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CELESTIAL SOVEREIGNTY AND THE PRECAUTIONARY PRINCIPLE: A LEGAL AND ETHICAL FRAMEWORK FOR ORBITAL DEBRIS MITIGATION IN THE AGE OF AI

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I. ABSTRACT

With more satellites, observatories and other space assets being deployed continuously, the global space economy has expanded rapidly for technological advancement. It has also resulted in the accumulation of orbital debris, which threatens the long-term sustainability of the near-Earth orbital environment. The issue involves international space law, artificial intelligence and environmental ethics, all of which must be understood collectively to develop a robust regulatory framework for space sustainability. The Supreme Court of India has substantially developed environmental jurisprudence by expanding Article 21 to include the right to clean air, a safe environment and ecological protection. This study argues for extending the precautionary principle and Article 21 of the Indian Constitution to outer space by treating the orbital environment as a shared ecological heritage. AI plays a dual role: it can assist in climate monitoring, space situational awareness and mitigation of risks to orbital assets, while also generating new legal challenges concerning algorithmic accountability in autonomous collision-avoidance manoeuvres. The paper further argues that Extended Producer Responsibility should be applied to satellite manufacturers and operators through legal and financial mandates for de-orbiting end-of-life assets, including de-orbit bonds and Orbital EPR Plans. Applying a pragmatist research paradigm, the paper examines existing ESG regulations and their inadequate consideration of orbital pollution. It finally argues for a Space Sustainability Treaty, supported by a proposed Delhi Declaration on Orbital Sustainability, incorporating AI-driven monitoring and

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a stewardship-based legal model to ensure that exploration of the final frontier does not repeat the collapse of terrestrial ecological systems.

II. KEYWORDS

Space Law, Orbital Debris, Artificial Intelligence, Precautionary Principle, Environmental Ethics.

III. INTRODUCTION

India's meteorological satellites INSAT-3D and INSAT-3DR sit at the heart of the country's climate-adaptation infrastructure.[3] Operating from geostationary orbit, they provide high-frequency imagery, vertical profiles of temperature and humidity, and derived products that feed directly into monsoon forecasting, cyclone tracking, flood warnings and heat-wave alerts.[4] These datasets are assimilated in numerical models at IMD and NCMRWF and underpin disaster-risk reduction for hundreds of millions of people, especially in coastal and agrarian regions. In climate-vulnerable India, the continued operation of such satellites is not a technical luxury; it is a lifeline and a precondition for climate justice.

That infrastructure, however, is embedded in an increasingly congested and hazardous orbital environment. ESA's [5]2025 Space Environment Report estimates about 54,000 debris objects larger than 10 cm, 1.2 million between 1 and 10 cm, and 140 million between 1 mm and 1 cm in Earth orbit. Around 39,000 objects are tracked by surveillance networks, but the vast majority of collision-relevant fragments remain untracked. Review studies show that even a 1 cm fragment, travelling at 7–10 km/s, can catastrophically

[3] eoPortal, 'INSAT-3DR (Indian National Satellite-3D Repeat)' (ESA eoPortal, 8 September 2016) https://www.eoportal.org/satellite-missions/insat-3dr accessed 8 February 2026.
[4] eoPortal, 'INSAT-3D and 3DS' (ESA eoPortal, 16 March 2024) https://www.eoportal.org/satellite-missions/insat-3d accessed 8 February 2026.
[5] European Space Agency, *ESA Space Environment Report 2025* (ESA 2025

damage or destroy a satellite and generate numerous secondary fragments, potentially contributing to a Kessler-type cascading debris regime.[6]

When this collision risk threatens India's climate-monitoring and disaster-warning satellites, the result is not merely a 'space operations' problem. It becomes a distributive justice problem: communities already exposed to climate vulnerability, including vulnerable populations in the Global South, face disproportionate harm if satellite-enabled early-warning and climate-information systems are degraded.[7] Orbital debris is as an environmental-justice and climate-justice issue. India's constitutional jurisprudence under Article 21, its precautionary and public-trust doctrines, and its experience with Extended Producer Responsibility (EPR) in terrestrial environmental regulation together provide a normative and institutional template to govern the near-Earth orbital environment as a shared ecological heritage.

At the same time, artificial intelligence (AI) plays a dual role. On the one hand, AI-driven systems enhance space situational awareness (SSA), collision avoidance and climate data assimilation, offering powerful tools to protect orbital assets and support climate-adaptation policymaking. On the other hand, opaque and unregulated AI-based autonomy in satellite operations raises fresh questions about liability, transparency and due process, questions that existing space law and India's data-protection regime only partially address.

Working within a pragmatist research paradigm, the paper links doctrinal analysis with policy design. It proposes:

1. Extending Article 21-based environmental stewardship to outer space through the precautionary principle.

[6] Abid Murtaza and others, 'Orbital Debris Threat for Space Sustainability and Way Forward' (2020) 8 *IEEE Access* 60999

[7] United Nations, 'Early Warnings for All' and/or UNEP, 'Climate Information and Early Warning Systems'.

2. Operationalising an EPR-style model for satellites and launchers via de-orbit bonds and ESG integration.
3. Embedding AI accountability standards in Indian and international space law; and
4. Advocating a "Space Sustainability Treaty" grounded in Indian constitutional and environmental ethics.

A. Research Objectives

The present study seeks to examine orbital debris as a legal, environmental and climate-justice concern requiring urgent regulatory attention. Its first objective is to analyse whether India's Article 21 environmental jurisprudence, particularly the precautionary principle, polluter-pays principle and public-trust doctrine, can be normatively extended to the near-Earth orbital environment. Secondly, the study evaluates the feasibility of adapting India's Extended Producer Responsibility model to satellite manufacturers, launch service providers and operators through de-orbit obligations, orbital EPR plans and financial responsibility mechanisms. Thirdly, it assesses the accountability challenges created by AI-driven space situational awareness, autonomous collision avoidance and algorithmic mission planning. Finally, the study proposes national, regional and international reforms for a binding and ethically grounded space-sustainability framework.

B. Research Questions

This paper addresses the following research questions:

1. Can Article 21 of the Indian Constitution and its environmental jurisprudence be extended, at least normatively, to the protection of the near-Earth orbital environment?
2. How can the precautionary principle, polluter-pays principle and public-trust doctrine inform legal duties for orbital debris mitigation?
3. Can India's Extended Producer Responsibility framework provide a workable model for regulating satellite end-of-life management and de-orbit obligations?

4. What legal standards should govern AI-driven collision avoidance, space situational awareness and autonomous orbital operations?
5. What role can India play in promoting a Space Sustainability Treaty or comparable international framework for responsible space governance?

C. Research Methodology

This study adopts a doctrinal and policy-analytical research methodology within a pragmatist research paradigm. It relies on primary legal sources, including Indian constitutional provisions, Supreme Court environmental jurisprudence, international space-law instruments, space-debris mitigation guidelines, statutory materials and policy documents. It also uses secondary sources such as scholarly articles, institutional reports and technical studies on orbital debris, artificial intelligence and space sustainability.

The paper applies analogical legal reasoning by transposing established environmental-law concepts, particularly Article 21 jurisprudence, the precautionary principle, the polluter-pays principle, the public-trust doctrine and Extended Producer Responsibility, from terrestrial environmental regulation to orbital sustainability. This approach is used because the near-Earth orbital environment shares key features with ecological commons: it is finite, vulnerable to cumulative harm and essential for public welfare, disaster warning and climate governance.

The methodology is reform-oriented rather than purely descriptive. It evaluates existing legal and policy gaps and proposes regulatory mechanisms such as de-orbit bonds, Orbital EPR Plans, AI auditability requirements and a Space Sustainability Treaty. A limitation of the study is that it does not rely on primary empirical data from Indian satellite operators or regulators regarding actual compliance with debris-mitigation obligations. Its conclusions are therefore based on doctrinal analysis, comparative regulatory reasoning and available institutional and technical literature.

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IV. ARTICLE 21 AND ENVIRONMENTAL STEWARDSHIP BEYOND THE ATMOSPHERE

Since the 1980s, the Supreme Court of India has read a substantive right to a clean and healthy environment into Article 21's guarantee of life and personal liberty. Early decisions such as *Rural Litigation and Entitlement Kendra v State of Uttar Pradesh* [8] treated environmentally destructive limestone quarrying in the Mussoorie hills as implicating Article 21 and ecological protection, even before the right to a clean and healthy environment was expressly consolidated in later environmental jurisprudence. Subsequent landmark cases, including *Subhash Kumar v State of Bihar* on water pollution and *M C Mehta v Union of India* [9] on the Oleum Gas Leak and absolute liability for hazardous industries, further strengthened the proposition that Article 21 protects life, health and environmental security.

In *Vellore Citizens' Welfare Forum v. Union of India*,[10] the Court explicitly integrated the precautionary principle, polluter-pays principle, and public-trust doctrine into Indian environmental law, treating them as part of the "law of the land" under Articles 21, 47, 48-A and 51-A(g). The precautionary principle, originally articulated in Principle 15 of the Rio Declaration, permits regulatory intervention where there is a threat of serious or irreversible harm, even without full scientific certainty, and in its "strong" version shifts the burden of proof to the proponent of a risky activity. Indian courts have applied this strong version in cases of industrial pollution and groundwater contamination, holding that lack of complete scientific evidence cannot justify inaction where the stakes are life, health, and ecological integrity.[11]

[8] *Rural Litigation and Entitlement Kendra v State of Uttar Pradesh* (1985) 2 SCC 431.
[9] *M C Mehta v Union of India* (Oleum Gas Leak case) (1987) 1 SCC 395.
[10] *Vellore Citizens' Welfare Forum v Union of India* (1996) 5 SCC 647.
[11] Jyoti Jindal & J & J Attorneys, 'The Precautionary Principle in the Indian Courts' (3 April 2023) https://www.jjandjattorneys.com/post/the-precautionary-principle-in-the-indian-courts accessed 8 February 2026.

The Court has also developed the public-trust doctrine, under which the State holds natural resources, such as forests, lakes, and hillocks, in trust for present and future generations and cannot abdicate this trusteeship through environmentally destructive allocations. Institutions like the National Green Tribunal operationalise this jurisprudence through specialised fact-finding and remedial powers, reinforcing a stewardship-based model of environmental governance.[12]

This constitutional trajectory offers a powerful lens for outer space. The near-Earth orbital environment, especially *low Earth orbit (LEO)* and *geostationary orbit (GEO)*, is functionally analogous to shared ecological systems: it is finite, vulnerable to cumulative impacts, and essential to critical services, including climate monitoring and disaster management. Internationally, the UN COPUOS Guidelines for the *Long-term Sustainability of Outer Space Activities (LTS Guidelines)* already conceptualise orbital sustainability in intergenerational terms but remain voluntary and non-binding.[13]

An Indian constitutional approach would treat the orbital environment as part of humanity's ecological commons, bringing it within the scope of Article 21's right to a healthy environment and the State's public-trust obligations. Under a precautionary reading, Indian regulators would be justified, even obliged, in imposing stringent debris-mitigation, de-orbit and AI-safety obligations on operators licensed under Indian jurisdiction, even where probabilistic models of debris evolution remain uncertain. This framing also aligns with India's educational and ethical traditions, for instance, Swami Vivekananda's insistence on the unity of knowledge and action by linking scientific understanding of orbital risk with duties of stewardship.

[12] Ibid.
[13] UNOOSA, 'Guidelines for the Long-term Sustainability of Outer Space Activities of the Committee on the Peaceful Uses of Outer Space'
(2021) https://www.unoosa.org/documents/pdf/PromotingSpaceSustainability/Publication_Final_English_June2021.pdf accessed 8 February 2026.

V. THE EPR MODEL FOR ORBITAL SUSTAINABILITY

A. Learning from India's EPR Experience

Extended Producer Responsibility (EPR) shifts the financial and operational responsibility for end-of-life management from the state and consumers to producers. India has progressively embedded EPR across multiple waste streams: e-waste, plastic packaging, batteries, hazardous and construction waste.

Under the *E-Waste (Management) Rules 2016* and the revised 2022 Rules, producers of electrical and electronic equipment must register, meet phased collection and recycling targets, and route waste through authorised recyclers. The Central Pollution Control Board's data show a steady increase in the percentage of generated e-waste that is formally collected and recycled, aided by digital EPR portals and environmental-compensation mechanisms. Similar EPR mandates under the *Plastic Waste Management Rules 2016* (and amendments) and the *Battery Waste Management Rules 2022* impose recovery targets and require producers to finance collection and environmentally sound recycling.

These regimes demonstrate that:

1. binding, target-based EPR obligations can move sectors from informal and unaccountable disposal to traceable circular-economy models; and
2. EPR compliance is increasingly viewed by investors and rating agencies as a core ESG parameter, affecting access to capital and valuations.

B. Transposing EPR to Orbital Operations

Existing debris-mitigation guidelines, such as the IADC and UN COPUOS Space Debris Mitigation Guidelines, remain non-binding and suffer from low compliance, particularly with respect to post-mission disposal and the 25-year de-orbit rule. Empirical analyses show that only around 60% of spacecraft in LEO comply with post-mission disposal recommendations, and even this figure is inflated by "natural compliance" due to low orbital altitudes. Debris-environment projections suggest that mitigation alone,

without active debris removal (ADR), will not stabilise LEO; even a complete halt in launches would not prevent long-term growth in debris due to ongoing fragmentation.

An EPR-based model for space would internalise these long-term environmental costs into the business models of satellite manufacturers and operators. Drawing on India's EPR practice and emerging proposals in the Indian space-law literature, the following elements could structure such a model:

1. **De-orbit Bonds as EPR Instruments:**

   Every licensed satellite or launch in India's jurisdiction (via IN-SPACE) would be required to post a de-orbit bond calibrated to mass, orbital altitude, and mission risk profile. The bond is refundable upon verified end-of-life disposal (controlled re-entry or re-orbiting to a graveyard orbit). Failure to de-orbit within a specified timeframe would forfeit the bond to a National Space Environment Fund, which finances ADR missions and SSA upgrades. This mirrors how EPR fees finance recycling infrastructure in e-waste and plastic regimes.

2. **Mandatory Orbital EPR Plans:**

   As a licensing condition, operators would submit Orbital EPR Plans detailing design-for-disposal measures, propellant reserved for de-orbiting, passivation protocols, and, where necessary, contracts with ADR providers. The earlier Draft Space Activities Bill 2017 should be treated only as a historical legislative proposal, since it did not mature into enacted legislation and has been overtaken by the post-2020 space-sector reforms. The current operative domestic framework is the Indian Space Policy 2023, under which IN-SPACe functions as the authorisation and facilitation body for non-governmental space activities. Accordingly, Orbital EPR Plans, de-orbit bonds and post-mission disposal obligations should be framed as conditions of IN-SPACe authorisation under the Indian Space Policy 2023 and

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should be incorporated into any future Space Activities legislation, including the reported 2025 redraft presently under inter-ministerial consultation.[14]

3. **Quantitative Performance Targets:**

   Analogous to e-waste and battery-recovery targets, Indian rules could set progressive benchmarks, for example, a specified percentage of Indian-licensed satellites in LEO must de-orbit within 5–10 years of end-of-life, considerably stricter than the current 25-year soft standard. Non-compliance would attract graded penalties, including loss of bond, monetary fines, and eventual licence suspension.

4. **Integration with ESG and Taxonomy Frameworks:**

   Orbital sustainability metrics, such as de-orbit compliance, collision-avoidance performance, and contribution to ADR, should be reported as part of listed companies' ESG disclosures and recognised within sustainable-finance taxonomies. As net-zero in space becomes an emerging theme, integrating "orbital pollution" into ESG standards would close a significant blind spot.[15]

From a cost–benefit perspective, the economic case for prevention is compelling. The capital cost of a modern meteorological or high-throughput communication satellite can exceed several hundred million dollars, while the marginal cost of additional propellant and hardware for reliable de-orbiting is a small fraction of that. Empirical modelling shows that the collision of two 1000-kg objects in LEO can generate several thousand trackable fragments and over 100,000 smaller fragments, raising collision risk non-linearly and jeopardising entire orbital shells. In this context, de-orbit bonds and EPR

[14] Draft Space Activities Bill 2017 (Government of India) https://prsindia.org/files/bills_acts/bills_parliament/1970/Draft%20Space%20Activities%20Bill%202017.pdf accessed 8 February 2026.
[15] EY, 'EPR Compliance: The New ESG Test for Indian Companies' (9 October 2025) https://www.ey.com/en_in/insights/strategy-transactions/epr-compliance-the-new-esg-test-for-indian-companies accessed 8 February 2026.

fees function not as punitive taxes but as insurance-like instruments that align private incentives with collective orbital stewardship.

Normatively, an orbital EPR model resonates with Article 21 based polluter-pays and precautionary principles. Operators profiting from orbital use must bear the long-term costs of keeping that environment safe, rather than externalising those costs onto future operators, states, or populations whose climate-adaptation capacity depends on functioning space infrastructure.

VI. AI AND ALGORITHMIC ACCOUNTABILITY IN ORBITAL OPERATIONS

A. AI as a Tool for Climate and Debris Governance

AI and machine-learning techniques already underpin multiple layers of the space-climate nexus. On the climate side, AI enhances assimilation of satellite data into numerical weather-prediction models and climate reanalyses, improving monsoon onset prediction, cyclone-track forecasting and extreme-event detection. INSAT-3D/3DR products, such as atmospheric motion vectors and high-resolution temperature and humidity profiles, are ingested into AI-assisted modelling systems, increasing forecast skill for rainfall extremes that critically affect Indian agriculture and disaster preparedness.

On the debris side, AI is increasingly used to improve orbit prediction for space debris, classify collision risk, and optimise avoidance manoeuvres. Machine-learning-based models can significantly improve orbit propagation for sparsely tracked debris compared to conventional methods, enhancing SSA and reducing false alarms. Reinforcement-learning algorithms have been successfully tested in simulation for autonomous multi-debris avoidance, reducing fuel consumption and enabling real-time decision-making where traditional optimisation methods are computationally expensive.

These capabilities, if responsibly deployed, are essential to sustaining climate-critical satellites in congested orbits and thus indirectly to safeguarding climate-justice interests.

B. Gaps in AI Liability and Data Protection

However, the increasing autonomy of AI-driven satellite operations raises thorny legal questions. If an AI-controlled collision-avoidance system misclassifies a conjunction and either fails to manoeuvre (causing a collision) or over-reacts (depleting fuel and shortening mission life), who bears responsibility—the satellite operator, software vendor, or AI developer? Traditional space-liability instruments, including the 1967 Outer Space Treaty and the 1972 Liability Convention, were not drafted with AI-driven collision-avoidance systems in mind and are largely silent on the internal allocation of algorithmic fault within the operator's ecosystem. However, the Outer Space Treaty remains foundational.

Article VI provides that States Parties bear international responsibility for national activities in outer space, whether carried out by governmental agencies or non-governmental entities, and must authorise and continually supervise such activities. Article VII further provides that a launching State is internationally liable for damage caused by its space object or component parts to another State Party or to its natural or juridical persons. Therefore, if an IN-SPACe-licensed private operator deploys an AI-based collision-avoidance system that fails and causes internationally cognisable damage, India's international responsibility and liability architecture may be engaged, even though the immediate operational failure occurs within a private entity's software or supply chain.

India's AI-governance framework has evolved beyond the earlier NITI Aayog 'Principles for Responsible AI' and 'Responsible AI for All' strategy. While those documents remain important foundational references, the more current cross-sectoral framework is the MeitY India AI Governance Guidelines, unveiled in November 2025 under the IndiaAI Mission. The Guidelines adopt a pragmatic and sector-sensitive approach to AI governance, organised around six governance pillars and guided by the central principle of 'Do No Harm'. They also provide practical guidance for industry, developers and regulators to ensure transparent, accountable and safe AI deployment.

For orbital operations, this updated framework is directly relevant because AI-based conjunction assessment, space situational awareness and autonomous collision-avoidance systems are safety-critical technologies capable of affecting satellite integrity, climate-monitoring infrastructure and cross-border liability. Accordingly, the paper should treat the MeitY Guidelines as the present primary reference point for Indian AI governance, while citing NITI Aayog's earlier principles as the normative foundation on which the current framework builds.The Digital Personal Data Protection Act 2023, grounded in Article 21's right to privacy post-*Puttaswamy*, is now operationalised through the Digital Personal Data Protection Rules 2025, notified by MeitY in November 2025.

The Rules are significant because they translate the Act's general obligations into a phased compliance framework dealing with notice, consent architecture, consent managers, breach notification, Data Protection Board procedures and related compliance duties. For SSA and AI-based collision-avoidance systems, this means that satellite operators and data fiduciaries handling personal data or mixed datasets connected with Indian data principals must build auditable consent and notice mechanisms, maintain breach-response protocols, and prepare for compliance according to the Rules' phased implementation timeline. However, neither the DPDPA nor the DPDP Rules 2025 creates a specific right against solely automated decision-making comparable to the EU GDPR.

This remains a regulatory gap where AI systems make safety-critical orbital decisions. In the space context, these gaps intersect. Automated collision-avoidance decisions can have life-and-death implications on the ground (by degrading climate-warning capacity) and create cross-border liability in space. Yet neither India's current space-policy instruments nor the *DPDPA* explicitly regulate algorithmic accountability in this domain.

The AI-governance analysis must also be updated to reflect post-2023 developments. In November 2025, MeitY released the India AI Governance Guidelines under the IndiaAI Mission, identifying the need for safe, inclusive, responsible and trustworthy AI adoption across sectors. These Guidelines are relevant to orbital operations because AI-based

conjunction assessment, debris tracking and autonomous manoeuvring are not ordinary commercial tools; they are safety-critical systems capable of affecting public infrastructure, disaster-warning capacity and cross-border space liability. Similarly, the DPDP Rules 2025 operationalise important aspects of India's data-protection framework, including the institutional structure of the Data Protection Board and compliance obligations for data fiduciaries.

However, neither the AI-governance framework nor the DPDP regime yet provides a space-specific standard for explainability, audit trails, human oversight or liability allocation in autonomous satellite operations. This regulatory silence strengthens the case for sector-specific AI clauses in IN-SPACe authorisations and future space legislation.

C. Towards an AI-Liability Framework for Orbital Operations

A constitutionally grounded framework for AI in space should combine Article 21's life, environment and privacy interests with the MeitY India AI Governance Guidelines 2025, NITI Aayog's earlier responsible-AI principles and relevant international space-law instruments, including the UN COPUOS Space Debris Mitigation Guidelines and Long-Term Sustainability Guidelines. The MeitY Guidelines should be treated as the current operative policy reference because they translate responsible-AI values into practical guidance for regulators and industry. In the space sector, these principles should be adapted into binding authorisation conditions requiring safety validation, explainability, audit logs, human oversight, incident reporting and independent review for AI-driven conjunction assessment and collision-avoidance systems.

Operators using AI-driven collision-avoidance or mission-planning systems should be required to maintain logs of model inputs, decision pathways, risk classifications, manoeuvre recommendations and human-override events, enabling post-incident forensic analysis. This would operationalise the MeitY Guidelines' emphasis on safe, transparent and accountable AI deployment in a space-sector context. IN-SPACe may also draw upon the RBI's FREE-AI Framework as a useful regulatory template: although designed for the financial sector, it shows how a sectoral regulator can translate cross-

sectoral AI principles into domain-specific requirements on infrastructure, policy, capacity, governance, protection and assurance. A similar sectoral model for space would require satellite operators to conduct pre-deployment safety testing, maintain explainability records, report AI-related incidents and submit high-risk systems to periodic third-party audits.

1. **Human-in-the-Loop for High-Risk Manoeuvres:** For manoeuvres involving non-negligible collision risk or fuel consumption beyond specified thresholds, regulations could require a human review and sign-off, except in time-critical situations explicitly defined ex ante. This mirrors global "human-in-the-loop" safeguards in safety-critical sectors and aligns with Article 21's demand for due care in life- and environment-affecting systems, especially where COPUOS guidelines already contemplate deliberate collision-avoidance manoeuvres based on available orbital data
2. **Presumption of Operator Liability:** In line with the strong precautionary principle and the State-responsibility structure of the Outer Space Treaty, liability within India's domestic licensing framework should presumptively rest with the IN-SPACe-authorised operator, irrespective of whether the proximate technical cause lies in an AI vendor's model, a software integrator's code or a third-party data provider's faulty conjunction assessment. This domestic presumption would not displace India's international obligations under Articles VI and VII of the Outer Space Treaty or the 1972 Liability Convention; rather, it would operate internally to ensure that the licensed operator remains the primary accountable entity before Indian regulators. Contractual indemnities, insurance, subrogation and vendor warranties may govern the operator's internal recovery against AI developers or suppliers, but affected states, operators or victims should not bear the burden of disentangling complex AI and space-industry supply chains.
3. **DPDPA-Aligned Data Governance:** SSA and AI-based collision-avoidance systems often process tracking data that may indirectly reveal sensitive operational information, including the location, movement or vulnerability of

strategic and national-security assets. Where such systems also involve personal data, operator metadata, personnel-linked access logs or identifiable user-account information, the DPDPA 2023 and DPDP Rules 2025 should guide sector-specific space-data governance. Purpose limitation, data minimisation and proportionate sharing should be supplemented by DPDP Rules-based operational requirements, including clear notice, consent-management architecture where consent is the lawful basis, breach-notification procedures and auditable compliance records. The consent-manager framework may be relevant where private satellite platforms, downstream analytics services or SSA-data interfaces process personal data on behalf of Indian users or institutional clients. Further, breach-notification duties should apply to cyber incidents affecting SSA databases, AI model logs or collision-avoidance platforms where personal data or user-linked operational data is compromised. Space-specific rules should therefore integrate the DPDP Rules 2025 with safety-based exceptions for necessary SSA data-sharing, ensuring that privacy compliance does not obstruct urgent collision avoidance, debris warnings or international space-safety coordination.[16]

Embedding these duties within India's domestic space-authorisation framework would not only protect constitutional rights but also position India as a norm-entrepreneur in global AI-in-space governance.

VII. TOWARD A SPACE SUSTAINABILITY TREATY: FROM NATIONAL REFORM TO GLOBAL NORM-SETTING

A further domestic-policy development must be expressly recognised. The Indian Space Policy 2023 is now the principal policy instrument governing the participation of non-government entities in Indian space activities. It assigns IN-SPACe a central role in promoting, guiding and authorising space activities, while ISRO is expected to focus

[16] Latham & Watkins, 'India's Digital Personal Data Protection Act 2023 vs the GDPR: A Comparison' (2023) https://www.lw.com/admin/upload/SiteAttachments/Indias-Digital-Personal-Data-Protection-Act-2023-vs-the-GDPR-A-Comparison.pdf accessed 8 February 2026.

more closely on research, development and advanced space missions. This policy shift is significant for orbital-debris governance because authorisation conditions can become the immediate regulatory site for imposing debris-mitigation plans, end-of-life disposal duties, de-orbit bonds and reporting obligations. The earlier Draft Space Activities Bill 2017 should therefore be treated only as a prior legislative proposal, not as the current operative framework. Any future Space Activities legislation must build upon the Indian Space Policy 2023 and convert its authorisation architecture into enforceable statutory obligations for orbital sustainability.

A. Immediate National Actions

India's Draft Space Activities Bill 2017 and subsequent policy instruments already provide a skeletal framework for private-sector participation, insurance and liability, but they pre-date the current explosion of mega-constellations, increasing reliance on the COPUOS Space Debris Mitigation and LTS Guidelines, advances in AI autonomy, and the ESG turn in corporate governance. Immediate national reforms could include:

1. **Incorporating Binding EPR and De-orbit Provisions:** Use the Indian Space Policy 2023 and IN-SPACe authorisation conditions as the immediate regulatory basis for debris-mitigation obligations, while incorporating stronger statutory duties into the forthcoming Space Activities legislation. The 2025 redraft, rather than the lapsed 2017 draft, should be treated as the more proximate legislative opportunity to mandate orbital-debris mitigation plans, de-orbit bonds, Orbital EPR Plans and time-bound post-mission disposal. These obligations should reference UN COPUOS, IADC and ISO debris-mitigation standards but go beyond their voluntary character by making compliance a condition of authorisation, insurance approval and continued operation.
2. **AI Governance Clauses in Space Licensing:** IN-SPACe's licensing conditions should explicitly require compliance with the MeitY India AI Governance Guidelines 2025 as the current cross-sectoral AI governance framework, while

also drawing on NITI Aayog's earlier responsible-AI principles as foundational guidance. For AI-driven satellite operations, authorisation conditions should require transparent model documentation, safety validation, human oversight for high-risk manoeuvres, incident reporting, cybersecurity safeguards and third-party audits. IN-SPACe should further develop a space-sector AI governance protocol modelled on the RBI FREE-AI Framework, which demonstrates how broad AI principles can be adapted by a sectoral regulator into practical obligations concerning governance, protection, assurance and capacity-building.

3. **National Space Environment Fund:** Establish a dedicated fund, financed through de-orbit bonds, licensing fees and penalties, to support indigenous ADR technology development, SSA infrastructure, and research on orbital-climate interactions.[17]

B. Regional Cooperation: An Asia–Pacific Space Sustainability Coalition

Given the transboundary nature of debris and the dense concentration of launch states and emerging space actors in Asia, India is well-placed to convene an Asia–Pacific coalition focused on:

1. Harmonising debris-mitigation and EPR standards across national regulators;
2. Sharing SSA data and AI-enabled conjunction-assessment tools;
3. Jointly funding demonstrator ADR missions and multi-mission satellite architectures that reduce launch numbers.

Such a coalition would build on, but also go beyond, the UN COPUOS LTS Guidelines by creating regionally coordinated, quasi-binding norms tailored to local launch patterns and climate vulnerabilities.

[17] Access Partnership, 'The Key Policy Frameworks Governing AI in India' (12 August 2025) https://accesspartnership.com/opinion/the-key-policy-frameworks-governing-ai-in-india/ accessed 8 February 2026.

C. A "Delhi Declaration on Orbital Sustainability"

At the multilateral level, India can leverage its standing in COPUOS and climate fora to propose a "Delhi Declaration on Orbital Sustainability", with three distinctive features:

1. **Constitutional Ethic of Stewardship:** Drawing explicitly on Article 21, the precautionary principle, polluter-pays and the public-trust doctrine, the Declaration would frame orbital sustainability as an extension of the right to a healthy environment and the duty to protect global ecological commons.
2. **Integration of EPR and AI Governance:** The Declaration would call for incorporating EPR-style obligations for satellite end-of-life management and explicit AI-accountability principles into future binding instruments or model national laws, recognising that AI and mega-constellations are now central drivers of orbital risk.
3. **Climate-Justice Lens and SDG Alignment:** By highlighting the dependence of SDG 13 (Climate Action), SDG 11 (Sustainable Cities) and SDG 2 (Zero Hunger) on reliable space-based climate services, the Declaration would argue for differentiated but common responsibilities: states and corporations that have contributed most to orbital congestion should shoulder a greater share of ADR and SSA costs, echoing climate-justice principles.

Such a treaty-building agenda does not compete with terrestrial climate agreements; rather, it safeguards the orbital infrastructure those agreements increasingly rely upon.

VIII. SUGGESTIONS AND RECOMMENDATIONS

To bring India's space-governance framework in line with constitutional environmental principles and contemporary orbital risks, the following recommendations are proposed. At the national level, India should incorporate binding debris-mitigation and end-of-life disposal obligations into its space-authorisation framework. IN-SPACe licensing conditions should require Orbital EPR Plans, de-orbit bonds, passivation protocols and verified post-mission disposal for satellites and launch-related objects. A dedicated

National Space Environment Fund may also be created through licensing fees, forfeited de-orbit bonds and penalties to finance active debris-removal missions, space situational awareness infrastructure and research on orbital-climate interactions.

Secondly, AI governance clauses should be embedded into space licensing. Operators using AI-driven collision-avoidance, conjunction-assessment or autonomous mission-planning systems should be required to comply with standards of safety, explainability, auditability, human oversight and incident reporting. These obligations would ensure that algorithmic systems affecting climate-critical orbital infrastructure remain transparent, reviewable and accountable.

Thirdly, India should promote regional cooperation through an Asia-Pacific Space Sustainability Coalition. Such a framework could harmonise debris-mitigation standards, enable responsible sharing of space situational awareness data, support AI-enabled conjunction-assessment tools and jointly finance demonstrator active debris-removal missions.

Finally, India should advocate a multilateral instrument, such as a Space Sustainability Treaty or a Delhi Declaration on Orbital Sustainability. This instrument should integrate the precautionary principle, polluter-pays principle, public-trust doctrine, Extended Producer Responsibility and AI-accountability norms. It should also recognise that orbital sustainability is connected to climate justice, because space-based data supports disaster warning, agricultural planning, climate adaptation and the protection of vulnerable communities.

IX. CONCLUSION

The technical and legal assessments of space operations over the last sixty years have shown three major problems which include fast growing commercial activities, slow development of regulatory frameworks, and ongoing dependence on voluntary guidelines for debris management. Satellites have become essential tools for climate research which helps societies that face risks, including India, to plan for climate

adaptation and disaster risk management. The continuation of current orbital activities will lead to near Earth environmental damage which prevents achievement of climate justice and sustainable development objectives that space-based data should support.

The Indian Constitution through Article 21 establishes a distinct legal pathway to follow. The Supreme Court established an environmental protection ethic through its decision which recognizes the right to a clean environment and the precautionary principle and polluter pays principle and the public trust obligations of the state.[18] India's implementation of EPR regulations for e-waste and plastic waste and battery disposal shows that establishing enforceable production targets leads industries toward responsible recycling practices. The responsible AI framework and data protection legislation of the organization provide a foundation which establishes algorithmic accountability requirements for safety critical systems, despite their incomplete status.

The process of converting home educational systems into space governance requires creative legal thinking because existing laws already define all necessary regulations. The complete space regulatory framework needs to include de orbit bonds, orbital EPR plans, AI liability regulations, due diligence requirements, national ADR and SSA funding, and both regional and global norm development leadership to achieve constitutional stability and climate justice.

Transformative education seeks to change both human thinking and environmental conditions through its method of connecting knowledge with moral conduct; therefore, space law must establish stewardship principles to change human behavior toward the space environment. The extension of Article 21 beyond earthbound territories constitutes a legal option for India which must create laws to prevent ecological disasters in the "final frontier" area.

[18] Delhi Law Academy, 'Right to Clean Environment - Article 21 of Constitution' (Delhi Law Academy, 11 November 2025) https://www.delhilawacademy.com/art-21-right-to-clean-environment/ accessed 8 February 2026.

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