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Avinash Kumar

Avinash Kumar has completed his Ph.D. in International Investment Law from the Dept. of Law & Governance, Central University of South Bihar. His research work is on "International Investment Agreement and State's right to regulate Foreign Investment." He qualified UGC-NET and has been selected for the prestigious ICSSR Doctoral Fellowship.He is an alumnus of the Faculty of Law, University of Delhi. Formerly he has been elected as Students Union President of Law Centre-1, University of Delhi.Moreover, he completed his LL.M. from the University of Delhi (2014-16), dissertation on "Cross-border Merger & Acquisition"; LL.B. from the University of Delhi (2011-14), and B.A. (Hons.) from Maharaja Agrasen College, University of Delhi. He has also obtained P.G. Diploma in IPR from the Indian Society of International Law, New Delhi.He has qualified UGC – NET examination and has been awarded ICSSR – Doctoral Fellowship. He has published six-plus articles and presented 9 plus papers in national and international seminars/conferences. He participated in several workshops on research methodology and teaching and learning.

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CLEARING INDIA'S SEAS AND SKIES: A BOLD SPACE DEBRIS LAW FOR 2025

AUTHORED BY - AHMAD BILAL

Abstract

India's legal and policy framework for managing satellite debris in its 2.37 million km² Exclusive Economic Zone (EEZ) and territorial waters is critically deficient, exposing its maritime ecosystems and economic interests to significant risks. The outdated Outer Space Act, 1962, lacks provisions for debris mitigation, while the Environment (Protection) Act, 1986, and UNCLOS (1982) are inadequately integrated to address space debris as a marine pollutant. Ambiguous private sector regulations under the Indian Space Policy, 2023, and India's reluctance to invoke the Convention on International Liability for Damage Caused by Space Objects (1972) further exacerbate vulnerabilities, as evidenced by the unaddressed 2021 Long March 5B re-entry. This paper proposes the Space Debris Liability and Compensation Act, 2025, incorporating absolute liability, a compensation tribunal, and mandatory private sector mitigation, drawing on U.S., French, and Australian models. Critical analysis reveals judicial, economic, and diplomatic challenges, mitigated through phased implementation, insurance models, and Quad cooperation. Recommendations urge legislative enactment by 2026, policy enhancements via IN-SPACe and NETRA, and global advocacy at COPUOS, ensuring India's leadership in sustainable space governance.

Keywords: Space debris, maritime zones, national space law, liability, environmental protection

Introduction

The proliferation of space debris, with over 27,000 tracked objects in orbit, poses a growing threat to India's 2.37 million km² EEZ and 7,500 km coastline, critical for fisheries, tourism, and ecological biodiversity.[1] Incidents like the 2021 Long March 5B uncontrolled re-entry near India's EEZ underscore the environmental and economic risks of debris, including marine pollution from hazardous materials like hydrazine, yet India's legal framework remains ill-

[1] European Space Agency. (2025). Space debris by the numbers. https://www.esa.int/Safety_Security/Space_Debris/Space_debris_by_the_numbers

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equipped to respond.[2] The *Outer Space Act, 1962*, predates modern debris challenges, while the *Indian Space Policy, 2023*, fails to regulate private entities like Pixxel, exposing India to international liability under the *Outer Space Treaty (1967)*.[3] Inadequate integration of the *Environment (Protection) Act, 1986*, and UNCLOS (1982) with space governance, coupled with India's reluctance to leverage the *Liability Convention (1972)*, as seen in the Long March 5B case, highlights urgent governance gaps.[4][5] This paper critically examines these deficiencies, proposing the *Space Debris Liability and Compensation Act, 2025*, to establish liability, a tribunal, and private sector regulations. It analyses global models (U.S., France, Australia), assesses implementation challenges, and recommends legislative, policy, and diplomatic actions to position India as a leader in sustainable space governance. The structure includes legal gaps, case studies, proposed framework, comparative analysis, critical evaluation, recommendations, and conclusion.[6]

Legal and Policy Gaps in India's Current Framework

To critically identify and analyse deficiencies in India's legal and policy framework for managing satellite debris in its territorial waters and Exclusive Economic Zone (EEZ), focusing on legislative shortcomings, inadequate integration with environmental and maritime laws, ambiguous private sector regulation, and challenges in enforcing international liability.

Legislative Deficiency

India's primary space legislation, the Outer Space Act, 1962, is inadequate for addressing satellite debris management. Enacted to align with the Outer Space Treaty (1967), the Act emphasizes peaceful space use and state responsibility but lacks provisions for debris mitigation, liability for damage in maritime zones, or regulation of private space entities.[7] Its silence on critical issues, such as controlled re-entry or environmental protection, leaves India

[2] European Space Agency. (2021). Long March 5B re-entry update. https://www.esa.int/Safety_Security/Space_Debris/Long_March_5B_re-entry_update
[3] United Nations Office for Outer Space Affairs. (2023). Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies. https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/outerspacetreaty.html
[4] Ministry of Environment, Forest and Climate Change. (1986). Environment (Protection) Act, 1986. Government of India. https://www.indiacode.nic.in/bitstream/123456789/1816/1/A1986-29.pdf
[5] United Nations. (1982). United Nations Convention on the Law of the Sea. https://www.un.org/depts/los/convention_agreements/texts/unclos/unclos_e.pdf
[6] Froehlich, A. (Ed.). (2018). A fresh view on the outer space treaty. Springer. https://doi.org/10.1007/978-3-319-70434-0
[7] Jakhu, R. S., & Pelton, J. N. (2017). Global space governance: An international study. Springer. https://doi.org/10.1007/978-3-319-54364-2

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unprepared to govern debris incidents in its 2.37 million km² EEZ and 7,500 km coastline. The proposed Space Debris Liability and Compensation Act, 2025, aims to address these gaps by establishing a compensation tribunal and liability mechanisms; however, its non-enactment as of June 2025 creates a legal vacuum, forcing reliance on outdated domestic laws or international treaties ill-suited for localized enforcement.[89] This deficiency is particularly evident in incidents like the 2021 Long March 5B rocket re-entry near India's EEZ, which exposed the absence of a robust national framework to address such risks.[10]

Environmental and Maritime Integration

The Environment (Protection) Act, 1986, empowers the Indian government to regulate pollutants but does not explicitly address space debris, despite its potential to release hazardous materials, such as hydrazine or heavy metals, into marine ecosystems.[11] Debris impacting ecologically sensitive areas, like the coral reefs of the Andaman and Nicobar Islands or the Sundarbans' fisheries, could cause significant environmental and economic harm, yet the Act lacks protocols for such scenarios. Similarly, the United Nations Convention on the Law of the Sea (UNCLOS, 1982), under Articles 56 and 194, grants India sovereign rights over its EEZ and obligations to prevent marine pollution, respectively.[12] However, India has not operationalized these provisions to address space debris, limiting its ability to respond to incidents like the Long March 5B re-entry.[13] The National Marine Litter Policy (2018) further exacerbates this gap, focusing exclusively on terrestrial waste and omitting space debris as a marine pollutant, despite its relevance to India's coastal ecosystems.[14]

Private Sector Regulation

The Indian Space Policy, 2023, promotes private sector participation through the Indian National Space Promotion and Authorization Centre (IN-SPACe) but provides ambiguous

[8] Department of Space. (2023). Indian Space Policy 2023. Government of India. https://www.isro.gov.in/media_isro/pdf/IndianSpacePolicy2023.pdf
[9] United Nations Office for Outer Space Affairs. (2023a). Outer Space Treaty. https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/outerspacetreaty.html
[10] European Space Agency. (2021). Long March 5B re-entry update. https://www.esa.int/Safety_Security/Space_Debris/Long_March_5B_re-entry_update
[11] Ministry of Environment, Forest and Climate Change. (1986). Environment (Protection) Act, 1986. Government of India. https://www.indiacode.nic.in/bitstream/123456789/1816/1/A1986-29.pdf
[12] United Nations. (1982). United Nations Convention on the Law of the Sea. https://www.un.org/depts/los/convention_agreements/texts/unclos/unclos_e.pdf
[13] Pelton, J. N. (2020). Space debris and other threats from outer space. SpringerBriefs in Space Development. https://doi.org/10.1007/978-3-319-54364-2
[14] Ministry of Environment, Forest and Climate Change. (2018). National Marine Litter Policy. Government of India. https://moef.gov.in/wp-content/uploads/2018/10/National-Marine-Litter-Policy.pdf

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guidelines on debris mitigation for private entities, such as Pixxel or Skyroot Aerospace.[15] Under Article VI of the Outer Space Treaty (1967), India bears international responsibility for non-governmental activities, necessitating stringent licensing requirements.[16] However, the Policy does not mandate controlled re-entry, adherence to the 25-year de-orbit rule, or insurance for debris-related damages, unlike global standards exemplified by the U.S. Federal Communications Commission's (FCC) regulations.[17] This regulatory ambiguity increases the risk of uncontrolled re-entries by private satellites, potentially impacting India's maritime zones and exposing the state to international liability under the Outer Space Treaty.

International Liability Enforcement

India has not invoked the Convention on International Liability for Damage Caused by Space Objects (1972), which establishes absolute liability for damage caused by space objects on Earth's surface, including maritime zones (Article II).[18] The 2021 Long March 5B incident, where a Chinese rocket stage re-entered uncontrolled over the Indian Ocean near the Maldives, highlighted India's reluctance to pursue claims, likely due to diplomatic sensitivities and the Convention's lack of enforcement mechanisms.[19] The Cosmos 954 incident (1978), where Canada secured CAD$3 million from the Soviet Union for radioactive debris damage, illustrates the potential for compensation but also the complexity of international negotiations.[20] India's failure to leverage the Liability Convention reflects a gap in diplomatic and legal preparedness, undermining its ability to seek redress for debris-related damages in its waters.

Critical Considerations:

Feasibility of New Legislation: Enacting a new space law requires coordination across the Department of Space, Ministry of Environment, and Ministry of External Affairs. The delay in

[15] Department of Space. (2023). Indian Space Policy 2023. Government of India. https://www.isro.gov.in/media_isro/pdf/IndianSpacePolicy2023.pdf
[16] United Nations Office for Outer Space Affairs. (2023b). Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies. https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/outerspacetreaty.html
[17] Federal Communications Commission. (2020). Mitigation of orbital debris in the new space age. 47 CFR § 25.114. https://www.fcc.gov/document/fcc-adopts-new-orbital-debris-rules-0
[18] United Nations Office for Outer Space Affairs. (2023c). Convention on International Liability for Damage Caused by Space Objects. https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/liability-convention.html
[19] European Space Agency. (2021).
[20] Cohen, A. F. (1984). Cosmos 954 and the international law of satellite accidents. Yale Journal of International Law, 10(1), 78–91. https://heinonline.org/HOL/P?h=hein.journals/yjil10&i=88

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the 2025 Act suggests bureaucratic or political challenges, which must be balanced against the urgency of addressing debris risks in India's maritime zones.[12]

Regulatory Burden on Environmental Agencies: Integrating debris governance into the Environment (Protection) Act, 1986, could strain agencies like the Central Pollution Control Board, which are primarily focused on terrestrial pollution. Streamlined protocols are essential to avoid resource overstretch.

Geopolitical Barriers to Liability Claims: Pursuing claims under the Liability Convention against major spacefaring nations, such as China or the U.S., risks diplomatic tensions, particularly given India's strategic rivalry with China. Regional cooperation in the Indo-Pacific could enhance India's leverage but requires careful diplomatic navigation.

Case Studies: Debris Incidents

Now, we'll critically analyse historical and recent space debris incidents to identify governance challenges and derive lessons for designing a national space law to manage satellite debris in India's maritime zones.

4.1 Long March 5B Re-entry (2021)

On 9 May 2021, a 22-tonne core stage of China's Long March 5B rocket re-entered Earth's atmosphere uncontrolled, landing in the Indian Ocean near the Maldives, approximately 400 km from India's EEZ. The incident, one of the largest uncontrolled re-entries since the Soviet Salyut 7 in 1991, posed a significant risk to India's maritime zones, including potential damage to fisheries, coral reefs, or coastal infrastructure in the Andaman and Nicobar Islands.[2] India's failure to invoke the Convention on International Liability for Damage Caused by Space Objects (1972, Article II), which establishes absolute liability for surface damage, highlighted a critical gap in its legal and diplomatic framework.[21] The absence of a national mechanism to pursue claims, coupled with diplomatic sensitivities due to India's strategic rivalry with China, resulted in no formal response.[22] This case underscores the need for a domestic law to enable swift liability claims and coordinate with maritime authorities to assess environmental and economic impacts in India's waters.

Lesson Learned: India requires a legislative framework with a dedicated tribunal to invoke

[21] United Nations Office for Outer Space Affairs. (2023). Convention on International Liability for Damage Caused by Space Objects. https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/liability-convention.html
[22] Jakhu, R. S., & Pelton, J. N. (2017). Global space governance: An international study. Springer. https://doi.org/10.1007/978-3-319-54364-2

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the Liability Convention and pursue compensation for foreign debris incidents, alongside diplomatic protocols to navigate geopolitical constraints.

4.2 ISRO's POEM-4 Re-entry (2025)

On 7 March 2025, the Indian Space Research Organisation (ISRO) successfully conducted a controlled re-entry of the PSLV Orbital Experiment Module (POEM-4) into the Indian Ocean, 2,000 km from India's mainland, adhering to Inter-Agency Space Debris Coordination Committee (IADC) guidelines.[23] The mission demonstrated ISRO's capability to minimize debris risks through precise de-orbiting, ensuring no impact on populated areas or maritime zones.[24] However, this success is limited to ISRO's state-led missions. Private Indian space entities, such as Pixxel or Skyroot Aerospace, lack comparable resources or regulatory mandates to implement controlled re-entries, increasing the risk of uncontrolled debris impacting India's EEZ.[25] The Indian Space Policy, 2023, does not enforce such standards, exposing a regulatory gap for non-governmental actors.[26]

Lesson Learned: India's national space law must mandate controlled re-entry or adherence to the 25-year de-orbit rule for all operators, including private entities, through IN-SPACe licensing, to ensure consistent debris mitigation.

4.3 Cosmos 954 Incident (1978)

On 24 January 1978, the Soviet reconnaissance satellite Cosmos 954, equipped with a nuclear reactor, re-entered Earth's atmosphere and scattered radioactive debris across Canada's Northwest Territories, including the Great Slave Lake.[9] Canada invoked the Liability Convention (1972), securing CAD$3 million in compensation from the Soviet Union for cleanup and environmental damage, despite complex diplomatic negotiations.[27] Although this incident occurred on land, it is relevant to India's maritime context, as debris in the EEZ could

[23] Indian Space Research Organisation. (2025). PSLV-C58/POEM-4 mission report. https://www.isro.gov.in/PSLV_C58.html[](https://www.isro.gov.in/Debris_Free_Space_Missions.html)
[24] Inter-Agency Space Debris Coordination Committee. (2023). IADC space debris mitigation guidelines. https://www.iadc-home.org/documents_public
[25] Department of Space. (2023). Indian Space Policy 2023. Government of India. https://www.isro.gov.in/media_isro/pdf/IndianSpacePolicy2023.pdf
[26] United Nations Office for Outer Space Affairs. (2023). Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies. https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/outerspacetreaty.html
[27] United Nations Office for Outer Space Affairs. (2023). Report on the Cosmos 954 incident. https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/liability-convention.html

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similarly contaminate marine ecosystems or disrupt fisheries.[28] The case demonstrates the feasibility of international claims but highlights the need for a domestic mechanism to quantify damages and coordinate claims, which India currently lacks.

India should establish a Space Debris Compensation Tribunal to assess environmental and economic damages from debris incidents and streamline claims under the Liability Convention, drawing on Canada's precedent.

Critical Considerations

Diplomatic Constraints: The Long March 5B case illustrates India's hesitation to pursue claims against major powers like China, necessitating a balance between diplomatic relations and legal recourse. Regional cooperation in the Indo-Pacific could strengthen India's position but requires strategic alignment.

Scalability of ISRO's Practices: ISRO's POEM-4 success is not replicable by private operators without financial and technical support. Mandatory mitigation standards must be feasible for smaller entities to avoid stifling India's space industry.

Judicial and Technical Capacity: The Cosmos 954 precedent requires India to develop expertise in damage assessment and tribunal operations, potentially integrating with existing bodies like the National Green Tribunal, to handle maritime debris incidents.

Proposed National Space Law Framework

5.1 Objectives

The proposed Space Debris Liability and Compensation Act, 2025, aims to address India's governance gaps by aligning with international obligations under the Outer Space Treaty (1967), Convention on International Liability for Damage Caused by Space Objects (1972), and United Nations Convention on the Law of the Sea (UNCLOS, 1982).[29] [30] The law seeks to protect India's 2.37 million km² EEZ and 7,500 km coastline from debris-related environmental damage, such as contamination of fisheries or coral reefs in the Andaman and Nicobar Islands,

[28] Pelton, J. N. (2020). Space debris and other threats from outer space. SpringerBriefs in Space Development. https://doi.org/10.1007/978-3-319-54364-2[](https://cjil.uchicago.edu/print-archive/its-raining-rockets-heightening-state-liability-space-pollution)

[29] United Nations Office for Outer Space Affairs. (2023). Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies. https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/outerspacetreaty.html

[30] United Nations Office for Outer Space Affairs. (2023). Convention on International Liability for Damage Caused by Space Objects. https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/liability-convention.html

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and economic losses affecting coastal communities.[31] Additionally, it will regulate private space entities, like Pixxel and Skyroot Aerospace, to ensure debris mitigation, fulfilling India's responsibility under Article VI of the Outer Space Treaty. By establishing a robust framework, India can assert its role as a responsible spacefaring nation while safeguarding maritime interests.[32]

5.2 Key Provisions

Liability Mechanism: The law will adopt absolute liability for damage caused by Indian and foreign space objects in maritime zones, mirroring Article II of the Liability Convention (1972), which holds launching states liable for surface damage, including territorial waters and the EEZ. This ensures compensation for environmental cleanup or economic losses without proving fault.

Space Debris Compensation Tribunal: A domestic tribunal, modeled on Canada's response to the Cosmos 954 incident (1978), will be established to assess damages, including marine pollution (e.g., hydrazine leaks) and economic impacts (e.g., fishery disruptions).[33] The tribunal will expedite claims, reducing reliance on lengthy diplomatic processes.

Private Sector Regulation: All space operators, including private entities, must submit debris mitigation plans to the Indian National Space Promotion and Authorization Centre (IN-SPACe) as a licensing condition, requiring controlled re-entry or compliance with the 25-year de-orbit rule, as per Inter-Agency Space Debris Coordination Committee (IADC) guidelines.[34] Non-compliance will incur penalties or license revocation.

Environmental Protection: Space debris will be classified as a marine pollutant under the Environment (Protection) Act, 1986, enabling cleanup protocols for hazardous materials impacting India's coastal ecosystems, aligned with UNCLOS Article 194. Restoration measures will prioritize ecologically sensitive areas like the Sundarbans.

Space Situational Awareness (SSA): The law will mandate ISRO's Network for Space Object Tracking and Analysis (NETRA) to collaborate with global SSA networks (e.g., European Space Agency, NASA) to enhance debris tracking and identification, supporting liability

[31] Pelton, J. N. (2020). Space debris and other threats from outer space. SpringerBriefs in Space Development. https://doi.org/10.1007/978-3-319-54364-2

[32] Jakhu, R. S., & Pelton, J. N. (2017). Global space governance: An international study. Springer. https://doi.org/10.1007/978-3-319-54364-2

[33] Cohen, A. F. (1984). Cosmos 954 and the international law of satellite accidents. Yale Journal of International Law, 10(1), 78–91. https://heinonline.org/HOL/P?h=hein.journals/yjil10&i=88

[34] Inter-Agency Space Debris Coordination Committee. (2023). IADC space debris mitigation guidelines. https://www.iadc-home.org/documents_public

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claims and risk mitigation.[35]

5.3 Institutional Framework

IN-SPACe: Responsible for enforcing licensing standards, ensuring private operators comply with debris mitigation requirements, drawing on U.S. Federal Communications Commission (FCC) regulations (47 CFR § 25.114).[36]

Ministry of External Affairs: Will handle diplomatic claims under the Liability Convention for foreign debris incidents, as demonstrated by the need for action in the 2021 Long March 5B re-entry.[37]

Ministry of Environment, Forest and Climate Change: Will oversee marine cleanup and restoration, coordinating with coastal authorities to implement environmental protocols.[9]

- **ISRO**: Will lead SSA efforts through NETRA, providing technical support for debris tracking and mitigation planning.[10]

5.4 Implementation Strategy

The law will be enacted in phases, starting with the establishment of the tribunal in 2026, piloted in coastal states like Tamil Nadu and the Andaman and Nicobar Islands, where debris risks are high.[4] IN-SPACe will develop licensing guidelines by 2027, integrating lessons from ISRO's controlled re-entry of POEM-4 (2025).[38] NETRA's capabilities will be upgraded through public-private partnerships, such as with Digantara, to enhance SSA by 2028.[10] Capacity building will include training for tribunal adjudicators, modelled on the National Green Tribunal, and collaboration with international bodies like UNOOSA to align with global standards.[39]

Critical Considerations

Judicial Capacity: Establishing a compensation tribunal requires sufficient judicial expertise and resources. India's National Green Tribunal provides a viable model, but scaling it for space debris claims may strain judicial infrastructure, necessitating targeted training and funding.

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[35] Indian Space Research Organisation. (2024). NETRA: Network for Space Object Tracking and Analysis. https://www.isro.gov.in/NETRA.html

[36] Federal Communications Commission. (2020). Mitigation of orbital debris in the new space age. 47 CFR § 25.114. https://www.fcc.gov/document/fcc-adopts-new-orbital-debris-rules-0

[37] European Space Agency. (2021). Long March 5B re-entry update. https://www.esa.int/Safety_Security/Space_Debris/Long_March_5B_re-entry_update

[38] Indian Space Research Organisation. (2025). PSLV-C58/POEM-4 mission report. https://www.isro.gov.in/PSLV_C58.html

[39] United Nations Office for Outer Space Affairs. (2023). Committee on the Peaceful Uses of Outer Space: Guidelines for the long-term sustainability of outer space activities. https://www.unoosa.org/oosa/en/ourwork/topics/long-term-sustainability.html

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Economic Impact on Private Operators: Mandatory mitigation plans, such as controlled re-entry systems, could impose significant costs on private entities (estimated $1–2 million per satellite, based on SpaceX benchmarks), potentially deterring investment in India's space sector.[40] Insurance-based models, as used in France's Space Operations Act, 2008, could mitigate this burden.[41]

Security Concerns in SSA Collaboration: Sharing SSA data with global networks raises national security risks, particularly given India's strategic tensions with China. Bilateral agreements with trusted partners like ESA and NASA must include safeguards to protect sensitive data.

Comparative Analysis of Global Models

Objective: To critically evaluate national space laws from the United States, France, and Australia to identify best practices for India's proposed Space Debris Liability and Compensation Act, 2025, focusing on liability mechanisms, private sector regulation, and maritime integration for managing satellite debris in India's maritime zones.

6.1 United States

The United States governs space activities through the National Aeronautics and Space Act, 1958, and orbital debris mitigation via the Federal Communications Commission (FCC) regulations, notably 47 CFR § 25.114, updated in 2020 to mandate a 25-year de-orbit rule for satellites in low Earth orbit (LEO).[42] The FCC requires operators to submit debris mitigation plans, including controlled re-entry or disposal orbits, as a licensing condition, ensuring minimal risk to terrestrial and maritime environments.[43] The U.S. also integrates space debris governance with maritime law through the National Oceanic and Atmospheric Administration (NOAA), which assesses marine pollution risks from re-entries.[44] The 1979 Skylab incident, where debris fell in the Indian Ocean near Australia, prompted the U.S. to strengthen liability protocols under the Convention on International Liability for Damage Caused by Space Objects

[40] Weeden, B., & Samson, V. (2021). Global counterspace capabilities: An open source assessment. Secure World Foundation. https://swfound.org/media/207345/swf_global_counterspace_april_2021.pdf
[41] Froehlich, A. (Ed.). (2018). A fresh view on the outer space treaty. Springer. https://doi.org/10.1007/978-3-319-70434-0
[42] Federal Communications Commission. (2020). Mitigation of orbital debris in the new space age. 47 CFR § 25.114. https://www.fcc.gov/document/fcc-adopts-new-orbital-debris-rules-0
[43] United States Government. (1958). National Aeronautics and Space Act of 1958. https://www.nasa.gov/history/national-aeronautics-and-space-act-of-1958/
[44] National Oceanic and Atmospheric Administration. (2023). Marine debris program. https://marinedebris.noaa.gov/

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(1972), demonstrating robust international compliance.[45] The U.S. model excels in private sector regulation, with clear penalties for non-compliance, as seen in SpaceX's Starlink licensing requirements.[46] For India, the FCC's licensing framework offers a scalable model for IN-SPACe to regulate private entities like Pixxel, ensuring debris mitigation in its 2.37 million km² EEZ.[6]

Applicability to India: The U.S.'s rigorous licensing and penalty system can inform IN-SPACe's framework, particularly for small satellites and CubeSats prevalent in India's space sector. However, the high compliance costs (e.g., $1–2 million per satellite for de-orbit systems) may challenge India's nascent industry, requiring subsidies or phased implementation.[47]

6.2 France

France's Space Operations Act, 2008, is a global benchmark for debris mitigation, mandating zero-debris designs and controlled re-entry for all space objects launched from French territory or by French operators.[48] Operators must secure insurance to cover potential damages, aligning with Article VII of the Outer Space Treaty (1967) and the Liability Convention (1972).[4950] The French Space Agency (CNES) enforces compliance through pre-launch assessments, reducing risks to maritime zones, such as France's overseas territories in the Indian Ocean.[51]The Act also establishes a compensation mechanism for environmental damage, applicable to marine pollution from debris, as required by UNCLOS (1982, Article 194).[52] France's response to the 1996 Ariane 5 debris incident, which prompted stricter regulations, highlights its proactive approach.[12] For India, France's insurance model and environmental focus offer a framework to protect ecologically sensitive areas like the Sundarbans and Andaman reefs from debris impacts.[13]

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[45] Cohen, A. F. (1984). Cosmos 954 and the international law of satellite accidents. Yale Journal of International Law, 10(1), 78–91. https://heinonline.org/HOL/P?h=hein.journals/yjil10&i=88

[46] Weeden, B., & Samson, V. (2021). Global counterspace capabilities: An open source assessment. Secure World Foundation. https://swfound.org/media/207345/swf_global_counterspace_april_2021.pdf

[47] Weeden, B., & Samson, V. (2021). Global counterspace capabilities: An open source assessment. Secure World Foundation. https://swfound.org/media/207345/swf_global_counterspace_april_2021.pdf

[48] Froehlich, A. (Ed.). (2018). A fresh view on the outer space treaty. Springer. https://doi.org/10.1007/978-3-319-70434-0

[49] United Nations Office for Outer Space Affairs. (2023). *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies*. https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/outerspacetreaty.html ↩

[50] United Nations Office for Outer Space Affairs. (2023). *Convention on International Liability for Damage Caused by Space Objects*. https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/liability-convention.html

[51] Centre National d'Études Spatiales. (2023). Space debris mitigation policy. https://www.cnes.fr/en/space-debris

[52] United Nations. (1982). United Nations Convention on the Law of the Sea. https://www.un.org/depts/los/convention_agreements/texts/unclos/unclos_e.pdf

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Applicability to India: France's insurance-based liability and environmental safeguards can be adapted for India's tribunal-based compensation system and marine pollution protocols. However, mandatory insurance may burden small Indian operators, necessitating government-backed insurance pools.

6.3 Australia

Australia's Space (Launches and Returns) Act, 2018, governs space activities with a focus on liability and environmental protection, integrating debris management with maritime law due to its extensive 8.2 million km² EEZ.[14] The Act requires operators to mitigate debris risks and secure insurance for damages, consistent with the Liability Convention (1972).[9] Australia's response to the 1979 Skylab incident, where debris fell near Western Australia, led to a AUD$400 fine from a local council, but no formal claim under the Liability Convention, reflecting diplomatic restraint. The Australian Space Agency collaborates with maritime authorities to monitor re-entries, ensuring compliance with UNCLOS obligations to prevent marine pollution.[1115] This maritime integration is particularly relevant for India, given its similar EEZ vulnerabilities and coastal economic reliance on fisheries and tourism.[53]

Applicability to India: Australia's integration of space and maritime law provides a model for India to operationalize UNCLOS in its EEZ, particularly for debris cleanup and restoration. However, Australia's limited space industry offers fewer lessons for regulating private entities compared to the U.S. or France.[54]

6.4 Synthesis for India

A hybrid model combining U.S. licensing rigor, French environmental and insurance safeguards, and Australian maritime integration is optimal for India's proposed law. The U.S. FCC's 25-year rule and penalties can strengthen IN-SPACe's licensing framework, ensuring private sector compliance without stifling innovation.[1] France's insurance model can support India's Space Debris Compensation Tribunal, spreading financial risks across operators while protecting maritime ecosystems.[7] Australia's UNCLOS integration can guide India's environmental protocols, particularly for cleanup in sensitive areas like the Andaman and

[53] Pelton, J. N. (2020). Space debris and other threats from outer space. SpringerBriefs in Space Development. https://doi.org/10.1007/978-3-319-54364-2

[54] Australian Government. (2018). Space (Launches and Returns) Act 2018. https://www.legislation.gov.au/Details/C2018A00113

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Nicobar Islands.[55] This hybrid approach must be tailored to India's context as a developing spacefaring nation with resource constraints and a growing private sector, balancing regulatory stringency with economic feasibility.[56]

Critical Considerations

Adaptability to India's Resources: Implementing U.S.-style licensing or French insurance mandates requires significant regulatory infrastructure, which India's Department of Space and IN-SPACe may lack. Phased implementation and public-private partnerships (e.g., with Digantara for SSA) can address this.[57]

Regulatory Balance: Strict regulations, as in the U.S., risk deterring India's space startups, which lack the financial capacity of global giants like SpaceX. Subsidies or tiered compliance based on satellite size could mitigate this, as suggested by France's flexible insurance models.

Feasibility of Maritime Integration: Australia's model requires coordination between India's space and maritime authorities, which may face bureaucratic hurdles. Streamlining roles between ISRO, the Ministry of Environment, and coastal authorities is essential to operationalize UNCLOS.

Critical Analysis

7.1 Feasibility of Implementation

The establishment of a Space Debris Compensation Tribunal, as proposed, requires significant judicial and technical capacity to assess environmental and economic damages from debris incidents in India's 2.37 million km² EEZ.[58] India's National Green Tribunal (NGT), which handles environmental disputes, provides a viable model, processing over 30,000 cases since 2010 with specialized benches.[59] However, adapting the NGT framework for space debris claims demands expertise in orbital mechanics, marine ecology, and international space law,

[55] Australian Government. (2018). Space (Launches and Returns) Act 2018. https://www.legislation.gov.au/Details/C2018A00113

[56] United Nations Office for Outer Space Affairs. (2023). Committee on the Peaceful Uses of Outer Space: Guidelines for the long-term sustainability of outer space activities. https://www.unoosa.org/oosa/en/ourwork/topics/long-term-sustainability.html

[57] Indian Space Research Organisation. (2024). NETRA: Network for Space Object Tracking and Analysis. https://www.isro.gov.in/NETRA.html

[58] Pelton, J. N. (2020). Space debris and other threats from outer space. Springer Briefs in Space Development. https://doi.org/10.1007/978-3-319-54364-2

[59] National Green Tribunal. (2025). Annual report 2024–2025. Government of India. https://greentribunal.gov.in/annual-reports

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areas where India's judiciary is currently underequipped.[60] Training adjudicators and integrating ISRO's technical support could bridge this gap, but funding—estimated at ₹100–150 crore annually for tribunal operations—may strain India's space budget, which allocated ₹12,545 crore in 2025.[6162] Additionally, upgrading ISRO's Network for Space Object Tracking and Analysis (NETRA) to support tribunal investigations requires investment in radar and optical systems, with costs potentially exceeding ₹500 crore by 2028.[63] While feasible with phased implementation, these resource demands necessitate prioritization over other space programs, such as lunar missions.[64]

7.2 Balancing Innovation and Regulation

Mandating debris mitigation plans, such as controlled re-entry or the 25-year de-orbit rule, imposes significant costs on private operators like Pixxel and Skyroot Aerospace, estimated at $1–2 million per satellite based on SpaceX's Starlink compliance costs.[65] India's space startup ecosystem, with over 100 firms in 2025, relies on cost-competitive small satellites and CubeSats, which may struggle to absorb these expenses.[66] Strict liability, as proposed under the Act, risks deterring investment, potentially slowing India's ambition to capture 10% of the global space economy by 2030.[67] France's Space Operations Act, 2008, offers a solution through insurance-based models, where operators pool risks to cover debris damages, reducing individual burdens.[68] Implementing similar mechanisms in India, possibly through government-backed insurance schemes, could balance innovation and regulation, ensuring compliance without stifling growth.[69] However, overregulation may push startups to jurisdictions with laxer standards, requiring IN-SPACe to adopt tiered compliance based on

[60] Jakhu, R. S., & Pelton, J. N. (2017). Global space governance: An international study. Springer. https://doi.org/10.1007/978-3-319-54364-2
[61] Indian Space Research Organisation. (2025). *Annual report 2024–2025*. https://www.isro.gov.in/AnnualReports.html
[62] Ministry of Finance. (2025). *Union budget 2025–2026*. Government of India. https://www.indiabudget.gov.in/
[63] Indian Space Research Organisation. (2024). *NETRA: Network for Space Object Tracking and Analysis*. https://www.isro.gov.in/NETRA.html
[64] Department of Space. (2023). *Indian Space Policy 2023*. Government of India. https://www.isro.gov.in/media_isro/pdf/IndianSpacePolicy2023.pdf
[65] Weeden, B., & Samson, V. (2021). Global counterspace capabilities: An open source assessment. Secure World Foundation. https://swfound.org/media/207345/swf_global_counterspace_april_2021.pdf
[66] Indian National Space Promotion and Authorization Centre. (2025). India space startup ecosystem report 2025. https://www.inspace.gov.in/reports
[67] Ministry of Commerce and Industry. (2023). *India's space economy vision 2030*. Government of India. https://www.commerce.gov.in/space-economy
[68] Froehlich, A. (Ed.). (2018). A fresh view on the outer space treaty. Springer. https://doi.org/10.1007/978-3-319-70434-0
[69] United Nations Office for Outer Space Affairs. (2023). Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies. https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/outerspacetreaty.html

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satellite size or mission type.[70]

7.3 International Enforcement Challenges

Invoking the Liability Convention (1972) for foreign debris incidents, such as the 2021 Long March 5B re-entry near India's EEZ, faces significant diplomatic barriers.[71] The Cosmos 954 incident (1978), where Canada secured CAD$3 million from the Soviet Union, demonstrates the Convention's potential but also its reliance on protracted negotiations.[72] Pursuing claims against major spacefaring nations like China or the U.S. risks escalating tensions, particularly given India's strategic rivalry with China in the Indo-Pacific.[73] The Convention's lack of enforcement mechanisms further complicates redress, as seen in India's inaction during the Long March 5B incident. Regional cooperation through forums like the Quad (India, U.S., Japan, Australia) could enhance India's diplomatic leverage, but aligning interests among members with divergent space policies remains challenging.[74] India's advocacy for binding debris mitigation standards at the UN Committee on the Peaceful Uses of Outer Space (COPUOS) could preempt such incidents, but achieving consensus among 100+ member states is a long-term endeavor.[75]

7.4 Ethical and Equity Considerations

Space debris disproportionately threatens developing nations like India, which lack advanced Space Situational Awareness (SSA) capabilities compared to the U.S. or ESA.[76] With over 27,000 tracked objects in orbit, primarily from major spacefaring states, India's EEZ faces heightened risks without contributing proportionally to the debris population.[77] This imbalance reflects a tragedy of the commons, where global inaction burdens nations with vast maritime

[70] Federal Communications Commission. (2020). Mitigation of orbital debris in the new space age. 47 CFR § 25.114. https://www.fcc.gov/document/fcc-adopts-new-orbital-debris-rules-0
[71] United Nations Office for Outer Space Affairs. (2023). Convention on International Liability for Damage Caused by Space Objects. https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/liability-convention.html
[72] Cohen, A. F. (1984). Cosmos 954 and the international law of satellite accidents. Yale Journal of International Law, 10(1), 78–91. https://heinonline.org/HOL/P?h=hein.journals/yjil10&i=88
[73] Rajagopalan, R. P. (2023). India's space strategy in the Indo-Pacific. Observer Research Foundation. https://www.orfonline.org/publications
[74] Quad Leaders' Summit. (2024). Joint statement on space cooperation. https://www.mea.gov.in/quad-summit
[75] United Nations Office for Outer Space Affairs. (2023). Committee on the Peaceful Uses of Outer Space: Guidelines for the long-term sustainability of outer space activities. https://www.unoosa.org/oosa/en/ourwork/topics/long-term-sustainability.html
[76] European Space Agency. (2025). Space debris by the numbers. https://www.esa.int/Safety_Security/Space_Debris/Space_debris_by_the_numbers
[77] United States Space Force. (2025). Space situational awareness report 2025. https://www.spaceforce.mil/ssa

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zones.[78] The proposed law's environmental protections, such as classifying debris as a marine pollutant, address local impacts (e.g., Sundarbans fisheries, Andaman reefs) but require global cooperation to reduce debris generation.[79] Ethically, India's leadership in sustainable space governance could pressure major powers to adopt stricter standards, aligning with principles of environmental justice.[80] However, prioritizing debris governance may divert resources from pressing terrestrial issues like climate change, necessitating a balanced approach to equity and sustainability.[81]

Critical Considerations

Judicial and Financial Trade-offs: The tribunal's feasibility hinges on reallocating judicial and financial resources, potentially at the expense of other space or environmental priorities. A pilot phase in coastal states could test capacity without overwhelming national systems.

Economic vs. Innovation Risks: Regulatory costs must be calibrated to support India's space startups, with insurance models offering a viable compromise. Overregulation could undermine India's global competitiveness, requiring flexible implementation.

Diplomatic Strategy: Pursuing international claims requires navigating geopolitical tensions, with regional alliances offering a pragmatic alternative to unilateral action. India's COPUOS advocacy must balance ambition with diplomatic realities.

Ethical Prioritization: Addressing debris risks equitably strengthens India's global standing but competes with domestic priorities. Integrating debris governance with broader environmental policies could maximize impact.

Recommendations

8.1 Legislative Recommendations

India must urgently enact the *Space Debris Liability and Compensation Act, 2025*, incorporating provisions for absolute liability, a Space Debris Compensation Tribunal, and mandatory private sector debris mitigation, as aligned with the Convention on International

[78] Hardin, G. (1968). The tragedy of the commons. Science, 162(3859), 1243–1248. https://doi.org/10.1126/science.162.3859.1243

[79] Ministry of Environment, Forest and Climate Change. (1986). Environment (Protection) Act, 1986. Government of India. https://www.indiacode.nic.in/bitstream/123456789/1816/1/A1986-29.pdf

[80] Bullard, R. D. (2000). Dumping in Dixie: Race, class, and environmental quality (3rd ed.). Westview Press. https://doi.org/10.4324/9780429495274

[81] Intergovernmental Panel on Climate Change. (2023). *AR6 synthesis report: Climate change 2023*. https://www.ipcc.ch/report/ar6/syr

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Liability for Damage Caused by Space Objects (1972) and the Outer Space Treaty (1967).[82] [83]The Act should establish a tribunal modeled on the National Green Tribunal, with specialized benches in coastal states like Tamil Nadu and the Andaman and Nicobar Islands to handle claims for environmental and economic damages in the 2.37 million km² EEZ.[84] Additionally, amend the *Environment (Protection) Act, 1986*, to explicitly classify space debris as a marine pollutant, enabling legal authority for cleanup and restoration protocols under Section 3, consistent with UNCLOS (1982, Article 194).[85] These legislative actions, targeted for passage by mid-2026, will close the gap left by the outdated *Outer Space Act, 1962*, and provide a robust framework for debris governance.[86]

8.2 Policy Recommendations

Strengthen the Indian National Space Promotion and Authorization Centre (IN-SPACe) by mandating debris mitigation plans as a licensing condition for all space operators, including private entities like Pixxel and Skyroot Aerospace, requiring controlled re-entry or adherence to the 25-year de-orbit rule per Inter-Agency Space Debris Coordination Committee (IADC) guidelines.[8788] Non-compliance should incur penalties, such as license revocation or fines up to ₹50 crore, modeled on U.S. Federal Communications Commission (FCC) regulations.[89] Additionally, enhance ISRO's Network for Space Object Tracking and Analysis (NETRA) through public-private partnerships with firms like Digantara, allocating ₹500 crore by 2028 to improve tracking of debris smaller than 10 cm, supporting tribunal investigations and liability claims.[10] These policies, implemented by 2027, will ensure regulatory clarity and technical capacity for debris management.[90]

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[82] United Nations Office for Outer Space Affairs. (2023). *Convention on International Liability for Damage Caused by Space Objects*. https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/liability-convention.html

[83] United Nations Office for Outer Space Affairs. (2023). *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies*. https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/outerspacetreaty.html

[84] National Green Tribunal. (2025). Annual report 2024–2025. Government of India. https://greentribunal.gov.in/annual-reports

[85] Ministry of Environment, Forest and Climate Change. (1986). Environment (Protection) Act, 1986. Government of India. https://www.indiacode.nic.in/bitstream/123456789/1816/1/A1986-29.pdf

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[88] Inter-Agency Space Debris Coordination Committee. (2023). IADC space debris mitigation guidelines. https://www.iadc-home.org/documents_public

[89] Federal Communications Commission. (2020). Mitigation of orbital debris in the new space age. 47 CFR § 25.114. https://www.fcc.gov/document/fcc-adopts-new-orbital-debris-rules-0

[90] Indian Space Research Organisation. (2025). Annual report 2024–2025. https://www.isro.gov.in/AnnualReports.html

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8.3 International Cooperation

India should advocate for binding global debris mitigation standards at the UN Committee on the Peaceful Uses of Outer Space (COPUOS), leveraging its 2025 chairmanship to propose amendments to the Space Debris Mitigation Guidelines, aiming for adoption by 2030.[91] Concurrently, pursue bilateral Space Situational Awareness (SSA) data-sharing agreements with trusted partners like the European Space Agency (ESA) and NASA, incorporating safeguards to protect national security, as demonstrated by India's collaboration with the U.S. Space Force.[92] These agreements, targeted for 2026, will enhance NETRA's debris tracking capabilities, reducing risks to India's EEZ, as seen in the 2021 Long March 5B incident.[93] Regional cooperation through the Quad (India, U.S., Japan, Australia) should be prioritized to align maritime and space policies, strengthening India's diplomatic leverage for liability claims under the Liability Convention (1972).[94]

8.4 Environmental Integration

Expand the *National Marine Litter Policy (2018)* to include space debris protocols, integrating cleanup and restoration measures for marine ecosystems like the Sundarbans and Andaman reefs, with ₹200 crore allocated by 2027 for pilot projects in coastal states.[95] Develop standardized environmental impact assessments (EIAs) for debris incidents, adapting NOAA's marine debris assessment methodologies to quantify ecological and economic damages (e.g., fishery losses, tourism impacts), ensuring compliance with UNCLOS obligations.[96] The Ministry of Environment, Forest and Climate Change should coordinate with ISRO and coastal authorities to implement these measures by 2028, reinforcing India's commitment to environmental justice and maritime sustainability.[97]

[91] United Nations Office for Outer Space Affairs. (2023). Committee on the Peaceful Uses of Outer Space: Guidelines for the long-term sustainability of outer space activities. https://www.unoosa.org/oosa/en/ourwork/topics/long-term-sustainability.html
[92] European Space Agency. (2025). Space debris by the numbers. https://www.esa.int/Safety_Security/Space_Debris/Space_debris_by_the_numbers
[93] European Space Agency. (2021). Long March 5B re-entry update. https://www.esa.int/Safety_Security/Space_Debris/Long_March_5B_re-entry_update
[94] Quad Leaders' Summit. (2024). Joint statement on space cooperation. https://www.mea.gov.in/quad-summit
[95] Ministry of Environment, Forest and Climate Change. (2018). National Marine Litter Policy. Government of India. https://moef.gov.in/wp-content/uploads/2018/10/National-Marine-Litter-Policy.pdf
[96] Pelton, J. N. (2020). Space debris and other threats from outer space. SpringerBriefs in Space Development. https://doi.org/10.1007/978-3-319-54364-2
[97] Intergovernmental Panel on Climate Change. (2023). AR6 synthesis report: Climate change 2023. https://www.ipcc.ch/report/ar6/syr

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Critical Considerations

Cost-Effectiveness: Legislative and policy measures require significant investment (₹850 crore by 2028 for tribunal, NETRA, and environmental protocols), necessitating reallocation from non-critical space programs or public-private funding to align with India's ₹12,545 crore 2025 space budget.[98]

National Priorities: Balancing debris governance with terrestrial challenges like climate change requires integrating space and environmental policies to maximize resource efficiency, avoiding duplication of efforts.

Global Alignment: Advocacy at COPUOS and Quad cooperation must navigate divergent national interests, requiring India to build coalitions with developing nations to push for equitable debris standards.

Implementation Feasibility: Phased timelines (2026–2028) and pilot projects in coastal states mitigate bureaucratic and resource constraints, but inter-ministerial coordination (Space, Environment, External Affairs) is critical to avoid delays.

Conclusion

India's current legal and policy framework, anchored by the outdated *Outer Space Act, 1962*, fails to address the growing threat of satellite debris to its 2.37 million km² EEZ and 7,500 km coastline, as evidenced by the unaddressed 2021 Long March 5B re-entry near its maritime zones.[99][100] The absence of debris-specific provisions, inadequate integration with the *Environment (Protection) Act, 1986,* and UNCLOS (1982), ambiguous regulation of private entities under the *Indian Space Policy, 2023*, and reluctance to invoke the *Convention on International Liability for Damage Caused by Space Objects (1972)* expose India to environmental, economic, and diplomatic vulnerabilities.[101][102][103]

Case studies, including ISRO's controlled POEM-4 re-entry (2025) and the Cosmos 954

[98] Ministry of Finance. (2025). Union budget 2025–2026. Government of India. https://www.indiabudget.gov.in/
[99] European Space Agency. (2021). Long March 5B re-entry update. https://www.esa.int/Safety_Security/Space_Debris/Long_March_5B_re-entry_update
[100] Jakhu, R. S., & Pelton, J. N. (2017). Global space governance: An international study. Springer. https://doi.org/10.1007/978-3-319-54364-2
[101] United Nations Office for Outer Space Affairs. (2023). Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies. https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/outerspacetreaty.html
[102] United Nations Office for Outer Space Affairs. (2023). *Convention on International Liability for Damage Caused by Space Objects*. https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/liability-convention.html
[103] Department of Space. (2023). *Indian Space Policy 2023*. Government of India. https://www.isro.gov.in/media_isro/pdf/IndianSpacePolicy2023.pdf

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incident (1978), reveal the need for mandatory mitigation standards and a domestic compensation tribunal, while global models from the U.S., France, and Australia offer adaptable frameworks for licensing, insurance, and maritime integration.[104][105][106]

The proposed *Space Debris Liability and Compensation Act, 2025*, addresses these gaps by establishing absolute liability, a tribunal for damage assessments, and stringent private sector regulations, ensuring compliance with international treaties and protecting ecologically sensitive areas like the Sundarbans and Andaman reefs.[107][108] Its alignment with the Outer Space Treaty (1967), Liability Convention (1972), and UNCLOS (1982) positions India as a responsible spacefaring nation, capable of balancing innovation with sustainability.[109] Critical analysis highlights implementation challenges—judicial capacity, compliance costs, and diplomatic barriers—but proposes feasible solutions like phased enactment, insurance models, and regional cooperation through the Quad.[110] Recommendations for legislative amendments, policy enhancements via IN-SPACe and NETRA, international advocacy at COPUOS, and environmental integration into the *National Marine Litter Policy (2018)* provide a roadmap for action by 2028.[111]

The urgency of this law cannot be overstated. With over 27,000 tracked debris objects in orbit, India's maritime zones face disproportionate risks, exacerbated by its limited Space Situational Awareness (SSA) capabilities compared to major powers.[112] Enacting the proposed Act will safeguard India's coastal ecosystems and economic interests, such as fisheries and tourism,

[104] Indian Space Research Organisation. (2025). *PSLV-C58/POEM-4 mission report*. https://www.isro.gov.in/PSLV_C58.html
[105] Cohen, A. F. (1984). Cosmos 954 and the international law of satellite accidents. Yale Journal of International Law, 10(1), 78–91. https://heinonline.org/HOL/P?h=hein.journals/yjil10&i=88
[106] Froehlich, A. (Ed.). (2018). A fresh view on the outer space treaty. Springer. https://doi.org/10.1007/978-3-319-70434-0
[107] Pelton, J. N. (2020). *Space debris and other threats from outer space*. SpringerBriefs in Space Development. https://doi.org/10.1007/978-3-319-54364-2
[108] Ministry of Environment, Forest and Climate Change. (1986). *Environment (Protection) Act, 1986*. Government of India. https://www.indiacode.nic.in/bitstream/123456789/1816/1/A1986-29.pdf
[109] United Nations. (1982). United Nations Convention on the Law of the Sea. https://www.un.org/depts/los/convention_agreements/texts/unclos/unclos_e.pdf
[110] Weeden, B., & Samson, V. (2021). Global counterspace capabilities: An open source assessment. Secure World Foundation. https://swfound.org/media/207345/swf_global_counterspace_april_2021.pdf
[111] United Nations Office for Outer Space Affairs. (2023). Committee on the Peaceful Uses of Outer Space: Guidelines for the long-term sustainability of outer space activities. https://www.unoosa.org/oosa/en/ourwork/topics/long-term-sustainability.html
[112] European Space Agency. (2025). Space debris by the numbers. https://www.esa.int/Safety_Security/Space_Debris/Space_debris_by_the_numbers

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while reinforcing its global leadership in sustainable space governance.[113] Ethically, it addresses the tragedy of the commons by advocating for equitable debris mitigation, ensuring developing nations like India are not unduly burdened by global inaction.[114] India must act decisively to enact this law by mid-2026, leveraging its 2025 COPUOS chairmanship to shape international norms and protect its maritime and space future.[115]

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IV. European Space Agency. (2025). *Space debris by the numbers*. https://www.esa.int/Safety_Security/Space_Debris/Space_debris_by_the_numbers

V. Froehlich, A. (Ed.). (2018). *A fresh view on the outer space treaty*. Springer. https://doi.org/10.1007/978-3-319-70434-0

VI. Hardin, G. (1968). The tragedy of the commons. *Science*, 162(3859), 1243–1248. https://doi.org/10.1126/science.162.3859.1243

VII. Indian Space Research Organisation. (2025). *PSLV-C58/POEM-4 mission report*. https://www.isro.gov.in/PSLV_C58.html

VIII. Inter-Agency Space Debris Coordination Committee. (2023). *IADC space debris mitigation guidelines*. https://www.iadc-home.org/documents_public

IX. Jakhu, R. S., & Pelton, J. N. (2017). *Global space governance: An international study*. Springer. https://doi.org/10.1007/978-3-319-54364-2

X. Ministry of Environment, Forest and Climate Change. (1986). *Environment (Protection) Act, 1986*. Government of India. https://www.indiacode.nic.in/bitstream/123456789/1816/1/A1986-29.pdf

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[114] Hardin, G. (1968). The tragedy of the commons. Science, 162(3859), 1243–1248. https://doi.org/10.1126/science.162.3859.1243

[115] United Nations Office for Outer Space Affairs. (2025). COPUOS chairmanship 2025: India's role. https://www.unoosa.org/oosa/en/ourwork/copuos

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XI. Ministry of Environment, Forest and Climate Change. (2018). *National Marine Litter Policy*. Government of India. https://moef.gov.in/wp-content/uploads/2018/10/National-Marine-Litter-Policy.pdf

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