance of preserving intangible cultural heritage like music and crafts.

3. India's War Against Terrorism

This chapter analyses India's evolved counter-terrorism strategy, triggered by a recent attack, detailing its military, institutional, and diplomatic dimensions.

I. Context and Policy Shift

Trigger: The Pahalgam Attack in Jammu & Kashmir on April 22, 2025, was a heinous attack on civilians that reinforced the persistent threat of cross-border terrorism.

Shift in Approach:

Past: India traditionally preferred dialogue and restraint with Pakistan.

Present: Due to Pakistan's continued use of terrorism as state policy, India has shifted to a proactive and pre-emptive counter-terrorism strategy.

New Policy: India now makes no distinction between terrorists and their supporters, treats any attack as an act of war, and no longer accepts Pakistan's "plausible deniability".

II. Military and Institutional Response

Military Operations:

Operation Sindoor: A swift, precise military operation targeting terrorist infrastructure of groups like LeT, JeM, and Hizbul Mujahideen in Pakistan and PoJK. It was the deepest military operation inside Pakistan since the 1971 War.

Historical Precedents: This follows a pattern of increasingly intense strikes, including the 2019 Balakot Airstrike, 2016 Surgical Strikes, and 2015 Operation Hot Pursuit in Myanmar.

Institutional Strengthening (Post-2008 Mumbai Attacks):

NIA: The National Investigation Agency was established in 2009 as the main counter-terror agency. The NIA Act was amended in 2019 to grant it jurisdiction outside India.

Intelligence Sharing: The Multi-Agency Centre (MAC) and National Intelligence Grid (NATGRID) were created to enable real-time intelligence and data sharing.

Countering Terror Financing: The Prevention of Money Laundering Act (PMLA) was strengthened in 2009 and 2023, lowering the beneficial ownership threshold to 10% and bringing crypto transactions under regulation.

III. Disrupting Insurgency and Diplomacy

Jammu & Kashmir: The focus is on halting local recruitment, disrupting the ecosystem of "hybrid" cadres, and tackling narco-terrorism, which funds terror groups. A 3-tiered counter-infiltration grid has significantly reduced violence.

Countering Radicalisation: Government actions include NIA arrests and continuous monitoring of online extremist content to counter drivers like propaganda and victimhood narratives.

Diplomatic Collaboration:

1. India uses multilateral platforms like the G20 and FATF to build consensus. In 2022, it hosted the UNSC Counter-Terrorism Committee and the INTERPOL General Assembly.
2. Bilateral cooperation has led to the successful extradition of 26/11 suspect Tahawwur Rana from the USA.

Way Forward: India must maintain military, intelligence, and diplomatic pressure to counter Pakistan's doctrine of "bleeding India with a thousand cuts" and adapt to evolving threats.

4. Sanskrit in Contemporary Times & NEP 2020

These chapters discuss the revival of Sanskrit, its relevance in the modern world, the challenges it faces, and the transformative role envisioned for it in the National Education Policy 2020.

I. Sanskrit's Relevance and Global Presence

Modern Revival: Despite being over 3,000 years old, Sanskrit is attracting growing interest in the digital age. It is not a "dead language" but a living intellectual force.
Grammar and Technology: The highly precise, algorithmic grammar of Panini's Aṣṭādhyāyī makes Sanskrit uniquely suitable for modern applications in Artificial Intelligence (AI) and Natural Language Processing (NLP).
Secular Knowledge: Beyond religious texts, Sanskrit is the language of seminal secular works in fields like planetary motion (Surya Siddhanta), medicine (Ayurveda), and statecraft (Artha sastra).
Global Academia: Sanskrit is taught at top universities like Harvard, Oxford, and Kyoto as a key to understanding philosophy and ancient science. Digital humanities projects like the Sanskrit WordNet are making its texts globally accessible.
Grassroots Movement: Organizations like Sanskrit Bharati lead a global movement to promote spoken Sanskrit through workshops and media, showing it is a vibrant, living language.

II. NEP 2020 and the Integration of Sanskrit

Policy Vision: The National Education Policy (NEP) 2020 formally acknowledges Sanskrit's significance and aims to fully integrate it into the modern education system. It positions Sanskrit as a bridge between ancient Indian knowledge systems and contemporary education.

School Education:

1. Sanskrit will be offered as a mainstream option under the three-language formula.
2. The pedagogy will shift from rote memorisation to immersive methods like Simple Standard Sanskrit (SSS) and Sanskrit Through Sanskrit (STS).

Higher Education: Sanskrit departments are envisioned as interdisciplinary hubs linked with modern disciplines like AI, cognitive science, and ecology.
Value-Based Education: Sanskrit texts like the Panchatantra and Hitopadesh will be used as ethical resources to teach values like Seva, Ahimsa, and Satya through storytelling.
Challenges: Key hurdles to this revival include a perception of elitism, a shortage of trained teachers, and a lack of standardised curricula. The NEP's approach is structural, aiming to overcome these barriers through comprehensive reforms.

5. Freedom of Good Health

This chapter details the Ayushman Bharat mission, a comprehensive initiative to provide accessible, affordable, and equitable healthcare to all citizens.
Concept: True freedom of health means access to medical care without financial, social, or institutional exclusion.
Four Pillars of Ayushman Bharat: The mission is built on four integrated pillars:
Ayushman Bharat Pradhan Mantri Jan Arogya Yojana (AB PM-JAY): Provides financial protection.
Ayushman Arogya Mandir (AAM): Strengthens community-level primary healthcare.
Ayushman Bharat Digital Mission (ABDM): Creates a secure, portable digital health data ecosystem.
Pradhan Mantri Ayushman Bharat Health Infrastructure Mission (PM-ABHIM): Strengthens health infrastructure at all levels.

AB PM-JAY (Financial Protection):

Launched in 2018, it's the world's largest public health assurance scheme.

1. It provides a ₹5 lakh annual health cover per family for secondary and tertiary care.
2. Impact (as of June 2025): Over 9 crore hospital admissions worth more than ₹1 lakh crore have been authorized. It covers over 32,000 hospitals, and women constitute ~50% of admissions. The transgender community was included in 2023.

PM-ABHIM (Infrastructure):

Launched in October 2021 with a corpus of ₹64,000 crore to boost primary and critical care infrastructure and prepare for future pandemics.

ABDM (Digital Empowerment):

ABHA ID: A unique 14-digit health ID to link and access medical records nationwide. As of mid-2025, over 79 crore ABHA IDs have been created.
Innovations: The **"Scan & Share"** feature allows for QR code-based OPD registration in under 5 minutes, having already saved an estimated 6 crore man-hours.

6. Empowering the Farmers

This chapter outlines the strategic shift in India's agricultural policy towards ensuring farmers' income security and empowering them as Agri-entrepreneurs.
Importance of Agriculture: The sector contributes ~18% to India's GVA and employs 46% of the workforce.
Shift in Policy Focus: The central goal has shifted from just production to ensuring income security for farmers.

Multi-pronged Strategy:

Reducing Cultivation Costs:

1. The Kisan Credit Card (KCC) Scheme provides short-term concessional credit at a 4% interest rate. Agri credit via KCC reached ₹10.20 lakh crore by March 2025.
2. Fertiliser subsidies on Urea and DAP shield farmers from price inflation.

Ensuring Remunerative Prices:

3. The Minimum Support Price (MSP) policy covers 22 crops and is fixed at 1.5 times the cost of production.

Post-Harvest Infrastructure:

4. The Agriculture Infrastructure Fund (part of Atmanirbhar Bharat) provides loans with 3% interest subvention to create infrastructure like cold storages and pack houses.

Farmer Producer Organisations (FPOs): Over 10,000 FPOs have been established to help farmers with fragmented holdings achieve economies of scale and better bargaining power.

Digital Agriculture Mission:

Agri Stack: A Digital Public Infrastructure (DPI) is being created with three registries: a geo-referenced plot registry, a farmer registry with a unique Farmer ID linked to Aadhaar, and a digital crop survey.
Benefits: This DPI enables instant KCC loan approvals, direct MSP registration, and precision advisory services.
SATHI Portal: A portal for Seed Authentication, Traceability, and Holistic Inventory to ensure farmers receive quality seeds.

7. Freedom with a Steel Resolve

This chapter traces the history of India's steel industry, from its celebrated pre-colonial past to its current status as a global powerhouse.

Pre-Colonial Fame:

In the 18th century, India was renowned for its high-quality wootz steel, produced using a charcoal-based iron method.
Major steel-making centers included Golconda, Mysore, and Gwalior. Indian swords made from this steel were globally reputed.

Use in Warfare:

1. Tipu Sultan's sword, used against the British in 1799, was made from wootz steel.
2. Tipu Sultan and Hyder Ali also used pioneering iron-cased rockets in the 1780 Anglo-Mysore War, which were superior to British versions.
3. Rani Lakshmibai of Jhansi was a sword-wielding queen who fought in the 1857 Sepoy Mutiny.

Rise of the Modern Industry:

1. The discovery of the Raniganj coalfield in 1815 and rich hematite deposits in Odisha in 1903-04 enabled large-scale, coke-fuelled production.
2. In 1905, the government contracted to buy 20,000 tonnes of steel rails annually from Indian companies.

3. The first modern Indian steel plant, Tata Steel, began construction in Jamshedpur in 1908 and rolled its first ingots in 1912.

Post-Independence Growth:

1. In 1947, India's steel production capacity was around 1 million tonnes.
2. Today, India is the 2nd largest crude steel producer in the world, marking a journey from colonial constraints to global leadership.

KRUKSHETRA

1. Agriculture 4.0 - Towards Agri-Tech Revolution

This chapter provides a comprehensive overview of the state of Indian agriculture, the urgent need for a technological transformation, the key components of digital agriculture, and the path forward.

I. Importance & Challenges of Indian Agriculture

Economic Backbone:

1. Agriculture employs 42.3% of India's workforce.
2. It contributes around 18.2% to the national GDP.

Persistent Challenges:

Low Productivity: Yields are 20-60% lower than global averages.
Climate Dependency: 52% of farming is rain-fed and heavily dependent on the monsoon.
Fragmented Landholdings: 89.4% of farmers are smallholders, owning less than 2 hectares of land.
Post-Harvest Losses: Significant losses ranging from 0.92% to 15.88% occur across various crops.
Livestock Issues: The sector is hampered by a lack of quality fodder, gaps in animal healthcare, and weak supply chains.

II. The Concept of Digital Agriculture (Agriculture 4.0)

The Need: A growing population necessitates a technological transformation to increase farmer incomes, ensure food security, and enhance sustainability.

Two Core Paradigms:

Smart Farm Digitisation (Farm-Level): This involves using technologies like IoT-based sensors, drones for spraying, automated irrigation, and mobile-based farm management platforms to make individual farms more responsive and efficient.
Smart Agri-Sphere Digitisation (Ecosystem-Level): This focuses on strengthening the entire agricultural ecosystem through satellite-based monitoring, blockchain-enabled supply chains, and digital platforms for market access, credit, and insurance.

III. Key Digital Interventions & Rural Readiness

Addressing Farm-Level Challenges:

Pest Control: Technology can help mitigate the 30-35% of crop losses caused by pests.
Water Management: With 70-80% of farmers dependent on groundwater, IoT sensors can cut water usage by approximately 50%.
Labour Shortages: Automation helps alleviate labour shortages, a problem cited by 90% of farmers.
Digital Readiness: Rural India is increasingly ready for this transition.

1. 85.5% of households have smartphones.
2. 86.3% have internet access at home.
3. 95.5% of rural youth (15-29) own smartphones.

IV. Agri Stack India: A Comprehensive Digital Backbone

Purpose: The Agri Stack, or Comprehensive Agriculture Management System (CAMS), is a digital public infrastructure designed for policy planning, monitoring, and real-time decision-making.
Key Components: It integrates multiple databases, including:

1. An Aadhaar-linked Farmer Database with information on FPO membership and landless workers.
2. Geo-tagged Land & Asset Records with soil health and ownership status.
3. Real-time data from satellites and weather alerts.

4. Linkages to credit and insurance like Kisan Credit Cards and PMFBY.
5. Integration with government schemes like
6. PM-KISAN for targeted delivery and grievance redressal.

V. Government Schemes & The Way Forward

Dhan-Dhaanya Krishi Yojana: A new scheme approved for a 6-year period starting in 2025-26, it will cover 100 districts selected for low productivity, low cropping intensity, and low credit disbursement. It will be implemented by converging 36 existing schemes across 11 departments.

The Path to Agriculture 4.0:

Infrastructure: Improve high-speed rural internet and ensure reliable power through renewable energy.

Capacity Building: Strengthen agricultural extension services and provide skill development in digital tools for farmers.

Institutional Support: Leverage the network of 113 ICAR institutes, 74 Agricultural Universities, 731 KVKs, and over 1 lakh PACS to drive adoption.

2. Conservation Agriculture: Practices and Perspectives

This chapter details the shift towards Conservation Agriculture (CA) as a sustainable alternative to the intensive farming practices of the Green Revolution.

I. Background and Core Principles

Legacy of the Green Revolution: While it achieved food self-sufficiency, it led to negative consequences like soil health degradation, water stress, and air quality deterioration. This prompted the search for more sustainable practices.

Three Core Principles of CA: Defined by the FAO, this system is built on three interconnected principles applied simultaneously:

1. Minimum Soil Disturbance: Using Zero Tillage (ZT) and direct seeding to prevent erosion and preserve soil organic matter.
2. Permanent Soil Cover: Using organic mulch or crop residue to shield the soil, conserve moisture, and boost biodiversity.
3. Crop Diversification: Employing crop rotation and intercropping to improve soil structure and fertility while breaking pest cycles.

II. Benefits of Conservation Agriculture

Yield and Cost:

1. In the Indo-Gangetic Plains, Zero Tillage has resulted in 10-17% higher yields for rice and wheat.
2. It leads to an average cost reduction of 15-16% per hectare, with savings of ₹5,760 per hectare in the Indo-Gangetic Plains.

Climate and Environment:

1. ZT can sequester up to 3,667 kgs of CO_2 per hectare per year.
2. It saves about 60 litres of fuel per hectare, reducing CO_2 emissions by 156 kgs per hectare annually.
3. It also leads to a 25-35% saving in water.

Human and Social:

1. Reduces the drudgery for women farmers by cutting down on nursery and tillage work.
2. Improves public health by lowering air pollution from residue burning and reducing groundwater contamination.

III. Adoption and Way Forward

Current Scale: CA is currently practiced on 25-30 million hectares by over 7 lakh farmers in India, concentrated in the rice-wheat belt of Punjab and Haryana but expanding to other states.

Success Story: In Rajanpur village, Bihar, there has been 100% adoption of Zero-Tillage for wheat, supported by CSISA and ICAR, leading to significant yield increases.

Challenges: Key barriers include the high cost of ZT machinery, knowledge gaps among farmers, competing uses for crop residue (fodder), and cultural resistance to new practices.

The Path Forward: The focus must be on establishing CA mechanisation hubs, developing sustainable business models, strengthening subsidy schemes, and scaling up farmer training through participatory extension models.

3. Gene Editing Technology - Transforming Agriculture

This chapter explores the revolutionary impact of gene editing, particularly CRISPR-Cas9, on creating climate-resilient, nutritious, and high-yielding crops.

I. Introduction to Gene Editing

A Revolutionary Tool: Genome editing helps in precisely tailoring crops with desirable traits like increased productivity, pest resistance, and climate resilience.

CRISPR-Cas9: Derived from a bacterial immune system, the CRISPR-Cas9 "genetic scissors" were developed by Jennifer Doudna and Emmanuelle Charpentier, who were awarded the Nobel Prize in Chemistry in 2020.

Advantages: It is more precise than older GM methods and has faster development cycles than traditional breeding.

II. Applications in Crop Improvement

Yield Enhancement: In rice, editing genes like OsAPL and OsSXK1 has led to higher yields. Over 55 rice genes have been edited for various improvements.

Nutritional Improvements (Biofortification):

1. Golden Rice with beta-carotene for Vitamin A.
2. Zinc-enriched rice and wheat.
3. Wheat with reduced gliadin for celiac patients.
4. Soybean with reduced phytic acid for better iron and zinc absorption.

Managing Stress:

Abiotic Stress: Genes have been edited in maize and wheat for drought tolerance and in other crops for flood and salinity tolerance.

Biotic Stress: Knocking out "susceptibility (S) genes" has led to resistance against blast disease in rice and citrus canker in citrus fruits.

III. India's Progress and Regulatory Framework

Breakthroughs in Rice: In 2025, ICAR developed the world's first two genome-edited rice varieties:

1. DRR Rice 100 (Kamla): Offers a 20% higher yield and matures 20 days earlier, saving water and reducing methane emissions.
2. Pusa DST Rice 1: Tolerant to saline and alkaline soils.

Other Achievements:

1. Development of mustard with reduced glucosinolate at Delhi University.
2. Creation of the first gene-edited sheep with 30% higher muscle mass by ICAR in Kashmir.
3. Ongoing research in 24 field crops and 15 horticultural crops.

Regulatory Framework:

1. Unlike GM crops, gene editing does not involve inserting foreign DNA.
2. In 2022, India issued guidelines exempting genome-edited crops developed using SDN1 and SDN2 techniques from the stringent biosafety rules that apply to GM crops.
3. However, challenges like off-target effects, gene flow to wild relatives, and ethical debates must be carefully managed.

4. Carbon Farming for Climate-Smart Agriculture

This chapter explains the concept of carbon farming, detailing how sustainable agricultural practices can turn farms into carbon sinks, providing both climate and economic benefits.

I. Agriculture's Dual Role in Climate Change

As a Source: Agriculture contributes nearly 20% of global GHG emissions through sources like livestock, chemical fertilisers, and paddy cultivation.

As a Sink: Through sustainable practices known as carbon farming, agriculture can capture and store atmospheric CO_2, transforming from a net emitter to a net absorber of GHGs.

II. Core Carbon Farming Practices

This approach involves a suite of practices designed to increase carbon in soil and vegetation:

Agroforestry: Combining trees with crops to sequester CO_2.

Reduced Tillage: Minimizing soil disturbance to keep carbon locked in the soil.

Cover Cropping: Planting crops like clover or vetch to cover bare soil, preventing carbon loss and improving fertility.

Biochar Application: Adding a special charcoal made from biomass to soil, where it stores carbon for centuries.

4Rs Nutrient Management: Applying the Right Source, Right Rate, Right Time, and Right Place for fertilisers to reduce emissions.

III. Carbon Markets and the Way Forward

Economic Incentive: Carbon farming allows farmers to earn a new revenue stream by selling carbon credits (where 1 credit equals 1 tonne of CO_2 removed).

India's Potential:

1. India has the potential to generate $63 billion in carbon revenue across 170 million hectares.
2. India was an early adopter of carbon trading and has the second-highest number of Clean Development Mechanism (CDM) projects globally, after China. The Indian Carbon Market was legalized via the Energy Conservation Amendment Act, 2022.

Challenges: Hurdles include the high cost of climate-smart technologies, lack of farmer awareness, and poor rural infrastructure.

The Path Forward: This requires a National Carbon Farming Mission, standardization of carbon measurement protocols, development of credible MRV (Measuring, Reporting, Verification) systems, and mobilizing KVKs for farmer training.

5. Ploughs to Precision

This chapter details the ongoing transformation of Indian agriculture from traditional, labour-intensive methods to modern, data-driven precision farming.

I. The Transition to Precision Agriculture

Economic Context: Agriculture provided livelihoods to over 46% of the population and contributed nearly 18% of GVA in 2023-24.

From Tradition to Technology: The sector is shifting from being dependent on manual labour and simple tools to adopting Precision Agriculture, which uses digital technologies for real-time, data-driven decision-making.

II. Key Digital Interventions

Artificial Intelligence (AI): AI is used to analyze big data from satellites and soil sensors for pest detection, yield prediction, and irrigation scheduling. Microsoft's

AI Farm Vibes in Baramati showed a 40% yield increase and 50% water savings.

Satellite and Remote Sensing: The government's FASAL programme with ISRO has improved crop forecasting and drought warnings.

Digital Marketplaces:

e-NAM (National Agriculture Market) has integrated 1,522 mandis and linked over 18 million farmers with buyers, promoting fair pricing.

Mobile Solutions: The Kisan Suvidha app provides real-time info, while the m-Kisan SMS service reaches 8.93 crore families in local languages.

Hardware Automation: Drones, automated irrigation systems like Nano Ganesh, and remote-operated transplanters are reducing labour effort and increasing efficiency.

III. Government Initiatives and the Way Forward

Digital Agriculture Mission (2024): Approved with a ₹2,817 crore outlay, this mission aims to build a unified digital ecosystem using AI, IoT, blockchain, and drones.
Agri Stack Project: This project is creating a digital database of over 11 crore farmers linked with Aadhaar, land records, and finances.
Namo Drone Didi (2023): With a funding of ₹1,261 crore, this scheme aims to empower 15,000 Women SHGs by distributing drones for smart spraying by 2026.
Challenges and Path Forward: The main hurdles are the digital divide, high costs of technology, limited digital literacy, and data privacy concerns. The way forward requires investment in digital infrastructure, farmer training in local languages, and a focus on affordable, farmer-centric technologies.

6. Agri Startups in India

This chapter highlights the booming aggrotech startup ecosystem in India, which is leveraging technology and innovation to solve long-standing agricultural challenges.

I. The Agritech Boom

The Problem: 80% of India's farmers are smallholders who face challenges like outdated techniques, lack of access to quality inputs and finance, and dependence on middlemen.
The Solution: Agritech startups are bridging these gaps with technology to improve productivity and streamline supply chains.
Growth & Investment: The sector has attracted $2.4 billion in funding since 2014, with deal volume up 28% in 2024 compared to 2023. By 2025, India is projected to have over 4,000 agritech startups.
Government Support: The Startup India initiative has recognized 2,800 agritech startups, providing them with tax exemptions and funding support.

II. Key Areas of Impact & Success Stories

Precision Farming: Startups provide AI and IoT tools that can increase yields by up to 30%.
Supply Chain Optimization: Startups like Ninja cart and Cromar connect farmers directly to buyers, reducing post-harvest losses which can be as high as 20-30% in perishables.
Agri-Fintech: Startups like Arya.ag and Jai Kisan are bridging credit gaps for farmers. Arya.ag has facilitated ₹15,000 crore in storage and ₹8,000 crore in financing.
Success Stories:
DeHaat: An end-to-end solutions platform serving over 265,000 farmers in Bihar, UP, and Odisha. It has helped increase farmer incomes by 20% through direct market linkages.
Farm theory: A startup tackling Agri-waste by collecting surplus or imperfect produce and selling it to processors and retailers like Reliance Retail. It helps farmers earn an extra ₹15,000 per season for crops that would otherwise be wasted.

III. Challenges and Conclusion

Hurdles: Startups face challenges of low digital literacy (only 23% of rural India has reliable smartphone + internet), high costs of technology for smallholders, and inconsistent state-level regulations.
Conclusion: With over $2.4 billion in investment and 4,000+ startups, the sector is poised for massive growth and can lead India into the fourth agricultural revolution by making farming more sustainable and profitable.

7. Cooperative Path to the SDGs

This final chapter underscores the crucial role of cooperatives in India's development, their natural alignment with the Sustainable Development Goals (SDGs), and the need for their modernization.

I. The Cooperative Advantage in India

Scale and Reach: India has a massive cooperative network, with over 8.5 lakh cooperatives and a membership of more than 30 crore people.
Historical Contributions: Cooperatives were central to India's major agricultural transformations:
1. Green Revolution: Enabled by credit and marketing coops like IFFCO and KRIBHCO.
2. White Revolution: Led by AMUL, which transformed India into the world's largest milk producer.

3. Blue Revolution: Strengthened by fishermen's cooperatives.

Alignment with SDGs: Unlike profit-driven corporations, cooperatives are people-centered and prioritize welfare, sustainability, and inclusiveness, making them natural partners for achieving the SDGs.

II. Recent Policy Push and Future Directions

Renewed Focus: The creation of a dedicated Ministry of Cooperation in 2021 and the Prime Minister's motto of "Sahkar Se Samriddhi" (Prosperity through Cooperation) have provided renewed momentum.

Reforms: Key reforms include introducing model bye-laws for PACS to make them multipurpose, establishing new multi-state cooperatives for seeds and exports, and creating a National Cooperative Database.

Emerging Cooperatives: While India's focus has been on traditional sectors, there is a need to expand into emerging areas like renewable energy, platform/IT, health and care, and ecotourism cooperatives to address modern challenges.

III. Challenges and Conclusion

Key Issues: Cooperatives in India face significant challenges, including weak management, political interference, lack of professionalism, uneven digital adoption, and limited access to capital.

The Path Forward: Modernisation and reform are essential to improve governance, adopt technology, engage youth, and simplify regulations.

Conclusion: Cooperatives are vital for India's goal of becoming a developed nation by 2047. By strengthening this democratic and scalable model, India can ensure its growth is people-Centered, equitable, and sustainable.

DOWN TO EARTH

1. Un SDG Report 2025: Progress Stalls or Reverses For 35% Of Targets

Context

Recent findings released ahead of the High-Level Political Forum on Sustainable Development, unveiled that about 35% of Sustainable Development Goals (SDGs) targets have either stalled or reversed.

Overview of the Sustainable Development Goals (SDGs)

Adoption: The SDGs were formally adopted in 2015 at the UN Sustainable Development Summit by all 193 UN Member States.

Scope: The framework consists of 17 interconnected goals and 169 targets, aiming for achievement by 2030.

Origins and Evolution:

1. 1992: Agenda 21 adopted at the Rio Earth Summit, focusing on sustainable development.
2. 2000: Millennium Development Goals (MDGs) launched to reduce extreme poverty globally.
3. 2012: Rio+20 Conference set the groundwork for SDGs.
4. 2015: SDGs formally launched, building on lessons from MDGs and Agenda 21.

Present Status (UN SDG Report 2025)

1. Only 35% of SDG targets are on track or making moderate progress.
2. Nearly 50% of targets are advancing too slowly.
3. About 18% of targets have regressed, particularly in areas of hunger, poverty, and climate resilience.

Most Affected Goals

SDG1 – No Poverty & Water Crisis:

1. 800 million people still live in extreme poverty.
2. By 2030, 8.9% of the global population may remain in poverty, failing SDG1.
3. In 2024, 2.2 billion people lacked safe drinking water, 3.4 billion lacked safe sanitation, and 1.7 billion lacked basic hygiene.

SDG2 – Zero Hunger:

4. Four out of seven targets are regressing.
5. In 2023, 9.1% of the global population (713–757 million) faced hunger, up from 7.5% in 2019.
6. Sub-Saharan Africa had the highest hunger rate (23.2%), while Southern Asia had the largest absolute number (281 million).
7. Food insecurity affected 2.33 billion people, 383 million more than in 2019.
8. Drivers include conflict, climate variability, economic shocks, with 50% of countries experiencing elevated food prices in 2023 — triple pre-pandemic levels.

SDG3 – Good Health and Well-Being:

9. Maternal mortality and universal health coverage targets show stagnation.
10. Global health systems weakened due to COVID-19, chronic underfunding, and systemic inequalities.

SDG4 – Quality Education:

11. Nearly 36% of children in low-income countries are out of school.
12. Learning proficiency remains low, hindering skill development.

SDG6 – Clean Water and Sanitation:

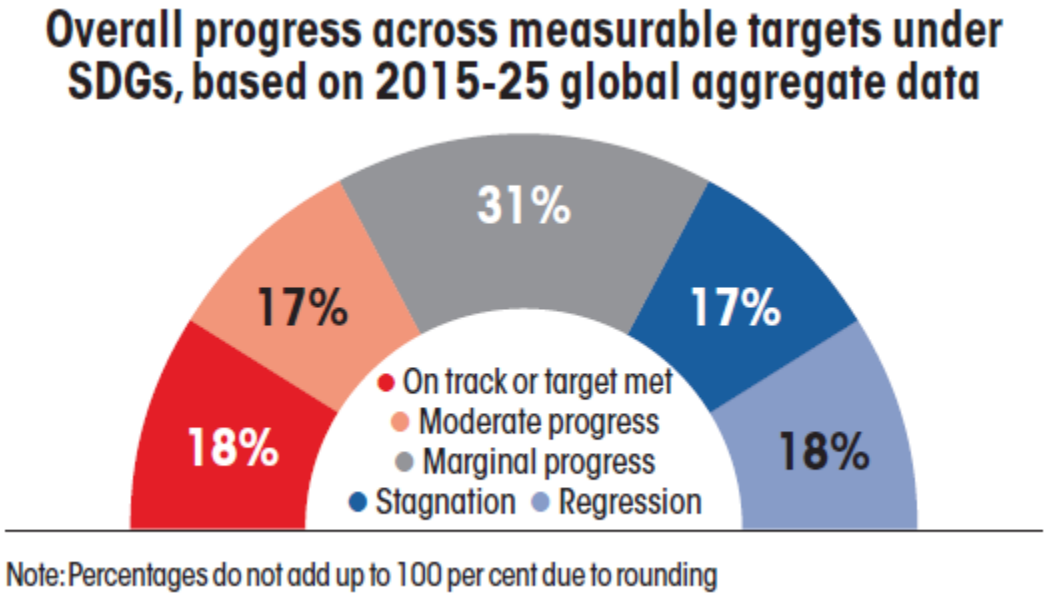
13. 3.4 billion people lack safely managed sanitation.
14. 1.7 billion people lack basic hygiene services.
15. Climate change and infrastructure gaps worsen global water stress.

SDG8 – Decent Work and Economic Growth:

16. Half of the tracked targets have stagnated or declined.
17. Informal employment rose to 57.8% of the global workforce in 2024.
18. Youth unemployment stood at 12.9%, nearly three times the adult rate (3.7%).

SDG14 – Life Below Water:

19. 40% of its targets are regressing.
20. Issues include marine pollution, declining fish stocks, and ecosystem degradation.
21. Despite urgency, SDG14 is the least funded SDG, as highlighted at UN Ocean Conference 3 (UN-OC 3).



Climate Emergency and Funding Gaps

1. 2024 was the hottest year on record, with temperatures 1.55°C above pre-industrial levels.
2. WMO predicts an 80% chance that an even hotter year will occur before 2030.
3. Development assistance fell 7.1% in 2024, ending a 5-year growth trend.
4. The SDG financing gap now stands at $4 trillion annually, severely impacting developing nations.

Promising Developments

1. HIV infections dropped by 40% since 2010.
2. Malaria control efforts saved 12.7 million lives since 2000.

3. Social protection coverage now reaches over 50% of the global population, showing gradual improvement.
4. SDG7 – Affordable and Clean Energy: 40% of sub-targets are on track, driven by renewable energy expansion.
5. SDG12 – Responsible Consumption and Production: 36% of sub-targets progressing, especially in sustainable procurement and R&D.

Key Challenges

Climate Change: Escalating disasters and biodiversity loss undermine development gains.
Conflict and Instability: Wars in Ukraine, Sudan, and Gaza disrupt multiple SDGs.
Debt and Financing: Developing countries face a grim economic outlook with a $4 trillion annual SDG financing gap.
Data Deficiency: Only about 70% of indicators have sufficient coverage, especially in low-income regions.

Road Ahead – Six-Point Acceleration Plan

1. Transform food systems for resilience and sustainability.
2. Expand energy access with renewable and clean technologies.
3. Accelerate digital transformation across sectors to improve inclusion and productivity.
4. Ensure inclusive education, addressing out-of-school children and learning gaps.
5. Create decent jobs and social protection, focusing on youth and informal sector workers.
6. Protect climate and biodiversity, integrating mitigation and adaptation strategies.
7. Data Systems: Adopt the Medellín Framework for Action to build robust, evidence-driven monitoring and policy frameworks.

2. India's New Epr Framework for Nonferrous Metals

Context

Recently, the Union government's updated rules provide ambitious recycling timelines for nonferrous metals with the introduction of a new Extended Producer Responsibility (EPR) framework but provide little clarity on implementation. The Government of India has introduced a significant environmental policy by notifying the Extended Producer Responsibility (EPR) framework for non-ferrous metals. Notified under the Hazardous and Other Wastes (Management and Transboundary Movement) Amendment Rules, 2025, this framework is set to become effective from April 1, 2026. Its primary objective is to integrate key metals such as aluminium, copper, zinc, and their alloys into a structured circular economy, making producers responsible for the end-of-life management of their products.

What the Framework Promises: Key Features Explained

The EPR framework is built on several core pillars designed to create a comprehensive and accountable system for metal waste management.

Wide Coverage and Scope:

The rules are designed to be all-encompassing, applying to a vast array of products that use non-ferrous metals. This reflects the deep integration of these metals into modern life.

Examples Include:

Aluminum: Beverage cans, packaging foils, aerosol cans, kitchen utensils, window frames, and parts used in automobiles and aircraft.
Copper: Electrical wiring and cables, plumbing pipes, electronic components (circuit boards), industrial machinery, and roofing materials.
Zinc: Galvanized steel (for rust-proofing), batteries, die-casting alloys for industrial parts, and automotive components.
By covering such a broad spectrum, the framework aims to capture a significant portion of the metal waste stream that currently ends up in landfills or is processed inefficiently.

Progressive Recycling Targets:

The framework introduces a phased and incremental approach to recycling, giving the industry adequate time to build capacity and adapt. This avoids imposing an immediate and unachievable burden.

The Timeline:

1. **2026–27:** The initial target is set at a modest 10%.
2. **Gradual Increase:** The percentage will be increased steadily in subsequent years.
3. **2032–33:** The final target is set to reach 75%.

This long-term, predictable timeline sends a clear signal to the industry to invest in modern recycling technologies, collection infrastructure, and partnerships to meet future obligations.

Digital Backbone for Transparency and Efficiency:

A cornerstone of the framework is the creation of a centralized online portal by the Central Pollution Control Board (CPCB). This digital platform is intended to be the single point of contact for all EPR-related activities.

Functions of the Portal:

Registration: All stakeholders will register on the portal, creating a national database.

Compliance Monitoring: Producers will file annual returns detailing production, waste collection, and recycling data, allowing the CPCB to track progress against targets in real-time.

EPR Certificate Trading: The portal will facilitate a market-based mechanism where certified recyclers can generate EPR certificates for the quantity of waste they process. Producers who exceed their targets can sell surplus certificates to those who fall short, creating a financial incentive for over-performance.

Inclusive Stakeholder Ecosystem:

The framework mandates the registration of every actor in the metal waste value chain, ensuring that responsibility is clearly defined and shared.

Key Stakeholders and Their Roles:

Producers/Importers: Those who introduce the products into the market. They are primarily responsible for meeting recycling targets.

Manufacturers: Companies that use these metals to create final products.

Recyclers & Refurbishers: Formal entities responsible for scientifically processing waste material and bringing it back into the economy.

Collection Agents: Organizations or individuals involved in aggregating waste from various sources.

Bulk Consumers: Large industries or entities that use significant quantities of these metals and generate substantial waste.

Implementation Challenges: Hurdles to Overcome

Despite its strong vision, the framework faces several practical challenges that could hinder its successful implementation.

Overburdened Central Pollution Control Board (CPCB):

1. The CPCB has been given a massive mandate to be executed within a very tight six-month timeframe. Its responsibilities include developing the complex online portal, drafting detailed operational guidelines, verifying stakeholder credentials, conducting nationwide inspections, and organizing awareness and training programs.
2. Given the CPCB's existing responsibilities and documented limitations in manpower and resources, this timeline appears highly optimistic and risks a rushed, inefficient rollout.

Exclusion and Marginalization of the Informal Sector:

3. A vast majority of metal waste in India is currently collected, segregated, and processed by the informal sector (e.g., scrap collectors, small aggregators). This sector is the backbone of the current recycling system.
4. The framework, in its current form, focuses heavily on formal registration and digital compliance, offering no clear roadmap for integrating these informal players. These risks disrupting the existing efficient collection networks and, more importantly, could lead to the loss of livelihoods for millions of people.

High Administrative Complexity:

5. The requirement for multiple registrations, constant data submission, and adherence to complex compliance norms can be particularly burdensome for Small and Medium Enterprises (SMEs).
6. These smaller players often lack the dedicated administrative staff or financial resources to navigate such a system, which could lead to non-compliance or force them out of the market, potentially leading to consolidation in Favor of larger corporations.

Lack of Clarity in Penalty Structures:

7. While the rules mention the imposition of "environmental compensation" for non-compliance, they fail to specify the methodology or formula for calculating these penalties.
8. This ambiguity creates significant uncertainty for businesses. Without a clear understanding of the financial risks associated with failing to meet targets, companies cannot effectively plan or budget for compliance, and it may also lead to arbitrary or inconsistent enforcement.

What Needs Strengthening: Recommendations for Success

To ensure the framework achieves its intended goals, the following areas require immediate attention and reinforcement.

Urgent Capacity Building:

1. The CPCB and the State Pollution Control Boards (SPCBs) must receive significant financial and technical support.
2. This includes investing in robust IT infrastructure for the portal, hiring personnel with expertise in data management and environmental auditing, and providing extensive training to existing staff to handle the new responsibilities effectively.

Formalizing and Integrating the Informal Sector:

3. A dedicated policy must be created to bring informal recyclers into the formal system.

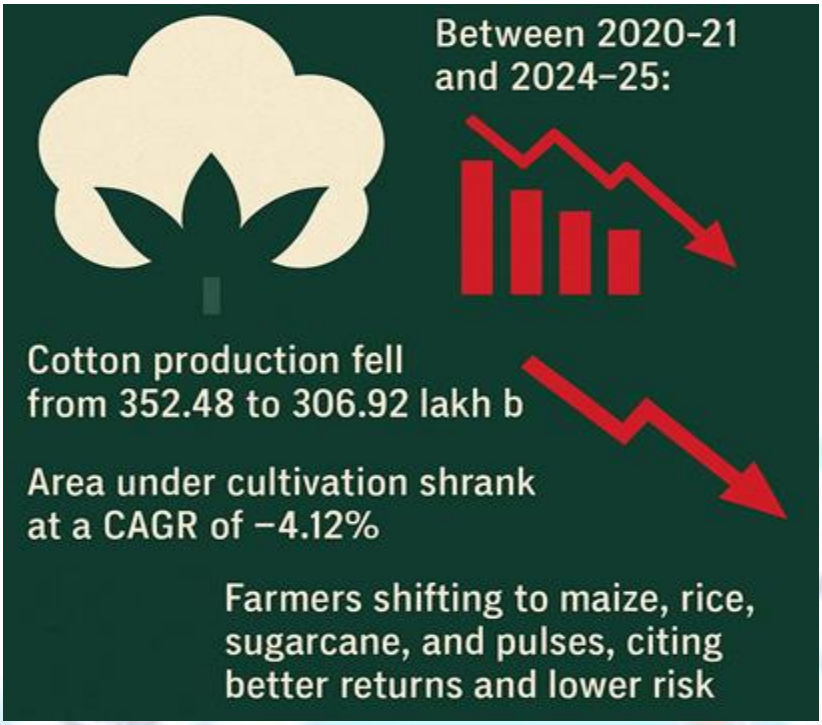
Possible Steps:

1. Simplify registration processes for them.
2. Provide training on safety, health, and advanced sorting techniques.
3. Offer financial support through subsidies or access to credit for upgrading their equipment.
4. Facilitate partnerships between informal collectors and formal Producer Responsibility Organizations (PROs) or recyclers.

Enhancing Transparency and Accountability:

4. The government must issue clear, unambiguous guidelines on critical aspects of the framework.
5. This includes publishing a transparent formula for calculating environmental compensation, establishing clear rules for the trading and pricing of EPR certificates, and defining standards for what constitutes "recycled content" to prevent fraudulent claims and ensure the system's integrity.

3. Herbicide Tolerant Cotton



What is Herbicide Tolerant (HT) Cotton?

HT cotton is a type of genetically modified crop engineered to withstand the application of specific herbicides, most commonly glyphosate. This broad-spectrum chemical is designed to kill most plants, making it an effective weed killer.

The primary advantage for farmers is simplified weed management. They can spray glyphosate across their entire field to eliminate weeds without damaging the cotton crop itself. However, this convenience comes with substantial and often severe downsides:

Rise of 'Superweeds': The widespread and repeated use of a single herbicide like glyphosate inevitably leads to the natural selection of weeds that are resistant to it. These herbicide-resistant weeds, often called 'superweeds', become extremely difficult and costly to control.

Environmental Contamination: Glyphosate can easily run off from fields into nearby streams, rivers, and groundwater. This contamination harms aquatic ecosystems, affecting fish and other organisms, and can work its way up the food chain.

Harm to Non-Target Organisms: The herbicide does not distinguish between weeds and other plants. It can kill beneficial plants, impact soil microorganisms crucial for soil health, and harm important insects, including essential pollinators like bees.

Degradation of Soil Health: Continuous exposure to powerful chemical herbicides can degrade soil quality, reduce biodiversity within the soil, and negatively impact long-term agricultural productivity.

Ecological Red Flags and Broader Impacts

The environmental concerns associated with HT cotton and glyphosate extend beyond the farm.

Threat to Keystone Species: In the delicate desert ecosystems of northwest India, the increased use of glyphosate poses a direct threat to Prosopis cineraria (Khejri tree). The Khejri is a keystone species, meaning it plays a critical role in maintaining the structure and health of its ecosystem by providing food, shelter, and soil stability. Its loss could have cascading negative effects on the entire region.

Lessons from Bt Cotton: The experience with another GM crop, Bt cotton, serves as a cautionary tale. While initially successful in controlling the American bollworm, pests quickly evolved. The pink bollworm developed resistance, and new threats like the tobacco streak virus (TSV) emerged, rendering Bt cotton less effective and making cultivation economically challenging for many farmers. There is a high risk that HT cotton will accelerate a similar cycle of pest and weed resistance.

Human Health Concerns: The health impacts of glyphosate remain a subject of intense global debate. Some studies and international health organizations have pointed to its potential as a carcinogen, raising serious questions about its safety for farmers and consumers.

Policy and Regulatory Failures

Despite being unapproved for commercial cultivation in India, the sale and planting of illegal HT cotton have exploded.

Massive Illegal Market: The illegal market is substantial, with sales of unauthorized seed packets jumping from an estimated 30 lakh in 2020 to over 75 lakhs in 2021.

Regulatory Inaction: The Genetic Engineering Appraisal Committee (GEAC), India's top regulatory body for GM crops, has been largely ineffective in preventing the spread of unapproved HT cotton. This failure undermines the entire regulatory framework for biosafety.

Deception of Farmers: Farmers are often drawn to HT cotton by aggressive marketing and unsubstantiated claims of doubled yields and reduced labour. However, these promises are not supported by credible agronomic data, leaving farmers vulnerable to crop failure and economic loss when the technology fails to perform as advertised.

The Path Forward

Reviving India's cotton sector requires moving away from a reliance on single-technology solutions and adopting a more sustainable and integrated approach.

Investment in Breeding: Focus should be on developing locally adapted, high-yielding hybrid cotton varieties through conventional breeding that have natural resistance to a range of pests and diseases.

Agricultural Diversification: Moving away from cotton monocultures and promoting diverse cropping systems can break pest cycles, improve soil health, and provide farmers with more stable incomes.

Ecological Farming: Investing in and promoting Integrated Pest Management (IPM) and other ecological farming practices can reduce the dependency on chemical inputs, lower cultivation costs, and create a more resilient agricultural system.

Strengthening Oversight: It is crucial to strengthen the regulatory capacity of bodies like GEAC to enforce bans on illegal GM crops and ensure that any future approvals are based on rigorous, independent, and transparent scientific evaluation.

4. Offshore Sand Mining in India

Context

Fisher communities in Kollam, Kerala, protest the government's plan to commence offshore sand mining.

1. Earlier, the Union government announced the auction of mineral blocks in the offshore areas of Gujarat, Andaman and Nicobar Islands and Kerala for extraction of lime mud, polymetallic nodules and sand.
2. Offshore sand mining is the process of extracting or dredging large quantities of sand from the seabed. This industrial activity is typically carried out at depths ranging from 22 to 45 meters to access sand deposits formed over time by marine processes. After being extracted, the sand is treated through desalination (removing salt) to make it suitable for construction purposes.

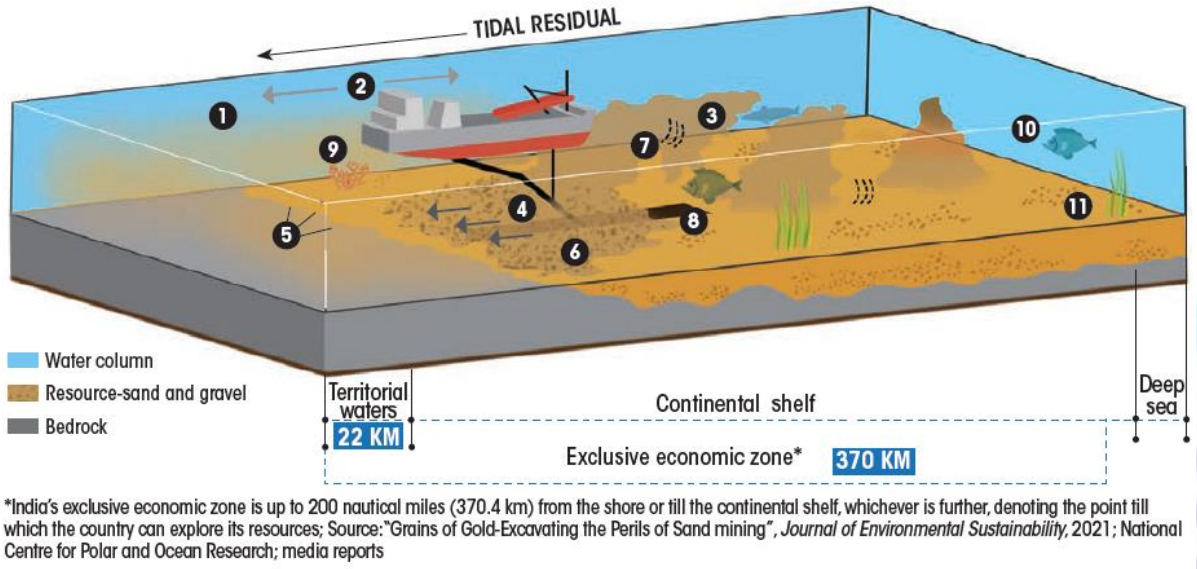
According to the Geological Survey of India (GSI), India has vast offshore sand reserves. For example, the offshore region of Kerala alone is estimated to hold 745 million tonnes of construction-grade sand, with the Kollam coast containing over 302 million tonnes.

HAZARDOUS CHURN

Offshore sand mining can result in habitat loss for marine species, adversely affecting communities that rely on fishing for livelihood

DIRECT AND INDIRECT IMPACTS OF OFFSHORE SAND MINING

1. Increased turbidity
2. Far-field changes in tides and currents
3, 4. Sand plume dispersal
5. Seabed sediment veneers
6. Deposition from sediment plumes
7. Ship/Machinery noise
8. Seabed removal: bathymetric change
9. Local extinctions, like coral loss
10. Habitat loss for marine species
11. Changes in species composition



*India's exclusive economic zone is up to 200 nautical miles (370.4 km) from the shore or till the continental shelf, whichever is further, denoting the point till which the country can explore its resources; Source: "Grains of Gold-Excavating the Perils of Sand mining", *Journal of Environmental Sustainability*, 2021; National Centre for Polar and Ocean Research; media reports

Legal Framework

While sand is classified as a 'minor mineral' under the Mines and Minerals (Development and Regulation) Act, 1957, which typically falls under state jurisdiction, offshore mining operates differently. It is governed by the central government's Offshore Areas Mineral (Development and Regulation) Act, 2002. This act was amended in 2023 to open up the sector to private companies and allow for long-term leases of up to 50 years.

Why the Government Supports It

The government views offshore sand mining as a viable solution for several reasons:

Economic Potential: The massive reserves can meet regional construction demands for decades. For instance, Kerala's offshore sand could satisfy its needs for 25 years at an annual consumption rate of 30 million tonnes.

Revenue Generation: The activity is expected to generate significant revenue for the government through shipping, trade, and the collection of Goods and Services Tax (GST).

Environmental Justification: It is often promoted as a more sustainable alternative to riverbed and coastal sand mining. These traditional forms of mining are highly destructive, causing severe riverbank erosion, altering water flow, and destroying critical habitats.

Ecological and Social Concerns

Despite the economic benefits, offshore mining poses serious threats to the marine environment and coastal communities.

Marine Habitat Disruption: The dredging process physically removes the top layer of the seabed, destroying the habitat for **benthic organisms** (like crabs, worms, and mollusks) that live in the sediment. This also disrupts vital fish breeding and spawning grounds.

Water Turbidity and Pollution: Dredging creates large underwater clouds of suspended sediment, known as plumes. These plumes increase water turbidity, blocking sunlight needed by marine plants and corals. They can also release trapped toxins or heavy metals from the seabed into the water column.

Coastal Erosion: Removing vast amounts of sand from the seabed can alter wave patterns and tidal currents. This can weaken natural coastal defenses like rocky reefs and sandbars, leading to increased shoreline erosion.

Threats to Livelihoods: The ecological damage directly impacts coastal communities. In Kollam, for example, the proposed mining area includes the Kollam Bank, a rich fishing ground that supports the livelihoods of over 25,000 fishers. Destroying this ecosystem would have devastating economic consequences for them.

Policy and Legal Safeguards

To mitigate these risks, the regulatory framework includes several proposed safeguards:

1. Mandatory Environmental Management Plans (EMPs) must be in place before any production can begin.
2. Production plans must align with ecological safeguards to minimize harm.
3. Close coordination is required between mining companies, state authorities, and scientific institutions like the National Institute of Oceanography (NIO) to ensure responsible practices.

5. UN Frontier Report 2025: Floods Unleash Toxic Legacy Chemicals from Sediments

Context

Recently, the UNEP 'Frontiers 2025: The Weight of Time' report revealed that the intensified flooding events are remobilizing long-buried toxic chemicals from river and coastal sediments, exposing ecosystems and human populations to serious health risks.

What Are Legacy Chemicals?

1. Legacy chemicals are persistent pollutants that were widely used in the past but have since been banned or restricted due to their toxicity. These include:

1. Heavy Metals: Lead, cadmium — toxic even at low concentrations;
2. Persistent Organic Pollutants (POPs): Pesticides, industrial by-products, synthetic chemicals.

2. These substances do not degrade easily and accumulate in sediments of polluted rivers, lakes, and estuaries.

1. Despite regulatory bans, they remain in the environment for decades.

How Floods Mobilize Toxic Sediments

Floodwaters can:

1. Re-suspend and redistribute contaminated sediments;
2. Spread pollutants across landscapes and into water bodies;
3. Introduce toxins into the food chain, affecting plants, animals, and humans.

Report cites examples such as:

1. Hurricane Harvey (2017): Released mercury and carcinogens into Galveston Bay, Texas;
2. Niger Delta floods (2012): Mobilized polycyclic aromatic hydrocarbons (PAHs);
3. Pakistan floods (2010): Swept away 2,835 metric tonnes of obsolete pesticides.

Health and Ecological Risks

Legacy chemicals can cause:

1. Neurotoxicity and immunotoxicity;
2. Kidney and bone damage;
3. Reproductive harm and cancers;
4. Endocrine disruption

In India, rivers like the Ganga, Hindon, and Vaigai show cadmium levels in sediments that exceed safe thresholds, posing risks to aquatic life and human health.

Climate Change Intensifies the Threat

1. Increased rainfall and tropical storms are driving more frequent and severe floods;
2. Urbanization and poor waste management exacerbate sediment contamination;

3. Millions of tonnes of POP waste remain in global landfills, vulnerable to flood exposure.

UNEP's Recommendations

Nature-based solutions: Wetlands, floodplains, riparian buffers;
Traditional infrastructure: Polders, dikes, retention basins;
Integrated river basin management: Balancing flood control, conservation, and water use;
Sediment pollution mapping: Geo-profiling of riverbeds to anticipate contamination;
Monitoring pollutant pathways: Tracking how toxins travel post-flood;

6. India Leads South Asia's Remarkable Progress in Childhood Immunization

Context

India has made significant strides in child immunization, reducing the number of zero-dose children—those who have missed all vaccinations— by 43% in just one year, according to new data released by WHO and UNICEF.

1. In 2023, India recorded 1.6 million zero-dose children. That number has now dropped to 0.9 million in 2024, marking a reduction of nearly 700,000 children.

Regional Immunization Hits Historic Highs

1. South Asia, as a region, achieved its highest-ever immunization coverage in 2024:
    1. 92% of infants received the third dose of the DTP vaccine (DTP3), up from 90% in 2023.
2. It surpasses even pre-COVID-19 levels.

Country-wise Highlights

Nepal: Halved the number of zero-dose children.
Pakistan: Achieved its highest-ever DTP3 coverage at 87%.
Afghanistan: Remains a concern with the lowest immunization coverage in the region and a slight decline compared to last year.

Measles Vaccine Uptake

1. 93% of infants received the first dose.
2. 88% received the second dose.
3. Reported measles cases dropped 39% in 2024.

HPV Vaccination Efforts

1. Bangladesh vaccinated over 7.1 million girls since launching its HPV program last year. Bhutan, Maldives, and Sri Lanka also reported steady increases. India and Pakistan are set to launch their HPV vaccination campaigns later in 2025.
2. Bhutan, Maldives, and Sri Lanka also reported steady increases.
3. India and Pakistan are set to launch their HPV vaccination campaigns later in 2025.

Challenges Ahead: 2.9 million Still Un- or Under Vaccinated

1. Despite the gains, over 2.9 million children in South Asia remain either unvaccinated or under vaccinated.
2. Health officials stress that reaching these children, particularly in remote and underserved areas, remains a critical priority.

7. Intense Marine Heatwave in Mediterranean Shocks With 8°c Warming

Context

The Mediterranean Sea is currently experiencing an unprecedented marine heatwave, with sea surface temperatures soaring up to 8°C above normal.

What's Happening?

1. Peak anomalies of +8°C have been recorded off the coasts of France and Italy, with absolute temperatures nearing 31°C (88°F).
2. The western Mediterranean basin, including the Balearic and Tyrrhenian Seas, is the worst affected.

3. The deviation from normal sea surface temperatures is six standard deviations—statistically placing it in the realm of near impossibility without global warming.

What's Causing It?

1. The primary driver is a heat dome—a high-pressure system that traps heat and suppresses wind activity, preventing ocean mixing. This leads to:
    1. Accumulated heat in surface waters;
    2. Amplified warming due to reduced aerosols and altered atmospheric circulation;
    3. A feedback loop between atmospheric and marine heatwaves
2. Afghanistan: Remains a concern with the lowest immunization coverage in the region and a slight decline compared to last year.

Ecological Fallout:

1. Mass mortalities of fish and invertebrates due to low oxygen levels;
2. Coral bleaching and die-offs of seagrass beds;
3. Disease outbreaks in mussel farms;
4. Threats to endangered species like the noble fan mussel.

A study published in Aquaculture (July 2024) found that marine heatwaves in the Mediterranean have tripled in frequency and now last 50% longer than they did 40 years ago.

8. India Reaches 50% Non-fossil Fuel Power Capacity

Context

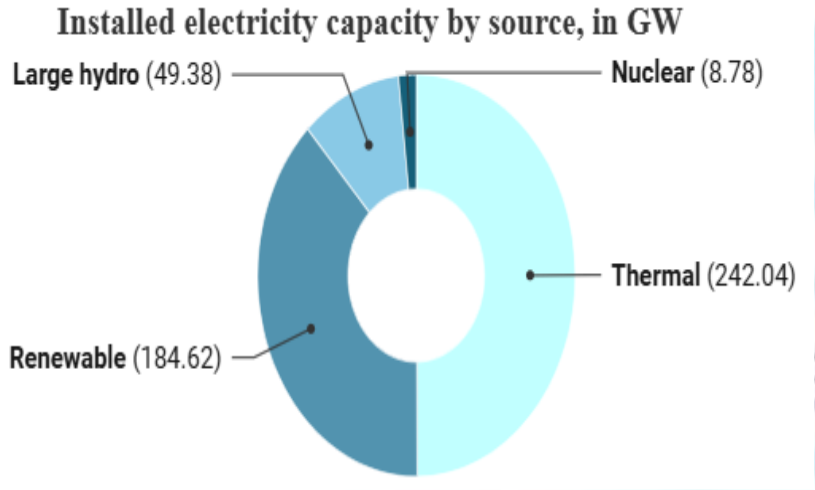
In a landmark achievement for clean energy, India has reached 50% of its installed electricity capacity from non-fossil fuel sources, five years ahead of its 2030 target under the Paris Agreement.

Numbers Behind the Milestone

Total installed capacity: 484.82 GW (as of June 30, 2025)

Non-fossil fuel sources: 242.78 GW (50.1%)

1. Renewables: 184.62 GW (38.08%)
2. Large hydro: 49.38 GW (10.19%)
3. Nuclear: 8.78 GW (1.81%)



It fulfills one of India's Nationally Determined Contributions (NDCs) under the Paris Agreement well ahead of schedule.

Related Efforts & Initiatives

PM-KUSUM: Promoted solar-powered irrigation and feeder-level solarisation;

PM Surya Ghar: Muft Bijli Yojana: Targeted rooftop solar for 10 million households;

Solar Parks & Wind-Solar Hybrid Policy: Enabled large-scale deployment of renewables;

Bioenergy Expansion: Boosted rural employment and circular economy goals.

What's Next?

1. 500 GW of non-fossil fuel capacity by 2030;
2. 45% reduction in emissions intensity of GDP;
3. Net-zero emissions by 2070

9. Coal: Balancing Energy Security and Climate Responsibility

Context

India, as the world's third-largest energy consumer, needs to reconcile its growing demand for power with the urgent need to address climate change.

About

1. Coal has long been the backbone of India's energy infrastructure, currently providing around 70–75% of electricity, and is projected to decline to 50% by 2030 as wind and solar expand.
2. It is abundant, cost-effective, and crucial for powering industries such as steel, cement, and chemicals.
3. Government has undertaken several key reforms to modernize the sector, including:
4. Commercial coal mining to attract private investment and boost efficiency;
5. Single-window e-auction systems to streamline coal distribution;
6. Reopening abandoned mines to maximize resource utilization.

Environmental Costs of Coal

1. Energy demand is set to double by 2030, essential for growth, livelihoods, and health.
2. Coal is a major contributor to environmental degradation, despite its economic benefits. Coalfired power plants account for:
3. 60% of particulate emissions;
4. Over 80% of mercury emissions;
5. 45–50% of sulphur dioxide emissions;
6. 30% of nitrogen oxide emissions.
7. Water consumption is another concern — coal power plants withdraw 65% of all freshwater used by Indian industry.
8. Recognizing these impacts, the Indian government has introduced stricter emission norms and mandated recycled water usage for plants along the Ganga.

Transitioning Responsibly: Clean Coal and Renewables

1. India's approach is not to abruptly phase out coal, but to displace it gradually with cleaner alternatives. Key strategies include:
2. Supercritical technology for new coal plants to reduce emissions;
3. Coal gasification and liquefaction to diversify coal use;
4. Carbon Capture and Storage (CCS) to mitigate CO_2 emissions;
5. Investments in renewable energy, with a target of 500 GW by 2030.
6. Coal India Limited has committed to installing 5 GW of renewable energy capacity, signalling a shift toward a more sustainable energy mix. of 500 GW by 2030.

Roadmap for Decarbonising Coal Power

1. Benchmarking Efficiency: Existing plants should be required to match the performance of the best units in their category.
2. For example, older but well-maintained plants such as Tata Power's Trom Bay unit demonstrate how efficiency standards can drive emission reductions across the fleet.
3. Biomass Co-Firing: Mandating a 20% switch to biomass for co-firing can significantly cut carbon emissions.
4. Many plants already co-fire biomass, making this a scalable and practical solution.
5. Policy and Market Reforms: Technological improvements alone will not suffice. Policy incentives and structural reforms are essential.
6. The current merit order dispatch system Favors cheaper, older plants that run dirtier.

7. Ultra-supercritical plants — though cleaner — often operate at less than 50% capacity, undermining their efficiency advantage.
8. A new system must prioritize environmental performance alongside cost to displace dirty coal effectively.

10. Future of Farming: Decline of Farms and the Aging Farmer Population

Context

Farming in India is facing unprecedented challenges as farms decline worldwide, farmers age, and youth shy away from agriculture, raising urgent questions about the future of food production.

Declining Workforce in Agriculture

1. Data from the International Labour Organization shows a sharp decline in agricultural employment:
2. In 1991, agriculture accounted for 43% of global employment.
3. By 2023, this share dropped to 26%.
4. The situation is particularly stark in India, where the 2011 Census revealed that 2,000 farmers quit farming every day.

Aging Farmers and Youth Disinterest

1. The average global age of farmers is 55 years, closer to retirement. Meanwhile, fewer young people are entering farming, seeing it as unprofitable and labour-intensive.
2. It poses a serious risk to sustaining food systems in the future.

Limits of Land and Climate Pressures

1. Farming is uniquely constrained:
2. Land is finite and faces competing demands from urbanization, industry, and conservation.
3. Climate change disrupts crop cycles, adding volatility to yields.
4. Despite advances, farming remains labour-intensive, deterring new entrants.
5. Hannah Ritchie of Our World in Data notes that global agricultural land use has peaked and is now in decline, marking 'a historic moment in humanity's relationship to the planet'.

Projected Decline of Farms

1. Zia Mehrabi (University of Colorado) offers one of the first global projections for farm numbers:
2. 2020: 616 million farms worldwide.
3. 2100: Expected to drop to 272 million.
4. Key drivers of this trend include urban migration and economic growth, leading to fewer people engaged in rural farming.
5. Low-income countries may see growth until 2070, after which decline is expected there too, while farms decline in higher-income regions.

Rising Farm Sizes and Consolidation

1. As farms decline, their average size will grow:
2. By 2050, global farm size is projected to increase by 10%.
3. By 2100, it is expected to double.
4. It could bring efficiency but also risks reducing diversity in farming practices.

Food Security Concerns

1. The decline raises critical questions about feeding a growing population:
2. Today, 600 million farms sustain 8 billion people.
3. By 2100, half the number of farms will need to feed even more people.
4. Small farms — though occupying only 25% of agricultural land — produce one-third of the world's food.
5. Their decline may disrupt biodiversity, reduce resilience, and weaken food supply chains.

Conclusion

1. The future of farming hinges on urgent reforms:
2. Education and support systems for farmers.

3. Sustainable land use policies.
4. Climate-resilient agricultural practices.
5. As the world faces fewer farmers, larger farms, and increasing food demand, decisive action is essential to safeguard food security and preserve farming as a viable profession for future generations.

11. New National Agriculture Policy

Context

Recently, the Union Ministry of Agriculture & Farmers Welfare, unveiled the new 'National Agriculture Policy' aimed to address the evolving challenges of climate change, market volatility, and farmer income security, and positioning India as a resilient and self-sufficient Agri-economy.

Core Objectives of the Policy

1. Increase crop production and productivity through improved seeds, precision farming, and technology adoption.
2. Reduce cost of production by promoting efficient irrigation, mechanization, and input subsidies.
3. Ensure remunerative prices for farmers to enhance income through better market access and MSP reforms.
4. Promote agricultural diversification into horticulture, pulses, oilseeds, and allied sectors.
5. Develop post-harvest infrastructure for value addition, storage, and processing.
6. Adapt to climate change through resilient cropping systems and risk mitigation strategies.

Sector Performance and Economic Impact

1. According to the Ministry of Statistics and Programme Implementation (MoSPI), the Gross Value Added (GVA) growth rate in agriculture and allied sectors for 2024–25 is estimated at 4.6%, reflecting the sector's robust performance despite global uncertainties.
2. India's domestic market remains vast, and agricultural self-sufficiency is not just an economic goal—it carries geopolitical significance.
3. The new policy reinforces this by aligning national schemes with state-level priorities, recognizing agriculture as a state subject.

Supporting Schemes and Missions

1. Digital Agriculture Mission: Creating digital public infrastructure and crop estimation tools.
2. Clean Plant Programme: Ensuring disease-free planting material for horticulture.
3. National Mission on Edible Oils – Oilseeds (NMEO): Boosting domestic oilseed production.
4. National Mission on Natural Farming (NMNF): Promoting chemical-free, sustainable farming practices.
5. Expanded Agriculture Infrastructure Fund (AIF): Supporting community farming assets and integrated processing projects.

Vision for New India

1. The policy reflects NITI Aayog's vision of transforming Indian agriculture through innovation, inclusivity, and sustainability.
2. It emphasizes stakeholder consultations, in-house research, and strategic inputs to the Prime Minister's Office for effective implementation.

12. Groundwater Keeps Ganga Flowing in Summer: IIT Roorkee Study

Context

Recently, a study by IIT Roorkee found that the Ganga River's summer flow of Ganga River is sustained by groundwater during the dry season.

Science Behind the Discovery

1. The study used advanced isotopic analysis to trace the Ganga's water sources from its Himalayan origin to its journey across the Indo-Gangetic plains, published in Hydrological Processes. The findings are striking:

2. Glacier melt contributes almost nothing to the river's flow once it enters the plains.
3. Groundwater discharge accounts for nearly all of the Ganga's summer flow up to Patna.
4. The river's volume increases by 120% along this stretch due to groundwater input.
5. However, 58% of the river's water evaporates during summer, a massive and often overlooked loss.

Resilient Aquifer System

1. The study challenges satellite-based narratives of widespread groundwater depletion. Using two decades of field data, researchers found:
2. Central Ganga plain aquifers remain stable, supported by shallow hand pumps.
3. The underground system is robust and resilient, still feeding the river reliably.
4. It noted that the Ganga basin holds about 8,300 billion cubic metres of groundwater, with 99% in alluvial deposits.
5. The shallow aquifers (~50 metres deep) contain nearly 30% of India's total replenishable groundwater resources.

Implications for River Management

1. These findings have profound implications for water policy and river rejuvenation efforts:
2. Namami Gange and Jal Shakti Abhiyan need to prioritize aquifer recharge and tributary revival.
3. Barrages and diversions need to be managed to maintain natural groundwater flow into the river.
4. Over-extraction and neglect of tributaries, not glacier retreat, are the real threats to the Ganga's summer flow.

13. Coral Reefs in Lakshadweep

Context

According to a study published in the journal Diversity and Distributions, coral cover in Lakshadweep nearly halved between 1998 and 2022, dropping from 37.2% to just 19.1% by 2022, due to repeated marine heatwaves and bleaching events.

Heatwaves and Bleaching: A Repeating Cycle

1. Lakshadweep has endured three major marine heatwaves over the study period—1998, 2010, and 2016 — each linked to El Niño events and rising sea surface temperatures.
2. These heatwaves triggered mass coral bleaching, with the 2010 event being the most severe, registering a Degree Heating Week (DHW) of 6.7.
3. Interestingly, while coral mortality has decreased over time, this is not necessarily a sign of resilience.
4. Researchers suggest that many heat-sensitive species have already vanished, leaving behind stress-tolerant genera like Porites, Isopoda, and Favia.

Recovery Needs Time — At Least Six Years

1. One of the study's most striking findings is that coral recovery accelerates only after a six-year gap between bleaching events.
2. Shorter intervals, such as the six years between 2010 and 2016, limit the ability of fast-growing genera like Acropora to bounce back.
3. It highlights the importance of giving reefs time to heal. Without sufficient pauses between heatwaves, even the most resilient coral communities may not survive.

Why Lakshadweep's Reefs Matter

1. Lakshadweep's coral reefs are not just ecological treasures—they are lifelines for local communities. They:
2. Support rich marine biodiversity;
3. Protect shorelines from erosion and storm surges;
4. Sustain fisheries and tourism-based livelihoods;
5. The loss of coral cover threatens all these functions, making reef conservation a socio-economic imperative.

14. Environment Protection (Management of Contaminated Sites) Rules, 2025

Context

The Union Ministry of Environment, Forest and Climate Change notified the Environment Protection (Management of Contaminated Sites) Rules, 2025, under the Environment Protection Act, 1986.

Key Provisions of the 2025 Rules

Identification and Notification: State Pollution Control Boards (SPCBs) must identify suspected contaminated sites and notify them to CPCB.

Site Assessment: Detailed risk assessments must be conducted to determine the extent and severity of contamination.

Remediation Plans: Polluters or responsible parties must submit site-specific remediation plans, subject to approval by CPCB.

Time-bound Cleanup: Remediation must be completed within a defined timeline, with penalties for non-compliance.

Public Disclosure: Information about contaminated sites and cleanup status must be made publicly accessible.

Institutional Mechanism

1. The rules empower CPCB as the nodal agency for oversight, supported by SPCBs and expert committees.
2. A national registry of contaminated sites will be maintained, and technical guidelines will be issued for remediation technologies, including bioremediation, soil washing, and containment.

What Are Contaminated Sites?

1. Contaminated sites are locations where soil, groundwater, or surface water has been polluted to levels that pose risks to human health or the environment.
2. India has over 250 such sites identified by the Central Pollution Control Board (CPCB), many of which remain untreated due to lack of legal clarity and funding mechanisms.

Why These Rules Matter

1. The 2025 rules bring India in line with global best practices, such as the US Superfund program and the EU's Soil Framework Directive.
2. India's industrial legacy includes thousands of sites contaminated with heavy metals, pesticides, hydrocarbons, and other toxins. These sites:
3. Threaten drinking water sources;
4. Harm agricultural productivity;
5. Pose long-term health risks to nearby communities;

Challenges Ahead

1. Funding mechanisms for remediation, especially where polluters are defunct
2. Capacity building at state and district levels
3. Robust monitoring and enforcement

15. Breaching of Planetary Boundaries

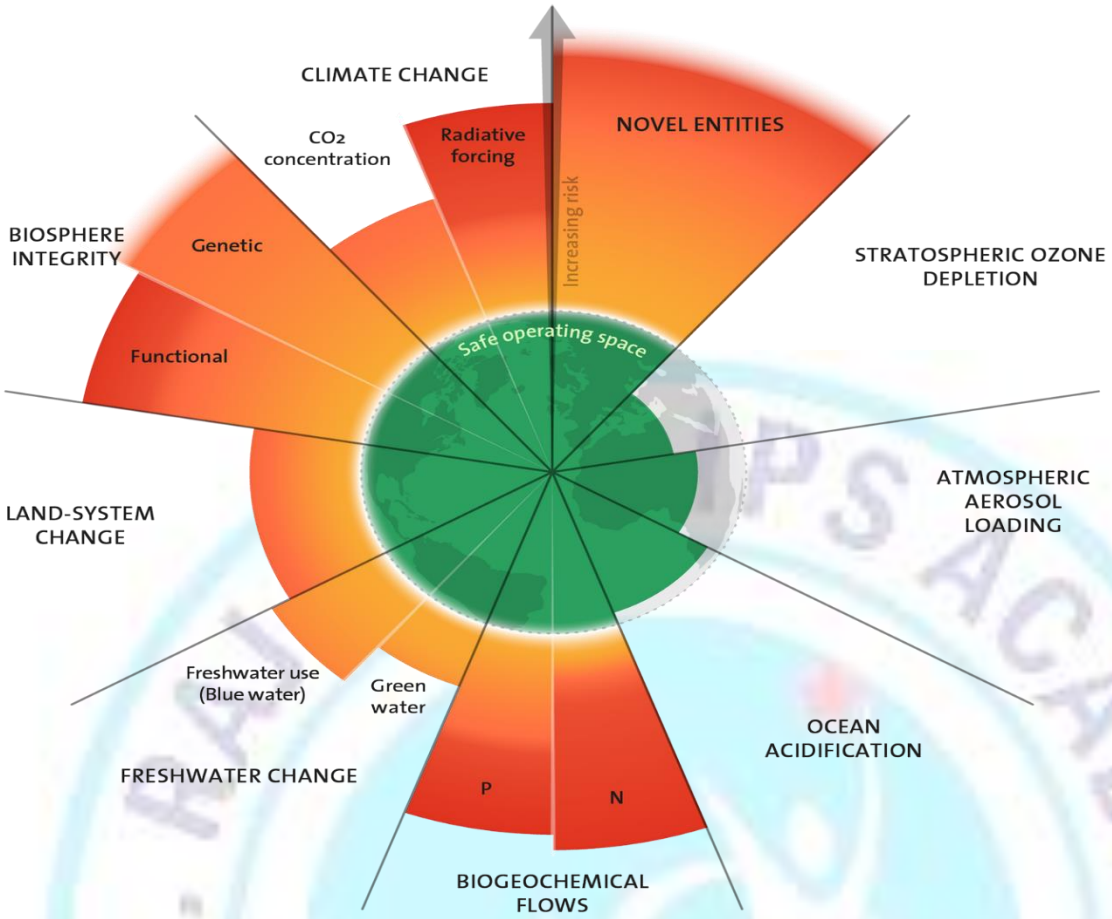
Context

According to a landmark study published in Science Advances, humanity has crossed six of the nine planetary boundaries that define Earth's safe operating space.

What Are Planetary Boundaries?

The planetary boundaries framework is a scientific concept that defines a "safe operating space for humanity" by identifying nine critical Earth system processes that are essential for maintaining the stable environmental conditions of the last 12,000 years, a period known as the Holocene epoch. First introduced in 2009 by a group of scientists led by Johan Rockström, this framework provides measurable

limits or "boundaries" for human activities. Staying within these boundaries is crucial to prevent the risk of triggering abrupt, irreversible, and potentially catastrophic environmental changes.
The nine interconnected planetary boundaries are:
Climate Change: Focuses on the concentration of greenhouse gases (like CO_2) in the atmosphere to prevent dangerous shifts in the global climate system.
Biosphere Integrity: Pertains to maintaining the diversity and resilience of ecosystems. It has two components: genetic diversity (extinction rates) and functional integrity (the energy flow within ecosystems).
Land-System Change: Measures the conversion of natural landscapes like forests, wetlands, and grasslands into agricultural land or urban areas, which affects climate, biodiversity, and water cycles.
Freshwater Change: Assesses the disruption of the global water cycle, including both "blue water" (rivers, lakes, groundwater) and "green water" (water available to plants in the soil).
Biogeochemical Flows: Concerns the massive alteration of the global nitrogen and phosphorus cycles, primarily due to the extensive use of fertilizers in agriculture, leading to widespread pollution.
Ocean Acidification: Tracks the decreasing pH of ocean surface waters, caused by the absorption of excess atmospheric CO_2, which threatens marine life, especially organisms with shells and skeletons like corals and shellfish.
Atmospheric Aerosol Loading: Pertains to the concentration of tiny particles (aerosols) in the atmosphere from pollution, which can affect climate patterns (like monsoons) and human health.
Stratospheric Ozone Depletion: Monitors the thinning of the Earth's ozone layer, which protects the planet from harmful ultraviolet (UV) radiation. This is a success story, as global action has started to reverse the damage.
Novel Entities: A broad category for new substances created and introduced into the environment by humans, such as microplastics, industrial chemicals, endocrine disruptors, and radioactive waste, which have the potential for widespread and irreversible effects.



What Does Breaching a Boundary Mean?

Breaching a planetary boundary does not signify an immediate, apocalyptic event. Instead, it means that humanity has pushed a critical Earth system beyond its safe operating space, entering a zone of high uncertainty and risk. It significantly increases the likelihood of triggering non-linear tipping points—thresholds beyond which a small change can cause a large, rapid, and often irreversible shift in the environment.

The framework is based on the remarkably stable climate of the Holocene, the period during which agriculture, cities, and complex human civilizations developed. By using computer models and historical data, scientists have estimated the natural state of these systems during the Holocene and defined boundaries to preserve that stability.

Already Breached Planetary Boundaries

As of recent assessments, humanity has already transgressed the safe limits for six of the nine boundaries:

Climate Change: The safe boundary is considered to be an atmospheric CO_2 concentration of 350 parts per million (ppm). The current level is around 420 ppm, pushing the planet toward dangerous temperature increases, extreme weather, and sea-level rise.

Biosphere Integrity: The natural rate of extinctions has been accelerated by human activity by 100 to 1,000 times. This dramatic loss of genetic diversity weakens ecosystems and their ability to provide essential services like pollination and water purification.

Land-System Change: The safe boundary requires retaining at least 75% of the world's original forest cover. Today, only about 60% remains, leading to biodiversity loss, carbon emissions, and disrupted weather patterns.

Freshwater Change: Human activities, including dam construction, large-scale irrigation, and pollution, have profoundly altered both blue and green water cycles, leading to water scarcity in some regions and increased flooding in others.

Biogeochemical Flows: The safe boundary for nitrogen and phosphorus has been massively overshot. Fertilizer runoff from farms pollutes rivers and coastal areas, creating vast "dead zones" where aquatic life cannot survive.

Novel Entities: The production and release of plastics, pesticides, and countless industrial chemicals have overwhelmed the planet's capacity to absorb them. These pollutants are accumulating in ecosystems, wildlife, and human bodies with unknown long-term consequences.

Global Implications

Crossing these boundaries has severe and interconnected consequences for both the planet and humanity. These include:

Ecosystem Collapse: Pushing systems like the Amazon rainforest or coral reefs past their tipping points could lead to their rapid collapse, causing a massive loss of biodiversity.

Intensified Climate Extremes: A destabilized climate system will result in more frequent and severe heatwaves, droughts, floods, and storms.

Food and Water Insecurity: Disruptions to water cycles and the collapse of pollinator populations threaten global agriculture and access to clean drinking water.

Increased Health Risks: Pollution from novel entities and the spread of pathogens from disrupted ecosystems pose direct threats to human health.

India's Role and Responsibility

As the world's most populous country, a major economy, and a region of immense biodiversity, India has a crucial role to play. The nation's rapid development contributes to planetary stress through emissions, land use, and pollution, but it is also highly vulnerable to the impacts of these changes. Experts urge India to take a leading role by:

Strengthening Environmental Regulations: Enforcing stricter laws on pollution, deforestation, and waste management.

Restoring Degraded Ecosystems: Investing in large-scale projects to reforest land, clean rivers, and protect wetlands.

Transforming Agriculture: Promoting sustainable farming practices that reduce reliance on chemical fertilizers and pesticides.

Investing in a Green Future: Accelerating the transition to clean energy sources like solar and wind and promoting a circular economy model that minimizes waste and maximizes resource efficiency.

16. Parijat Tree (Sacred Baobab)

Context

Recently, the National Green Tribunal (NGT) directed the Union Environment Ministry, the Botanical Survey of India, and state authorities to respond to concerns about the extinction risks faced by Parijat Trees (Sacred Baobab) in Uttar Pradesh due to weather vagaries and excessive harvesting.

About the Parijat Tree (Sacred Baobab)

1. The Parijat tree — botanically known as Adansonia digitata and commonly referred to as the sacred baobab — is one of India's most enigmatic and ecologically significant trees.
2. It is native to Africa, and often associated with legends from the Mahabharata and is considered a celestial tree that descended from heaven.
3. It is found in isolated pockets of Uttar Pradesh, particularly in Kintoor (Barabanki), Jhusi (Prayagraj), and Sultanpur, these trees are believed to be over 800 years old and are steeped in myth, medicine, and environmental importance.
4. According to the Botanical Survey of India, the tree's high internal water content — up to 79% — helps it remain structurally stable even in arid conditions.
5. However, recent studies show alarming drops in moisture levels: 45.2% in Jhusi and just 39.7% in Kintoor, making the trees vulnerable to collapse.

Medicinal and Cultural Significance

Leaves and pulp: Used in juices and food supplements;
Bark and roots: Known for anti-inflammatory, antidiabetic, and antioxidant properties;
Fruit: Rich in vitamin C, calcium, and Fiber; used in traditional remedies;
Wood and shell: Crafted into utensils and ceremonial items;
The tree is a **carbon sink,** helping mitigate climate change by absorbing atmospheric CO_2.

17. Crop Area Affected Due to Monsoon Rains

Context

1. Recently, the Union Minister of Agriculture and Farmers Welfare revealed that over 158,000 hectares of cropped area have been affected due to hailstorm, heavy rain or flood during the 2025 southwest monsoon season in India.
2. The damage spans multiple crop types, including Paddy, Wheat, Barley, Mustard, Jowar, Bajra, Maize, Onion, and Horticultural crops.

Impact on Kharif Season

1. The timing of the rainfall has been especially damaging to the Kharif season.
2. Paddy, which is typically sown between mid-June and mid-July, has seen delayed transplanting due to waterlogged fields.
3. Farmers in several districts have reported losses in maize and cotton, with fears of pest outbreaks compounding the crisis.

Government Response

1. State governments are conducting crop damage assessments;
2. Relief measures under the Pradhan Mantri Fasal Bima Yojana (PMFBY) are being activated
3. Advisories from the Indian Meteorological Department (IMD) are being issued to guide farmers on drainage and re-sowing;

Climate Extremes and Policy Challenges

1. The frequency and intensity of monsoon anomalies — early onset, flash floods, and erratic rainfall— are increasing due to climate change.
2. This year's rainfall patterns have caught forecasters off guard, with sub-daily rainfall extremes becoming more common.
3. Agricultural scientists are calling for:
4. Improved early warning systems;
5. Flexible sowing calendars;
6. Climate-resilient crop varieties;
7. Expanded insurance coverage for smallholder farmers;