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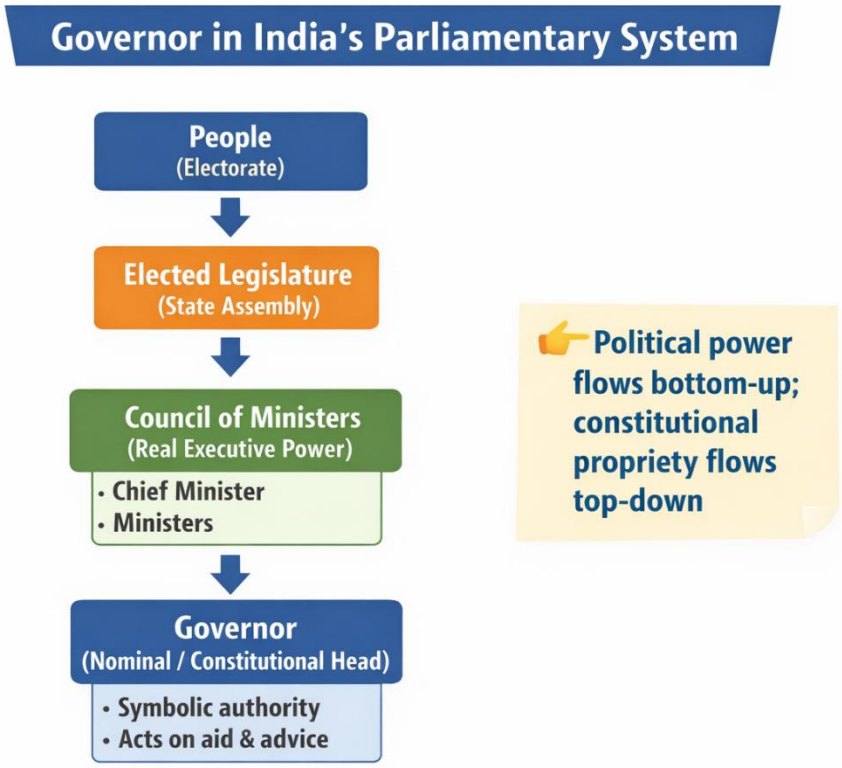
1. Governor's Address to the State Legislature: Constitutional Scheme and Emerging Issues

a. Governor in the Constitutional Framework

India follows a parliamentary system of government at both the Union and State levels. Under this system, real executive power vests in the Council of Ministers, headed by the Prime Minister at the Union level and the Chief Minister at the State level. The President and the Governor function as constitutional or nominal heads, symbolising the authority of the State rather than exercising political power.

This arrangement reflects a foundational principle of parliamentary democracy:
political authority flows from the elected legislature, while constitutional heads ensure continuity, legality, and constitutional propriety.

Accordingly, the Governor is expected to act strictly within constitutional limits and almost invariably on the aid and advice of the Council of Ministers. The Governor's Address to the State Legislature must therefore be understood within this broader constitutional framework of limited discretion and democratic accountability.



b. Nature and Purpose of the Governor's Address

The Governor's Address is a formal constitutional communication through which the policies, priorities, and legislative agenda of the elected State government are placed before the legislature.

Its purpose is threefold:

Informative Function

- It apprises legislators of the government's proposed policies and programmes for the coming year or term.

Deliberative Function

- It provides a structured basis for debate through the Motion of Thanks, allowing members to scrutinise, criticise, or endorse government commitments.

Accountability Function

- It reinforces the principle of executive responsibility to the legislature, which lies at the heart of parliamentary governance.

Crucially, the address does not reflect the personal views of the Governor. In constitutional substance, it is the statement of the elected government, delivered through the Governor as a constitutional formality.

c. Constitutional Provisions Governing the Address

The Constitution deals with the Governor's Address primarily under Articles 175 and 176, each serving a distinct purpose.

i. Article 175: Discretionary Address

Article 175 empowers the Governor to address:

- The Legislative Assembly, or
- Both Houses in States with bicameral legislatures

Such an address may be delivered at any time.

However, this provision:

- Is discretionary, not mandatory
- Is rarely invoked in practice
- Does not relate to the annual or post-election policy statement

Therefore, Article 175 must not be confused with the mandatory constitutional address under Article 176.

ii. Article 176: Mandatory Address

Article 176 occupies a central position in the constitutional scheme. It mandates that the Governor shall address the State Legislature:

- At the commencement of the first session after a general election to the Legislative Assembly
- At the commencement of the first session of every calendar year

The use of the word "shall" makes this obligation constitutionally binding.

The address under Article 176:

- Is prepared and approved by the Council of Ministers
- Is formally delivered by the Governor
- Is followed by a Motion of Thanks, which opens the government's policies to legislative debate

This process converts the Address into a vital instrument of democratic accountability and legislative oversight.

d. Constitutional Convention Governing the Address

Over decades of parliamentary practice, a clear convention has evolved regarding the Governor's Address.

Under this convention:

Nature of the Role

- The Governor reads the address exactly as approved by the Council of Ministers

Limits on Intervention

- The Governor does not add, omit, or modify any portion
- Personal disagreement with policy is constitutionally irrelevant

Forum for Disagreement

- Policy disagreements are resolved within the legislature, not by the Governor

This convention safeguards:

- The political neutrality of the Governor
- Respect for the electoral mandate
- The smooth functioning of parliamentary democracy

e. Judicial Interpretation and Limits on the Governor

i. Shamsher Singh v. State of Punjab (1974)

The Supreme Court held that:

- The Governor is a constitutional head, not an alternative executive authority
- Executive powers must be exercised on the aid and advice of the Council of Ministers, except in narrowly defined situations
- Personal discretion is exceptional and cannot become the norm

This reasoning applies squarely to the Governor's role under Article 176.

ii. Nabam Rebia v. Deputy Speaker (2016)

The Court further clarified that:

- The Governor must not act in a manner that destabilises an elected government
- Constitutional powers must be exercised with restraint, neutrality, and constitutional morality

Any conduct that substitutes personal judgment for elected authority is constitutionally impermissible.

f. Emerging Deviations in Practice

In recent years, particularly in certain Opposition-ruled States, the following deviations have been observed:

- Failure to deliver the mandatory address
- Selective omission of cabinet-approved portions
- Refusal to read the approved text in full
- Substitution of the address with personal remarks or commentary

These actions represent departures from both constitutional text and settled conventions.

g. Constitutional Concerns Raised by Such Deviations

These practices are constitutionally problematic for multiple reasons:

Violation of Article 176

- The duty to address the legislature is mandatory, leaving no scope for refusal

Breach of Parliamentary Principle

- The Governor has no veto or policy-filtering role at this stage

Federal Implications

- Such conduct weakens federal balance
- It undermines executive accountability to the legislature
- It politicises a constitutionally neutral office

If normalised, these deviations risk converting the Governor into a political actor, contrary to constitutional design.

h. Governor's Oath and Constitutional Morality

Under Article 159, the Governor swears to preserve, protect, and defend the Constitution and the law.

Disregarding mandatory duties or settled conventions:

- Violates the spirit of the oath
- Erodes trust between constitutional institutions
- Breaches the principle of constitutional morality, which demands fidelity not only to the text but also to constitutional values

i. Observations of Reform Commissions

Sarkaria Commission (1988)

The Commission emphasised that the Governor must:

- Act strictly as a constitutional head
- Maintain political neutrality
- Respect constitutional conventions
- Promote cooperative federalism

Punchhi Commission (2010)

The Commission recommended:

- Consultation with the Chief Minister in Governor's appointment
- A restrained and non-confrontational role within the federal structure

These recommendations aim to restore trust and institutional harmony.

j. Way Forward

A sustainable resolution lies in constitutional discipline, not political confrontation. This requires:

- Strict adherence to Article 176
- Faithful implementation of Supreme Court judgments
- Revival and respect for constitutional conventions
- Serious consideration of reform commission recommendations

Such measures are essential for strengthening cooperative federalism and democratic institutions.

Conclusion

The Governor's Address is a constitutional instrument of democratic accountability, not a platform for individual discretion. Its legitimacy flows from the electoral mandate, and its effectiveness depends on neutrality, restraint, and constitutional fidelity.

Preserving the sanctity of this institution is indispensable for the health of India's federal and parliamentary democracy.

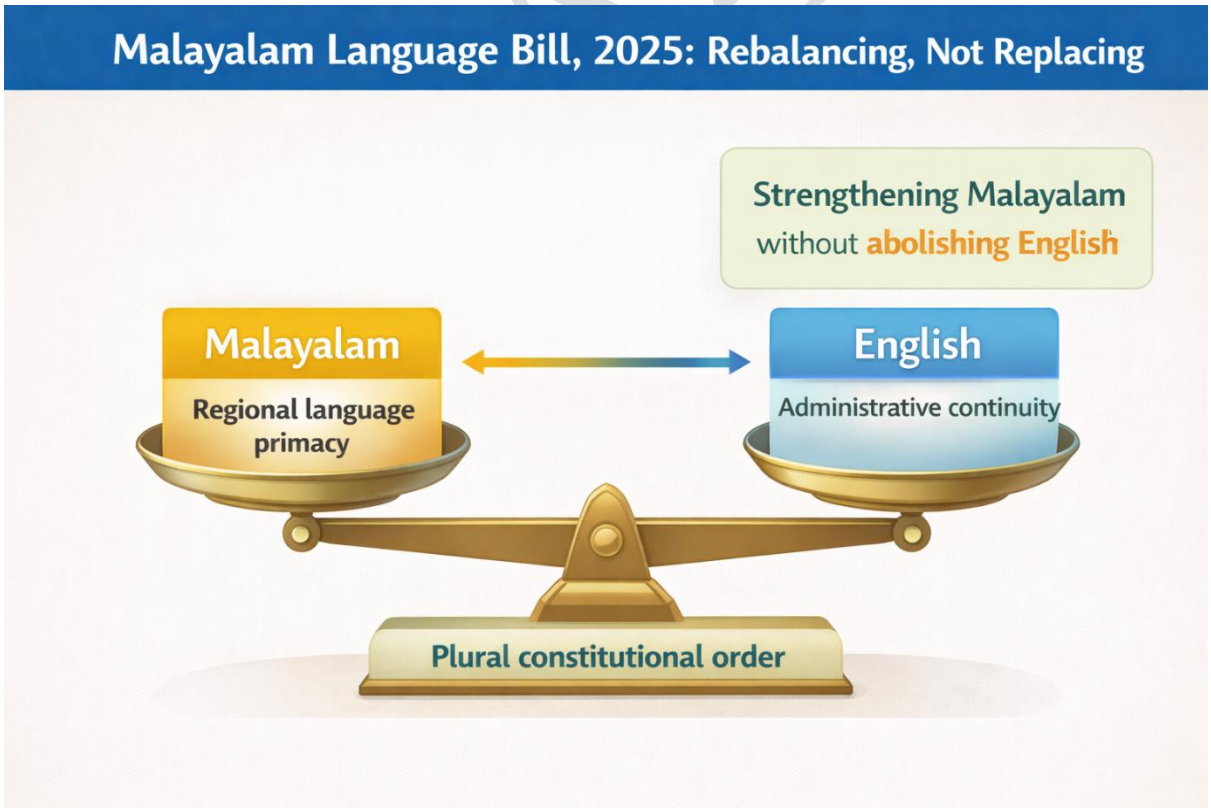
2. The Malayalam Language Bill, 2025

a. Understanding the Malayalam Language Bill, 2025

The Malayalam Language Bill, 2025 is a legislative initiative of the State of Kerala aimed at formally asserting Malayalam as the principal official language of the State. The Bill seeks to ensure the systematic and expanded use of Malayalam across governance, education, judiciary, public communication, commerce, and digital administration, while remaining within the constitutional framework of India.

Historically, Kerala has followed a dual official language arrangement, with both Malayalam and English used for official purposes. While Malayalam has remained dominant in social and cultural life, English has continued to play a significant role in administration, higher education, and legal processes. The present Bill does not abolish this duality outright. Instead, it seeks to recalibrate the linguistic balance by strengthening the primacy of Malayalam in governance, without eliminating English or infringing upon minority linguistic rights.

Thus, the Bill represents not a rejection of multilingualism, but an attempt to reinforce the regional language within a plural constitutional order.



b. Constitutional Basis of the Bill

The constitutional validity of the Malayalam Language Bill flows from the language-related provisions of the Indian Constitution, which recognise linguistic diversity as a core feature of Indian federalism.

i. Article 345: State Autonomy in Language Policy

Article 345 empowers a State Legislature to adopt any language in use within the State for official purposes. This provision forms the primary constitutional anchor of the Bill and affirms the autonomy of States to shape their linguistic governance structures.

ii. Articles 346 and 347: Federal Coordination and Minority Recognition

Articles 346 and 347 regulate:

- Communication between States and between the Union and States
- Recognition of languages spoken by substantial linguistic minorities

These provisions underline that State language autonomy must coexist with inter-State coordination and minority accommodation.

iii. Articles 29 and 30: Safeguards for Linguistic Minorities

Articles 29 and 30 protect the cultural and educational rights of linguistic minorities, ensuring that language policies do not translate into cultural exclusion or educational disadvantage.

Taken together, these provisions establish that while language policy lies within the State domain, it is constitutionally constrained by minority rights and federal balance.

c. Core Provisions of the Bill

i. Declaration of Official Language

The Bill formally declares Malayalam as the official language of the State of Kerala, giving statutory clarity to a practice long established in social and cultural terms but lacking comprehensive legal articulation.

ii. Domains of Application

The Bill envisages the use of Malayalam across multiple public domains, including:

- Government offices and public administration
- Educational institutions
- Judicial processes (in a phased manner)
- Public communication and State-linked commercial transactions
- Digital governance platforms

The emphasis is on gradual and structured expansion, rather than abrupt replacement of existing practices.

iii. Legislature and Judiciary

All Bills and Ordinances introduced in the State Legislature are to be drafted in Malayalam.
In the judicial sphere, the Bill provides for progressive translation of proceedings and judgments, recognising both the need for accessibility and the practical constraints of legal administration.

iv. Institutional Framework

To support implementation, the Bill proposes:

- Renaming the existing language department as the Malayalam Language Development Department
- Establishment of a Malayalam Language Development Directorate

These institutions are tasked with promoting Malayalam in information technology, open-source software, and digital governance, thereby aligning linguistic policy with technological modernisation.

d. Language Policy in Education

The educational provisions of the Bill adopt a calibrated and limited approach, avoiding universal imposition.

Malayalam is made a compulsory first language only in government and aided schools, and only up to Class 10. This mandate does not extend to unaided private schools or constitutionally protected minority institutions.

By restricting the scope of compulsion, the Bill attempts to balance linguistic promotion with educational plurality, competitive learning outcomes, and constitutional protections.

e. Protection of Linguistic Minorities

One of the most significant features of the Bill is its explicit protection of linguistic minorities, addressing a major shortcoming of earlier legislative attempts.

Non-Obstante Clause (Clause 7)

Clause 7 contains a non-obstante clause, ensuring that linguistic minorities — including Kannada, Tamil, Tulu, and Konkani speakers — retain the right to:

- Correspond with the State Secretariat
- Communicate with heads of departments
- Engage with local government offices in their mother tongue.

This safeguard is especially relevant in border districts, where such minorities are geographically concentrated.

The overriding nature of this clause ensures that minority rights prevail even in the event of conflict with other provisions of the law.

f. Historical Background: The 2015 Malayalam Language Bill

The 2025 Bill must be understood in continuity with an earlier legislative attempt in 2015.

The 2015 Bill sought to make Malayalam the sole official language of the State. It was reserved for the President's assent, which was ultimately withheld.

The primary objections included:

- Conflict with the Official Languages Act, 1963
- Inconsistency with the Right to Education Act, 2009
- Tension with the national three-language formula
- Inadequate safeguards for linguistic minorities

The 2025 Bill represents a corrective redrafting exercise, consciously designed to address these constitutional and legal deficiencies.

g. Karnataka's Objections to the Bill

The Government of Karnataka has raised objections, particularly concerning the Kannada-speaking population of Kasaragod district.

i. Educational Concerns

Kannada-speaking students in Kasaragod have traditionally studied Kannada as their first language. Karnataka fears that the strengthened promotion of Malayalam may indirectly discourage Kannada-medium education, accelerating the decline of Kannada schools already facing numerical reduction.

ii. Minority Rights Concerns

It is argued that the Bill may dilute the spirit of Articles 29 and 30 by creating indirect linguistic pressure on minority students, even if formal safeguards exist.

iii. Conflict with Central Frameworks

The Bill has also been alleged to conflict with central legislations and national language frameworks, particularly in education.

h. Assessing the Constitutionality of the Bill

From a constitutional perspective, the Bill presents both strengths and challenges.

i. Supporting Factors

- Clear grounding in Article 345
- Explicit minority safeguards through a non-obstante clause
- Correction of flaws present in the 2015 Bill
- Alignment with the principle of linguistic federalism

ii. Areas of Concern

- Sensitivity of implementation in border districts
- Risk of perceived linguistic imposition
- Potential for inter-State political friction

Ultimately, the constitutionality of the Bill will depend not merely on its text, but on the manner and spirit of implementation.

i. Way Forward

A sustainable path forward requires:

- Context-sensitive implementation, especially in minority-dominated border districts
- Area-specific exemptions where necessary
- Continuous monitoring of educational outcomes
- Sustained inter-State dialogue rooted in cooperative federalism

Equally essential is strict adherence to Articles 29 and 30, alongside alignment with broader governance goals such as inclusive institutions under Sustainable Development Goal 16.

Conclusion

The Malayalam Language Bill, 2025 exemplifies the exercise of State autonomy in language policy within the Indian constitutional framework. Its success will ultimately rest on achieving a careful balance between linguistic identity and minority protection, demonstrating how linguistic federalism can function through sensitivity, accommodation, and constitutional discipline.

3. Disturbed Areas Laws and Regulation of Property Transfers

a. Conceptual Overview

The regulation of property transfers in *disturbed areas* represents a complex intersection of public order, individual liberty, and constitutional governance. In recent years, certain Indian States have enacted or proposed laws empowering the executive to declare specific localities as disturbed and to regulate—sometimes prohibit—the transfer of immovable property within such areas.

Immovable property in this context includes land, residential houses, and buildings. Once an area is notified, private transactions such as sale, purchase, gift, or lease are subjected to prior State approval.

The stated rationale is rooted in experiences of communal violence, prolonged unrest, and forced migration, where residents may be compelled to sell property under fear, coercion, or economic distress. However, when the State enters the domain of private property transactions, serious constitutional, legal, and ethical questions arise.

b. Understanding the Concept of a "Disturbed Area"

A *disturbed area* refers to a locality that the State government considers sensitive or volatile due to a sustained breakdown of public order. Such disturbances may arise from communal riots, recurring mob violence, prolonged social unrest, or sudden population movements generating social tension.

Crucially, the term "disturbed area" has no mention or definition in the Constitution of India. There is also no uniform national framework governing its declaration. Its meaning, scope, and consequences depend entirely on the language of individual State laws and the discretion exercised by the executive.

This absence of constitutional or statutory uniformity lies at the heart of most legal and judicial challenges to such legislation.

c. Core Architecture of Disturbed Areas Property Laws

The defining feature of these laws is mandatory prior State permission for the transfer of immovable property located within a notified disturbed area.

Key operational features typically include:

Prior Approval Requirement

- Any sale, purchase, gift, exchange, or long-term lease requires written approval from a designated authority.
- Transactions undertaken without permission are declared legally invalid.

Penal and Regulatory Consequences

- Registration of such transfers may be cancelled.
- Parties may face fines or other statutory penalties.

Through this mechanism, a traditionally private civil transaction is transformed into a matter of public regulatory control, justified on grounds of public order.

d. Objectives Claimed by the State

The State advances multiple justifications to defend such regulatory intervention.

Prevention of Distress Sale
During periods of violence or fear, property owners—often minorities—may be compelled to sell assets at prices far below market value. Regulatory oversight is projected as a protective mechanism against such exploitation.

Protection of Tenants from Forced Eviction
Communal unrest frequently creates conditions where tenants are unlawfully evicted without due process. State supervision of transfers is argued to safeguard tenancy rights.

Maintenance of Public Order
The State contends that sudden or unregulated demographic changes in sensitive localities may intensify social tensions and trigger further violence. Controlled property transfers are thus framed as *preventive* rather than punitive measures.

e. Constitutional and Legal Framework

The Constitution provides both enabling authority and limiting safeguards for such laws.

Legislative Competence

- Under the Seventh Schedule, *public order* and *land* fall within the State List, granting States legislative competence.
- The right to property under Article 300A is no longer a fundamental right, allowing regulation through law.

Constitutional Constraints

- **Article 14** mandates equality before law and prohibits arbitrary State action.
- **Article 19(1)(e)** guarantees the right to reside and settle in any part of India.
- **Article 300A** requires that any deprivation or restriction of property must follow due process of law.

Thus, while regulation of property is constitutionally permissible, it must be reasonable, proportionate, non-discriminatory, and procedurally fair.

f. Major Constitutional Concerns

Despite legislative competence, several constitutional vulnerabilities persist.

Vagueness and Indeterminacy
Terms such as *demographic imbalance*, *improper clustering*, or *social disturbance* lack precise legal definition. Laws based on such vague standards are susceptible to challenge under Article 14 for arbitrariness.

Excessive Executive Discretion
The executive often retains unilateral authority to:

- Declare an area as disturbed,
- Determine the duration of notification, and
- Approve or reject individual property transactions.

The absence of objective criteria and procedural safeguards creates scope for selective or biased application.

Indirect Restriction on Freedom of Settlement
Although Article 19(1)(e) is not explicitly restricted, denial of property purchase effectively prevents individuals from settling in particular localities, producing a *substantive* rather than *formal* restriction.

Due Process under Article 300A
Blanket, indefinite, or poorly reasoned controls often fail the constitutional test of proportionality and procedural fairness required for lawful property regulation.

g. Social and Economic Implications

Beyond constitutional legality, such laws have significant societal consequences.

Economic Effects

- Property values in notified areas decline due to regulatory uncertainty.
- Investor confidence weakens, discouraging development and slowing urban growth.

Social Consequences

- These laws risk institutionalising residential segregation.
- When property transactions become identity-sensitive or administratively filtered, governance appears partial rather than neutral.

Over time, this fosters a trust deficit between citizens and the State, undermining the very social harmony the laws claim to protect.

h. Comparative and Judicial Perspective

The Gujarat Disturbed Areas Act is the oldest and most litigated example of such legislation.

Judicial Approach
Courts have consistently held that:

- Public order is a legitimate State objective, but
- Restrictions must be reasonable, proportionate, and based on objective criteria.

Comparative Global Practice
Globally, democratic states rarely regulate demographic patterns through property controls. Public order is generally addressed through policing, criminal law, rehabilitation, and reconciliation rather than restrictions on private property transactions.

i. Way Forward: Towards Constitutional Balance

A constitutionally sustainable approach requires restraint, precision, and accountability.

Legal Clarity

- Core terms must be clearly defined to eliminate ambiguity.

Procedural Safeguards

- Notifications should be time-bound and subject to periodic review.
- Executive discretion must be guided by objective criteria.

Institutional Remedies

- Independent appellate mechanisms should be provided against arbitrary denial of permission.

Governance-First Strategy

- Rather than demographic control, the State should prioritise effective policing, victim compensation, rehabilitation, and community reconciliation.

Conclusion

While the State may regulate property transfers to protect public order in disturbed areas, such powers must remain narrowly tailored, transparent, and time-bound. Without clear definitions, procedural safeguards, and accountability, these laws risk arbitrariness and social fragmentation. Ultimately, durable public order is better secured through effective governance, policing, and reconciliation rather than prolonged control over private property transactions.

4. Arbitration Council of India (ACI) and Contemporary Reforms in Indian Arbitration Law

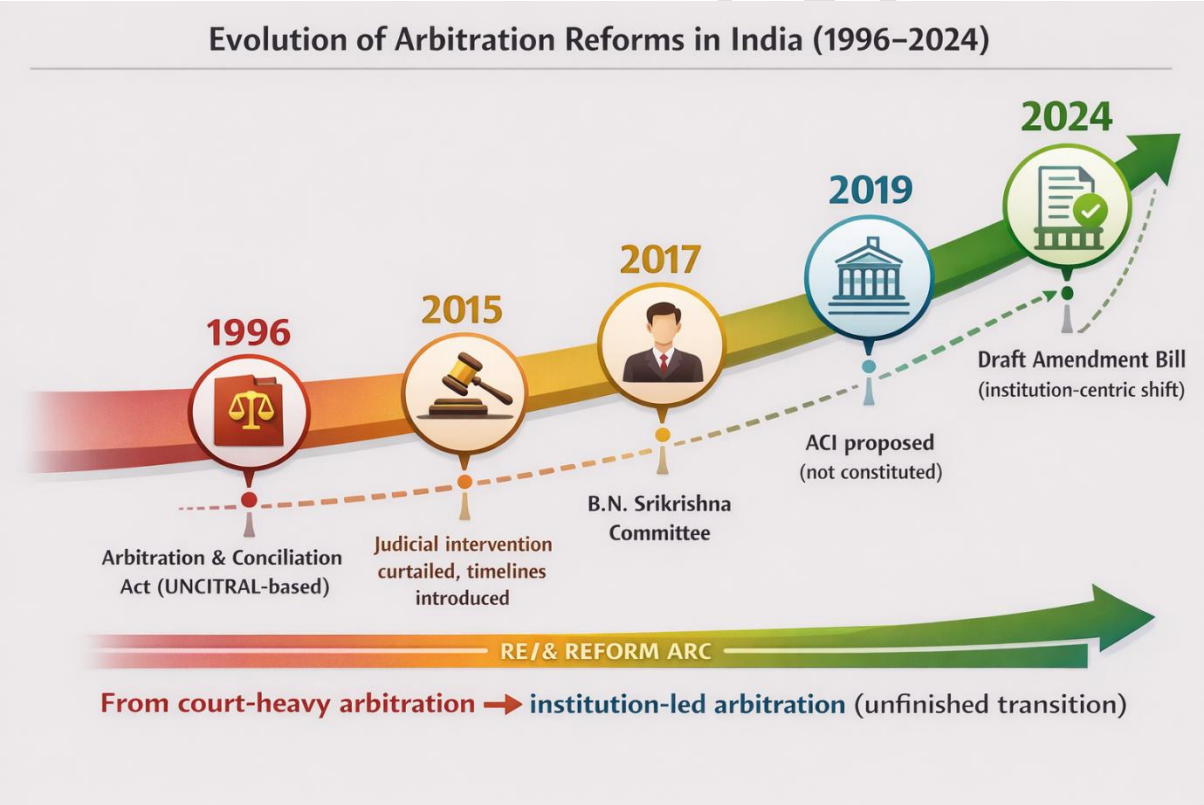
a. Arbitration in India

Arbitration is a form of alternative dispute resolution in which parties voluntarily agree to resolve disputes through a neutral third party—an arbitrator—instead of approaching ordinary courts. In India, arbitration is governed by the Arbitration and Conciliation Act, 1996, which is largely based on the UNCITRAL Model Law, thereby aligning Indian arbitration with internationally accepted legal standards.

The core objectives of India's arbitration framework include ensuring speedy dispute resolution, minimising judicial intervention, preserving party autonomy, and improving the investment climate by enhancing ease of doing business. In principle, arbitration is intended to provide a faster, flexible, and commercially sensitive alternative to conventional litigation.

In practice, however, India's arbitration ecosystem has suffered from serious structural deficiencies. Frequent judicial interference at multiple stages, prolonged timelines in the making and enforcement of arbitral awards, and an excessive dependence on ad hoc arbitration have undermined its effectiveness. Over time, these weaknesses eroded confidence among domestic and foreign investors alike.

Recognising these challenges, Parliament introduced major legislative reforms in 2015 and 2019, aimed at limiting judicial overreach and promoting institutional arbitration.



b. Arbitration Council of India: Concept and Present Status

The Arbitration Council of India (ACI) was envisaged under the Arbitration and Conciliation (Amendment) Act, 2019 as a central body to promote, regulate, and standardise arbitration practices in India. Despite having a statutory basis, the ACI has not yet been constituted.

This institutional vacuum has significant consequences. Several reform measures linked to institutional arbitration remain non-operational, and India continues to lack a unified regulatory architecture for arbitration. Consequently, the gap between legislative intent and on-ground outcomes persists.

c. Rationale Behind the Proposal for ACI

The idea of the Arbitration Council of India emerged from the recommendations of the High-Level Committee on Arbitration (2017), chaired by Justice B. N. Srikrishna. The Committee undertook a comprehensive review of India's arbitration framework.

It observed that Indian arbitration was overwhelmingly ad hoc in nature, lacked credible domestic arbitral institutions, and operated without uniform standards for arbitrators or institutions. This fragmented system discouraged both domestic commercial actors and foreign investors from choosing India as a preferred seat of arbitration.

To address these systemic deficiencies, the Committee recommended the establishment of a central body that could promote institutional arbitration, prescribe minimum quality benchmarks, and support India's ambition of becoming a global arbitration hub.

d. Envisaged Functions of the Arbitration Council of India

The Arbitration Council of India was conceptualised as an apex body combining regulatory oversight with developmental functions.

i. Promotion of Institutional Arbitration

- Encouraging a shift from ad hoc arbitration to institutional arbitration
- Enhancing predictability, procedural efficiency, and credibility of arbitral processes

ii. Grading of Arbitral Institutions

- Evaluation based on infrastructure, expertise, transparency, and efficiency
- Providing guidance to parties in selecting reliable institutions
- Creating competitive pressure to improve institutional quality

iii. Accreditation and Regulation of Arbitrators

- Recognition of professional bodies accrediting arbitrators
- Prescription of uniform ethical and professional standards
- Addressing concerns regarding arbitrator competence and impartiality

iv. Advisory and Knowledge Functions

- Advising the government on arbitration policy and legal reforms
- Acting as a repository of arbitral awards to promote consistency and institutional learning

e. Concerns Regarding Independence and Impartiality of the ACI

A major criticism of the Arbitration Council of India relates to its institutional independence.

The composition of the proposed Council grants significant appointment and nomination powers to the Union Government. This is problematic because the government and public sector undertakings are among the largest litigants in arbitration proceedings in India. Such a structure creates a perceived conflict of interest, particularly when the same authority influences grading of arbitral institutions and accreditation standards.

This perception undermines a core principle of arbitration—neutrality. A regulator seen as government-dominated risks eroding confidence among private parties, discouraging foreign investors, and weakening India's credibility as a neutral arbitration destination.

f. Criticisms of the 2019 Arbitration Amendments

The 2019 amendments, though reform-oriented, attracted significant criticism.

First, the establishment of a central regulator raised concerns of excessive centralisation, potentially constraining the autonomy of arbitral institutions. Second, the power to accredit an unlimited number of institutions risked dilution of quality rather than its enhancement.

Critics also argued that the regulatory model deviated from global best practices. Leading arbitration hubs such as Singapore and Hong Kong rely on strong, market-driven institutions rather than government-controlled regulatory councils. Finally, the continued non-constitution of the ACI exposed serious implementation gaps in India's arbitration reform agenda.

g. Draft Arbitration and Conciliation (Amendment) Bill, 2024: Key Proposals

The Draft Amendment Bill, 2024 aims to revitalise institutional arbitration while further limiting judicial intervention.

i. Redefinition of Arbitral Institutions

- Any body conducting arbitration under its own procedural rules qualifies
- Removal of court-based designation enhances party autonomy

ii. Restriction of Judicial Interim Measures

- Courts to intervene mainly before commencement or after award
- Reduced disruption of ongoing arbitral proceedings

iii. Rationalisation of Commencement Timelines

- Ninety-day period calculated from filing of interim application
- Minimisation of delays caused by prolonged court hearings

iv. Formal Recognition of Emergency Arbitration

- Provision for urgent interim relief by emergency arbitrators
- Reduced dependence on courts during early stages

v. Strengthening Institutional Powers

- Extension of timelines for awards by institutions
- Reduction of arbitrators' fees for attributable delays
- Substitution of arbitrators where necessary

vi. Introduction of Appellate Arbitral Tribunals

- Optional contractual mechanism
- Bar on court-based setting-aside applications if chosen

h. Key Concerns with the Draft Bill, 2024

Excessive restriction of judicial oversight may weaken safeguards against procedural unfairness. Many Indian arbitral institutions currently lack the institutional capacity and credibility to exercise expanded powers effectively.

The success of emergency arbitration depends heavily on trust in institutions, which is still evolving. Similarly, appellate arbitration may add an additional layer of proceedings, potentially undermining the objective of speedy dispute resolution rather than advancing it.

i. Way Forward

For arbitration reforms to succeed, the Arbitration Council of India must be constituted with strong safeguards for independence and transparency. Appointments should involve multi-stakeholder representation rather than exclusive executive control.

Policy focus should shift from over-regulation to strengthening a limited number of credible arbitral institutions. Building trust through rigorous ethical standards, professional training, and time-bound procedures is essential. Reducing the government's litigation culture through improved contract management and dispute prevention mechanisms is equally critical.

India's arbitration framework must also align with broader governance objectives, particularly Sustainable Development Goal 16, which emphasises peace, justice, and strong institutions.

Conclusion

India's arbitration reforms will succeed not merely through legislative amendments, but through the creation of credible, independent, and professionally trusted institutions. Only such an ecosystem can restore confidence among domestic stakeholders and position India as a globally respected arbitration hub.

GS Paper II: Current Affairs

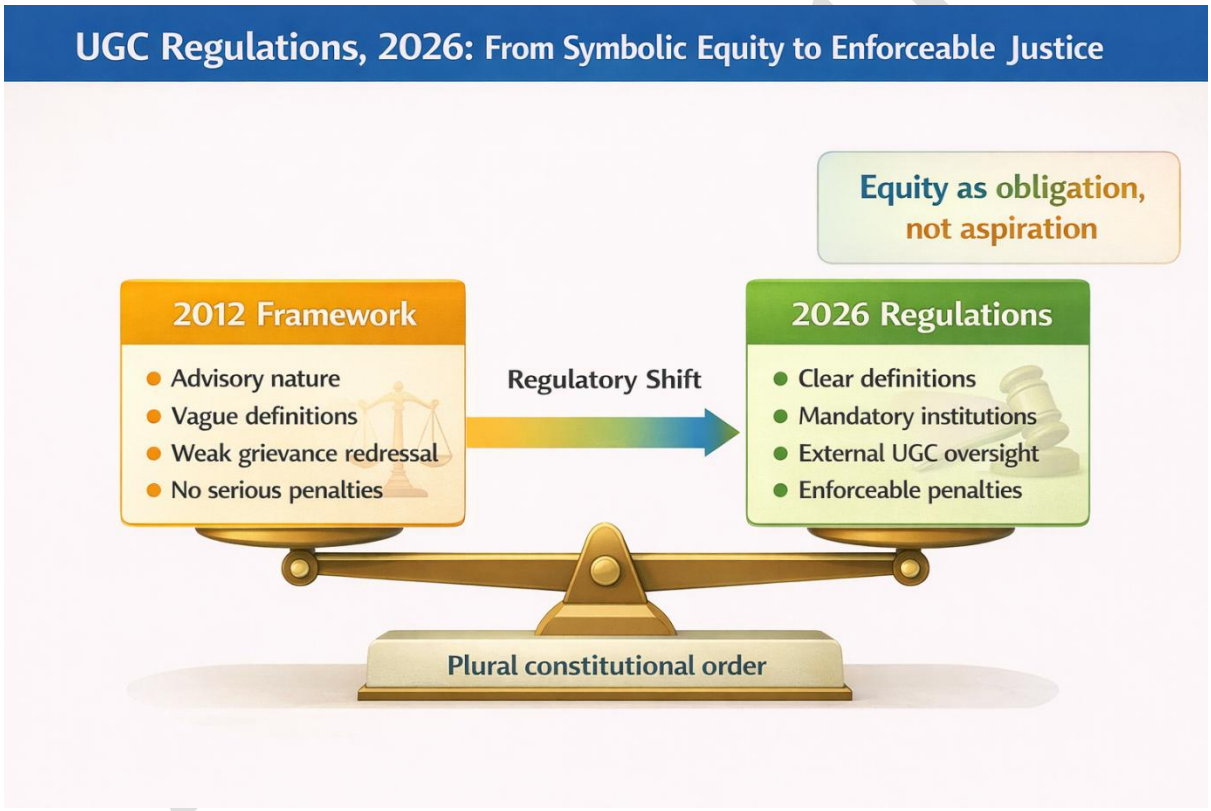
1. UGC Regulations on Caste Discrimination in Higher Education, 2026

a. Introduction

The UGC (Promotion of Equity in Higher Education Institutions) Regulations, 2026 represent a major regulatory intervention aimed at eliminating caste-based discrimination and institutionalising equality, dignity, and inclusion within India's higher education system. Framed by the University Grants Commission (UGC), these regulations apply uniformly to all UGC-recognised universities and colleges across the country.

The 2026 regulations replace the earlier anti-discrimination framework of 2012. While the earlier rules formally acknowledged the problem of discrimination, they suffered from weak enforcement mechanisms, vague definitions, and absence of meaningful penalties. As a result, discrimination often remained unaddressed at the institutional level.

The new regulations mark a decisive shift from symbolic commitment to enforceable standards, clearly signalling that equity in higher education is not optional, but a regulatory and constitutional obligation.



b. Rationale: Why Such Regulations Are Necessary

Higher education institutions are often projected as engines of social mobility and equal opportunity. However, lived experiences across many campuses reveal persistent patterns of exclusion, marginalisation, and unequal treatment, particularly affecting students from Scheduled Castes (SCs), Scheduled Tribes (STs), and Other Backward Classes (OBCs).

Students from these communities have frequently reported:

- Social isolation and exclusion
- Biased academic evaluation
- Harassment and humiliation
- Institutional neglect and delayed grievance handling

The earlier regulatory framework failed to:

- Clearly define what constitutes discrimination
- Provide robust and independent grievance redressal
- Impose serious consequences for institutional failure

The 2026 regulations seek to bridge the gap between constitutional ideals and campus realities, ensuring that equality is actively practised within institutional structures, rather than merely proclaimed in policy documents.

c. Constitutional Foundations of the Regulations

The UGC Equity Regulations draw legitimacy from multiple provisions of the Indian Constitution, which collectively establish social justice as a foundational objective of governance.

i. Equality and Non-Discrimination

Article 14 guarantees equality before the law, while Article 15 prohibits discrimination on grounds such as caste, religion, and sex.

ii. Enabling Provisions for Educational Equity

Articles 15(4) and 15(5) empower the State to make special provisions for socially and educationally backward classes, particularly in matters of education.

iii. Directive Principle of Social Justice

Article 46, a Directive Principle of State Policy, places a constitutional duty on the State to promote the educational and economic interests of SCs, STs, and OBCs and to protect them from social injustice.

Viewed together, these provisions make it clear that preventing caste discrimination in education is not an administrative choice, but a constitutional mandate.

d. Scope of Protection under the 2026 Regulations

The regulations adopt an explicitly inclusive approach by clearly identifying the categories of persons entitled to protection.

These include:

- Students belonging to SCs, STs, and OBCs
- Women
- Persons with disabilities
- Any other individual associated with higher education institutions

A crucial development is the explicit inclusion of OBCs in the final regulations. OBCs were absent from the initial draft, but following widespread criticism, they were formally incorporated, reinforcing the comprehensive and corrective nature of the equity framework.

e. Defining Caste-Based Discrimination

One of the most significant contributions of the 2026 regulations is their clear and expansive definition of caste-based discrimination.

In simple terms, caste-based discrimination refers to any unfair treatment imposed solely on the basis of caste or tribe. The regulations recognise multiple manifestations of discrimination, including:

- Biased evaluation and academic prejudice
- Social exclusion and segregation

- Harassment and humiliation
- Neglect or denial of equal access to educational opportunities

Importantly, the regulations recognise both:

- Explicit discrimination, which is direct and visible
- Implicit discrimination, which operates subtly through institutional practices and informal behaviour

By acknowledging indirect and structural forms of exclusion, the regulations address the deep-rooted nature of caste-based inequality in education.

f. Mandatory Institutional Mechanisms

i. Equity Committee

Every higher education institution must constitute an Equity Committee, headed by the head of the institution.

The committee must include representation from:

- Scheduled Castes
- Scheduled Tribes
- Other Backward Classes
- Women
- Persons with disabilities

The committee's functions include:

- Addressing complaints of discrimination
- Promoting an inclusive campus environment
- Monitoring equity-related concerns

To prevent inactivity, the regulations mandate that the committee must meet at least twice every year.

ii. Equal Opportunity Centre

In addition to the Equity Committee, institutions must establish an Equal Opportunity Centre.

Its functions extend beyond grievance redressal and include:

- Awareness creation and sensitisation
- Student support and counselling
- Promotion of social inclusion

The centre is required to submit bi-annual reports to the UGC, creating a formal structure of documentation and accountability.

g. Monitoring and Oversight by the UGC

To ensure that the regulations do not remain confined to paperwork, the UGC has instituted a national-level monitoring framework.

This includes:

- Regular scrutiny of institutional compliance reports
- Evaluation of the functioning of Equity Committees
- Assessment of grievance redressal processes

By introducing external oversight, the regulations reduce the risk of internal committees shielding institutional failures and strengthen regulatory accountability.

h. Penalties for Non-Compliance

A defining feature of the 2026 regulations is the introduction of stringent penalties for non-compliance.

Institutions failing to implement the mandated provisions may face:

- Debarment from offering academic programmes
- Withdrawal of UGC recognition
- Other actions permitted under the UGC Act

This represents a clear shift from earlier advisory frameworks and transforms equity from a moral expectation into a legally enforceable obligation.

i. Significance of the Regulations

From multiple perspectives, the regulations carry wide-ranging significance:

- **Social justice:** Protection of dignity and equal opportunity for marginalised students
- **Governance:** Introduction of transparency, accountability, and enforceability in higher education administration
- **Education reform:** Creation of safer and more inclusive learning environments

They also reinforce the equity-oriented vision of the National Education Policy, 2020, aligning institutional practices with national reform goals.

j. Implementation Challenges

Despite their strengths, the regulations face practical challenges:

- Risk of committees existing only in form, not substance
- Fear of retaliation or stigma discouraging student complaints
- Need for sustained sensitisation of faculty and administrators to recognise implicit bias
- Dependence on the monitoring capacity and institutional resolve of the UGC

Addressing these challenges is crucial for meaningful impact.

k. Way Forward

Effective implementation requires:

- Strengthening grievance redressal mechanisms
- Ensuring independent and functional Equity Committees
- Institutionalising regular sensitisation programmes
- Transparent public disclosure of compliance reports

Aligning higher education governance with Sustainable Development Goal 4 (inclusive education) and SDG 10 (reducing inequality) can provide additional normative direction.

Conclusion

The UGC Equity Regulations, 2026 represent a shift from symbolic anti-discrimination norms to constitutionally grounded, enforceable equity governance, seeking to eliminate caste-based discrimination in higher education through clear definitions, mandatory institutions, explicit inclusion of OBCs, and strict regulatory penalties.

2. Women's Night Shifts to Women's Safety Net Rules Under New Labour Codes

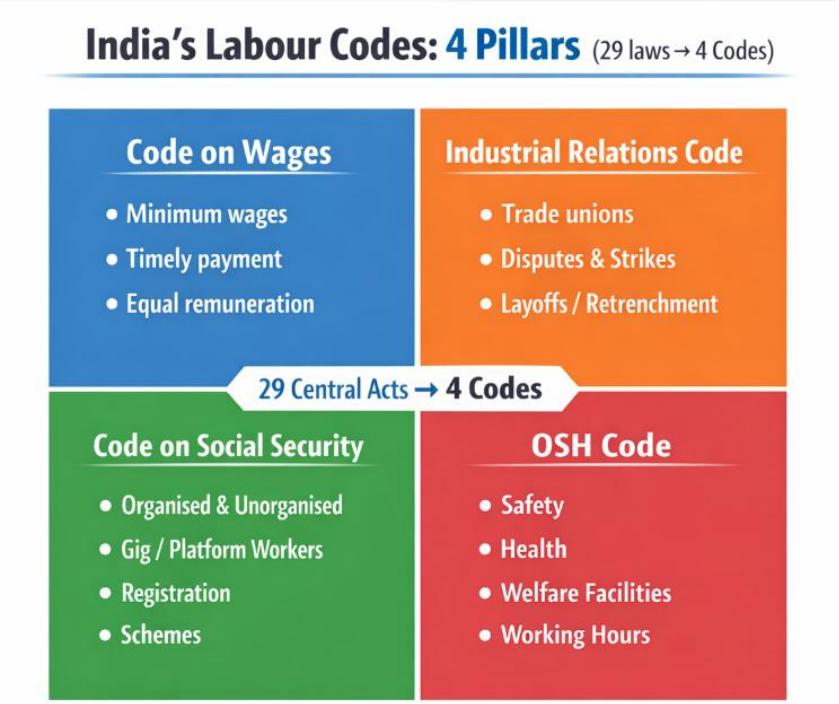
a. Introduction

India's labour law framework has long been characterised by fragmentation, multiplicity of statutes, and uneven enforcement. Over decades, numerous central labour laws were enacted to address specific issues—wages, industrial disputes, safety or social security—often functioning in isolation. This resulted in high compliance costs for employers, regulatory ambiguity, and inadequate protection for workers, particularly in an economy dominated by informality, contractualisation and emerging forms of work.

To overcome these structural limitations, Parliament enacted four comprehensive Labour Codes, consolidating 29 central labour laws into a unified framework. The reform seeks to create a simpler, uniform and inclusive labour regime that balances economic efficiency, worker welfare and social justice.

b. The Four Labour Codes: Structural Context

India's labour law consolidation rests on four Codes, each addressing a distinct dimension of labour regulation.



i. Code on Wages

This Code ensures minimum wages, timely payment of wages, and equal remuneration for equal work, aiming to reduce wage-related inequalities and simplify wage determination across sectors.

ii. Industrial Relations Code

It governs trade unions, industrial dispute resolution, strikes, layoffs, and retrenchment, attempting to balance workers' rights with industrial stability and ease of doing business.

iii. Code on Social Security

This Code significantly expands the scope of welfare by covering organised workers, unorganised workers, gig workers and platform workers, reflecting the changing nature of employment.

iv. Occupational Safety, Health and Working Conditions Code (OSH Code)

The OSH Code consolidates laws relating to workplace safety, health standards, welfare facilities, and working hours, making it central to issues of humane working conditions.

c. Regulation of Working Hours

i. Weekly Working Hours

The Labour Codes prescribe a maximum working limit of 48 hours per week, continuing India's long-standing commitment to humane working conditions. This ceiling aligns with International Labour Organization (ILO) standards and draws normative support from the Directive Principles of State Policy, which emphasise just and humane conditions of work.

By retaining a clear weekly cap, the Codes seek to prevent excessive exploitation while allowing enterprises sufficient operational flexibility.

ii. Daily Working Hours and Spread-Over

While the weekly limit is statutorily fixed, daily working hours, rest intervals and spread-over are left to be detailed through subordinate legislation.

The term spread-over refers to the total duration from the beginning to the end of a working day, including rest breaks. Draft rules under the OSH Code had proposed a maximum spread-over of 12 hours, aiming to balance industrial flexibility with worker protection.

This approach reflects a conscious shift away from rigid uniformity towards sector-sensitive regulation, recognising the diversity of India's labour market.

d. Women's Night Shifts

i. Nature of the Provision

One of the most debated reforms under the Labour Codes is the permission granted to women to work during night shifts, generally defined as work between 7 p.m. and 6 a.m. This marks a departure from earlier blanket restrictions that effectively excluded women from certain sectors and roles.

Importantly, the provision does not mandate night work for women. Employment during night hours is voluntary and subject to compliance with prescribed safeguards.

ii. Rationale and Significance

The reform reflects a shift from a protectionist mindset to a rights-based and equality-oriented approach. By enabling women to work night shifts, the law expands employment opportunities in sectors such as manufacturing, logistics, IT and services, which increasingly operate round-the-clock.

This aligns with constitutional principles of equality before law and non-discrimination, while responding to the demands of a modern, globalised economy.

iii. Safeguards for Women Workers

To balance opportunity with safety, employers are required to ensure:

- Safe transportation facilities
- Adequate lighting and workplace security
- Surveillance systems
- Effective grievance redressal mechanisms

These safeguards underline the principle that gender equality in employment must be accompanied by safety, dignity and institutional accountability.

e. Contract Employment and Gratuity

A notable reform under the Labour Codes relates to gratuity eligibility for contract workers. Under the new framework, contract workers become eligible for gratuity after completing one year of service.

Earlier, gratuity was typically linked to longer periods of continuous service, which excluded a large segment of workers engaged on short-term or renewable contracts. By reducing the eligibility threshold, the Codes acknowledge the structural shift towards contractualisation in India's labour market.

This reform strengthens the principle of fair compensation and reduces economic insecurity among temporary workers.

f. Registration of Informal Workers

i. Understanding Informal Workers

Informal workers are those operating outside formal employment arrangements and lacking access to institutional social security. This category includes:

- Daily wage labourers
- Migrant workers
- Domestic workers
- Self-employed individuals
- Gig and platform workers

Given that nearly 90% of India's workforce is informal, their exclusion from welfare mechanisms has been a major policy challenge.

ii. Provision under the Code on Social Security

The Code on Social Security mandates the registration of all informal workers aged 16 years and above. Registration serves as the foundational step for identifying beneficiaries and extending social security coverage.

iii. Importance of Registration

Registration enables:

- Targeted delivery of welfare schemes
- Portability of benefits for migrant workers
- Improved labour market data and policy planning
- Gradual formalisation of the economy

This provision represents a critical shift from fragmented welfare delivery to a data-driven and inclusive social security framework.

g. Transition from the Old Regime to the New Codes

Until the new Codes are fully operationalised through notified rules, existing labour laws and rules continue to remain in force. This transitional arrangement ensures legal continuity, prevents regulatory vacuum, and avoids disruption to workers' rights and employer obligations.

Such continuity reflects a pragmatic and phased approach to reform rather than abrupt legislative overhaul.

h. Implementation Challenges

Despite their reformist intent, the Labour Codes face several practical challenges:

- Ensuring women's safety during night shifts requires effective enforcement, not just formal compliance
- Labour being a Concurrent Subject necessitates strong Union–State coordination, risking uneven implementation
- MSMEs often face limited compliance capacity
- Informal workers may struggle with awareness, digital access and registration hurdles

These challenges underline that legislative reform must be matched by administrative capacity, institutional coordination and sustained outreach.

Conclusion

The Labour Codes represent a fundamental shift in India's labour governance, moving from fragmented regulation to a unified, rights-oriented framework. Provisions relating to working hours, women's night shifts, and informal worker registration reflect an effort to reconcile economic flexibility with social protection.

3. The SHANTI Bill and India's Nuclear Sector: Changes, Implications, and Debate

a. Introduction

Nuclear energy occupies a strategic position in India's development trajectory. It provides clean, reliable, and continuous baseload power, while reducing dependence on imported fossil fuels. Since Independence, India's nuclear sector has remained largely under State control, shaped by concerns of national security, safety, and long-term environmental responsibility.

The Sustainable Harnessing and Advancement of Nuclear Energy in India Bill (SHANTI Bill) marks a significant departure from this tradition. By opening the civilian nuclear power sector to private and foreign participation, while retaining majority government control, the Bill introduces a new governance framework. This shift has generated intense debate around safety, liability, accountability, and the balance between public interest and market participation.

b. India's Nuclear Programme: Institutional and Strategic Background

India's nuclear programme has been State-led since the 1950s, governed primarily by the Atomic Energy Act, 1962 and the Civil Liability for Nuclear Damage Act, 2010.

i. Institutional Structure

- Nuclear power generation has been the exclusive domain of the Nuclear Power Corporation of India Limited (NPCIL).
- The Atomic Energy Commission and Department of Atomic Energy provided policy and strategic direction.

ii. Scale and Strategic Vision

- India currently operates 25 nuclear reactors across 7 nuclear power stations.
- The long-term roadmap is anchored in the three-stage nuclear programme, aimed at exploiting India's abundant thorium reserves.

This model ensured technological self-reliance, with indigenous capability in reactor design, fuel fabrication, and reprocessing.

c. The SHANTI Bill: Scope and Objectives

The SHANTI Bill represents a comprehensive restructuring of India's civilian nuclear energy sector.

i. Stated Objectives

- Strengthening long-term energy security
- Ensuring round-the-clock baseload electricity
- Supporting India's clean energy transition and Net Zero target for 2070
- Facilitating deployment of advanced technologies, including Small Modular Reactors (SMRs)

ii. Reform Philosophy

Rather than outright privatisation, the Bill adopts a regulated partnership model, combining:

- State oversight and strategic control
- Private capital and operational efficiency
- Selective technological collaboration

This sets the stage for a controlled opening of a traditionally closed strategic sector.

d. Opening of the Nuclear Sector under SHANTI

A central reform under the Bill is the ending of NPCIL's monopoly in civilian nuclear power.

i. Nature of Private and Foreign Participation

- Private participation permitted up to 49%, with the government retaining at least 51% control.
- Sensitive activities—fuel production, enrichment, reprocessing, and waste management—remain under State control.

ii. Scope of Participation

- Indian private firms may build, own, and operate nuclear plants, subject to licensing.
- Participation allowed in equipment manufacturing, fuel fabrication, and R&D.
- Foreign companies may supply technology and equipment, but ownership and operational control remain regulated.

Thus, the sector transitions from a State monopoly to a State-led, tightly regulated partnership framework.

e. Strengthening Regulation: Role of the Atomic Energy Regulatory Board

Opening the sector necessitates stronger oversight.

i. Statutory Empowerment

- The Atomic Energy Regulatory Board (AERB) is granted statutory status.
- It becomes directly answerable to Parliament, rather than functioning solely through executive authority.

ii. Regulatory Functions

- Licensing of nuclear facilities
- Enforcement of radiation protection standards
- Oversight of emergency preparedness
- Periodic safety inspections and quality assurance

This reform seeks to enhance regulatory credibility and independence in a more complex nuclear ecosystem.

f. Changes in the Nuclear Liability Framework

The most controversial dimension of the SHANTI Bill relates to nuclear liability.

i. Earlier Liability Regime

- Operators could seek recourse against suppliers for defective equipment or negligence.
- This upheld accountability but discouraged foreign suppliers.

ii. New Liability Structure

- Supplier liability is removed.
- Operator liability is capped, with different ceilings for large reactors, medium plants, and SMRs.
- Liability beyond the cap is borne by the Union Government or a dedicated Nuclear Liability Fund.
- Financial penalties for violations are also capped.

iii. Government Rationale

The government argues that a predictable and limited liability regime is essential to:

- Attract investment
- Reduce risk uncertainty
- Enable access to advanced nuclear technologies

g. Continuity of Indigenous Capability

Despite liberalisation, the Bill does not dismantle India's technological autonomy.

Indigenous Strengths

- Mastery of Pressurised Heavy Water Reactor (PHWR) technology
- Indigenous fuel fabrication and reprocessing
- Operationalisation of fast breeder reactor technology
- Continued research on thorium-based reactors

Foreign collaboration is projected as complementary, not a substitute for domestic capability.

h. Concerns Raised by the Opposition

The SHANTI Bill has faced sustained criticism on multiple fronts.

i. Safety and Liability Concerns

- Removal of supplier liability dilutes the polluter pays principle.
- Accident risks are shifted to the State and society.
- Liability caps are seen as inadequate in light of disasters such as Chernobyl and Fukushima.

ii. Governance and Transparency Issues

- Certain provisions restrict disclosure of nuclear information.
- Potential dilution of the Right to Information framework.

iii. Labour and Institutional Concerns

- Exclusion of nuclear workers from general labour safety laws.
- Questions over the necessity of foreign participation despite strong indigenous expertise.

These critiques highlight fears of privatised profits and socialised risks.

i. Government's Justification

The government defends the Bill on strategic and developmental grounds.

Key Arguments

- Nuclear power is essential for clean, reliable energy expansion.
- Reduced reliance on coal supports climate commitments.
- Strong regulation, not supplier liability, is the primary safety guarantee.
- Reforms enhance India's credibility in global nuclear cooperation.

Conclusion

The SHANTI Bill represents a profound shift in India's nuclear governance, attempting to reconcile energy security and clean growth with market participation and technological collaboration. While it promises faster capacity expansion, it also raises fundamental questions about safety, liability, transparency, and public accountability.

Ultimately, the success of the SHANTI framework will depend not merely on legislative intent, but on the strength and independence of regulatory institutions, robust oversight, and an uncompromising safety culture. Only under these conditions can nuclear energy advance India's development goals without eroding public trust or environmental responsibility.

4. Performance-linked Agricultural Scheme Convergence under PM-RKVY

a. Overview: From Fragmented Schemes to Outcome-based Agriculture

India's agricultural policy architecture is undergoing a significant structural transition. For decades, agricultural governance was characterised by a multiplicity of narrowly focused schemes, each operating in isolation. While well-intentioned, this silo-based approach led to fragmented planning, administrative inefficiencies, and weak outcome monitoring.

The proposed convergence of multiple agricultural schemes under the Prime Minister's Rashtriya Krishi Vikas Yojana (PM-RKVY), coupled with the introduction of performance-linked funding, marks a decisive philosophical shift. The emphasis is moving away from mere input distribution towards measurable outcomes, reform incentives, and accountability.

At its core, this reform seeks to improve public expenditure efficiency, incentivise states to undertake meaningful agricultural reforms, and strengthen cooperative federalism. Agriculture, constitutionally a state subject, is now being governed through a framework that balances state-level flexibility with outcome-based accountability.

b. PM-RKVY as an Umbrella Framework for Agricultural Federalism

The Rashtriya Krishi Vikas Yojana was launched in 2007 with the objective of achieving holistic development of agriculture and allied sectors. Its foundational principle is that states are best positioned to understand their local agricultural needs.

Unlike rigid centrally designed schemes, PM-RKVY allows states to prepare district-level and state-level agricultural plans, reflecting local agro-climatic conditions, cropping patterns, and socio-economic realities. This built-in flexibility makes PM-RKVY particularly suitable as an umbrella framework under which diverse agricultural interventions can be harmonised.

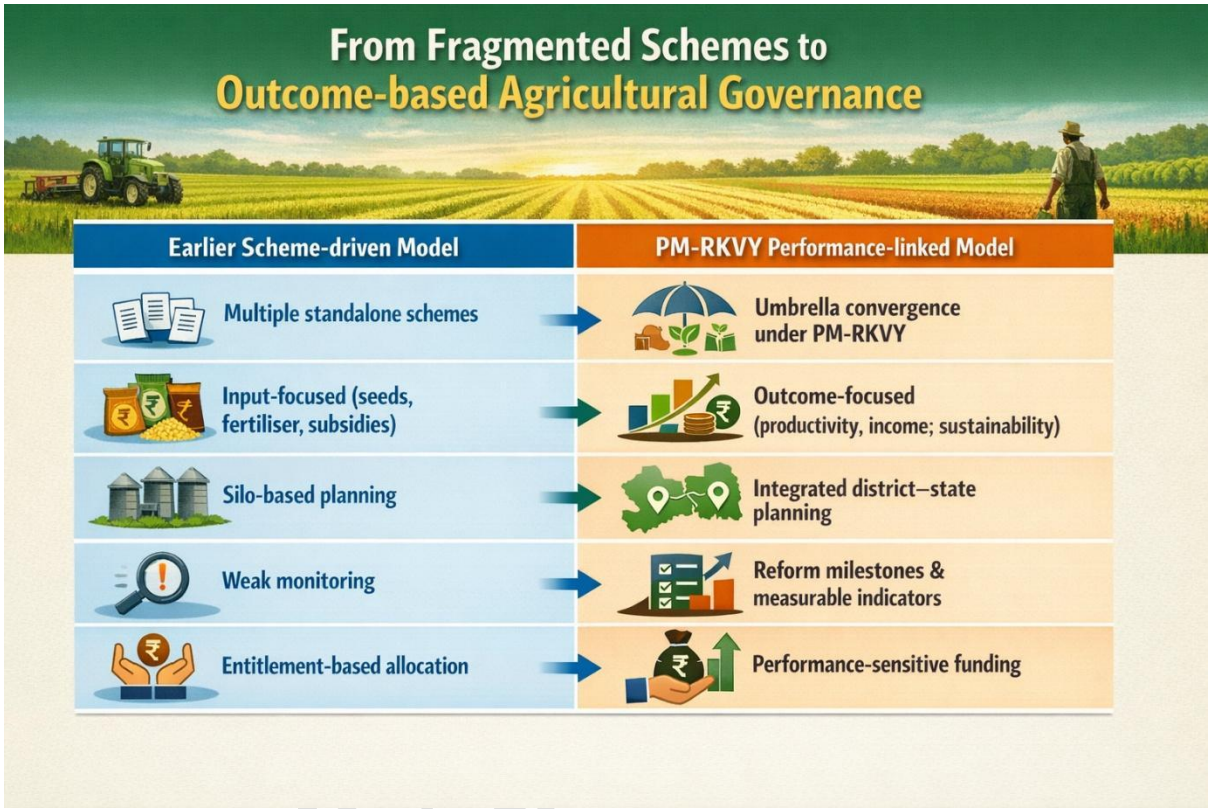
c. Rationale for Scheme Convergence

Prior to convergence, India's agricultural policy landscape was marked by a proliferation of schemes operating independently, often pursuing overlapping objectives such as income enhancement, sustainability, and diversification.

This fragmentation resulted in:

- Administrative duplication
- Disjointed planning processes
- Multiple reporting requirements
- Weak monitoring of outcomes

States were compelled to navigate diverse guidelines and compliance frameworks, which diluted focus and accountability. Convergence under PM-RKVY is therefore aimed at simplifying governance, enhancing policy coherence, and ensuring optimal utilisation of public funds.



d. Schemes Proposed to be Merged under PM-RKVY

Under the proposed framework, several existing agricultural schemes are to be subsumed within PM-RKVY, including:

Krishonnati Yojana

- Focuses on productivity enhancement, diversification, and income growth
- Covers crop development, mechanisation, and extension services

National Mission on Natural Farming

- Promotes chemical-free and sustainable agricultural practices
- Emphasises soil health, biodiversity, and reduced input costs

National Bee and Honey Mission

- Strengthens apiculture and pollination-based livelihoods
- Enhances farm incomes through allied agricultural activities

While sectorally diverse, these schemes share common objectives of income enhancement, sustainability, and resilience, making their integration both logical and administratively efficient.

e. Funding Structure after Convergence

The proposed merger retains the existing federal funding architecture, thereby preserving fiscal balance:

- General category states: 60:40 (Centre : State)
- North-Eastern and Himalayan states: 90:10
- Union Territories: 100% central funding

This differentiated funding structure recognises varying geographical, fiscal, and administrative capacities, while reinforcing the principles of cooperative federalism.

f. Transition from Need-based to Performance-based Funding

Traditionally, PM-RKVY allocations were guided by structural and demographic indicators, such as:

- Net un-irrigated area
- Share of small and marginal farmers
- Youth population

While these indicators reflected developmental needs, they did not capture governance quality or reform efforts. The proposed reform introduces a new parameter assessing reform initiatives and milestones achieved by states, assigned a 30% weightage, the highest among all criteria.

This marks a fundamental shift in agricultural federalism—from entitlement-based allocations to performance-sensitive public financing.

g. Understanding Reform-linked Funding

Reform-linked funding rewards states that design, implement, and sustain agricultural reforms effectively. The emphasis shifts towards:

- Policy innovation
- Institutional strengthening
- Demonstrable improvements in productivity, sustainability, and market integration

This approach draws inspiration from:

- The Fifteenth Finance Commission's emphasis on performance incentives
- NITI Aayog's advocacy of outcome-based governance

Agriculture is thus being aligned with a broader results-oriented public finance framework.

h. Significance of the New Framework

Governance Perspective

- Strengthens cooperative federalism with accountability
- Retains state autonomy while incentivising results

Agricultural Perspective

- Encourages crop diversification and natural farming
- Promotes allied sectors such as apiculture
- Enhances resilience to climate and market shocks

Fiscal Perspective

- Improves value for money
- Reduces inefficiencies of entitlement-based spending

i. Challenges and Risks

Key concerns associated with performance-linked convergence include:

- Risk of widening inter-state disparities, as administratively stronger states may consistently outperform weaker ones
- Ambiguity in reform indicators if benchmarks are not clearly defined
- Capacity constraints in poorer states limiting reform implementation
- Potential over-centralisation of reform templates, undermining local diversity

j. International Comparisons

Several countries have adopted results-based agricultural financing:

- European Union: Payments linked to sustainability and environmental outcomes
- Australia: Grants tied to productivity and climate resilience
- Brazil: Incentives linked to environmental compliance

India's evolving PM-RKVY framework is broadly aligned with these international best practices, while being adapted to its federal context.

k. Way Forward

For effective implementation, the following steps are essential:

- Clearly defined, transparent, and measurable reform indicators
- Targeted capacity-building and handholding for weaker states
- Independent evaluation mechanisms involving institutions like NITI Aayog and third-party audits
- Alignment with global commitments such as SDGs 2 (Zero Hunger), 12 (Responsible Consumption), and 16 (Institutions)

Conclusion

The convergence of agricultural schemes under PM-RKVY, combined with reform-linked funding, marks India's transition from scheme-driven agriculture to an outcome-oriented, accountable, and reform-led model of governance.

By harmonising flexibility with accountability, the framework strengthens cooperative federalism while promoting sustainable agricultural growth. If implemented with clarity, transparency, and inclusiveness, it holds the potential to fundamentally reshape India's agricultural governance landscape.

GS Paper II: International Relations

1. India–European Union Free Trade Agreement

a. Understanding the India–EU Free Trade Agreement

A Free Trade Agreement (FTA) is a structured arrangement between two or more trading partners aimed at reducing or eliminating customs duties, simplifying regulatory procedures and facilitating the smoother movement of goods, services, investment and professionals. The core objective is to expand trade by lowering artificial barriers while ensuring predictability and stability for businesses.

The India–European Union Free Trade Agreement represents a comprehensive economic partnership between India and the European Union, a bloc of twenty-seven countries. Together, the two partners account for nearly two billion people and a substantial share of global trade, investment flows and consumer demand.

In terms of scale, depth and economic reach, this agreement is India's largest and most ambitious trade arrangement to date, marking a decisive evolution in India's external economic engagement.

b. Background: Why an FTA Became Necessary

Economic relations between India and the European Union have historically been strong. The EU has consistently ranked among India's largest trading partners, while India represents an expanding and strategically important market for European firms.

Existing Trade Profile

- India's exports to the EU include textiles and apparel, gems and jewellery, pharmaceuticals and engineering goods
- EU exports to India focus on high-value manufactured products such as machinery, automobiles, chemicals and advanced equipment

Formal negotiations for an FTA began in 2007, but progress remained slow for over a decade.

Reasons for Prolonged Stalemate

- India's high tariffs on automobiles and wines
- EU's stringent regulatory, labour and environmental standards
- Differences over sustainability and market access commitments

Over time, global conditions changed significantly. Supply chain disruptions, rising protectionism and strategic uncertainty created incentives for deeper and more reliable economic partnerships, leading to renewed momentum in India–EU negotiations.

c. Scope and Nature of the Agreement

The India–EU FTA goes beyond tariff reductions to encompass a comprehensive economic partnership.

- Trade in goods and services
- Investment facilitation and protection
- Mobility of professionals
- Cooperation in technology, security and defence

This reflects the understanding that modern trade agreements shape long-term economic and strategic alignment. The FTA is therefore best viewed not merely as a commercial instrument, but as a strategic economic framework linking markets with geopolitical cooperation.

d. Key Trade Provisions and On-Ground Changes

i. Market Access for Indian Exports

A major outcome of the agreement is significantly improved access for Indian exports to European markets.

- Nearly all Indian exports to the EU become duty-free
- Enhanced price competitiveness in high-income markets

Sectors expected to benefit the most include:

- Textiles and apparel
- Leather and footwear
- Gems and jewellery
- Pharmaceuticals
- Engineering goods

For labour-intensive industries, this creates opportunities for scale expansion, employment generation and deeper integration into European supply chains.

ii. Market Access for European Exports

India's market opening under the agreement is phased and sector-specific, aimed at protecting domestic industry from sudden shocks.

- Automobiles: tariff reductions within fixed quotas
- Wines and spirits: gradual tariff cuts
- Machinery, electrical equipment, aircraft and railway components: movement towards zero-duty access

Importantly, most agricultural products remain outside the agreement, safeguarding Indian farmers and rural livelihoods.

e. Economic Significance for India

The agreement has the potential to provide a strong boost to manufacturing, exports and investment.

- Improved access to a large, high-income market encourages Indian firms to scale up production
- Exposure to European standards promotes quality upgrading and higher value addition
- Increased European investment can bring advanced technology, innovation and managerial practices

Overall, the FTA supports India's integration into global value chains and aligns with the objective of building a competitive manufacturing base.

f. Strategic and Geopolitical Importance

The India–EU FTA signals a shift in India's trade strategy towards selective integration with trusted, rule-based economies.

- Diversifies trade partnerships amid global supply chain fragmentation
- Reduces vulnerability to geopolitical and economic shocks
- Reinforces commitment to an open, predictable and rules-based trading order

In a period of uncertainty in multilateral trade institutions, deeper engagement with the EU enhances India's economic resilience and strategic autonomy.

g. Regulatory and Climate Dimension

A sensitive aspect of the negotiations concerned the EU's environmental and regulatory framework, particularly the Carbon Border Adjustment Mechanism (CBAM).

India's primary concern was that climate measures should not function as disguised trade barriers for developing economies. Under the agreement:

- India has secured flexibility comparable to other major partners
- Developmental priorities are balanced with climate responsibility
- The principle of common but differentiated responsibilities is implicitly respected

This ensures that climate action does not undermine trade competitiveness.

h. Challenges and Concerns

The agreement also presents notable implementation challenges.

- Compliance with European regulatory and quality standards may raise costs for MSMEs
- Domestic automobile manufacturers may face increased competition
- Effective execution requires strong institutional coordination

Additionally, the EU's complex internal ratification process may delay full operationalisation, highlighting that outcomes depend not only on negotiation but on sustained follow-through.

i. Way Forward

To fully realise the benefits of the FTA, India must:

- Strengthen domestic quality and standards infrastructure
- Support MSMEs through technology upgradation and skill development
- Use the agreement to move manufacturing towards higher value-added segments

Aligning trade expansion with goals of innovation, decent work and sustainable growth will ensure durable economic transformation.

Conclusion

The India–European Union Free Trade Agreement symbolises India's transition from tariff-based protection to strategic integration within the global economy, combining economic growth objectives with long-term geopolitical alignment and resilience.

2. Pax Silica and Its Importance for India

a. Introduction

In the 21st century, technology has emerged as a decisive source of national power, shaping economic growth, military capability, governance capacity, and societal transformation. Technologies such as semiconductors, Artificial Intelligence (AI), and advanced electronics are now as strategically significant as oil or nuclear energy were in earlier periods.

However, these technologies are critically dependent on complex and highly concentrated global supply chains, especially those involving Rare Earth Elements (REEs) and advanced manufacturing inputs. Disruptions in these supply chains can paralyse entire industries and constrain national decision-making.

It is in this context that the concept of Pax Silica has emerged. It represents an effort by technologically advanced and like-minded countries to build secure, diversified, and trusted technology supply chains, ensuring that technological interdependence promotes stability rather than strategic vulnerability. For India, Pax Silica has direct implications for strategic autonomy, economic resilience, and technological self-reliance.

b. What Is Pax Silica?

Pax Silica is an emerging strategic framework aimed at ensuring peace and stability in the global technology ecosystem.

- *Pax* denotes peace, order, and stability
- *Silica* refers to silicon, the foundational material of semiconductor technology

Together, Pax Silica signifies a global order where critical technology supply chains—semiconductors, AI hardware, and rare earths—are governed by cooperation, transparency, explainability, and trust, rather than coercion or monopoly control.

In essence, it seeks to prevent the weaponisation of technology supply chains in geopolitics.

c. Why Pax Silica Has Become Necessary

i. Centrality of Semiconductors and AI

Semiconductors are the backbone of:

- Digital economy
- Telecommunications
- Defence platforms
- Electric vehicles
- Artificial Intelligence systems

AI systems, in turn, depend on high-performance chips, data centres, and advanced computing hardware. Control over these inputs translates into economic power and strategic leverage.

ii. Concentration of Rare Earth Supply Chains

Rare Earth Elements are essential for:

- Semiconductor manufacturing
- EV motors and batteries
- Renewable energy systems
- Precision defence electronics

Currently, China dominates mining, processing, and refining of REEs, creating a structural dependency for many countries, including India.

iii. Strategic Use of Supply Chains

Recent years have shown that:

- Export controls
- Licensing regimes
- Technology restrictions

can be used as tools of geopolitical pressure. These developments have demonstrated that economic dependence can directly constrain strategic choices, making supply chain security a core national interest.

d. Core Objectives of Pax Silica

The Pax Silica framework rests on three interlinked objectives:

- **Reducing coercive dependencies**
  Avoid excessive reliance on any single country for critical technologies or minerals.
- **Securing end-to-end supply chains**
  From mining and processing to manufacturing, logistics, and digital infrastructure.
- **Building trusted technology ecosystems**
  Based on transparency, reliability, rule-based cooperation, and shared norms.

e. India's Experience: Why Pax Silica Matters

India's own industrial experience highlights the risks of concentrated supply chains.

- Dependence on Chinese rare-earth magnets disrupted automobile and electronics manufacturing.
- Supplies were restored only after restrictive licensing conditions, exposing India's vulnerability to external decisions.

These episodes underline a key lesson:
Technological dependence directly narrows strategic autonomy, especially during geopolitical tensions.

f. Importance of Pax Silica for India

i. Securing Critical Minerals

Pax Silica can help India:

- Diversify sources of Rare Earth Elements
- Reduce exposure to export restrictions
- Support key sectors such as electronics, EVs, renewables, and defence manufacturing

ii. Supporting Semiconductor Mission

India's Semiconductor Mission aims to build:

- Fabrication
- Assembly
- Testing and packaging capabilities

Integration with trusted global supply chains can:

- Enable access to advanced equipment and materials
- Facilitate technology partnerships
- Strengthen India's position in global value chains

iii. Strengthening the AI Ecosystem

India's AI growth is supported by:

- Digital public infrastructure
- Start-up ecosystem
- Large domestic market

Pax Silica can enhance:

- Access to advanced computing hardware
- Research collaboration
- Scalable deployment of Indian AI solutions

iv. Leveraging India's Human Capital

India possesses a large pool of:

- Engineers
- Scientists
- Semiconductor and AI professionals

This allows India to act as a technology partner and contributor, not merely a consumer within Pax Silica arrangements.

g. India's Strategic Value to Pax Silica

India contributes uniquely to the framework through:

- **Market scale**: Large domestic demand
- **Manufacturing potential**: Alternative to concentrated hubs
- **Rule-based democracy**: Enhances trust
- **Digital governance experience**: Proven large-scale deployment capability

As a strategically autonomous country, India also broadens Pax Silica's legitimacy beyond a narrow alliance-centric structure.

h. Challenges and Cautions for India

Despite benefits, India must proceed carefully:

- Domestic semiconductor and AI ecosystems are still evolving
- Risk of asymmetric dependence on advanced technology providers
- Need to preserve policy flexibility and strategic autonomy
- Avoid replacing one dependency with another through restrictive technology regimes

i. China Factor and Emerging Technology Blocs

The global order is witnessing the emergence of parallel technology ecosystems:

- One centred on China-dominated supply chains
- Another around Pax Silica-type trusted networks

India's engagement choices will shape:

- Its long-term technological resilience
- Its position in fragmented global value chains
- Its ability to navigate great-power competition

j. Way Forward for India

India should:

- Engage with Pax Silica in a calibrated and issue-based manner
- Use it to diversify critical minerals and accelerate semiconductor capacity
- Strengthen AI research and hardware access
- Maintain partnerships beyond any single bloc to preserve autonomy

Conclusion

Pax Silica reflects a fundamental shift in global geopolitics, where control over technology and supply chains rivals traditional strategic resources. For India, it offers an opportunity to secure critical inputs, advance frontier technologies, and emerge as a trusted and responsible global technology partner. With a balanced approach, India can leverage Pax Silica to strengthen its technological future while safeguarding its long-term strategic independence.

3. International Solar Alliance: Structure, Role and the Implications of Major Power Withdrawal

a. Understanding the International Solar Alliance

The International Solar Alliance (ISA) is a treaty-based intergovernmental organisation established to promote the large-scale deployment of solar energy, particularly in developing countries located in the tropical belt.

The core challenge ISA seeks to address is not the availability of sunlight, but the capacity to convert solar potential into usable energy. Many developing countries possess abundant solar resources, yet face persistent barriers such as:

- High upfront capital costs
- Limited access to affordable and long-term finance
- Technological and skill deficits
- Weak regulatory and institutional frameworks

ISA was conceived as a collective mechanism to overcome these constraints. Its overarching objective is to make solar energy financially viable, technologically accessible and institutionally sustainable, especially for countries that are otherwise marginalised in the global clean energy transition.

b. Genesis and Institutional Profile

The International Solar Alliance was launched in 2015 as a joint diplomatic initiative by India and France, symbolising a partnership between climate leadership from the Global South and institutional support from an advanced economy. The framework agreement entered into force in 2017, following ratification by the required number of member states.

ISA is headquartered in Gurugram, Haryana, making it one of the few major international organisations based in India. Its membership has expanded to over one hundred countries, with strong representation from:

- Africa
- Asia
- Latin America
- Small Island Developing States

This wide and inclusive membership base has positioned ISA as a key pillar of India's climate diplomacy, South–South cooperation, and leadership among developing countries.

c. Functional Role of ISA: What It Does in Practice

ISA does not directly construct solar power plants or generate electricity. Instead, it operates as an enabling and facilitative platform that strengthens the overall ecosystem for solar deployment.

Mobilisation of Finance

- Works with multilateral development banks, sovereign funds and private investors
- Reduces perceived investment risks in developing countries
- Helps lower borrowing costs for solar projects

Capacity Building

- Supports training programmes for policymakers, regulators and technicians
- Enhances institutional readiness for solar planning and regulation

Project Development and Aggregation

- Promotes standardised project designs
- Aggregates demand across multiple countries
- Helps create bankable project proposals

Through these functions, ISA deepens South–South cooperation, enabling countries with similar developmental constraints to share solutions rather than pursue fragmented, isolated efforts.

d. Financial Impact of Withdrawal by a Major Power

From a narrow financial standpoint, the withdrawal of a single major country does not severely disrupt ISA's functioning.

- Member contributions form only a limited share of ISA's total resource pool
- Most programmes rely on multilateral institutions and pooled financing mechanisms
- Ongoing projects and administrative operations continue largely uninterrupted

As a result, ISA does not face an immediate funding crisis, project collapse or institutional paralysis due to such withdrawal.

e. The Deeper Impact: Confidence and Credibility

The more significant impact of a major power's withdrawal lies in the realm of confidence and perception.

Solar investments in developing and climate-vulnerable countries depend heavily on:

- Long-term concessional finance
- Stable political signals on climate commitment
- Positive risk assessments by international lenders

When a major power disengages from global or plurilateral climate initiatives, it can subtly weaken confidence in the durability of international climate cooperation. This may lead to:

- Greater caution among lenders
- Slower project approvals
- Higher cost of capital

These effects are felt most acutely by African countries, least-developed economies and small island states, which already face structural disadvantages in accessing global finance.

Thus, ISA's challenge becomes one of maintaining trust and momentum, rather than merely replacing lost funds.

f. Implications for India's Solar Manufacturing Ecosystem

India's solar manufacturing sector remains largely insulated from such external developments.

- Growth is driven primarily by strong domestic demand
- Supported by consistent policy measures and production-linked incentives
- Gradual expansion across cells, modules and early-stage upstream components

Crucially, India's solar manufacturing ecosystem does not depend on any single external country for market access or critical inputs. Therefore, withdrawal from ISA by another country does not directly:

- Raise production costs
- Disrupt supply chains
- Slow domestic capacity expansion

g. Impact on Solar Investments Within India

Solar investments in India are unlikely to be affected in the short to medium term.

- Most large projects are backed by long-term power purchase agreements
- Revenue certainty is ensured through central and state agencies
- Investor confidence is anchored in structural fundamentals

Key drivers such as rising electricity demand, policy continuity and tariff visibility remain intact. As a result, domestic solar deployment continues on a strong and stable trajectory.

h. Indirect Challenges for India

The subtler challenge lies in external markets, particularly in developing regions.

- ISA has helped open solar opportunities in Africa and other Global South regions
- Indian firms have leveraged these platforms to expand overseas

If confidence weakens and project pipelines slow in these regions:

- Indian companies may face fewer international opportunities
- India's role as a facilitator of South-led climate solutions becomes diplomatically more demanding

This represents a strategic and leadership challenge, rather than an immediate economic disruption.

i. Implications for Global Climate Governance

Such episodes reflect a trend towards a more fragmented and decentralised climate governance system.

- Leadership by major powers has become less predictable
- Greater responsibility shifts to middle powers and developing country coalitions

In this context, platforms like ISA gain importance as vehicles for collective action. However, this also places greater pressure on them to deliver results despite constrained resources and uncertain geopolitical backing.

For India, this dual reality increases both its influence and responsibility in shaping global climate outcomes.

j. Way Forward

Going ahead, ISA must prioritise:

- Strengthening innovative climate finance instruments, such as blended finance and credit guarantees
- Shielding vulnerable countries from fluctuations in global political commitment

India can reinforce ISA by:

- Diversifying partnerships with European countries and multilateral development banks
- Engaging regional financial institutions
- Maintaining domestic credibility through progress in grid integration, energy storage and transmission expansion

By consolidating ISA as a dependable platform for the Global South, India can transform a moment of uncertainty into an opportunity for sustained and credible climate leadership.

Conclusion

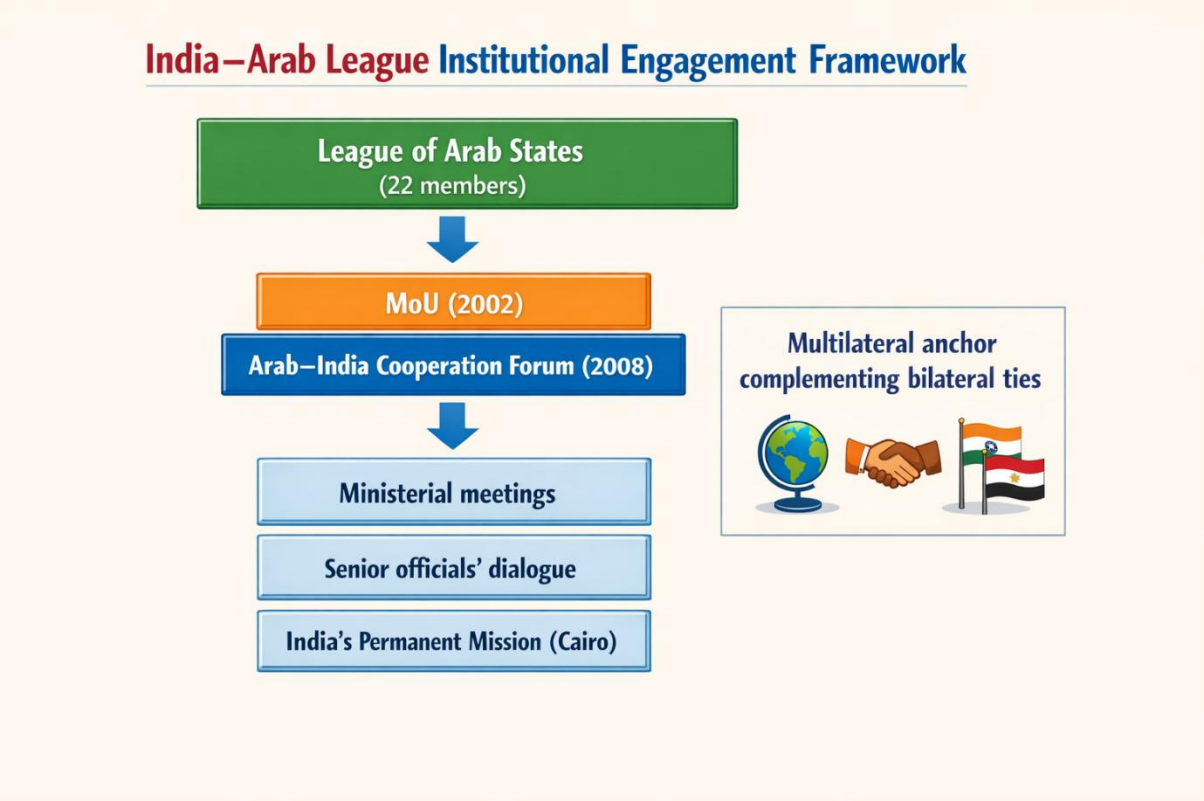
The International Solar Alliance represents a novel model of climate cooperation led by the Global South, focused on practical solutions rather than abstract commitments. While withdrawal by a major power may not weaken its finances, it tests the Alliance's credibility and momentum. For India, this moment underscores both a challenge and an opportunity—to reinforce ISA through innovation, partnerships and delivery, and to consolidate its role as a credible leader in shaping an equitable global energy transition.

4. India–Arab League Relations: Bridging Cultures and Creating Opportunities

a. Introduction

India–Arab League relations constitute one of the most consequential regional partnerships in India's foreign policy architecture. Anchored in centuries-old civilisational contacts, maritime trade routes, cultural exchanges, and enduring people-to-people linkages, the relationship has steadily evolved beyond its historical foundations.

In the contemporary period, this engagement has acquired a distinctly strategic character, encompassing energy security, trade and investment, defence cooperation, maritime security, counter-terrorism, and emerging digital domains. As India's global footprint expands and West Asia continues to occupy a pivotal position in global energy flows and geopolitical stability, engagement with the Arab League has assumed a central role in India's external relations. The partnership today reflects not only shared interests but also a convergence of long-term strategic visions.



b. The Arab League and India's Institutional Engagement

i. The League of Arab States

The League of Arab States, commonly known as the Arab League, was established in 1945 as a regional organisation representing Arab countries of West Asia and North Africa. It comprises twenty-two member states and seeks to promote political coordination, economic cooperation, cultural integration, and regional stability among its members.

The Arab League functions as a collective diplomatic platform, allowing member states to articulate common positions on regional and global issues while preserving national sovereignty.

ii. Framework of India–Arab League Engagement

India's engagement with the Arab League was institutionalised through a Memorandum of Understanding signed in 2002. This cooperation was further strengthened by the establishment of the

Arab–India Cooperation Forum in 2008, which provides a structured mechanism for dialogue across political, economic, and cultural domains.

Regular meetings at the level of Foreign Ministers and senior officials have enhanced diplomatic coordination. India's Ambassador to Egypt serves as India's Permanent Representative to the Arab League, underscoring the importance New Delhi attaches to this regional grouping.

This institutional framework places India's West Asia policy within a multilateral regional context, complementing its strong bilateral relations with individual Arab states.

c. Key Pillars of India–Arab League Relations

i. Energy Security as the Core Pillar

Energy security remains the most critical foundation of India–Arab League relations. Arab countries collectively supply nearly three-fifths of India's crude oil imports and around seventy per cent of its natural gas requirements. Additionally, more than half of India's fertiliser imports originate from the region, linking West Asia directly to India's agricultural stability.

Key energy partnerships include:

- Iraq, Saudi Arabia, and the United Arab Emirates as major crude oil suppliers
- Qatar as a long-term and reliable supplier of liquefied natural gas
- Participation of the United Arab Emirates in India's strategic petroleum reserves

These arrangements ensure energy affordability, supply stability, and insulation from global market disruptions, thereby supporting sustained economic growth.

ii. Trade, Investment and Economic Cooperation

Economic engagement constitutes the backbone of India–Arab League relations. Bilateral trade between India and Arab League countries has crossed USD 240 billion annually, making the region one of India's largest trading partners. The United Arab Emirates stands out as India's most significant commercial partner within the Arab world.

Key dimensions of economic cooperation include:

- Comprehensive Economic Partnership Agreements with countries such as the UAE and Oman
- Large-scale investments by Arab sovereign wealth funds in Indian infrastructure, ports, logistics, renewable energy, and digital sectors
- Emergence of the India–Middle East–Europe Economic Corridor as a new geoeconomic initiative enhancing connectivity and supply-chain resilience

These developments position India as a central node in transcontinental trade networks linking Asia, West Asia, and Europe.

iii. Strategic and Defence Cooperation

India's engagement with Arab League countries has expanded decisively into the strategic and defence domain. Strategic partnerships have been formalised with countries such as Oman, the United Arab Emirates, Saudi Arabia, Egypt, and Qatar.

Defence cooperation encompasses:

- Structured defence dialogues and institutional mechanisms
- Joint military exercises and naval exchanges
- Logistics support and port access arrangements

India has also emerged as a credible defence exporter, offering platforms such as the Tejas light combat aircraft, missile systems like BrahMos and Aakash, and artillery equipment.

A particularly significant asset is access to Duqm Port in Oman, which enhances India's naval operational reach and maritime domain awareness in the Indian Ocean Region.

iv. Maritime Security and Indian Ocean Cooperation

Maritime cooperation represents a vital pillar of India–Arab League relations. A substantial proportion of India's external trade transits through critical Sea Lines of Communication such as the Red Sea, the Suez Canal, and the Gulf of Aden.

Cooperation in this domain includes:

- Joint anti-piracy operations
- Maritime surveillance and information sharing
- Capacity building for regional maritime security

India's approach is guided by the SAGAR doctrine—Security and Growth for All in the Region—reinforcing its role as a net security provider in the Indian Ocean.

v. Counter-Terrorism and Security Convergence

India and Arab League countries face shared threats from terrorism, extremism, and radicalisation. This common security challenge has led to expanding cooperation in counter-terrorism efforts.

Key areas of convergence include:

- Intelligence sharing and capacity building
- Coordinated action against terror financing
- Diplomatic support for India's concerns regarding cross-border terrorism

This shared security outlook has strengthened normative alignment and enhanced mutual trust in multilateral forums.

vi. Digital, Financial and Emerging Areas of Cooperation

India–Arab League relations are steadily expanding into new domains shaped by technological transformation. India's digital public infrastructure has found increasing acceptance in the Arab world.

Notable areas include:

- Adoption of Unified Payments Interface and RuPay systems
- Rupee–Dirham settlement mechanisms to reduce transaction costs
- Collaboration in fintech, cyber security, space applications, drones, and emerging defence technologies

These developments reflect India's transition from a traditional market to a technology and solutions partner.

vii. Alignment of Long-Term Strategic Visions

A defining feature of India–Arab League relations is the convergence of long-term national visions. Saudi Arabia's Vision 2030, the UAE's Centennial 2071, Oman's Vision 2040, and India's Viksit Bharat 2047 emphasise diversification, innovation, human capital development, and sustainability.

India is increasingly viewed as a strategic partner in achieving these ambitions, strengthening long-term engagement and strategic trust.

d. Challenges and Constraints

Despite its strengths, the partnership faces certain structural and geopolitical challenges:

- Political instability and conflicts in parts of West Asia
- India's heavy dependence on the region for energy supplies
- Intra-regional rivalries among Arab states
- Intensified geopolitical competition involving extra-regional powers

Addressing these challenges requires calibrated diplomacy, diversification strategies, and strategic autonomy.

e. Way Forward

The future trajectory of India–Arab League relations lies in deepening strategic trust while broadening cooperation. Priority areas include:

- Securing long-term energy partnerships alongside diversification of India's energy mix
- Further institutionalisation of defence and maritime cooperation
- Sustained political support for economic corridors and connectivity projects
- Leveraging digital and financial integration for high-growth opportunities
- Active diplomatic engagement to promote regional stability

Conclusion

India–Arab League relations have evolved from historically rooted interactions into a comprehensive strategic partnership. As India consolidates its position as a major global power and the Arab world undergoes economic and strategic transformation, this partnership promises mutual growth, stability, and strategic depth.

Shaped by shared interests, converging visions, and growing trust, India–Arab League relations are poised to remain a cornerstone of India's engagement with West Asia in the decades ahead.

GS Paper III: Economics

1. Advanced Chemistry Cell (ACC) Manufacturing in India

a. Understanding Advanced Chemistry Cells (ACC)

Advanced Chemistry Cells (ACC) are next-generation rechargeable battery cells designed to store electrical energy efficiently, safely, and at high density. They form the technological backbone of electric mobility and renewable energy systems, including electric vehicles (EVs), grid-scale energy storage, and integration of solar and wind power.

Unlike conventional batteries, ACCs rely on advanced electro-chemical technologies, most notably lithium-ion chemistry and its emerging variants such as lithium iron phosphate (LFP) and solid-state batteries. Their key advantage lies in high energy density, which means more energy can be stored in a smaller and lighter package—an essential requirement for EVs and modern power systems.

In contrast, traditional lead-acid batteries use outdated chemistry, are bulky, heavy, and offer limited storage capacity. While they remain suitable for inverters and basic automotive uses, they are inadequate for electric mobility or large-scale renewable integration. For India's clean energy transition, ACC batteries are indispensable rather than optional.

b. Strategic Importance of ACC Manufacturing for India

India currently imports the overwhelming majority of its battery cells, with heavy dependence on China for finished cells, battery components, and processing technologies. This dependence creates multiple vulnerabilities.

- **Economic vulnerability:** Import dependence increases costs and limits domestic value addition.
- **Strategic vulnerability:** Supply disruptions can directly derail India's EV and renewable energy ambitions.
- **Industrial vulnerability:** Absence of domestic ACC manufacturing excludes India from one of the fastest-growing global manufacturing sectors.

Indigenous ACC manufacturing is therefore essential to:

- Reduce import dependence
- Strengthen energy security
- Enable large-scale EV adoption
- Support the Make in India programme
- Generate high-skill manufacturing employment

Without domestic battery capability, India's clean energy transition remains structurally fragile.

c. ACC Production Linked Incentive (PLI) Scheme: Design and Objectives

To catalyse domestic battery manufacturing, the Government of India launched the ACC Production Linked Incentive (PLI) Scheme in 2021 under the Ministry of Heavy Industries.

Key design features of the scheme include:

- **Total financial outlay:** ₹18,100 crore
- **Target capacity:** 50 gigawatt-hours (GWh) of battery manufacturing
- **Incentive structure:** Linked to actual production and sales, not investment announcements

The output-linked design was intended to ensure that incentives reward real manufacturing outcomes and prevent the creation of non-performing assets.

d. Operational Mechanism of the ACC-PLI Scheme

Under the scheme, incentives are disbursed only after battery cells are manufactured and sold, with a maximum incentive ceiling of approximately ₹2,000 per kilowatt-hour.

Participation conditions were deliberately stringent:

- **Minimum investment requirement:** ₹1,100 crore
- **Domestic value addition targets:**
  - 25% within two years
  - 60% within five years
- **High net-worth criteria** per unit of capacity

The policy intent was to attract large, financially strong firms capable of establishing globally competitive giga-factories.

e. Implementation Reality: Outcomes on the Ground

Despite ambitious targets, actual outcomes have fallen short.

- Against the envisaged 50 GWh capacity, only around 30 GWh was finally allocated.
- Of this, merely about 1.4 GWh is currently operational.
- Around 8.6 GWh remains under delayed development.
- No firm has yet commenced large-scale commercial battery sales, resulting in zero incentive disbursement so far.

This significant gap between policy intent and industrial delivery points to deeper structural challenges beyond fiscal incentives.

f. Structural Constraints Limiting ACC Manufacturing

Several interlinked structural constraints have impeded progress.

i. Technology Deficit

The most fundamental limitation is the absence of indigenous battery cell technology. ACC manufacturing requires deep expertise in:

- Cell chemistry
- Precision manufacturing
- Proprietary intellectual property

Many selected firms lacked prior ACC experience and depended heavily on foreign technical partners.

ii. High Entry Barriers

Stringent net-worth requirements and auction-based capacity allocation excluded mid-sized battery manufacturers who possessed relevant experience and could have scaled up with targeted support.

iii. Weak Battery Ecosystem

Battery manufacturing depends on a broader ecosystem, including:

- Critical minerals such as lithium, cobalt, and nickel
- Refining and processing capacity
- Cathode, anode, and separator manufacturing

These upstream and midstream capabilities remain underdeveloped in India.

iv. Continued Dependence on China

China dominates mineral processing, manufacturing equipment, and technical know-how. Delays in visas for Chinese engineers further slowed project execution, exposing the risks of ecosystem dependence.

g. Economic and Strategic Implications

Slow progress in ACC manufacturing has wide-ranging consequences:

- Slower electric vehicle adoption
- Continued import dependence and trade imbalance
- Limited domestic value addition
- Reduced capacity to integrate renewable energy efficiently into the power grid

India risks missing a critical window to integrate into global battery supply chains, while inadequate storage capacity weakens the reliability of renewable-based power systems.

h. Lessons from Global Battery Manufacturing Models

International experience shows that successful battery manufacturing rests on ecosystem depth rather than incentives alone.

- **China:** Built an end-to-end ecosystem covering mining, refining, manufacturing, and recycling
- **South Korea:** Invested heavily in R&D and specialised industrial clusters
- **Japan:** Focused on long-term technological leadership and innovation

In contrast, India's approach has relied largely on financial incentives without parallel ecosystem development, limiting the scheme's effectiveness.

i. Way Forward: Building Sustainable ACC Capability

A sustainable approach to ACC manufacturing requires policy reorientation.

- **Lower entry barriers** to accommodate specialised battery firms with proven technical capability
- **Direct support for R&D**, technology acquisition, and skill development
- **Ecosystem investment** in mineral processing, recycling, and component manufacturing
- **Strategic technology partnerships and joint ventures** to bridge short-term gaps
- **Supply chain diversification** to reduce geopolitical vulnerability

ACC policy must also align with national priorities such as the EV policy, the National Energy Storage Mission, and Sustainable Development Goals 7 and 9, which emphasise clean energy and industrial innovation.

Conclusion

India's ACC manufacturing push reflects strong strategic intent but limited industrial depth. Battery manufacturing is not merely about capacity targets or fiscal incentives; it requires technology ownership, integrated supply chains, and a skilled ecosystem.

Without these foundations, incentive-driven schemes risk producing delayed projects rather than resilient manufacturing capabilities. A decisive shift from incentive-centric to ecosystem-centric policy is essential if India is to secure its position in the global clean energy and electric mobility landscape.

2. European Union Regulatory Regime and Its Impact on India–EU Trade

a. Introduction

In contemporary international trade, market access is no longer determined primarily by customs duties. Increasingly, it is shaped by rules, standards, and regulatory requirements. While earlier forms of protectionism relied on tariffs and quotas, advanced economies today use regulatory frameworks to influence who can trade, what can be traded, and under what conditions.

The European Union represents the most prominent example of this shift. Its expanding regulatory regime—especially in areas related to climate change, sustainability, environmental protection, and corporate responsibility—has emerged as the single most significant constraint on India's trade engagement with Europe.

b. How the European Union Shapes Global Trade Through Regulation

The European Union sets some of the world's highest regulatory standards in environmental protection, climate mitigation, human rights, corporate accountability, and product safety. These standards apply not only to European producers but to all firms seeking access to the EU market.

As a result, regulatory compliance has become a de facto gatekeeper to trade with Europe. In practice, this means that market access is increasingly determined by a country's regulatory capacity and institutional preparedness, rather than by tariff concessions alone.

c. Why Regulations Matter More Than Tariffs for India

A defining feature of India–EU trade is that most Indian exports already enter the European market at relatively low tariff rates. Consequently, further tariff reductions through a Free Trade Agreement offer only marginal additional gains.

In contrast, regulatory compliance imposes continuous and often high costs. Exporters must invest in

- documentation and reporting systems,
- certification and verification mechanisms, and
- ongoing monitoring of supply chains.

These costs fall disproportionately on micro, small and medium enterprises (MSMEs), which form the backbone of India's export sector.
Therefore, for India, regulatory barriers are far more consequential than tariff barriers in determining real and sustained market access to the European Union.

d. Key European Union Regulations Affecting India

i. Carbon Border Adjustment Mechanism (CBAM)

The Carbon Border Adjustment Mechanism imposes a charge on imports based on the carbon emissions generated during production. It primarily targets energy-intensive sectors such as steel, aluminium, cement, fertilisers, and related industrial goods.

For India, CBAM raises the cost of exporting steel and aluminium to Europe. Indian producers may be forced to absorb part of this cost by lowering prices, leading to reduced profit margins. In effect,

CBAM functions as a carbon-linked trade barrier, posing difficulties for a developing economy that is still transitioning towards low-carbon manufacturing.

ii. European Union Deforestation Regulation (EUDR)

The EU Deforestation Regulation aims to prevent products linked to deforestation from entering the European market. Exporters must provide detailed traceability data, linking products to the exact land on which they were produced.

This poses particular challenges for India, where agriculture is dominated by small and fragmented landholdings. Establishing precise farm-level traceability across millions of small farmers significantly increases compliance costs and administrative complexity for Indian agricultural exports.

iii. Corporate Sustainability Due Diligence Directive (CSDDD)

Under the Corporate Sustainability Due Diligence Directive, companies must assess their entire supply chains for risks related to human rights violations, environmental harm, and unethical practices.

For Indian exporters, this creates multiple difficulties:

- collecting reliable data across long and fragmented supply chains,
- protecting commercially sensitive information, and
- bearing high compliance costs without adequate institutional support.

Small and medium enterprises face the heaviest burden, as they lack the financial and organisational capacity to meet such extensive requirements.

e. Structural Asymmetry in Regulatory Capacity

A core problem in India–EU trade is the asymmetry in regulatory capacity. The European Union possesses advanced institutions, strong enforcement mechanisms, and the financial ability to absorb compliance costs. India's regulatory systems, by contrast, are still evolving.

European agriculture is characterised by larger and more consolidated farms, while Indian agriculture is dominated by smallholders. European MSMEs are relatively resilient, whereas Indian MSMEs are far more vulnerable to regulatory shocks.
This structural imbalance creates an unequal trading environment, even under conditions of formal trade liberalisation.

f. Impact on India's Trade and Industrial Sector

The cumulative impact of EU regulations is a decline in the competitiveness of Indian exports. Manufacturing costs rise, compliance burdens increase, and profit margins shrink—especially for MSMEs.

In several sectors, regulatory barriers have the potential to neutralise the benefits of tariff reductions, effectively shifting trade advantages towards developed economies with stronger regulatory infrastructure. As a result, expected gains from trade liberalisation may not fully materialise.

g. Role of the India–European Union Trade Agreement

The India–EU trade agreement provides an important institutional platform to address regulatory challenges. It enables

- structured dialogue on standards,
- scope for mutual recognition of conformity assessments,
- phased or flexible implementation of regulations, and
- provision of technical assistance and capacity-building.

However, unless regulatory concerns are addressed meaningfully, the agreement risks delivering asymmetric outcomes. Tariff concessions alone cannot offset deep regulatory disadvantages.

h. Way Forward: India's Strategic Response

Domestically, India must invest in

- improving environmental and quality standards,
- developing robust traceability and data systems, and
- supporting MSMEs through finance, technology, and institutional capacity-building. Accelerating the transition to low-carbon manufacturing is also essential.

Externally, India should seek flexibility and transitional arrangements within EU regulations, push for harmonisation of standards, and consistently highlight developmental differences. Continuous engagement through trade and regulatory dialogue is crucial to prevent regulations from becoming disguised trade barriers.

Conclusion

The European Union's regulatory regime reflects a fundamental shift from tariff-based protection to rule-based control of global trade. For India, the central challenge lies in adapting to these rules without undermining growth, exports, and livelihoods.

How effectively India manages regulatory barriers will determine whether India–EU trade evolves into a genuinely balanced and mutually beneficial partnership, or remains structurally unequal despite formal trade liberalisation.

GS Paper III: Environment

1. Aravalli Hills and 'Strategic Exemptions': Environmental Governance at a Crossroads

a. Introduction

The debate surrounding the Aravalli Hills brings into sharp focus a deeper structural challenge in India's environmental governance. It highlights how conflicts between ecological protection, climate responsibility, and strategic or industrial imperatives are increasingly resolved not through transparent legal standards, but through loosely defined claims of "strategic interest". Such strategic exemptions, often justified in the name of national security or critical mineral needs, tend to bypass established environmental safeguards.

This approach raises fundamental concerns relating to the rule of law, environmental justice, and the long-term sustainability of development. The Aravalli case, therefore, extends far beyond a single region and offers a lens to examine how India governs its natural resources under growing economic, industrial and geopolitical pressures.

b. Ecological Significance of the Aravalli Hills

The Aravalli range is among the oldest mountain systems in the world and plays a vital ecological role across north-western India.

i. Environmental and Climatic Functions

- It supports groundwater recharge in Rajasthan, Haryana and the National Capital Region.
- It acts as a natural barrier against the eastward spread of desertification from the Thar Desert.
- It moderates local climate, improves air quality and sustains forests, scrublands and wildlife corridors.

ii. Human and Developmental Relevance

- These functions are directly linked to water security, climate resilience and habitability.
- Degradation of the Aravallis affects some of India's most densely populated and economically important regions.

c. Existing Environmental Stress in the Region

The Aravalli ecosystem is already under severe and long-standing pressure.

i. Sources of Degradation

- Decades of legal and illegal mining have scarred large tracts of land.
- Rapid urban expansion and infrastructure projects have fragmented habitats.
- Deforestation and altered drainage patterns have weakened natural recharge systems.

ii. Fragile Baseline

- Groundwater levels have declined sharply in many areas.
- Even limited regulatory relaxation risks irreversible ecological damage.

In such fragile landscapes, precaution and strict protection become more essential rather than dispensable.

d. Minerals and Strategic Considerations

i. Mineral Potential of the Aravallis

The Aravalli region is believed to contain a variety of mineral resources.

Types of Minerals

- Base metals and bulk construction materials.
- Certain minerals classified as strategically important, linked to renewable energy, advanced manufacturing and defence technologies.

ii. Strategic Rationale

From the State's perspective, mineral extraction is framed as a strategic necessity.

Security and Self-Reliance Arguments

- Heavy dependence on imported critical minerals creates supply vulnerabilities.
- Global supply chains are increasingly shaped by geopolitics and export controls.
- Domestic access is presented as essential for defence preparedness, energy transition and industrial self-reliance.

This rationale brings national security concerns into direct tension with environmental protection in ecologically sensitive landscapes.

e. Judicial and Administrative Responses

i. The Supreme Court's Position

The Supreme Court has consistently acknowledged the ecological importance of the Aravalli Hills.

Protective Interventions

- Attempts to define the extent of the Aravalli range using objective criteria.
- Restrictions on new mining activity and prohibition of mining in core or inviolate areas.
- Emphasis on sustainable mining plans.

Limited Strategic Exceptions

- Narrow exemptions have been allowed for minerals deemed critical for strategic or atomic purposes.
- These are described as strategic exemptions, intended to meet genuine national needs.

ii. Administrative Practice

Parallel to judicial oversight, executive discretion has expanded.

Use of Executive Flexibility

- Environmental clearance processes allow exemptions from public consultation for strategic projects.
- Office memoranda are used to fast-track approvals.
- Post-facto environmental clearances have become more common.

This shifts decision-making from transparent, rule-based processes to discretionary executive action.

f. The Core Problem with Strategic Exemptions

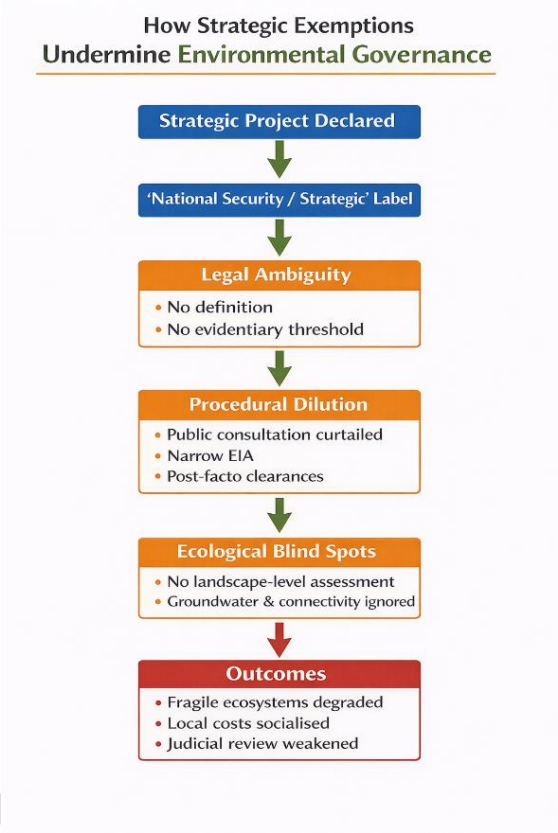
i. Absence of Clear Legal Standards

India lacks a binding legal framework to assess when strategic interests justify environmental dilution.

Legal Gaps

- No clear evidentiary thresholds or proportionality tests.
- No mandatory assessment of less harmful alternatives.
- National security is often treated as self-evident and beyond scrutiny.

This weakens judicial review and democratic oversight.



ii. Erosion of Environmental Safeguards

Strategic exemptions often dilute core procedural protections.

Procedural Weakening

- Curtailment of public participation.
- Narrowed environmental impact assessments.
- Ignoring cumulative and long-term impacts.

This undermines principles such as the precautionary principle, intergenerational equity and the public trust doctrine.

iii. Fragmented Landscape Governance

Project-specific exemptions treat ecosystems as isolated units.

Ecological Blind Spots

- Lack of landscape-level assessment.
- Failure to account for connectivity, groundwater recharge and desertification control.

This fragmented approach does not reflect ecological reality.

g. Climate Commitments and Industrial Pressures

India faces a genuine policy dilemma.

i. Competing Imperatives

- Climate commitments require protection of ecosystems, carbon sinks and resilience.
- Industrial growth and strategic autonomy require minerals and infrastructure.

ii. Risks of Ad Hoc Resolution

- Strategic exemptions shift environmental costs onto fragile ecosystems and local communities.
- Regulatory uncertainty increases.
- Credibility of climate commitments is weakened by signalling that safeguards are negotiable.

h. National Significance of the Aravalli Case

The debate is emblematic of a broader trend in environmental governance.

Systemic Trends

- Dilution of environmental regulations in the name of strategic urgency and ease of doing business.
- Shrinking space for scientific assessment and public oversight.
- Normalisation of exceptions even in ecologically sensitive areas.

The issue is therefore about how India balances growth, security and sustainability across its landscapes.

i. Moving from Discretion to Rule-Based Governance

A sustainable resolution demands institutional reform.

i. Legal and Regulatory Reforms

- Clear legal standards to define genuine strategic necessity.
- Objective criteria subject to transparency and judicial review.

ii. Strengthening Environmental Assessment

- Mandatory landscape-level and cumulative impact assessments.
- Special focus on groundwater, climate resilience and ecological connectivity.

iii. Enhancing Transparency and Alternatives

- Public disclosure of environmental risks.
- Serious evaluation of alternatives such as recycling, import diversification and exploration in less sensitive regions.

iv. Coherent Mineral Strategy

- A long-term mineral policy aligned with ecological limits and strategic needs.

Conclusion

The Aravalli Hills debate exposes a critical fault line in India's environmental governance. While national security and mineral self-reliance are legitimate priorities, pursuing them through opaque and discretionary strategic exemptions undermines the rule of law and risks long-term ecological damage.

A credible path forward lies in rule-based, science-driven and transparent decision-making, where strategic needs are balanced against environmental protection through accountability rather than exception. Only such an approach can reconcile development imperatives with the constitutional promise of environmental protection for present and future generations.

2. U.S. Withdrawal from Global Climate Frameworks and Its Impact on Climate Action

a. Introduction

Global climate action rests on three interlinked pillars: multilateral cooperation, shared scientific understanding, and predictable climate finance. The United Nations Framework Convention on Climate Change (UNFCCC) provides the political and legal architecture for collective action, while the Intergovernmental Panel on Climate Change (IPCC) supplies authoritative scientific assessments that inform negotiations, national policies, and even judicial reasoning.

A withdrawal by the United States—the world's largest historical emitter and a key architect of the post-war international order—therefore has implications that go far beyond its domestic policy choices. Such a move affects trust, reciprocity, and the overall credibility of global climate governance.

Understanding these consequences is essential to assessing the future trajectory of international climate action.

b. Drivers Behind the U.S. Exit from UNFCCC and IPCC

The impulse to withdraw from global climate frameworks is shaped primarily by domestic political and ideological factors.

i. Sovereignty and economic concerns

- International climate commitments are perceived as constraints on national sovereignty.
- Emission limits are framed as threats to industrial competitiveness and fossil fuel–based growth.

ii. Ideological contestation of climate science

- Climate regulation is portrayed as economically burdensome.
- Scientific consensus is sometimes questioned or politicised.

iii. Political economy pressures

- Strong influence of coal, oil, and gas lobbies.
- Climate policy becomes polarising in electoral politics.

iv. National interest narrative

- Multilateral regimes are seen as imposing disproportionate obligations on developed countries.
- Flexibilities available to emerging economies are portrayed as unfair.

c. What Withdrawal from the UNFCCC Implies

i. Legal and Institutional Consequences

Loss of Party status

- The U.S. would no longer be a Party to the UNFCCC.
- Participation in Conference of Parties (COP) negotiations would cease.

Automatic exit from subsidiary agreements

- Withdrawal from UNFCCC entails exit from all protocols under it.
- Includes the Paris Agreement.

ii. Impact on Accountability Mechanisms

Exit from transparency and reporting systems

- No participation in global stocktake processes.
- Weakening of mutual monitoring and peer pressure.

Broader implication

- Climate governance relies on trust and reciprocity rather than enforcement.
- U.S. exit weakens the credibility of this cooperative framework.

d. Implications of Distancing from the IPCC

The IPCC plays a distinct but critical role in climate governance by synthesising global scientific knowledge.

i. Institutional impact

- U.S. would no longer officially nominate experts.
- Reduced influence over assessment processes.

ii. Scientific contribution

- American scientists may still contribute informally.
- Expertise is not lost, but institutional ownership is weakened.

iii. Deeper concern

- Weakening of the science–policy interface.
- Shared scientific benchmarks lose political authority when major powers disengage.

e. Impact on Global Climate Finance

Climate finance is among the most contentious pillars of climate negotiations.

i. Role of multilateral funds

- Green Climate Fund and Global Environment Facility operate under UNFCCC.
- Support mitigation and adaptation in developing countries.

ii. Consequences of U.S. exit

- Reduced influence over design and allocation of climate finance.
- Greater political ease for future administrations to withhold contributions.

iii. Trust deficit for developing countries

- Finance targets have already expanded beyond the $100 billion goal.
- Withdrawal by a major historical emitter raises equity concerns.

f. Effects on International Climate Cooperation

Climate negotiations function on reciprocal expectations.

i. Disruption of collective balance

- Other countries may delay or dilute commitments.
- Equity-based demands from developing nations intensify.

ii. Political cover for climate laggards

- Withdrawal legitimises inaction by others.
- Slows urgent global emission reductions.

iii. Fragmentation of governance

- Shift towards regional, bilateral, or minilateral arrangements.
- Weakening of universality and legitimacy of UN-led frameworks.

g. Economic and Strategic Costs for the United States

Ironically, withdrawal may harm U.S. interests.

i. Economic uncertainty

- Policy volatility increases investor risk.
- Long-term planning becomes difficult.

ii. Trade and competitiveness risks

- Exposure to carbon border adjustment mechanisms.
- Climate-linked trade and finance standards disadvantage non-aligned exporters.

iii. Strategic costs

- Loss of leadership in setting global rules.
- Reduced influence over emerging green industrial standards.

h. Options for Policymakers, Especially in Developing Countries

i. International Strategies

Strengthen issue-based coalitions

- Focus on adaptation, finance, and equity.

Alternative leadership

- European Union, emerging economies, and vulnerable country groups.
- Role of cities, firms, and sub-national actors.

ii. Domestic Resilience

Invest in climate adaptation

- Disaster preparedness and early-warning systems.
- Climate-resilient agriculture and heat action plans.

Reduce dependence on uncertain global finance

- Integrate climate resilience into development planning.

Conclusion

Withdrawal of the United States from the UNFCCC and IPCC does not halt global climate action, but it weakens trust, slows cooperation, and raises the cost of collective response. Climate change is a global commons challenge that cannot be addressed through unilateralism.

In the long run, even major powers risk economic and strategic losses by distancing themselves from multilateral climate governance. Sustainable climate action depends not only on emission targets, but on credibility, cooperation, and a shared sense of responsibility.

3. Artificial Intelligence and Its Environmental Impact

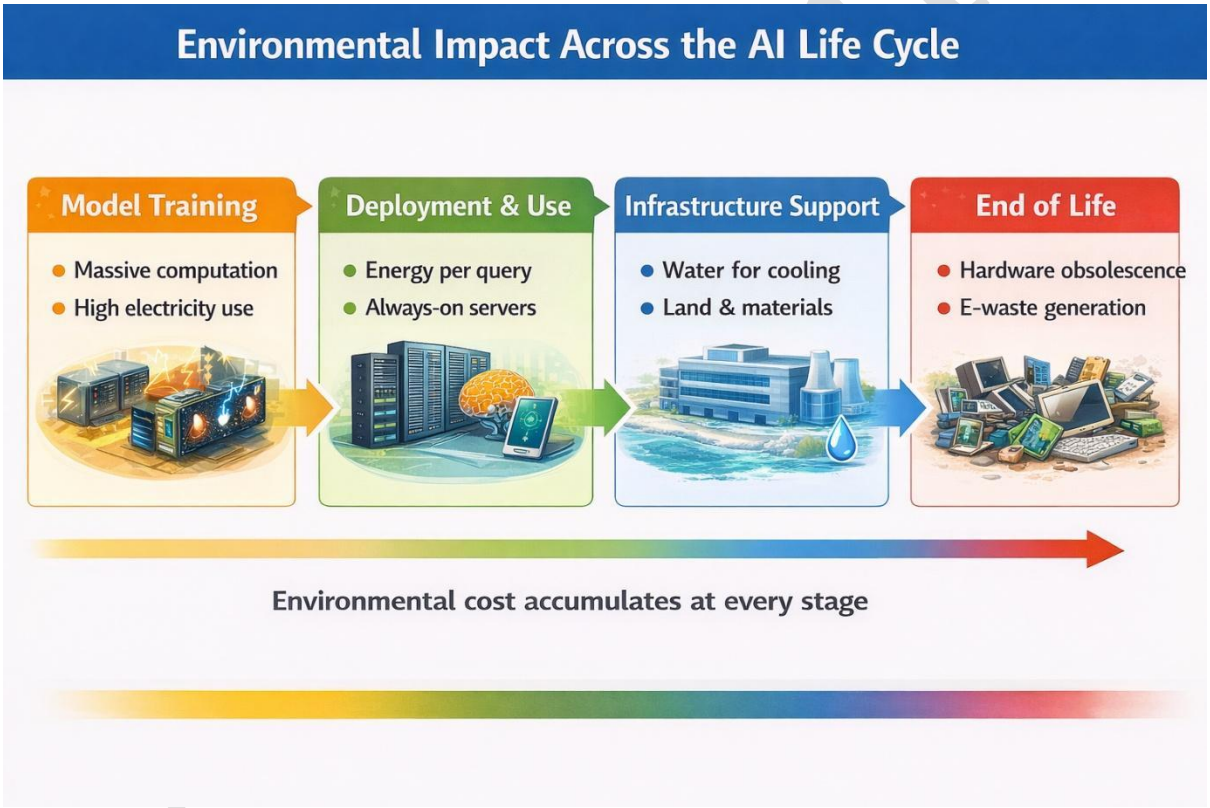
a. Artificial Intelligence and the Sustainability Question

Artificial Intelligence has moved rapidly from a specialised technological field to a foundational infrastructure shaping modern societies. It is now embedded in healthcare diagnostics, agricultural forecasting, education platforms, financial systems, governance processes, and national security architectures. India, too, views Artificial Intelligence as a key driver of productivity, efficiency, and economic growth.

However, the dominant narrative surrounding Artificial Intelligence focuses almost entirely on its benefits and strategic potential. The environmental costs associated with its development and deployment remain largely invisible in public discourse.

In reality, Artificial Intelligence systems rely on energy-intensive computation, water-intensive cooling mechanisms, and resource-heavy digital infrastructure. These dependencies contribute to carbon emissions, ecological stress, and climate change.

Understanding the environmental footprint of Artificial Intelligence is therefore essential if technological progress is to remain aligned with sustainability, responsible governance, and intergenerational equity.



b. Environmental Impact Across the AI Life Cycle

i. Energy Consumption

Artificial Intelligence systems require vast computational power, provided by high-performance servers housed in large data centres.

- Training large AI models involves repeated processing of massive datasets, consuming significantly more electricity than conventional digital services.
- Even routine use of AI-enabled applications often requires higher energy per query compared to traditional internet searches.
- As model complexity increases, energy demand rises proportionately.

At its core, Artificial Intelligence is computationally intensive, and higher computational complexity directly translates into higher energy consumption.

ii. Carbon Emissions

Much of the electricity powering global data centres continues to be generated from fossil fuels.

- Training a single large AI model can generate carbon emissions running into hundreds of thousands of kilograms of carbon dioxide.
- Continuous scaling of AI across sectors magnifies cumulative emissions.
- These emissions undermine climate mitigation efforts and sustainable development goals.

As Artificial Intelligence expands, its carbon footprint increasingly resembles that of energy-intensive industrial sectors.

iii. Water Consumption

Artificial Intelligence infrastructure depends heavily on freshwater resources.

- Data centres require large volumes of water for cooling servers and preventing overheating.
- Globally, AI-driven data centres consume billions of cubic metres of water annually.
- This intensifies stress in water-scarce regions, aggravating resource competition.

The environmental burden of Artificial Intelligence thus extends into questions of water security and environmental justice.

iv. Land Use and Electronic Waste

- Expansion of data centres requires land, construction materials, and supporting infrastructure, often altering local land-use patterns.
- AI hardware such as servers and processors has a limited operational lifespan.
- Rapid technological obsolescence generates large quantities of electronic waste containing toxic components.

Improper disposal of e-waste contaminates soil, water bodies, and ecosystems, creating long-term environmental hazards.

c. Global Recognition of AI's Environmental Costs

International institutions increasingly recognise that Artificial Intelligence is not environmentally neutral.

- UNESCO's 2021 Ethics of Artificial Intelligence framework explicitly identifies environmental harm as a key ethical concern.
- The United Nations Environment Programme has highlighted AI's life-cycle environmental footprint.
- The OECD has emphasised the need for systematic measurement of AI-related environmental impacts.

Regulatory responses are also emerging.

- The European Union has introduced transparency requirements related to emissions from data centres.
- Legislative discussions in the United States increasingly address environmental dimensions of advanced digital technologies.

These developments signal that AI governance must extend beyond data and ethics to include sustainability.

d. India's Current Policy Approach

In India, Artificial Intelligence policy discussions are largely framed around innovation, competitiveness, and digital public infrastructure.

- Environmental costs associated with AI are neither systematically measured nor explicitly regulated.
- Large-scale data centres and AI infrastructure remain largely outside environmental regulatory scrutiny.

A major gap exists within India's Environmental Impact Assessment framework. The EIA Notification of 2006 focuses on industrial, mining, and physical infrastructure projects, while AI infrastructure remains largely excluded. As a result, environmental consequences of AI expansion escape formal assessment.

e. Importance of Measuring AI's Environmental Impact

Without reliable measurement, the environmental costs of Artificial Intelligence remain invisible.

- Policymakers lack credible data to design effective regulations.
- Fragmented estimates weaken accountability and public awareness.
- Environmental harm remains externalised.

Effective governance requires clear metrics covering energy use, carbon emissions, water consumption, material intensity, and life-cycle impacts across both training and deployment phases.

Measurement is the foundation upon which credible regulation and responsible innovation must rest.

f. Role of Standards and Disclosure Mechanisms

- Uniform standards are essential for comparability and credibility of environmental impact assessments.
- Common indicators and reporting frameworks should be developed through collaboration among industry, academia, and environmental institutions.
- AI-related environmental impacts can be integrated into Environmental, Social and Governance disclosure norms.

In India, institutions such as the Ministry of Corporate Affairs and the Securities and Exchange Board of India can mandate transparency, aligning digital innovation with responsible business conduct.

g. Towards Sustainable Artificial Intelligence

Reducing AI's environmental footprint does not require abandoning technological progress.

- Algorithmic efficiency can be improved by optimising models and reusing pre-trained systems.
- Data centres can transition towards renewable energy and water-efficient cooling technologies.
- Artificial Intelligence itself can support environmental protection through climate modelling, energy optimisation, and resource management.

Sustainability and innovation are therefore complementary rather than conflicting goals.

h. Way Forward for India

- AI infrastructure should be recognised as an environmental governance issue, not merely a technological domain.
- Large data centres should be brought within environmental assessment frameworks.

- India must develop standardised systems for measuring AI-related environmental impacts aligned with global best practices.
- Mandatory disclosure of AI-related emissions and resource use should be incorporated into corporate reporting norms.
- India's AI strategy must align with the Sustainable Development Goals, particularly those related to climate action and responsible consumption.

Conclusion

Artificial Intelligence holds immense promise for economic development and social transformation. However, unchecked expansion carries significant environmental risks that cannot be ignored. India must move beyond viewing Artificial Intelligence solely as a growth engine and confront its hidden ecological costs. By measuring impacts, strengthening regulation, and promoting sustainable AI practices, technological advancement can be harmonised with environmental sustainability and intergenerational justice.

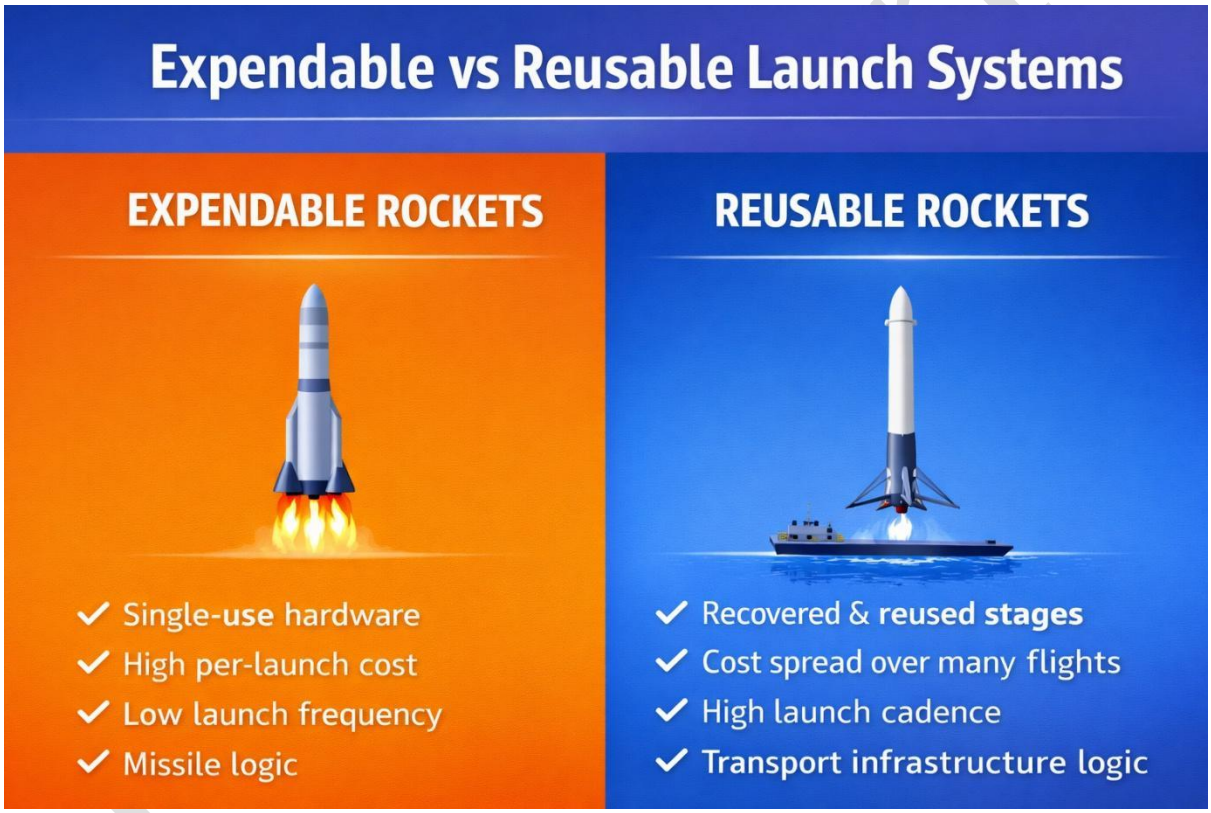
GS Paper III: Science and Technology

1. Reusability in Space Launch Systems

a. Introduction

For decades, access to outer space was based on expendable launch vehicles (ELVs)—rockets that were used once and discarded after a single mission. While technically reliable, this approach made space activities high-cost, resource-intensive, and slow to scale, limiting participation largely to governments and a few strategic missions.

The emergence of reusable launch systems (RLS) represents a structural shift in space technology. By enabling the recovery and reuse of major rocket components, especially the first stage, reusability transforms spaceflight from a one-time engineering feat into a repeatable transportation system, similar in logic to civil aviation. This shift is central to making space activities economically viable, environmentally sustainable, and strategically scalable.



b. Why Space Access Has Historically Been Expensive

Rocket Mass and Fuel Constraint

Rocket design is constrained by a fundamental physical reality: fuel is heavy. To lift fuel, additional fuel is required, which further increases mass. This creates a cascading effect where:

- Over 90% of a rocket's launch mass is fuel and fuel tanks
- Less than 3–4% is useful payload

This relationship is explained by the Tsiolkovsky Rocket Equation, which shows that achieving orbital velocity requires exponentially increasing propellant.

Economic Consequence

As a result:

- Rockets are extremely large and complex
- Manufacturing costs are high
- Each launch consumes enormous material and energy resources

This structural inefficiency historically made space access expensive and infrequent.

c. Why Rockets Traditionally Use Multiple Stages

Logic of Staging

To reduce dead weight, rockets are designed with multiple stages:

- Each stage has its own engines and fuel
- Once fuel is exhausted, the stage is jettisoned
- Remaining stages accelerate more efficiently

Economic Limitation of Expendability

While staging improves performance, it also means:

- High-value hardware is discarded after every launch
- Entire rockets must be rebuilt for each mission

India's PSLV and LVM-3, like most traditional launch vehicles, follow this fully expendable model, which keeps per-launch costs high despite reliability.

d. What Is Reusability in Launch Systems?

Reusability refers to the recovery, refurbishment, and repeated use of rocket components, primarily the first stage, which performs the most energy-intensive phase of flight.

Why the First Stage Matters

- Accounts for 60–70% of total launch vehicle cost
- Operates in dense atmosphere
- Experiences maximum mechanical and thermal stress

Recovering this stage yields the highest economic return.

Philosophical Shift

Reusability marks a shift from:

- Rockets as *disposable missiles*
  to
- Rockets as *reusable transport infrastructure*

e. Methods of Achieving Reusability

Vertical Landing via Retro-Propulsion

- Engines are reignited during descent
- Controlled deceleration and vertical landing
- Requires high-precision guidance and navigation

Example: SpaceX Falcon 9, Blue Origin New Shepard

Winged Re-entry and Horizontal Landing

- Vehicle re-enters atmosphere like a spaceplane
- Lands on a runway similar to an aircraft
- Reduces landing stress and refurbishment needs

Indian context: ISRO's Reusable Launch Vehicle – LEX (Landing Experiment)

Sea-Based Recovery

- Downrange landing on autonomous drone ships
- Enables higher payload capacity for certain missions
- Expands recovery flexibility

f. Technological Enablers of Reusability

Reusability became feasible due to multiple technological advances:

Technology Area	Contribution
Engine design	Throttling, multiple restarts
Materials science	Heat-resistant alloys, thermal protection
Automation & AI	Precision navigation and landing
Additive manufacturing	Faster, cheaper component production
Systems integration	Rapid inspection and turnaround

Together, these advances converted reusability from a conceptual idea into an operational capability.

g. Economic Significance

Cost Reduction

- Hardware cost spread over multiple flights
- Launch cost per kg reduced by 5–20 times
- Enables affordable satellite deployment

Higher Launch Frequency

- Faster turnaround times
- Rapid constellation deployment
- Responsive space missions (defence, disaster management)

Commercial Space Expansion

Lower entry barriers have driven private participation. The global space economy is projected to cross USD 1 trillion in the coming decade.

h. Environmental and Sustainability Dimension

Reusable systems contribute to sustainable space activities by:

- Reducing demand for raw materials
- Lowering manufacturing energy consumption

- Preventing ocean pollution from discarded stages
- Minimising space debris generation

i. Importance for Human Spaceflight

Human missions involve:

- Life-support systems
- Redundancy and safety margins
- Higher mission costs

Reusable systems reduce the marginal cost per mission, making:

- Sustained low Earth orbit presence
- Lunar and interplanetary missions more economically viable.

This is critical for long-term human space exploration.

j. Challenges and Limitations

Reusability has practical constraints:

- Material fatigue due to repeated thermal and mechanical stress
- Inspection and refurbishment costs
- Economic trade-off beyond a certain number of reuses

Hence, success depends not on maximum reuse, but on minimal maintenance and rapid turnaround design.

k. Global Status of Reusable Launch Systems

- SpaceX: First-stage reuse exceeding 30 flights
- Blue Origin: Proven vertical landing technology
- China: Active testing by private firms
- Global trend: Shift towards partially and fully reusable architectures

l. India's Position

Current Progress

- Winged RLV experiments
- Autonomous landing capabilities demonstrated

Existing Gaps

- Operational launch vehicles remain expendable
- Higher per-launch costs compared to reusable systems

Strategic Imperative

Reusability is essential for:

- Global competitiveness
- Commercial launch market participation
- Long-term human spaceflight programmes

m. Way Forward

- Integrate reusability into future launch vehicle design
- Reduce stages and improve engine efficiency
- Minimise refurbishment cycles
- Strengthen public–private collaboration
- Align space policy with sustainability and cost-efficiency

Conclusion

Reusability represents a paradigm shift in space access. By transforming rockets from disposable assets into reusable infrastructure, it enables affordable, frequent, and environmentally responsible spaceflight. For India, advancing reusable launch systems is not merely a technological choice, but a strategic necessity for securing a strong position in the future global space economy.

2. Futuristic Marine and Space Biotechnology

a. Introduction

Futuristic marine and space biotechnology refers to advanced biological research and production systems that draw upon some of the most extreme and underexplored environments known to humanity, primarily the deep oceans and outer space. These environments host organisms that survive under conditions radically different from those on land, such as extreme pressure, salinity, radiation, temperature variation, and microgravity.

The study and application of such organisms open new pathways for:

- Generating advanced biological knowledge
- Discovering novel bioactive compounds
- Developing high-performance biomaterials
- Designing sustainable and low-resource manufacturing processes

Since large-scale commercial utilisation of these domains is still limited, marine and space biotechnology are widely regarded as frontier areas of science and technology with long-term strategic significance.

b. Marine Biotechnology: Scope and Significance

Marine biotechnology involves the scientific study and practical use of marine organisms, including microorganisms, algae, seaweeds, and other marine life forms, for producing valuable goods and services.

i. Areas of Application

Marine biotechnology finds applications across multiple sectors:

- Pharmaceuticals and nutraceuticals
- Industrial enzymes and bio-catalysts
- Biomaterials and biodegradable plastics
- Food ingredients and functional foods
- Biostimulants and bio-based chemicals

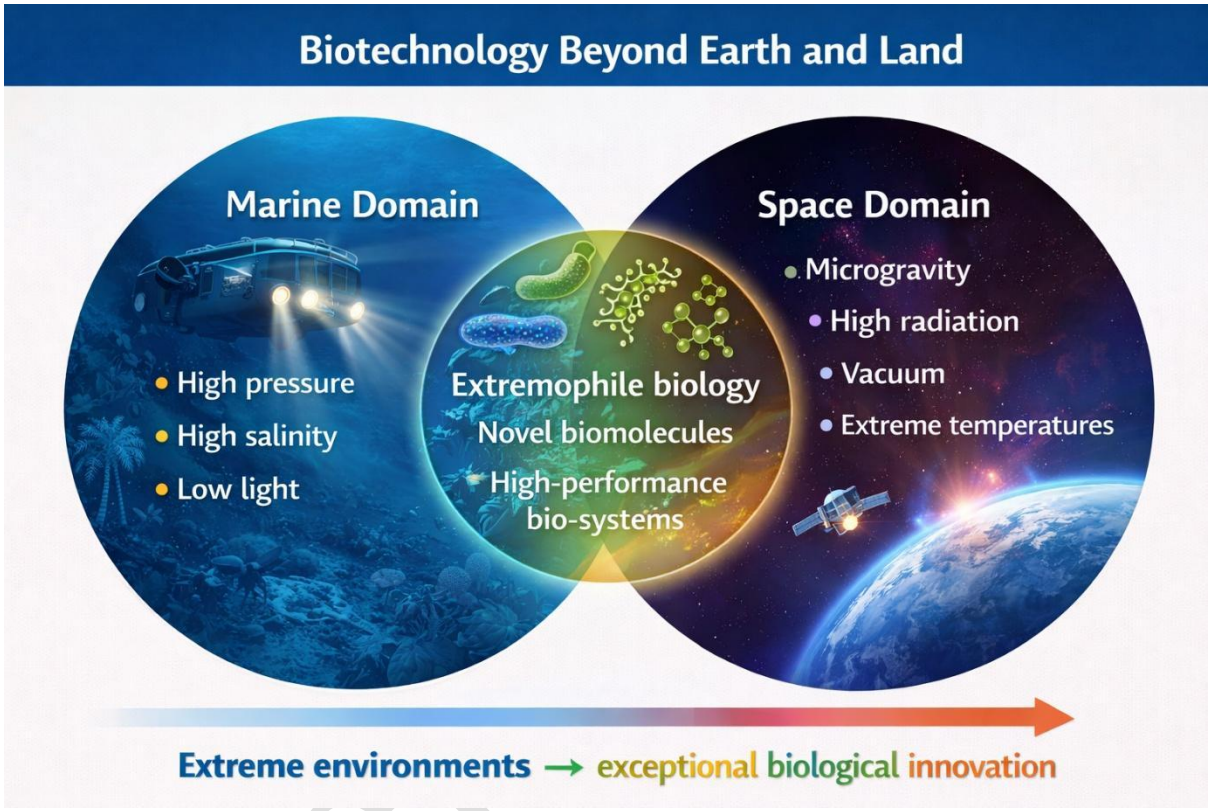
ii. Unique Value of Marine Organisms

Marine organisms have evolved under high pressure, high salinity, low light, and nutrient-scarce conditions. As a result, they produce:

- Enzymes stable under extreme conditions
- Novel chemical compounds with high bioactivity
- Metabolic pathways rarely seen in terrestrial organisms

These properties make marine bio-resources particularly valuable for industrial processes requiring stability, efficiency, and resilience.

Marine biotechnology therefore holds promise not only for innovation in medicine and industry, but also for developing environmentally sustainable alternatives to land- and freshwater-intensive production systems.



c. Space Biotechnology: Exploring Life Beyond Earth

Space biotechnology focuses on understanding how biological systems behave in the microgravity and high-radiation environment of outer space. It examines the responses of microbes, plants, human cells, and tissues beyond Earth's gravity-bound conditions.

i. Key Research Areas

Major areas of space biotechnology include:

- Space-based food production systems
- Maintenance of astronaut physical and mental health
- Protein crystallisation for advanced drug discovery
- Stem cell and regenerative medicine research
- Closed-loop life-support systems for air, water, and waste recycling

ii. Scientific and Terrestrial Benefits

Experiments conducted in space often reveal biological behaviours impossible to observe on Earth, such as altered cell growth, gene expression, and protein formation. These insights benefit:

- Long-duration space missions
- Earth-based medicine and biotechnology

In this sense, space biotechnology acts as a bridge between space exploration and cutting-edge biomedical and industrial research.

d. Relevance of These Technologies for India

i. Sustainability and Resource Security

Marine biotechnology can provide India with new sources of food, energy, chemicals, and biomaterials, reducing pressure on:

- Agricultural land
- Freshwater resources
- Fossil-based industrial inputs

ii. Space Ambitions and Human Exploration

With India's expanding space programme, space biotechnology becomes critical for:

- Reliable food systems for astronauts
- Maintaining health during long-duration missions
- Enabling biological manufacturing beyond Earth

These capabilities are essential for future space stations and deep-space missions.

iii. Economic and Strategic Dimensions

Both marine and space biotechnology support biomanufacturing, a high-growth sector with applications in healthcare, pharmaceuticals, cosmetics, and green industries. Early investment can translate into:

- Technological leadership
- Strategic autonomy
- Long-term economic competitiveness

e. India's Present Position

i. Marine Biotechnology

India enjoys strong natural advantages:

- A coastline exceeding 11,000 kilometres
- An Exclusive Economic Zone of over 2 million square kilometres

However, India's share in global marine biotechnology remains limited.
Seaweed cultivation illustrates this gap clearly:

- India produces around 70,000 tonnes of seaweed annually
- Yet imports key derivatives such as agar, carrageenan, and alginates

This reflects underdevelopment in value-added marine bioprocessing.

ii. Space Biotechnology

India has made a more visible start through ISRO:

- Microgravity experiments on microbes and algae
- Research on space food and life-support systems
- Studies on human health in space

However, these efforts remain largely research-oriented, with limited translation into a comprehensive industrial ecosystem.

f. Government Initiatives and Policy Support

The government has begun recognising the strategic importance of these sectors through:

- Blue Economy framework
- Deep Ocean Mission
- BioE3 Programme (Biotechnology for Economy, Environment, and Employment)

These initiatives aim to:

- Scale up marine biomass production
- Link research institutions with industry
- Promote sustainable biomanufacturing

Nevertheless, private sector participation remains limited, mainly due to high costs, long gestation periods, and technological uncertainty.

g. Global Developments

i. European Union

The EU supports large-scale programmes on:

- Marine bioprospecting
- Algae-based biomaterials through shared research infrastructure and funding.

ii. China

China has rapidly expanded:

- Industrial-scale seaweed farming
- Marine bioprocessing and exports

iii. United States

The US leads in space biotechnology through:

- NASA
- Use of the International Space Station

Focus areas include drug discovery, regenerative medicine, and technologies for long-duration space missions.

These trends highlight the competitive and strategic nature of futuristic biotechnology.

h. Strategic Importance

Marine and space biotechnology are still at an early stage of development. Countries that invest early are likely to gain advantages in:

- Technology and innovation ecosystems
- Bio-based industrial supply chains
- Global standard-setting and influence

For India, the convergence of marine and space biotechnology offers an opportunity to:

- Become a global hub for sustainable biomanufacturing
- Strengthen leadership in space exploration
- Advance environmental stewardship

i. Key Challenges

Major challenges include:

- Fragmented research efforts
- Slow transition from laboratory to industry
- High capital and technological risks
- Absence of a clearly articulated national roadmap

Without coordinated planning and sustained investment, India risks falling behind global leaders in these frontier domains.

j. Way Forward

A coherent national roadmap for marine and space biotechnology should involve:

- Stronger public–private partnerships
- Investment in shared research and testing infrastructure
- Integration with Blue Economy, space, and biomanufacturing policies
- Targeted incentives to reduce private-sector risk
- International collaboration to accelerate learning and innovation

Conclusion

Futuristic marine and space biotechnology harness extreme environments such as deep oceans and outer space to generate high-value biological products, offering India a strategic pathway towards sustainable biomanufacturing, technological leadership, and long-term space exploration.

GS Paper III: Security

1. Hypersonic Missiles in India: LR-AShM and Emerging Capabilities

a. Understanding Hypersonic Missiles: Starting from the Basics

Hypersonic missiles are weapon systems capable of travelling at speeds exceeding Mach 5, that is, five times the speed of sound. At such extreme velocities, a missile can traverse hundreds or even thousands of kilometres within minutes, leaving the adversary with very limited reaction time.

However, speed alone does not define hypersonic weapons. Their strategic significance flows from the combined effect of three factors:

- Extreme velocity, which compresses detection and response timelines
- In-flight manoeuvrability, allowing course corrections during flight
- Reduced predictability and detectability, especially by conventional radar systems

Unlike traditional ballistic missiles that follow relatively predictable paths, hypersonic weapons can change direction mid-course and often operate at lower altitudes within the atmosphere. This makes their trajectories difficult to calculate, thereby undermining the effectiveness of existing missile defence systems.

b. Broad Classification of Hypersonic Weapons

Conceptually, hypersonic weapons are divided into two major categories, based on their mode of propulsion and flight behaviour.

i. Hypersonic Glide Vehicles (HGVs)

A hypersonic glide vehicle is initially launched using a rocket booster, which accelerates it to very high speed and altitude. After this boost phase:

- The glide vehicle separates from the rocket
- It re-enters the atmosphere
- It glides unpowered at hypersonic speeds while manoeuvring laterally and vertically

This glide phase allows the weapon to follow an unpredictable, non-linear path, significantly complicating interception.

ii. Hypersonic Cruise Missiles (HCMs)

Hypersonic cruise missiles operate entirely within the atmosphere and rely on advanced air-breathing engines, particularly scramjets, to maintain hypersonic speed throughout their flight.

These systems represent the most technologically demanding class of hypersonic weapons due to challenges related to propulsion stability, combustion, and heat management at extreme speeds.

India's Long Range Anti-Ship Missile (LR-AShM) falls under the hypersonic glide vehicle category.

c. Long Range Anti-Ship Hypersonic Missile (LR-AShM): An Overview

The Long Range Anti-Ship Hypersonic Missile (LR-AShM) is an indigenously developed weapon system designed by the Defence Research and Development Organisation (DRDO) to meet the long-range maritime strike requirements of the Indian Navy.

The missile is specifically intended to neutralise high-value enemy naval assets, including major surface combatants, operating far from India's coastline. Its development represents a significant milestone in India's transition towards advanced, indigenous, precision-strike capabilities in the maritime domain.

d. Key Characteristics of LR-AShM

The LR-AShM integrates range, speed, manoeuvrability, and precision into a single platform.

Extended Range

- Operational range of approximately 1,500 km
- Scope for longer-range variants in the future

Hypersonic Speed

- Achieves extremely high speeds soon after launch
- Maintains hypersonic velocity for most of its flight

Target Engagement Capability

- Capable of striking both static and moving naval targets
- Essential for modern anti-ship warfare, where targets are rarely stationary

Trajectory and Propulsion

- Follows a quasi-ballistic trajectory
- Powered by a two-stage solid rocket motor

Deployment Vision

- Current focus on naval and coastal defence roles
- Planned variants for the Army and Air Force under a joint-services framework

e. The Concept of a Quasi-Ballistic Flight Path

Traditional ballistic missiles follow a high-altitude, smooth parabolic arc. Once detected, their trajectory can be calculated with reasonable accuracy, allowing missile defence systems to plan interception.

In contrast, a quasi-ballistic hypersonic missile:

- Begins with a ballistic-like boost phase
- Transitions to lower atmospheric flight
- Executes continuous manoeuvres during the glide phase

This hybrid behaviour combines the launch characteristics of ballistic missiles with the unpredictability of atmospheric flight. The result is a constantly changing trajectory that defies easy prediction, severely complicating defensive responses.

f. Challenges in Detection and Interception

The LR-AShM strains conventional air and missile defence architectures due to multiple reinforcing factors.

Low-Altitude Flight

- Reduces early detection by radar systems
- Radar coverage is constrained by the curvature of the Earth

Extreme Speed

- Compresses decision-making timelines to minutes or seconds
- Leaves little scope for layered defensive responses

Continuous Manoeuvring

- Prevents accurate prediction of impact point
- Undermines interceptor guidance algorithms

Atmospheric Flight Profile

- Avoids tracking systems optimised for high-altitude ballistic threats

Taken together, these features make hypersonic glide weapons among the most difficult threats to counter in contemporary warfare.

g. Strategic Significance for India

i. Maritime Security and Sea Denial

LR-AShM significantly strengthens India's sea-denial capability, enabling it to prevent adversary naval forces from operating freely in critical maritime spaces. This is especially relevant in the Indian Ocean Region, where control over sea lanes is central to national security.

ii. Enhancing Deterrence

A credible hypersonic anti-ship capability raises the cost of hostile naval operations by placing even well-defended, high-value warships at risk. This contributes to deterrence by uncertainty and denial.

iii. Operational Flexibility and Jointness

Planned induction across all three services aligns with India's emphasis on joint operations and integrated theatre commands, providing rapid response options across domains.

h. India's Broader Hypersonic Technology Ecosystem

The development of LR-AShM reflects advances in several foundational technologies:

- High-temperature materials capable of withstanding extreme thermal stress
- Advanced guidance, navigation and control systems at hypersonic speeds
- Precision targeting under severe aerodynamic conditions

Parallel efforts are underway in hypersonic cruise missile development, which relies on scramjet propulsion.

A key propulsion distinction is important:

- Ramjets operate efficiently at lower supersonic speeds
- Scramjets are designed for sustained operation beyond Mach 5

Scramjets involve complex airflow management, combustion stability, and thermal control, making them among the most challenging propulsion systems in aerospace engineering.

i. India in the Global Hypersonic Landscape

Globally, only a small group of states have demonstrated credible hypersonic weapon capabilities. India's progress reflects:

- Maturation of indigenous research and development
- Growing depth in advanced materials and propulsion science
- Alignment with the broader push for strategic autonomy and self-reliance

This trajectory reduces long-term dependence on external suppliers in a domain that is increasingly central to future warfare.

j. Way Forward

India's hypersonic journey must prioritise:

- Faster integration of sensors, guidance systems, and warhead technologies
- Timely induction across all three services to ensure operational credibility
- Sustained investment in materials science and propulsion research

Equally important is the integration of hypersonic weapons into a network-centric operational framework, combining satellite surveillance, real-time intelligence, and maritime domain awareness. Such integration will ensure that hypersonic capabilities function not as standalone assets, but as a core component of India's evolving deterrence and maritime security doctrine.

Conclusion

The LR-AShM represents a major leap in India's maritime strike and deterrence capabilities, combining hypersonic speed with manoeuvrability to challenge existing naval defences. Beyond a single missile system, it reflects India's growing technological maturity in hypersonic warfare and strengthens its ability to safeguard strategic interests, particularly in the maritime domain.

2. India's Maritime Policy: Evolution, Significance, and Future Direction

a. Maritime Policy as a Structural Theme in India's Strategy

India's maritime policy is best understood not as a short-term response to emerging threats, but as a long-term strategic evolution shaped by geography, history, economic interests, and security imperatives. With the Indian Ocean surrounding the subcontinent on three sides and some of the world's busiest sea lanes passing close to its shores, India's prosperity and security are deeply intertwined with the maritime domain.

It reflects how India seeks to convert its geographical advantage into strategic influence while balancing power, cooperation, and regional stability.

b. Geographical Foundations of India's Maritime Outlook

India's strategic worldview has been shaped by two enduring geographical features:

The Himalayan Barrier

- Provided historical protection from northern invasions
- Anchored India's continental boundaries and security concerns

The Indian Ocean Openness

- Enabled trade, cultural exchange, and diplomatic outreach
- Served as India's primary interface with the external world

While most invasions historically occurred through land routes in the north-west, maritime routes facilitated commerce and cultural diffusion. This dual geography explains why India's civilisation remained inwardly secure yet outwardly connected.

c. Historical Evolution of India's Maritime Engagement

i. Ancient and Medieval Maritime Traditions

India's maritime orientation has deep historical roots:

Trade and Cultural Networks

- Indian sailors navigated routes linking East Africa, West Asia, and Southeast Asia
- Maritime trade supported the spread of religions, ideas, and cultural practices

Naval Power and Political Authority

- The Chola Empire projected naval power across Southeast Asia
- The Marathas developed strong coastal defence and sea-control capabilities

These experiences demonstrate that maritime strength historically served both economic and strategic objectives.

ii. Colonial Disruption and Early Independence

European colonial powers leveraged superior naval capabilities to dominate Indian Ocean trade routes and establish political control over the subcontinent. After independence in 1947, India's strategic focus shifted towards:

- Territorial consolidation
- Land-based security challenges

As a result, maritime policy remained relatively underdeveloped for several decades, despite India's favourable geography.

d. Strategic Reorientation since the 1980s

A major reorientation began in the mid-1980s due to:

- Rising dependence on sea routes for energy imports
- Expanding volume of maritime trade
- Growing strategic importance of the Indian Ocean Region

Key developments included:

- Strengthening of the Indian Navy
- Maritime boundary agreements with neighbouring states
- Expansion of maritime diplomacy with Australia, Japan, and ASEAN countries

Collectively, these shifts marked India's re-emergence as a significant maritime actor.

e. The Indo-Pacific Framework and India's Maritime Vision

The Indo-Pacific concept links the Indian Ocean with the western Pacific, reflecting integrated economic and strategic realities. For India, it is not merely a geographical construct but a strategic framework encompassing:

- Economic connectivity
- Security cooperation
- Regional balance

India's vision emphasises a:

- Free
- Open
- Inclusive
- Rules-based maritime order

While conscious of strategic competition—particularly with China—India seeks to avoid zero-sum rivalries and instead prioritises stability, dialogue, and rule-based conduct.

f. Maritime Partnerships and Strategic Autonomy

India follows a policy of multi-alignment, not rigid alliances:

i. Key Strategic Partners

- Japan and Australia for Indo-Pacific security
- France due to its Indian Ocean presence

ii. Regional Engagement

- Capacity-building and coastal security assistance to Indian Ocean littoral states
- Deep maritime engagement with ASEAN for sea lane security

iii. Managing Strategic Competition

- Complex engagement with China marked by competitive coexistence
- Emphasis on dialogue alongside deterrence

This diversified approach preserves strategic autonomy while expanding India's maritime influence.

g. India as a Net Security Provider in the Indian Ocean

India's anti-piracy operations in the Arabian Sea marked a strategic milestone:

- Shift from a defensive posture to proactive regional security
- Protection of international shipping lanes
- Effective humanitarian assistance and disaster relief operations

These actions have built trust among Indian Ocean littoral states and reinforced India's image as a responsible maritime power committed to regional stability.

h. Maritime Governance and Regional Challenges

South Asian maritime governance faces persistent challenges:

- Weak institutions
- Political instability
- Governance deficits in several coastal states

These vulnerabilities have enabled greater external influence through infrastructure and connectivity projects linked to broader geopolitical initiatives. India's response focuses on:

- Transparent partnerships
- Sustainable connectivity
- Respect for sovereignty

Rather than coercion, India promotes cooperative maritime governance rooted in mutual benefit and long-term resilience.

i. Economic and Technological Dimensions of Maritime Policy

India's contemporary maritime policy integrates security with development, particularly through the Blue Economy:

Economic Pillars

- Sustainable fisheries
- Offshore energy resources
- Port-led development
- Maritime tourism

Technological Enablers

- Maritime surveillance
- Underwater domain awareness

Climate change adds a new strategic dimension, making coastal resilience and adaptation central to both economic planning and security policy.

j. Power Projection and Strategic Balance

India's maritime power projection is deliberately restrained:

- Presence without aggression

- Deterrence without dominance
- Stability over confrontation

This balanced posture distinguishes India from purely militaristic strategies and reinforces its role as a stabilising force in the Indian Ocean Region.

k. Challenges Ahead

India's maritime trajectory will be shaped by:

- Intensifying strategic competition with China
- Gaps in advanced naval and underwater technologies
- Institutional coordination challenges among maritime agencies
- Climate change–induced risks to coastal infrastructure and livelihoods

Addressing these issues requires sustained investment, policy coherence, and diplomatic engagement.

l. Way Forward

Key priorities must include:

- Strengthening maritime governance institutions
- Enhancing naval and technological capabilities
- Deepening maritime diplomacy and multilateral cooperation
- Promoting a sustainable and inclusive Blue Economy

India should continue to treat the Indian Ocean as a shared regional commons, not a contested arena.

Conclusion

India's maritime policy has evolved from a civilisational tradition of trade and cultural exchange into a comprehensive strategic framework encompassing security, economics, and diplomacy.

In the coming decades, effective maritime governance will be critical to India's emergence as a leading Indo-Pacific power and a trusted net security provider, capable of shaping a stable, inclusive, and rule-based maritime order.

GS Paper III: Disaster Management

1. Krishikul Model of Farm Income Augmentation (Beed, Maharashtra)

a. Introduction

Indian agriculture has long been marked by low and unstable farm incomes, fragmented landholdings, chronic water stress, and weak integration with markets. While policy discourse frequently invokes the goal of doubling farmers' income, credible, large-scale, and durable success stories on the ground have been limited.

Against this backdrop, the Krishikul initiative implemented in Beed district of Maharashtra by the Global Vikas Trust stands out as an exceptional case. What makes the model analytically significant is not merely the magnitude of income enhancement—exceeding a ten-fold increase per acre—but the *nature* of this transformation. The gains are not driven by short-term subsidies or relief measures; rather, they arise from a structural reorganisation of farming systems, integrating production, water security, finance, and markets.

b. Why Beed District Is a Critical Test Case

Beed district occupies a central place in the study of agrarian distress in India.

i. Structural Agrarian Vulnerabilities

- Located in the rain-shadow region of Maharashtra, Beed is chronically drought-prone.
- Agriculture has traditionally depended on low-value and high-risk crops such as soybean and cotton.
- Farmers have remained exposed to climatic uncertainty and price volatility, leading to unstable incomes.

ii. Acute Water Stress

- Excessive groundwater extraction pushed water tables to depths of nearly 400 feet in many areas.
- Irrigation became expensive, unreliable, and unsustainable.
- The outcome was widespread indebtedness, distress migration, and social vulnerability.

The fact that such a region could witness sustained and large-scale income enhancement makes the Krishikul experience analytically significant rather than anecdotal.

c. Core Philosophy of the Krishikul Approach

At the heart of the Krishikul model lies a clear insight:
Farm incomes cannot rise sustainably unless multiple constraints are addressed simultaneously.

i. Limits of Isolated Interventions

- Productivity gains alone are inadequate without water security.
- Crop diversification fails without institutional capacity and finance.

- Higher output does not translate into higher income without market access.

ii. Systems-Based Design

The initiative therefore adopted a holistic, systems-based approach, synchronising:

- Cropping pattern transformation
- Water resource regeneration
- Institutional and human capacity building
- Financial inclusion and risk mitigation

This integrated design explains the durability and scalability of outcomes achieved under the model.

d. Key Components of the Krishikul Model

i. Building Trust as the Foundation

- The intervention began with sustained engagement, not technology or finance.
- Field teams listened to farmers' concerns and acknowledged past policy failures.
- This trust-building helped overcome resistance to abandoning familiar crops.

Agricultural reform is as much a social and behavioural process as a technical one.

ii. Diversification towards High-Value Horticulture

- Farmers shifted from soybean and cotton to fruit-based horticulture.
- High-density plantation techniques were promoted, increasing output per acre.
- Fruit crops enabled earlier income realisation and higher value per unit of land.

In drought-prone regions with scarce land and water, such diversification represents a rational income-resilience strategy.

iii. Lowering Input Costs through Aggregation

- High entry costs were addressed through bulk procurement of quality saplings.
- Aggregation reduced sapling prices to nearly half of retail rates.
- CSR funding further subsidised costs for farmers.

This demonstrates the governance value of collective action and demand pooling, shielding farmers from exploitative input markets.

iv. Institutional Capacity through the Krishikul Campus

- A dedicated 25-acre Krishikul campus was developed using CSR resources.
- The campus functioned as a centre for training, experimentation, and demonstration.
- Farmers were trained in professional orchard management—pruning, nutrition, and pest control.

This ensured that productivity gains were sustained over time, rather than declining after initial adoption.

v. Addressing Water Scarcity through Groundwater Recharge

Water security, the most binding constraint, was addressed directly.

- Interventions included farm ponds, check dams, and vertical recharge structures (Global River Aquashafts).
- These structures enabled filtered surface water to percolate into aquifers, preventing siltation.
- Groundwater levels rose dramatically—from around 400 feet to nearly 50 feet in several areas.

This revival of aquifers ensured reliable irrigation, anchoring the sustainability of the horticulture-based model and offering a practical illustration of sustainable water resource management.

vi. Formal Credit Backed by Risk Mitigation

- Banks were directly engaged to provide institutional credit.
- A First Loss Default Guarantee corpus was created to reduce lenders' risk.
- This reassured banks and expanded access to formal finance for small farmers.

The model highlights how innovative risk-sharing mechanisms can unlock rural credit without undermining financial discipline.

e. Measured Outcomes and Scale

The outcomes were independently evaluated by the Tata Institute of Social Sciences (2024).

i. Income Impact

- Per-acre income increased from approximately ₹38,000 to nearly ₹4 lakh.
- This represents a more than ten-fold rise, sustained over time.

ii. Scale of Intervention

- Coverage of ~43,000 acres
- Beneficiaries: ~30,000 farm families
- Villages covered: ~5,000
- Plantation of over 6 crore fruit trees

These figures place Krishikul among the largest NGO-led agricultural transformation initiatives in India.

f. The Structural Constraint of Market Access

Despite strong production-side gains, a critical limitation remains.

- Farmers currently receive only 25–33% of the final consumer price.
- Intermediaries capture most of the value.
- Absence of cold storage, grading, processing, and direct market access constrains income potential.

Without addressing this bottleneck, income growth risks plateauing despite higher output.

g. Way Forward: Integrating Farmers into the Value Chain

The next phase must shift from production to value-chain control.

i. Key Priorities

- Strengthening Farmer Producer Organisations (FPOs)
- Investment in cold chains, storage, and processing infrastructure
- Enabling branding and direct market access

ii. Role of the State and Partnerships

Scaling such models requires:

- Coordinated Centre–State support
- NGO and private sector partnerships
- Public investment and enabling policy frameworks

Only such coordination can convert local success into systemic transformation.

h. Comparative Perspective: Lessons from the White Revolution

The Krishikul experience parallels the Kheda milk experiment, which later scaled into the White Revolution.

- Initial pilot success
- Subsequent institutionalisation through NDDB and Operation Flood
- Strong state support and financing

Proven agricultural pilots require institutional backing and state involvement to achieve national impact.

Conclusion

The Krishikul model demonstrates that substantial and sustained farm income enhancement is achievable, even in ecologically fragile and drought-prone regions. Its strength lies in a holistic design that integrates cropping choices, water management, institutional capacity, finance, and markets.

For India to move beyond rhetorical commitments to farmer prosperity, such models must be scaled and institutionalised. True income transformation will occur only when farmers gain control not merely over production, but over the entire agricultural value chain.

In this sense, Krishikul is not just a success story—it is a template for future agricultural reform in India.

2. Economic Cost of Natural Disasters in India and the Role of Disaster Risk Financing

a. Introduction

Natural disasters in India can no longer be treated as isolated humanitarian emergencies. They have evolved into a permanent structural challenge to economic development. Climate change, rapid and unplanned urbanisation, environmental degradation, and rising population exposure have together increased both the frequency and intensity of disasters.

Empirical assessments indicate that India loses nearly 0.4 per cent of its Gross Domestic Product (GDP) every year due to natural disasters. Such recurring losses underline that disaster management is no longer limited to relief and rehabilitation. It has become a macroeconomic and fiscal issue, directly influencing growth prospects, public expenditure priorities, and long-term development planning.

b. Disaster Landscape in Emerging Asia

Emerging Asia—comprising India, China, and the ASEAN countries—is among the most disaster-prone regions globally.

i. Scale and Frequency

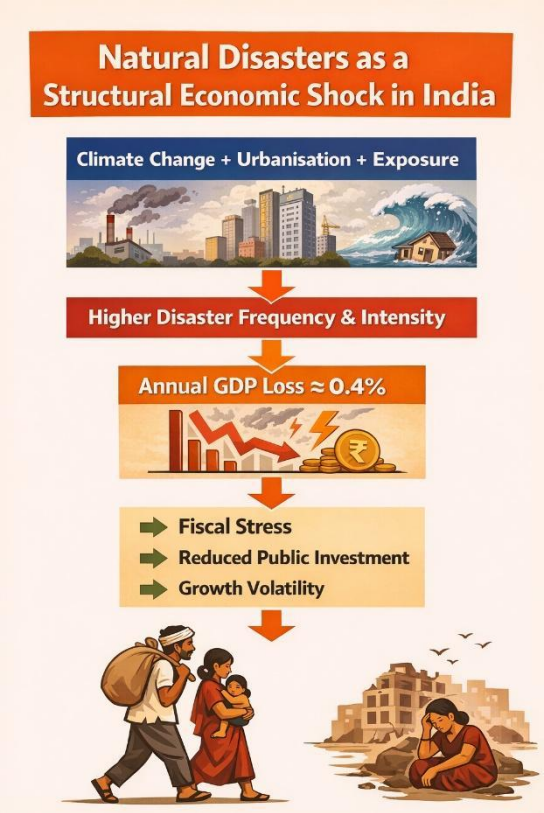
- The region has experienced close to 100 natural disasters annually over the past decade.
- Nearly 80 million people are affected every year, reflecting high exposure levels.
- Rapid infrastructure expansion into hazard-prone zones has amplified economic losses.

ii. Changing Nature of Risk

- Climate variability is increasing disaster intensity.
- Dense populations magnify the human and economic impact.
- Urban growth without adequate planning has raised vulnerability.

c. Types of Natural Disasters and Regional Variation

Natural disasters are broadly classified into hydrological, meteorological, climatological, and geophysical hazards, each with distinct spatial patterns.



i. India's Disaster Profile

- Hydrological hazards dominate—riverine floods, flash floods, and landslides.
- Meteorological risks, such as cyclones and heatwaves, have increased, especially in coastal and urban regions.
- Geophysical risks, mainly earthquakes, are concentrated in the Himalayan belt and the North-East.

ii. Comparative Regional Exposure

- The Philippines and Vietnam face higher cyclone exposure.
- China and Indonesia experience greater seismic and volcanic risks.

Disaster risk reduction strategies must be hazard-specific and region-specific, rather than uniform across countries or regions.

d. Rising Economic Losses from Disasters

The economic cost of disasters has risen sharply across Emerging Asia.

i. Long-Term Loss Trends

- Between 1980 and 2024, disaster-related losses amounted to hundreds of billions of dollars in the region.
- India's average annual loss from 1990 to 2024 remained close to 0.4 per cent of GDP.

ii. Developmental Implications

- Reduced fiscal space for productive investment.
- Diversion of public expenditure away from health, education, and infrastructure.
- Disproportionate impact on poor and vulnerable communities.

Thus, disasters function as a systemic drag on inclusive growth and poverty reduction, reinforcing existing inequalities.

e. India's Global Risk Position

The World Risk Index 2025 places India among the highest-risk countries globally, ranking second in Emerging Asia after the Philippines.

Components of Risk

- Exposure: Large population living in hazard-prone areas.
- Vulnerability:
  - Structural susceptibility (informal housing, fragile infrastructure)
  - Limited coping capacity
  - Constraints on long-term adaptive capacity

Despite improvements in response mechanisms, these structural factors ensure that even moderate hazards translate into large-scale economic losses.

f. Why Disaster Risk Financing Has Become Essential

India's traditional disaster management approach has relied heavily on post-disaster relief and reconstruction funding.

Limitations of Relief-Centric Models

- Delays in fund mobilisation.
- Ad hoc budget reallocations.
- Increased fiscal stress after major disasters.

Over time, disasters have come to be recognised as sudden fiscal shocks, disrupting development planning and public finances. This has elevated the importance of disaster risk financing.

g. Concept of Disaster Risk Financing

Disaster Risk Financing (DRF) refers to financial strategies that ensure the timely, predictable, and adequate availability of funds after disasters, while minimising economic disruption.

i. Core Features

- Emphasis on ex-ante financial preparedness rather than only ex-post relief.
- Faster recovery and reduced long-term development losses.
- Enhanced fiscal and economic resilience.

ii. Key Instruments

- Disaster response funds and fiscal reserves
- Insurance and reinsurance mechanisms
- Risk pooling arrangements
- Catastrophe bonds
- Contingent credit lines

h. Strengthening India's Disaster Risk Finance Framework

A robust disaster risk financing architecture must address both financial preparedness and risk reduction.

i. Data-Driven Risk Assessment

- Reliable disaster loss databases.
- Hazard-specific and region-specific risk mapping.
- Informed fiscal planning and prioritisation.

ii. Shift towards Proactive Financing

- Greater use of insurance and risk transfer mechanisms.
- Reduced dependence on emergency budget reallocations.
- Improved fiscal stability during shocks.

iii. Integration with Development Planning

- Climate-resilient infrastructure development.
- Risk-sensitive urban planning.
- Investment in early warning systems and community preparedness.

iv. Multi-Level Governance

- Coordination between the Centre and States.
- Partnerships with the private sector.
- Engagement with domestic and international financial institutions.

Conclusion

The persistent loss of nearly 0.4 per cent of GDP every year due to natural disasters demonstrates that disasters are not peripheral events but a central determinant of India's economic trajectory. As climate risks intensify, disaster management must move beyond a relief-oriented framework to one centred on risk reduction and financial resilience.

Strengthening disaster risk financing can safeguard development gains, reduce fiscal volatility, and support a more resilient growth path. While natural hazards may be unavoidable, their economic impact can be substantially mitigated through foresight, planning, and sound financial preparedness.

Reader's Note — About This Current Affairs Monthly Compilation

Dear Aspirant,

This document is part of the PrepAlpine Current Affairs Series — designed to bring clarity, structure, and precision to your UPSC learning.

While every effort has been made to balance depth with brevity, please keep the following in mind:

1. Orientation & Purpose

This compilation is curated primarily from the UPSC Mains perspective — with emphasis on conceptual clarity, analytical depth, and interlinkages across GS papers.

However, the PrepAlpine team is simultaneously developing a dedicated Prelims-focused Current Affairs Series, designed for:

- factual coverage
- data recall
- Prelims-style MCQs
- objective pattern analysis

This Prelims Edition will be released separately as a standalone publication.

2. Content Length

Some sections may feel shorter or longer depending on topic relevance and news density.
To fit your personal preference, you may freely resize or summarize sections using any LLM tool (ChatGPT, Gemini, Claude, etc.) at your convenience.

3. Format Flexibility

The formatting combines:

- paragraphs
- lists
- tables
- visual cues

—all optimised for retention.

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If you feel any important theme is missing or under-covered, simply post it in the "Suggestions" channel on our Discord server.

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