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1. Building India's climate resilience with water at the core (TH)

General Studies Paper- GS III (Environment & Disaster Management)

Topic- Conservation, environmental pollution and degradation, environmental impact assessment; Disaster and disaster management.

Sub-Topic- Climate Change Adaptation, COP-30 Belém Indicators, Water Security (WASH), and India's Water Governance.

1. Introduction

COP-30, held in Belém, Brazil (November 2025), has been termed the "COP of Implementation." It marked a fundamental shift in global climate discourse by placing water at the centre of climate survival. Recognizing that climate change is primarily experienced through hydrological disruptions—floods, droughts, and erratic monsoons—the summit integrated Water, Sanitation, and Hygiene (WASH) into global climate accountability frameworks. For India, this provides a structured roadmap to align its vast water missions with international adaptation indicators.

2. Climate Change- A Crisis Experienced Through Water

Water systems act as the primary medium through which climate variability impacts human civilization—

Extreme Weather- Flooding paralyzes urban centres, while prolonged droughts destabilize rural agrarian economies.

Cryosphere Risks- Rapid melting of Himalayan glaciers threatens the perennial nature and stability of major North Indian river systems.

Coastal Vulnerability- Rising sea levels lead to saline intrusion, contaminating freshwater aquifers used for drinking and irrigation.

Agricultural Feedback- Agriculture accounts for 40% of human-induced methane emissions (rice, livestock). Consequently, water-use efficiency and wastewater recycling have become dual-purpose mitigation and adaptation strategies.

3. The Belém Adaptation Indicators (UAE Framework)

The summit introduced 59 Belém Adaptation Indicators to monitor global progress under a structured system—

WASH Integration- For the first time, universal access to safe drinking water and resilient sanitation infrastructure are treated as core climate indicators.

Disaster Risk Governance- Early Warning Systems- Global mandate to implement multi-hazard warning systems by 2027.

Vulnerability Assessments- A requirement for updated national-level vulnerability mapping by 2030.

System Resilience- Moving beyond "building infrastructure" to ensuring that systems (pumps, pipes, and treatment plants) remain functional during climate shocks.

4. India's Foundations in Water Governance

India has already established institutional frameworks that align with the Belém goals—

Institutional Integration- The creation of the Ministry of Jal Shakti (2019) unified fragmented water management under one roof.



Water Vision 2047- A long-term roadmap focusing on sustainability, equity, and resilience.

Scientific Mapping- NAQUIM 2.0 (National Aquifer Mapping) provides hydrogeological data for local-level groundwater management.

River Rejuvenation- The National Mission for Clean Ganga (NMCG) has evolved to integrate biodiversity and digital monitoring, acting as a buffer against climate variability.

5. Key Challenges for India in 2026

Despite a strong foundation, three systemic risks persist-

Water Stress Testing- Most climate disasters in India are water-related. Existing systems need "stress testing" to ensure service delivery during extreme floods or droughts.

The Finance Gap- While global discussions target \$1.3 trillion annually by 2035, adaptation finance remains uncertain. Water projects must be rebranded as "Climate Investments" to attract global green capital.

Digital Fragmentation- India possesses vast hydrological data, but it is siloed. There is a need for an integrated AI-driven dashboard linking weather data, crop advisories, and financial flows.

6. The Path Forward- Operationalising Adaptation

Policy Convergence- Unifying diverse programs (Jal Jeevan Mission, Atal Bhujal Yojana, PMKSY) under a single climate-stress indicator framework.

Digital Public Infrastructure (DPI)- Leveraging India's DPI to provide real-time, AI-based decision support for water governance.

Global South Leadership- By operationalizing the Belém indicators, India can serve as a laboratory for climate adaptation strategies for other developing nations.

7. Conclusion

The shift at COP-30 from promises to measurable outcomes ensures that climate adaptation is no longer an abstract concept but a measurable system of survival. Resilience must be measured not by the volume of infrastructure created, but by the uninterrupted service of water and sanitation systems during the inevitable climate shocks of the future. By aligning its internal reforms with the Belém Indicators, India can secure its water future and lead the Global South in climate-resilient development.

Source- <https://www.thehindu.com/opinion/op-ed/building-indias-climate-resilience-with-water-at-the-core/article70747277.ece>

Question

"COP-30 at Belém signalled a transition from 'Climate Promises' to 'System-based Adaptation,' with water as its core pillar. Elucidate the significance of the Belém Adaptation Indicators for India and discuss the challenges in converging India's existing water missions with these global accountability frameworks." (250 Words, 15 Marks)

1. Introduction

COP-30 in Belém (2025) institutionalized the "UAE Framework for Global Climate Resilience," placing water at the heart of climate adaptation. By integrating 59 specific indicators, it demands that countries move beyond symbolic resilience to measurable, functional systems that survive climate stress.

2. Significance of Belém Indicators for India

Framework for Accountability- The indicators provide India with a global benchmark to measure the success of the Jal Jeevan Mission and Swachh Bharat Mission through a "climate lens."

Disaster Preparedness- The mandate for multi-hazard early warning systems by 2027 aligns with India's need to protect its vulnerable coastal and Himalayan populations.

WASH as Adaptation- It legitimizes India's focus on sanitation and hygiene as critical components of climate survival, not just public health.

3. Challenges in Convergence

Institutional Silos- While the Ministry of Jal Shakti exists, convergence with the Ministry of Agriculture and MoEFCC (Environment) for integrated "Water-Food-Climate" action is still in its nascent stages.

Data Harmonization- India's vast hydrological data (from CWC, CGWB, and IMD) is often digitally fragmented, making real-time "climate stress testing" difficult.

Funding and Finance- Shifting from "Routine Sectoral Spending" to "Climate Adaptation Finance" requires a new fiscal vocabulary to tap into international green funds and fulfill the New Collective Quantified Goal (NCQG).

4. Conclusion

The Belém Indicators act as a "global dashboard for survival." For India, the transition from infrastructure building to system-based resilience is the next frontier. Success will depend on the digital integration of hydrological data and the mobilization of adaptation finance, ensuring that India's growth remains "water-secure" in a warming world.

Source- <https://www.thehindu.com/opinion/op-ed/building-indias-climate-resilience-with-water-at-the-core/article70747277.ece>

2. Renewable Energy Transition and Grid stability challenges (IE)

General Studies Paper- GS III (Economic Development & Environment)

Topic- Infrastructure- Energy, Ports, Roads, Airports, Railways etc.; Conservation, environmental pollution and degradation.

Sub-Topic- Renewable Energy Transition, Grid Stability, Decarbonization, and Thermal Power Inflexibility.

1. Introduction

In 2025–26, India's energy landscape reached a significant milestone where renewable energy (RE) capacity accounted for over 51% of total installed power. However, this rapid expansion has hit a technological bottleneck- Renewable Energy Curtailment. Despite adding record solar and wind capacity, India is losing terawatts of clean power because the country's coal-fired thermal plants lack the operational flexibility to scale down when the sun is shining or the wind is blowing. This imbalance creates fiscal stress for developers and hinders India's path toward its 2030 climate goals.

2. Background & Key Definitions

To understand the crisis, it is essential to define the core technical concepts governing the Indian power sector-

Renewable Energy Curtailment- The deliberate reduction in output from renewable sources (solar/wind) below what could have been produced. This happens when the grid cannot absorb the power or when supply exceeds demand.

Minimum Technical Load (MTL)- The lowest power level at which a thermal unit can operate safely and stably without being shut down entirely.

Grid Frequency- The "heartbeat" of the power system. In India, it must be maintained within a tight band of 49.90–50.05 Hz. If supply exceeds demand, the frequency rises, risking equipment damage and grid collapse.

Ramping- The ability of a power plant to increase (ramp-up) or decrease (ramp-down) its electricity output over a specific period.

3. India's Renewable Energy Expansion (2025–26)

Capacity Milestone- India added over 44 GW of RE in 2025 alone, bringing the total installed RE capacity to 262 GW.

500 GW Target- The current growth is a stride toward the "Panchamrit" target of achieving 500 GW of non-fossil fuel capacity by 2030.

Solar Dominance– Solar energy remains the primary driver due to falling photovoltaic (PV) costs and the success of the National Solar Mission and massive solar parks.

4. The Problem– Operational Inflexibility of Coal Plants

Coal-fired plants currently form the "baseload" of India's grid, but their rigid design conflicts with variable renewables.

The 55% Barrier– Most Indian coal plants cannot operate below 55% of their capacity (MTL). Even when solar power is at its peak during the day, these plants continue to generate high volumes of electricity.

Technical Risks– Operating below the MTL causes boiler instability, turbine stress, and increased wear and tear, making operators reluctant to flex.

Economic Inefficiency– Ramping plants up and down frequently (cycling) reduces fuel efficiency and increases maintenance costs for thermal developers.

5. Consequences of Grid Inflexibility

Feature	Impact of Inflexibility / Curtailment
Energy Loss	2.3 TWh of solar power lost in late 2025—enough to power 14 lakh households.
Financial Cost	₹575–690 crore paid in compensation to RE developers due to "Must-Run" status violations.
Grid Stability	In May 2025, frequency stayed above safe limits 20% of the time, increasing the risk of blackouts.
Climate Goal	Curtailment slows down actual decarbonization as coal continues to burn while clean energy is wasted.

6. Policy Efforts & Technological Solutions

The government and the Central Electricity Authority (CEA) are moving to modernize grid management–

Reducing MTL– There is a strong policy push to lower the Minimum Technical Load from 55% to 40% through technical retrofitting.

Incentive Schemes– The CEA has proposed financial incentives for thermal plants that demonstrate high flexibility and rapid ramping capabilities.

Energy Storage Systems (ESS)–

1. Battery Storage– Capturing mid-day solar peaks for use during evening demand surges.
2. Pumped Hydro Projects (PHP)– Using surplus RE to pump water uphill, acting as a "giant battery" for the grid.

Unified National Grid– Leveraging India's "One Nation, One Grid, One Frequency" to move surplus power from RE-rich states to power-deficit regions instantly.

7. Conclusion

The success of India's green energy transition no longer depends solely on adding more solar panels or wind turbines; it depends on Grid Intelligence. Integrating 262 GW of renewables requires a "flexible" fossil-fuel backbone that acts as a support rather than a barrier. By lowering thermal MTL, investing in storage, and digitizing grid monitoring, India can ensure that every unit of clean energy produced reaches the consumer, securing both the environment and the economy.

Question

"While India has achieved a milestone of over 50% installed capacity from non-fossil fuel sources, the phenomenon of 'Renewable Energy Curtailment' poses a significant threat to the financial and environmental viability of the energy transition. Analyse the factors contributing to this curtailment and suggest measures to enhance grid flexibility." (250 Words, 15 Marks)

1. Introduction

By early 2026, India's renewable energy (RE) capacity reached 262 GW, accounting for more than 51% of total installed capacity. However, the lack of operational flexibility in the coal-based thermal fleet—which provides the essential baseload—has led to the curtailment of approximately 2.3 TWh of

solar power in late 2025. This waste of clean energy highlights a growing mismatch between capacity addition and grid modernization.

2. Factors Contributing to RE Curtailment

Thermal Inflexibility (Minimum Technical Load)– Most coal plants in India are designed to run at a steady state and cannot safely operate below 55% of their capacity. During peak solar hours, these plants cannot "ramp down" sufficiently to accommodate surging RE.

Grid Frequency Management– To maintain stability, the grid frequency must stay within 49.90–50.05 Hz. When RE supply exceeds demand and thermal plants remain rigid, frequency rises, forcing grid operators to curtail RE to prevent system failure.

Technological and Maintenance Barriers– Frequent ramping (cycling) of coal units causes boiler instability and increases wear and tear, making thermal operators reluctant to adjust output.

Must-Run Status Violations– Despite RE having "must-run" status, grid security concerns often take precedence, leading to curtailment and subsequent financial compensation burdens of over ₹600 crore on the exchequer.

3. Measures to Enhance Grid Flexibility

Lowering Minimum Technical Load (MTL)– Retrofitting coal plants to operate at 40% MTL (down from 55%) would create more "room" for variable RE during peak generation.

Deployment of Energy Storage– Pumped Hydro Projects (PHP)– Utilizing surplus RE to pump water, which can then generate power during evening peaks.

1. **Battery Energy Storage Systems (BESS)**– Providing rapid-response frequency regulation and peak-shaving capabilities.

Market-Based Economic Dispatch (MBED)– Moving toward a unified national scheduling system to allow RE to flow from surplus to deficit regions across state boundaries seamlessly.

Incentivizing Flexibility– The Central Electricity Authority (CEA) should implement a tariff structure that rewards thermal plants for "ramping services" rather than just energy volume.

4. Conclusion

The success of India's 2030 target of 500 GW non-fossil capacity depends on transitioning from a rigid grid to an "intelligent" grid. Integrating renewables requires not just more panels and turbines, but a flexible fossil-fuel backbone and robust storage infrastructure. Solving the curtailment crisis is essential to ensure that India's green growth is both technologically stable and economically sustainable.

3. Are We Facing an AI Nightmare? Scenario Planning Should Begin (MT)

General Studies Paper– General Studies Paper III – Science and Technology

Topic– Developments and applications of Artificial Intelligence

Sub-Topic– Science and technology policy and governance

Introduction

Artificial Intelligence (AI) is rapidly transforming economies by enhancing productivity and automating tasks across sectors. While AI offers significant opportunities for innovation and growth, it also raises concerns about job displacement, inequality, and economic disruption. This has made scenario planning and policy preparedness essential to manage potential risks.

1. AI as a Disruptive Economic Force

1. AI can automate both routine and cognitive tasks, unlike previous technological revolutions.
2. It increases efficiency and productivity but may reduce demand for certain types of labour.
3. Sectors such as finance, manufacturing, services, and administration are particularly affected.

2. Nature of Employment Disruption

Job Displacement

1. Many existing jobs, especially repetitive or rule-based roles, may be replaced by AI systems.



Job Transformation

1. AI will also create new roles requiring advanced digital and analytical skills.

Skill Polarisation

1. Demand may increase for high-skilled jobs, while low- and mid-skilled jobs decline, widening inequality.

3. Economic and Social Implications

Inequality

1. Unequal access to technology and skills can increase income and opportunity gaps.

Labour Market Uncertainty

1. Rapid technological change creates instability in employment patterns.

Geopolitical Competition

1. Countries leading in AI may gain economic and strategic advantages, influencing global power structures.

4. Need for Scenario Planning

1. Governments must anticipate multiple scenarios, including high job displacement or balanced job creation outcomes.
2. Scenario planning helps design adaptive policies for labour markets, education, and social protection.
3. It ensures preparedness for uncertain technological and economic futures.

5. Policy Measures for Managing AI Impact

Skill Development and Reskilling

1. Invest in digital literacy, AI-related skills, and lifelong learning systems.

Strengthening Social Safety Nets

1. Expand social security, unemployment support, and income protection mechanisms.

Encouraging Innovation

1. Promote AI research, startups, and industry-academia collaboration.

Regulation and Ethical Governance

1. Develop frameworks for responsible AI use, data protection, and accountability.

6. Balanced Approach to AI Adoption

1. AI should be viewed as a tool for augmenting human capabilities rather than replacing them entirely.
2. Policies must ensure that technological progress leads to inclusive and sustainable development.

Conclusion

AI presents both opportunities and risks for economies and societies. Effective scenario planning, skill development, and regulatory frameworks are essential to harness its benefits while mitigating potential disruptions, ensuring that AI contributes to inclusive growth and long-term economic stability.

Source- <https://www.livemint.com/opinion/online-views/raghuram-rajan-ai-job-scarcity-policy-makers-scenario-planning-artificial-intelligence-employment/amp-11773298566007.html>

UPSC Mains Practice Question

Q. Artificial Intelligence has the potential to transform labour markets and economic structures.

Discuss the challenges posed by AI-driven automation and suggest policy measures to manage its impact. (250 words)

Model Answer

Introduction

Artificial Intelligence (AI) is emerging as a transformative technology that is reshaping industries and labour markets. While it enhances productivity and innovation, it also raises concerns about job displacement and economic inequality, making policy intervention essential.

Challenges of AI-Driven Automation

1. Job Displacement

1. Automation of routine and cognitive tasks can reduce employment opportunities in certain sectors.

2. Skill Gaps

1. Rapid technological change creates a mismatch between existing skills and new job requirements.

3. Rising Inequality

1. High-skilled workers benefit more, increasing income disparities.

Policy Measures

1. Skill Development

1. Promote reskilling and digital education programs.

2. Social Protection

1. Strengthen safety nets and income support systems.

3. Innovation Ecosystem

1. Encourage AI research and entrepreneurship.

Conclusion

Managing the impact of AI requires a balanced approach that combines technological advancement with social protection and skill development. This will ensure that AI contributes to inclusive and sustainable economic growth.

Source- <https://www.livemint.com/opinion/online-views/raghuram-raj-an-ai-job-scarcity-policy-makers-scenario-planning-artificial-intelligence-employment/amp-11773298566007.html>

4. India And Israel (TS)

General Studies Paper- General Studies Paper II – International Relations

Topic- India and its bilateral relations

Sub-Topic- India's foreign policy and strategic autonomy

Introduction

India-Israel relations have evolved significantly since the establishment of full diplomatic ties in 1992. Over the years, cooperation between the two countries has expanded across defence, agriculture, technology, and trade. At the same time, India has attempted to maintain strategic autonomy and balanced diplomacy in West Asia, given its broader regional interests.

1. Evolution of India-Israel Relations

1. India historically maintained a cautious approach towards Israel due to Cold War politics and support for the Palestinian cause.
2. Full diplomatic relations were established in 1992, marking the beginning of stronger bilateral engagement.
3. High-level visits and diplomatic interactions have deepened strategic cooperation between the two countries.

2. Key Areas of Cooperation

Defence and Security Cooperation

1. Israel is among India's major defence suppliers, providing advanced military technology and equipment.
2. Collaboration includes surveillance systems, missiles, and defence electronics.

Agriculture and Water Management

1. Israel has supported India through agricultural technology, irrigation techniques, and water management practices.

Science and Technology

1. Partnerships exist in areas such as innovation, cybersecurity, artificial intelligence, and research collaboration.

Trade and Investment

1. Bilateral trade has grown steadily, including cooperation in high-technology sectors and industrial development.

3. Strategic Context in West Asia

1. India must balance relations with Israel, Iran, and Arab Gulf countries simultaneously.
2. The region is crucial for India due to energy security, trade routes, and the presence of a large Indian diaspora.
3. Therefore, India follows a pragmatic and balanced diplomatic approach.

4. Challenges in the Relationship

1. Regional conflicts involving Israel and Palestine create diplomatic sensitivities.
2. India must maintain its traditional support for Palestinian statehood while expanding cooperation with Israel.
3. Domestic political debates sometimes influence perceptions of India's foreign policy choices.

5. Significance for India's Foreign Policy

1. India's engagement with Israel demonstrates its multi-alignment strategy.
2. The relationship strengthens defence capabilities, technological innovation, and agricultural productivity.
3. Balanced diplomacy allows India to pursue national interests without compromising regional partnerships.

Conclusion

India-Israel relations represent an important pillar of India's foreign policy, particularly in defence and technological cooperation. By maintaining strategic autonomy and balancing ties with other West Asian partners, India can continue to deepen this partnership while safeguarding its broader regional and global interests.

Source- <https://www.thestatesman.com/opinion/india-and-israel-1503570276.html>

UPSC Mains Practice Question

Q. India-Israel relations have expanded significantly in recent decades while India continues to maintain balanced relations with other West Asian countries. Discuss the significance and challenges of this relationship in the context of India's strategic autonomy. (250 words)

Model Answer

Introduction

India and Israel established full diplomatic relations in 1992, and since then their partnership has expanded across defence, agriculture, science, and technology. While strengthening ties with Israel,

India has simultaneously maintained relations with other West Asian countries, reflecting its commitment to strategic autonomy in foreign policy.

Significance of India–Israel Relations

1. Defence and Security Cooperation

1. Israel is a major supplier of advanced defence technology and military equipment to India.

2. Agricultural and Technological Collaboration

1. Cooperation in irrigation, water management, and agricultural innovation has improved productivity.

3. Innovation and Research

1. Partnerships in cybersecurity, artificial intelligence, and scientific research strengthen India's technological capabilities.

Challenges

1. Regional Political Sensitivities

1. Conflicts in West Asia require India to balance relations with Israel, Palestine, and Arab countries.

2. Domestic Political Debates

1. Public discourse sometimes frames the relationship in ideological or political terms, affecting perceptions.

Conclusion

India–Israel relations highlight India's pragmatic foreign policy approach that prioritises national interests while maintaining balanced regional engagement. Strengthening cooperation with Israel while sustaining ties with other West Asian partners reflects India's commitment to strategic autonomy and multi-alignment.

Source- <https://www.thestatesman.com/opinion/india-and-israel-1503570276.html>