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FROM SOVEREIGNTY TO SUSTAINABILITY: EXAMINING INDIA'S SPACE LAW TRAJECTORY WITH COMPARATIVE INSIGHTS ON ENVIRONMENTAL DEGRADATION IN OUTER SPACE

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ABSTRACT

India's ascent as a prominent spacefaring nation has been marked by a dynamic interplay between sovereignty-driven objectives and emerging imperatives for environmental sustainability. This research examines the evolution of India's space law framework, tracing its trajectory from a focus on national control and strategic autonomy to a gradual, though incomplete, integration of environmental considerations. The research situates India's policies within the broader context of international space law, including obligations under the Outer Space Treaty and evolving norms on space debris mitigation & protection of the outer space environment. Drawing on comparative insights from US, EU, & China, the research highlights how other major space powers have adopted regulatory mechanisms to incentivize debris mitigation, enforce accountability, and promote sustainable practices. In contrast, India's legal regime remains anchored in draft legislation and agency-level protocols that lack binding force and transparency. The research identifies critical gaps in India's approach, such as the absence of enacted national legislation explicitly addressing environmental degradation in outer space and limited institutional capacity to monitor and enforce compliance among emerging private actors. The research argues that as India accelerates its commercial and scientific activities in space, the urgency of integrating robust environmental safeguards into domestic law becomes paramount. It proposes a comprehensive legislative framework that embeds sustainability obligations, strengthens regulatory oversight, and positions India as a proactive contributor to the global governance of outer space.

Keywords: Space Law, Outer Space Treaty, Sovereignty, Sustainability, Environmental Degradation, Space Debris, Orbital Debris Mitigation, Space Governance

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INTRODUCTION

The contemporary epoch has witnessed an unprecedented proliferation of space activities, propelled by both state actors and private enterprises that transcend the conventional boundaries of territorial sovereignty. The global paradigm shift towards the commercialization and militarization of outer space has disrupted the classical legal constructs embedded in the Outer Space Treaty of 1967, which enshrines outer space as the *province of all mankind*. In practice, technological advancements have enabled a handful of technologically advanced nations to exert de facto control over orbital resources, satellite networks, and strategic vantage points, thereby engendering a contest over not merely access but also the governance of the extraterrestrial commons. This acceleration of activity has concomitantly precipitated complex regulatory dilemmas, including but not limited to the unchecked accumulation of orbital debris, the contamination of celestial bodies, & dual-use character of satellite constellations that blur the demarcation between peaceful utilization and national security imperatives. These developments underscore the exigency of recalibrating international and municipal legal frameworks to ensure that the exploitation of space does not compromise its long-term sustainability or the equitable interests of the broader international community (Jakhu & Pelton, 2017).

Against this backdrop, India has emerged as a paradigmatic example of an ascending spacefaring nation whose trajectory embodies both the aspirations & contradictions inherent in contemporary space governance. From its inception as a developmental endeavor premised on self-reliance and technological sovereignty, India's space programme has progressively evolved into a multifaceted enterprise encompassing commercial satellite launches, strategic military capabilities, and ambitions for deep-space exploration. ISRO, supported by ancillary entities such as Antrix Corporation and NewSpace India Limited, has positioned the country among the foremost providers of affordable launch services, thereby reshaping the global market dynamics for small satellite deployment (Lyall & Larsen, 2018). However, India's rapid ascent has not been matched by an equally robust domestic legal regime capable of reconciling the imperatives of sovereignty, commercialization, and environmental stewardship. The lacunae in India's statutory framework, particularly concerning space debris mitigation and liability apportionment, pose acute legal and policy challenges that warrant critical examination in light of comparative international standards and emerging sustainability norms.

The establishment of the ISRO in 1969 signified a pivotal institutional development, situating India's nascent space programme within a centrally coordinated, state-driven framework. The creation of the Space Commission & Department of Space (DoS) further entrenched executive control, embedding space policy formulation within a bureaucratic apparatus answerable directly to the Prime Minister's Office. While this centralization afforded India the capacity to pursue strategic autonomy and technological self-reliance in the Cold War context, it simultaneously precluded the emergence of an independent statutory regulatory architecture. Unlike jurisdictions where enabling legislation demarcates clear regulatory competencies and accountability obligations, India's initial framework was characterized by executive notifications and policy directives lacking the force and precision of binding statutory instruments. This foundational reliance on administrative instruments rather than legislative enactment continues to exert structural constraints on India's capacity to operationalize transparency, liability, and environmental accountability mechanisms in line with international obligations (Jasentuliyana, 1992).

Between the 1970s & early 2000s, India's space policy evolved incrementally through sector-specific policies that were reactive rather than anticipatory. Notably, the Satellite Communication Policy (SATCOM Policy) & Remote Sensing Data Policy (RSDP) were promulgated as executive policy documents aimed at regulating access, dissemination, and commercial utilization of space-based data and services. While these instruments delineated procedural thresholds for licensing and approval, they fell short of establishing enforceable environmental safeguards or debris mitigation obligations. This regulatory lacuna reflected a preoccupation with sovereignty and control over strategic resources, with little emphasis on sustainability or compliance reporting frameworks. Consequently, India's regulatory approach retained an opaque, executive-centered character that did not subject ISRO and related entities to rigorous statutory oversight or judicial scrutiny, an omission increasingly incongruent with evolving global norms of transparency and environmental stewardship in outer space activities (Sadeh, 2006).

The introduction of the Space Activities Act, 2017 marked the first substantive attempt to codify India's obligations under the Outer Space Treaty and related instruments into domestic law. The Act sought to define the scope of permissible space activities, establish licensing requirements, and

allocate liability for damage caused by space objects. However, critical scrutiny reveals that the Act remained largely declaratory, vesting expansive discretionary authority in the Central Government without articulating detailed substantive standards for debris mitigation, environmental impact assessment, or compliance verification. Further, the Act conspicuously omitted provisions that would compel operators to internalize the environmental costs of their activities or to submit to independent regulatory audits. Despite subsequent iterations, the legislation has yet to be enacted, perpetuating a regulatory vacuum in which private sector participation is encouraged without the concomitant imposition of binding obligations to ensure environmental sustainability or adherence to best practices in orbital debris management (Hertzfeld & Williamson, 2014).

India's trajectory of space law development is undergirded by a set of normative commitments privileging sovereignty, technological self-reliance, and strategic security considerations over sustainability and environmental accountability. The national space programme has historically operated as an extension of strategic policy, with legal frameworks subordinated to geopolitical imperatives & aspiration to achieve parity with established space powers. The recent pivot towards commercialization, manifest in policy liberalization, public-private partnerships, & creation of entities such as NewSpace India Limited, has not been accompanied by a commensurate recalibration of the legal architecture to incorporate enforceable environmental obligations or transparent compliance protocols. Consequently, India's evolving space law corpus reflects an asymmetry between the promotion of economic and strategic interests, on the one hand, & articulation of binding sustainability norms on the other. This disjuncture raises fundamental questions about India's capacity to reconcile its sovereign prerogatives with its obligations under customary and treaty-based international space law to protect the outer space environment as the "province of all humankind" (Wouters, Hansen, & Amez, 2019).

SOVEREIGNTY IN OUTER SPACE LAW

The Outer Space Treaty of 1967, often described as the Magna Carta of space law, establishes the foundational principle that outer space, including the Moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, use, occupation, or any other means (Article II). This precept effectively circumscribes classical notions of territorial sovereignty by precluding any extension of State dominion into the celestial realm. The Treaty further obliges States to undertake

activities in outer space exclusively for the benefit and in the interests of all countries, thereby framing space as a global common imbued with a fiduciary responsibility. The Liability Convention of 1972 operationalizes this fiduciary responsibility by imposing absolute liability upon launching States for damage caused on the surface of the Earth or to aircraft in flight, and fault-based liability for damage occurring elsewhere in space. Complementing these obligations, the Registration Convention of 1975 obliges States to maintain and furnish records of space objects launched into Earth orbit or beyond, thereby enhancing transparency and accountability (Masson-Zwaan & Hofmann, 2019).

India, as an early signatory and party to the principal space treaties, has consistently affirmed the non-appropriation principle while simultaneously asserting its sovereign prerogative to exercise jurisdiction and control over space objects it launches or procures to be launched. This dual posture emerges clearly from India's treaty ratification practice and policy pronouncements, whereby the State acknowledges the inalienability of the commons yet retains exclusive functional jurisdiction over its registered objects (Article VIII, Outer Space Treaty). The Space Activities Act, 2017, further codifies this duality by stipulating licensing requirements and conditions for private entities engaging in space activities, which must be subject to Indian authorization and continuing supervision. Notably, India's regulatory schema reflects a deliberate effort to harmonize the constitutional imperative of sovereignty over national assets with the constraints of international law (Tronchetti, 2013).

The inherently dual-use character of many space technologies presents a complex challenge to the ostensibly peaceful orientation of international space law. In particular, satellite systems capable of earth observation, communications interception, and precision navigation may also be leveraged for military applications, blurring the boundary between civil and defense purposes. India's demonstration of anti-satellite (ASAT) capability through "Mission Shakti" in March, 2019 exemplifies this strategic ambiguity. While India defended the operation as a measured step to secure its space-based assets and deter potential adversaries, the resultant debris field invoked widespread concern regarding long-term environmental hazards & stability of the orbital commons. Though no explicit treaty prohibition currently exists against ASAT testing per se, such activities arguably contravene the spirit, if not the letter, of Article IX of the Outer Space Treaty, which mandates that States avoid harmful contamination and adverse interference with the peaceful exploration and use of outer space. The Mission Shakti test thus underscores the tension between sovereign security

prerogatives & collective interest in preserving a safe and sustainable space environment (Singh, 2021).

Despite the clear articulation of principles in treaty law, the enforcement of obligations under space law remains fraught with uncertainty. Notably, no international adjudicatory body with compulsory jurisdiction has yet been seized of a contentious dispute arising directly from space activities. While the Permanent Court of Arbitration adopted Optional Rules for disputes relating to outer space activities (2011), their application remains contingent upon State consent. The liability regime established by the Liability Convention, though theoretically robust, has seen only a single claim formally resolved, the 1978's Cosmos 954 incident between Canada & Soviet Union, which was settled diplomatically rather than through judicial determination. This paucity of jurisprudence perpetuates ambiguity in the scope and application of key treaty obligations, including the standard of due regard, thresholds for "harmful interference", and modalities of compensation for transboundary damage. For India, this lacuna underscores the necessity of enacting comprehensive domestic legislation to provide a determinate framework for liability, compliance, and recourse, thereby reinforcing the credibility of its adherence to international norms while safeguarding national interests in an increasingly contested orbital domain (Gowrinathan, 2020).

INDIA'S SPACE LAW TRAJECTORY

The Indian Space Policy 2023, formally approved on April 6, 2023, constitutes a transformative reorientation of India's regulatory and institutional approach to space activities. This policy underscores deliberate transition from predominantly state-driven paradigm to progressively privatized and commercially liberalized framework. Its stated objective is to augment India's proportional stake in the global space economy from a modest 2% to an ambitious 9% within the span of this decade, thereby positioning the nation as a consequential actor in the emergent space-industrial complex. The policy delineates a reallocation of institutional functions and mandates, especially with respect to ISRO, which shall progressively recede from routine operational manufacturing and deployment undertakings and instead prioritize intensive research and development activities. These advanced pursuits encompass the development of critical technological capabilities, such as indigenous systems for human spaceflight, next-generation reusable launch

vehicle architecture, and interplanetary exploration initiatives directed toward deep space scientific missions (Neha, 2023).

In furtherance of this structural reconfiguration, the policy establishes the Indian National Space Promotion and Authorization Center (IN-SPACe) as an autonomous statutory entity endowed with a dual mandate: regulatory oversight and facilitation of space-sector engagement by non-governmental entities. IN-SPACe operates as a centralized, single-window mechanism for authorizing, monitoring, and adjudicating private participation in India's space program. Among its enumerated responsibilities is the institutional facilitation of technology transfers from governmental entities to private stakeholders, thereby catalyzing domestic capacity-building and commercialization. In tandem, IN-SPACe is vested with the authority to ensure adherence to India's international legal obligations arising under treaties and customary principles governing outer space activities, including but not limited to the Outer Space Treaty, 1967, Liability Convention, & Registration Convention (Hobe, 2019).

Complementing this institutional framework is the operational role assigned to NewSpace India Limited, government-owned corporate vehicle specifically tasked with the monetization of space assets and technologies originally developed by ISRO. NSIL is empowered to enter into commercial arrangements for procuring space-based infrastructure and services from private and foreign entities. This operational interface effectively delineates the commercialization function from ISRO's R&D-centric mandate, thus creating a clearer institutional demarcation between scientific innovation and market-oriented exploitation of space assets.

A cardinal feature of the policy is its explicit recognition of the private sector's prerogative to engage comprehensively in end-to-end space activities. This encompasses a broad spectrum of permissible operations, including but not limited to the design, manufacturing, and deployment of satellites; provision of launch services; and establishment of space-based communication networks. Notably, the policy confers upon NGEs the entitlement to own and operate satellites in both geostationary orbits & non-geostationary orbits, subject to regulatory compliance with applicable orbital slot coordination, spectrum allocation, and safety standards.

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Despite these substantive innovations, the policy has been subject to critical scrutiny on account of the absence of a consolidated legislative enactment, commonly referred to as a dedicated Space Act, 2017, that would furnish a comprehensive legal framework governing licensing, foreign direct investment modalities, liability apportionment, and dispute resolution. In the interim, regulatory clarity is dependent on subordinate instruments such as the Norms, Guidelines, and Procedures for Implementation of Space Activities in India, 2024, which by their very nature lack the normative force and permanence of primary legislation. The reliance on such guidelines has engendered concerns regarding legal certainty and predictability for both domestic and international investors. Moreover, the policy's permissive provision authorizing NGEs to undertake the commercial recovery and utilization of space resources has been identified as potentially incongruent with India's obligations under Article I of the Outer Space Treaty, which characterizes outer space as the "province of all mankind" and imposes limitations on national appropriation and exclusive exploitation (Weeden, 2014).

The operational dimension of India's evolving space ecosystem is further elaborated in the Indian Space Situational Assessment Report, 2024, promulgated by ISRO's System for Safe and Sustainable Space Operations Management. This comprehensive report documents the quantum and operational status of India's on-orbit assets, specifying that during the reporting period of 2024, India conducted the launch of 136 spacecraft, of which 53 remained operational as of the reporting date, comprising 22 satellites in low Earth orbit and 31 in geosynchronous Earth orbit. The report further records the execution of 10 collision avoidance maneuvers, each necessitated by the escalating risk posed by orbital congestion and proliferation of non-functional debris objects (Neha, 2024).

Consistent with its international commitments and domestic objectives for sustainable space utilization, India has announced the Debris-Free Space Missions initiative at the 42nd plenary session of the Inter-Agency Space Debris Coordination Committee convened in Bengaluru between 2023 and 2024. This initiative articulates a national ambition to achieve zero-debris space missions by the end of the decade, thereby establishing India as an exemplar of responsible space stewardship. Complementing this aspirational trajectory is the Space Vision 2047's roadmap, a long-range policy instrument which envisions the operationalization of reusable launch vehicles by 2025, the

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construction of an indigenous modular space station by 2028, & execution of a manned lunar landing mission by 2040.

The challenge of space debris management remains an existential risk to the sustainability of near-Earth space activities. Space debris, legally and operationally defined as any human-made object in orbit that no longer serves a functional purpose, presents material hazards to both operational satellites and crewed missions. As of 2024, the aggregate number of active satellites surpassed 10,000 globally, with SpaceX alone accounting for an estimated 60% of such deployments under its Starlink constellation program. The accelerated pace of constellation proliferation has compounded the debris hazard, necessitating increasingly sophisticated mitigation protocols (ISRO, 2024).

India has undertaken a range of proactive measures in this domain. In 2024 alone, ISRO conducted 10 collision avoidance maneuvers to preserve operational integrity and executed de-orbiting procedures for satellites including Scatsat-1, INS-2B, and EOS-7, thereby reducing the risk of fragmentation. The PSLV Orbital Experimental Modules were purposefully lowered to an altitude of approximately 350 kilometers to facilitate atmospheric reentry and disposal. The NGP 2024 regulations impose affirmative obligations upon operators to conduct pre-launch assessments of the projected space environment population, ensure alignment with UN Committee on the Peaceful Uses of Outer Space, Space Debris Mitigation Guidelines adopted in 2007, and furnish comprehensive post-launch environmental impact reports to IN-SPACe (ISRO, 2024).

SUSTAINABILITY AND ENVIRONMENTAL DEGRADATION IN OUTER SPACE

Environmental degradation in outer space encompasses a spectrum of anthropogenic impacts that fundamentally threaten the sustainable use of the extraterrestrial commons. Foremost among these is the phenomenon of space debris proliferation, comprising defunct satellites, spent rocket stages, fragmentation remnants, and other residual artefacts that accumulate in Earth orbit with cumulative and often exponential hazard potential. Legally, the characterization of such debris implicates the obligations of launching States under Article VI and Article VII of the Outer Space Treaty (1967), particularly the duty to exercise “continuing supervision” and bear “international liability” for damage inflicted by their space objects. Additionally, contamination of celestial bodies, whether through microbial transfer, chemical residues, or mechanical disruption, raises profound normative

tensions between the principle of free exploration & corollary duty to avoid "harmful contamination" codified in Article IX of the Treaty. Atmospheric pollution arising from rocket launches further compounds these liabilities, introducing particulate emissions and ozone-depleting substances into the stratosphere, thereby establishing a nexus between space law and international environmental law (Slobodian, 2021).

In response to these exigencies, an emergent corpus of soft-law instruments and technical standards has sought to articulate a normative baseline for debris mitigation and environmental stewardship. The 2007's UN COPUOS Guidelines on Space Debris Mitigation & 2019's Long-Term Sustainability Guidelines collectively advance non-binding framework emphasizing pre-launch risk assessment, post-mission disposal protocols, & minimization of accidental break-ups. However, these guidelines are constrained by their voluntary nature & absence of robust verification or enforcement mechanisms, limiting their normative efficacy. Complementing these are ISO standards, notably ISO 24113, which codify precise technical prescriptions on debris mitigation but remain similarly reliant on voluntary adherence. Comparative practice demonstrates variable degrees of operationalization, the European Space Agency's Clean Space Initiative represents a proactive institutional commitment to lifecycle environmental accountability and active debris removal technologies; US, through its Orbital Debris Mitigation Standard Practices and licensing mandates administered by the Federal Communications Commission, imposes conditional obligations on operators; while Japan has pioneered debris remediation capabilities, including experimental removal missions (Singh, 2019).

CONCLUSION & THE WAY FORWARD

The trajectory of India's space law underscores a discernible shift from an exclusive emphasis on sovereign prerogatives and strategic autonomy to an incipient acknowledgment of environmental stewardship as an indispensable facet of responsible spacefaring. Nonetheless, this evolution remains legally inchoate, as evidenced by the persistent absence of a comprehensive statutory framework that concretely operationalizes sustainability obligations under domestic law. While the Space Activities Act, 2017 gestures toward compliance with international norms, particularly Outer Space Treaty & COPUOS debris mitigation guidelines, it stops short of codifying enforceable duties or articulating precise liability contours for environmental harm arising from state and non-state activities. The imperative, therefore, is twofold: first, to enact legislation that unambiguously embeds environmental

due diligence as binding obligation, coupled with robust compliance and verification mechanisms; and second, to cultivate institutional capacities that can enforce such obligations with transparency and consistency. As India consolidates its commercial and strategic presence in outer space, it must resist the temptation to defer sustainability in favor of expedience. Instead, a forward-looking regulatory paradigm, grounded in the precautionary principle, proportional liability regimes, and explicit licensing conditions for private actors, will be indispensable to reconcile sovereign interests with ergo omnes character of obligations owed to the international community to preserve the outer space environment. In this regard, India is uniquely positioned not only to harmonize its domestic legal architecture with global best practices but also to assume normative leadership in shaping emerging customary law that situates environmental protection at the core of space governance.

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