



JOURNAL OF INTERNATIONAL LAW, POLITICS AND SOCIETY

An International Open Access Double Blind Peer Reviewed

ISSN No.: 3108-0464

Volume 2 | Issue 3 (Jul.-Sep.) | 2026

Art. 17

Disrupting the Final Frontier: Rethinking Space Law through Sustainability and Democratic Governance

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Recommended Citation

Dr. Anita Singh, *Disrupting the Final Frontier: Rethinking Space Law through Sustainability and Democratic Governance*, 2 JILPS 327-350 (2026).

Available at www.jilps.in/current-issue/

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Disrupting the Final Frontier: Rethinking Space Law through Sustainability and Democratic Governance

ABSTRACT

The realm of outer space, which was once perceived as the common heritage of mankind has rapidly turned into an exclusive domain of technologically advanced nations, becoming a hub of commercial operations owing to the rapid technological advancement, growing engagement of non-state & private stakeholders coupled with intense geo-political dynamics. The rudimentary international law on space governance has often fallen short of facing numerous contemporary challenges posed by such intensifying operations including the issues concerning the orbital debris proliferation, satellite mega-constellations, and emergent plans for asteroid mining and lunar colonization. While a more stringent regulation might be the immediate means to cater to the growing challenges, however, there is a need to put concentrated efforts in rethinking the new nuances of space governance, the foundation of which has to be rooted in the principles of sustainability and democratic accountability.

KEYWORDS

Space law, sustainability, democratic governance, Outer Space Treaty, global commons, orbital debris, space mining, environmental law, global equity.

INTRODUCTION

The realm of outer space is often identified as the 'final frontier' for the human mankind. This analogy, while, evoked multiple responses on numerous levels. However, it conceals a growing simmering discourse that even outer space, is not a limitless expanse, which is immune to the ecological, political, and ethical dilemmas that confront Earth. On the other hand, human mankind has been expanding its presence in the extra-terrestrial realm and such a replication translates into replication of untenable loops of resource exploitation, environmental degradation, and geopolitical contestation, a pattern, well-known to the terrestrial beings.

With the advent of human presence in the outer space, more specifically with the launch of *Sputnik I* in 1957, the international community has

essentially relied upon the Outer-Space Treaty¹ and the subsequent international legal instruments that followed which were critical in reiterating an important principle that the outer space is ultimately the '*common heritage of mankind*', thereby restricting the national usage or appropriation of outer space in the interest of the respective nations².

Nonetheless, it is also worth noting that, these international legal instruments were brought into being in a geo-political atmosphere wherein the technological capabilities to '*explore*' and also perhaps '*exploit*' outer space were restricted to specifically the '*space-faring elite club*' maneuvered by the two superpowers of that time. A time, when the thought of commercial exploitation was not fathomed and the discourse surrounding environmental sustainability was simply simmering.

However, if you look at this scenario from the standpoint of the contemporary legal developments, the situation has drastically turned around. Proliferation of private companies such as SpaceX, Blue Origin, and OneWeb have surpassed technological capacities of the national / governmental entities in their quest to '*explore*' and '*exploit*' outer space³. The current usage of outer space is full of such instances where governmental and more so with non-governmental private entities have completely taken over the commercial space operations having scant regards to the fundamental principles of international space law. For instance, the large-scale satellite networks do carry the potential of revolutionizing the global telecommunication dynamics, however, it also brings with it the various perils that results from over-crowding the orbital space with an unprecedented density, raising collision risks and threatening astronomical research⁴. Similarly, while national

¹ Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (Outer Space Treaty), opened for signature 27 January 1967, 610 UNTS 205 (entered into force 10 October 1967).

² Joanne Gabrynowicz, 'The Outer Space Treaty and the Principle of Common Heritage' (2016) 41 *Journal of Space Law* 1–15; Brian Weeden, 'Historical Evolution of the Outer Space Treaty and Its Implications' (2017) 33 *Space Policy* 12–20.

³ 'SpaceX's Crewed Launch Restores America's Status Among an Elite Group of Spacefaring Nations', *Time* (31 May 2020); Jonathan Watts, 'Polaris Dawn Astronauts Complete First Commercial Spacewalk' *The Guardian* (12 September 2024).

⁴ Yongjing Ruan and others, 'Preliminary Safety Analysis of Megaconstellations in Low Earth Orbit: Assessing Short-Term and Long-Term Collision Risks' (2024) *Applied Sciences* 14(7) 2953; Andrew Williams and others, 'A Report to ESO Council on the Impact of Satellite Constellations' (9 August 2021) *arXiv* (preprint) <https://arxiv.org/abs/2108.03999>.

appropriation of outer space has been the long-standing norm of using resources in outer space, nonetheless, governments are extensively discussing & engaging in space resource extraction, from asteroid mining to lunar ice harvesting⁵. The doctrines promoting peaceful uses of outer space seems to have faltered when examined from the perspective of misuse of dual use technologies and contested war fighting domain⁶. Developments, many more like these, render the current governance framework increasingly inadequate.

In the light of the aforesaid observations, this paper, proposes to advance two primary arguments. Firstly, sustainability of usage of outer space should be considered as the core and the primarily goal while engaging in any kind of operations in outer space. This should be the core objective of future space operations and future space law. It should no longer be viewed from the lens of an aspirational add-on, which can be over seeing or be put on a back-burner in order to prioritize aspects. It should be a binding, operational standard.

The next aspect critical for this is to incorporate a renewed understanding of democratic governance which essentially stands on the pillar of transparency, inclusivity & equitable participation in decision-making. All these three aspects needs to be institutionalised in the context of space governance in order to ensure that the realm of outer space remains a domain which is shared by all, as envisaged under the '*common heritage of mankind*' principle. Needless to say, this bridging the gap between the vision of the fundamental principles of international space law and the contemporary practices revolving around the context of commercialization of outer space activities requires a rethinking of the very construct of international space law. Outer space law principles require more than the notion of '*Non-Appropriation*' in order to protect itself from the ramifications of the contemporary space operations involving a select few countries. A new active stewardship model informed by environmental and human rights principles.

In order to build upon the aforesaid argument, the paper adopts a comparative and interdisciplinary approach for research. It explores the

⁵ John G Wrench, 'Non-Appropriation, No Problem: The Outer Space Treaty Is Ready for Asteroid Mining' (2019) 51 *Case W Res J Int'l L* 437; Sam Kole, 'Who Owns Space? The Legal Battle Brewing Over Asteroid Mining' (Vanderbilt JETLaw, March 2025).

⁶ Fabio Tronchetti, *Fundamental Principles of Space Law in the Globalized Era* (Springer 2013) ch 4.

various principles of international space law, international environmental law, and the recent developments on a policy level, i.e., the Artemis Accords⁷. Furthermore, the paper also explores a series of technical literature on orbital debris mitigation and space traffic management, as well as political economy analyses of the emerging space industry. By integrating these perspectives, the paper offers both a critical diagnosis of the problem and concrete reform proposals.

HISTORICAL DEVELOPMENT OF SPACE LAW

The foundation of international space law and space governance originated and developed against the intriguing geo-political and technological developments in the 1950s and 1960s. The launch of the Sputnik I satellites by the erstwhile Soviet Union kickstarted a '*space race*' within the technological advanced nations who wants to explore this uncharted territory. A territory, which witnessed both a surge of international cooperation as well as competition in the next few decades between the so-called elite powers. Various international organizations too, including the United Nations started responding to such developments. The United Nations for instance, established the '*Committee on the Peaceful Uses of Outer Space (COPUOS)*' way back in 1959 which was specifically tasked with the responsibility to craft an international law on space activities with an objective of ensuring that outer space and its operations are only used with a peaceful objective and its operations ultimately benefit the '*all mankind*' or at least a majority of it⁸.

The Outer Space Treaty 1967

The Outer Space Treaty 1967⁹ is considered as the *magna carta* of international space law and rightly so. It acknowledged, codified and vehemently attempted to codify the certain key principles governing a series of commercial & non-commercial operations in outer space. Some of these key principles included bestowing the freedom to explore outer

⁷ NASA, *The Artemis Accords: Principles for Cooperation in the Civil Exploration and Use of the Moon, Mars, Comets, and Asteroids for Peaceful Purposes* (13 October 2020) <https://www.nasa.gov/wp-content/uploads/2020/10/Artemis-Accords-signed-13Oct2020.pdf> accessed 16 August 2025.

⁸ UNGA Res 1472 (XIV) *International Co-operation in the Peaceful Uses of Outer Space* (12 December 1959) UN Doc A/RES/1472(XIV); see also Francis Lyall and Paul B Larsen, *Space Law: A Treatise* (2nd edn, Routledge 2018) 36–40.

⁹ Outer Space Treaty (n 2)

space for the benefit of all mankind¹⁰. Secondly, the principle of National Non-Appropriation, a fundamental notion that protects the abundant resources of outer space from being exploited exclusively by few nations. Thus, in effect it prohibits, any form of sovereign claim over celestial bodies¹¹.

Third comes the principle of '*Peaceful Uses of Outer Space*' thereby encouraging the member nations to use outer space and its resources for advancement of mankind and also thus bans placement of any form of nuclear weapons in the orbit¹². This significant principle thus prohibits any form of military use of outer space thereby protecting outer space from becoming a potent war zone. Fourthly, the principle of '*State Responsibility for National Space Activities*' is another pertinent principle ensuring accountability of the state parties as far as their operations is concerned in the outer space¹³. This accountability stretches across any form of activities, whether governmental or non-governmental. With accountability comes liability and thus lastly, the principle of '*State Liability*' is equally and perhaps more relevant, especially given the context of space operations. This principle holds the state parties liable for any damage caused by their respective space objects¹⁴.

These fundamental principles that are embedded in this treaty reflects a deliberate and conscious effort to ensure that the space governance is not subjected to the rule of law applicable to terrestrial beings and operations. This demarcation and identification of a legal system dedicated specifically to the activities of outer space is absolutely critical and pertinent. There have been numerous criticisms on the way the principles are comprehended and implemented. Some call this treaty a compromise between the super powers of that time to secure cooperation and no competition in outer space activities and thus, they adopted a mid-way approach which incorporates the principles in such a way that it ensures open access while, at the same time, it avoids disputes over contentious issues like resource ownership or environmental protection. Despite the apparent criticism, the significance of the Outer Space Treaty in shaping the landscape of international space law cannot be ignored.

¹⁰ Outer Space Treaty (n 2) art I

¹¹ Outer Space Treaty (n 2) art II

¹² Outer Space Treaty (n 2) art IV

¹³ Outer Space Treaty (n 2) art VI

¹⁴ Outer Space Treaty (n 2) art VII.

Rescue Agreement 1968

The Rescue Agreement of 1968¹⁵ provides the much-needed humanitarian impetus to the Outer Space Treaty of 1967. It obligates the state parties to render all forms of potential assistance to astronauts who are subjected to any form of distress, irrespective of their nationality or the nature of mission they are engaged in¹⁶. In the event of any untoward incident, the states parties, in whose jurisdiction the incident occurs are obligated to inform the launching state and the United Nations, if for any reason, such astronauts land unexpectedly in their territory. Most significantly, it also obligates such a state party to rescue and return the space objects which are found in their respective territories owing to such an unfortunate incident to the launching authority¹⁷.

The Rescue Agreement while implemented and adopted with a noble intention, the effective implementation of the treaty is premised upon the cooperative & benevolent spirit of the state parties¹⁸. However, such a charitable spirit is often questioned in today's contemporary context given the numerous avenues and geo-political interests that is slowly pushing the state parties towards commercial exploitation of outer space and exploring the opportunities to potentially using outer space resources for military purposes. The agreement also falls short of addressing the status of 'space tourists' & 'commercial crew' who are not technically 'astronauts' yet, form a crucial segment of space activities / space tourism of today¹⁹.

Liability Convention

The Liability Convention 1972²⁰ is another critically relevant international legal instrument, particularly, in the context of

¹⁵ *Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space* (opened for signature 22 April 1968, entered into force 3 December 1968) 672 UNTS 119 (Rescue Agreement).

¹⁶ Ibid. art 1

¹⁷ Ibid. 4

¹⁸ Joanne Gabrynowicz, 'The Rescue Agreement: Principles and Practical Challenges' (2018) 43 *Journal of Space Law* 25-40.

¹⁹ Cambridge University Press, 'Space Tourism (Chapter 1): The Duty to Rescue and Commercial Spacecraft' in *Who Owns Outer Space?* (online resource), discussing whether "personnel of a spacecraft" includes commercial tourists.

²⁰ *Convention on International Liability for Damage Caused by Space Objects* (opened for signature 29 March 1972, entered into force 1 September 1972) 961 UNTS 187 (Liability Convention).

contemporary space operations. The Convention prescribes for an ‘*absolute liability*’ for any damage caused by a space object on the surface of the earth or to an aircraft in flight²¹. On the other hand, it also prescribes for a fault-based liability for any damage that is caused in the outer space resulting from the space operations undertaken by that particular state party²². The Convention, thereafter, provides mechanisms for states to claim compensation through diplomatic channels²³. This segment of international space law is also crucial in the contemporary context, when many governmental as well as non-governmental entities are gradually and extensively getting engaged in commercial space operations. This treaty, thus, not only brings in the much-needed clarity on the various contours of state liability as far as their space operations is concerned but also establishes diplomatic channels for enforcement. However, the convention falters in its cumbersome enforcement mechanisms. Further, it is the State, as the licensing authority bears the accountability for private and other commercial space operators due to the fact of their registration. However, this interpretation of the norm prescribed under the Liability Convention fails to see the light of the day, when viewed from the context of contemporary developments. For instance, in today’s times of mega-constellations and commercial space operations, norms like these create a wide accountability pothole especially for collective and overarching concerns involving space debris²⁴.

Registration Convention 1976

The Registration Convention of 1976²⁵ is the fourth leg in the regime of international space law that focuses on the procedural aspects of space operations. It obligates the state parties to maintain a national registry of space objects and also share information space operations of a particular state party, namely, the ‘*Launch Details*’ i.e., date, location, and orbital

²¹ Ibid. art II

²² Ibid. art III

²³ Ibid. n 19

²⁴ Frans G von der Dunk, *International Space Law* (Edward Elgar 2015) ch 5; Stephen Gorove, ‘Liability in Space Law: An Overview’ in Karl-Heinz Böckstiegel (ed), *Space Law: Basic Legal Documents* (Martinus Nijhoff 1990).

²⁵ *Convention on Registration of Objects Launched into Outer Space* (opened for signature 14 January 1975, entered into force 15 September 1976) 1023 UNTS 15 (Registration Convention).

parameters of a space object with the United Nations for information and record keeping²⁶.

This convention was crafted with the intention to promote transparency, however, numerous open ended and generic language of the treaty has made it difficult to continuously monitor or track the compliance. Over the years, it has been regularly noted that many states, usually under report, often omit to mention critical details or even fail to update the current status of the space operations, not even, if it is active or dormant²⁷ thereby questioning its efficacy and relevancy in today's complicated multi-party commercial space operations.

Moon Agreement 1979

The Moon Agreement of 1979²⁸ was considered as a path-breaking instrument in the domain of international space law. It was an honest attempt to tie up the loose ends of the previous four international conventions with an objective to provide a comprehensive regime suitable for contemporary space governance for the moon and other celestial bodies within their solar system. Applicable to all forms of celestial bodies (including their surface & sub-surface), except, earth, the Moon Agreement reinforced the principle of '*Common Heritage of Mankind*' and declared moon and other celestial bodies are common heritage of mankind²⁹. It explicitly extended this principle and added the concept of '*benefit sharing*' in the same³⁰. It categorically mentioned that any space operations or activities that are conducted on the Moon or other celestial bodies shall be conducted for the benefit of the mankind and thus, the fruits of the said labour shall be shared with all. In doing so, special emphasis should be given to the growing needs of the developing countries.

²⁶ Ibid. art II & IV

²⁷ UN General Assembly - Report of the Committee on the Peaceful Uses of Outer Space, UN Doc A/AC.105/1258 (2022); Irmgard Marboe, 'National Registries of Space Objects' in Stephan Hobe, Bernhard Schmidt-Tedd and Kai-Uwe Schrogl (eds), *Cologne Commentary on Space Law: Volume II* (Carl Heymanns 2013) 265-283.

²⁸ *Agreement Governing the Activities of States on the Moon and Other Celestial Bodies* (opened for signature 18 December 1979, entered into force 11 July 1984) 1363 UNTS 3 (Moon Agreement).

²⁹ Ibid. art 1 - 11

³⁰ Ibid. art 11 (7)

Towards this end, it also prescribes for establishment of international regime to regulate the exploration, exploitation and subsequently, sharing of benefits amongst the member nations³¹. A substantive leg of this agreement also focussed upon encouraging the state parties to avoid harmful contamination of the moon and other celestial bodies and ensure that the space activities do not result in such contamination thereby safeguarding the lunar environment³².

However, despite and perhaps, owing to its progressive vision, the Moon Agreement failed to secure the sufficient number of ratifications till date, including no support from the space faring nations. Reasons like concerns over economic disincentives for commercial ventures, fears of sovereignty dilution, and the Agreement's lack of detailed operational mechanisms has led to this untimely failure of a progressive treaty³³. The Moon Agreement and its fundamental principles stands in stark contrast to many domestic legislations³⁴ that allows the respective national entities to exclusively extract resources for domestic or national purposes. Many soft law instruments that came thereafter also went against the very core of the moon agreement. For instance, the *Artemis Accord*, a US led international framework encouraged bilateral arrangements and partnerships over multilateral governance, thereby risking a fragmented legal order in space governance³⁵.

These early space law regimes were drafted with a vision to explore and use the resources of outer space as a potential frontier beneficial for all, a frontier that is immune from the terrestrial politics and territorial disputes. Therefore, these regimes, heavily focused upon the norms of scientific exchange, treating outer space as a common heritage of mankind as well as ensuring the uses of outer space be restricted for peaceful purposes. However, democratic and sustainable space

³¹ Ibid. 6, art 11(5) – 11(7)

³² Ibid. 6 art 7(1)

³³ Fabio Tronchetti, *The Exploitation of Natural Resources of the Moon and Other Celestial Bodies* (Martinus Nijhoff 2009) 77–84; Stephan Hobe, Bernhard Schmidt-Tedd and Kai-Uwe Schrogl (eds), *Cologne Commentary on Space Law: Volume II* (Carl Heymanns 2013) 312–318; Frans G von der Dunk, *Handbook of Space Law* (Edward Elgar 2015) 308–312.

³⁴ *US Commercial Space Launch Competitiveness Act 2015*, Pub L No 114-90, 129 Stat 704; *Loi du 20 juillet 2017 sur l'exploration et l'utilisation des ressources de l'espace* [Law of 20 July 2017 on the Exploration and Use of Space Resources], Journal Officiel du Grand-Duché de Luxembourg, A-674, 28 July 2017; *Act on the Promotion of Business Activities Related to the Exploration and Development of Space Resources* (Law No 83 of 2021) [Japan Space Resources Act 2021].

³⁵ *Artemis Accord*, n (8)

governance never saw the light of the day in a comprehensive manner.

SPACE GOVERNANCE & CONTEMPORARY CHALLENGES

The world, following the period of cold war witnessed a diverse range of intensified operations in outer space. The domain of space was no longer limited to the two so-called superpowers, but it slowly witnessed the proliferation of new entrants like Japan, China, India, and the European Union which were slowly developing significant capabilities in space technology³⁶. Along with governmental entities, there was surge of private players in space activities who entered this field with transformative technologies³⁷. However, such an unprecedented proliferation also brought along with itself, a slew of concerns challenging the very foundational norms of international space law.

The realm of outer space has now revolutionized itself from a domain of state-led operations and space exploration into a domain of complex legal, commercial, and environmental challenges. While, theoretically, the foundational principles of international space law is still considered significant, but on papers and academic discourses. The relevancy and application of these principles is being constantly questioned and strained by the 21st century realities. This segment of the paper attempts to understand some of these critical challenges of contemporary space governance.

Space Militarization

Outer space has always been a domain of strategic competition, in every sphere. Despite the categoric prohibition under the Outer Space Treaty³⁸, states, including state parties to the treaties have pursued military activities in the outer space³⁹. Initially, this began behind the garb of dual use technologies and now, such activities are being undertaken openly thereby threatening the very core of the international space law

³⁶ Stephan Hobe, 'Historical Background of Space Law and Recent Developments' (2017) 66 *Zeitschrift für Luft- und Weltraumrecht* 385.

³⁷ Henry R Hertzfeld and Frans G von der Dunk, 'Bringing Space Law into the Commercial World: Property Rights Without Sovereignty' (2005) 6(1) *Chicago Journal of International Law* 81.

³⁸ Outer Space Treaty, n (2), art IV

³⁹ Cassandra Steer, 'Global Commons, Cosmic Commons: Implications of Military and Security Uses of Outer Space' (2018) 19 *Georgetown Journal of International Affairs* 9.

principles⁴⁰. In fact, it is not the technology, which is technically at fault or neither can it be categorized as a 'peaceful' or 'military' one. It is the way the technologies are used that often casts aspersions on its usage. Technologies like as satellites for navigation and communications have become necessary for communication in contemporary world. However, states have been regularly using these satellites to understand the placement and movement of military contingents of various countries⁴¹. Such instances, blurs the line between civilian and military applications of space technologies.

And then there are open challenges enforcing a nation's unfettered right to access and use the outer space. For instance, the Anti-Satellite Weapons Tests conducted by China in 2007 and thereby by India in 2019 and by many other countries have not only highlighted the cross-roads at which military competition and sustainability challenges lie but has also reflected the urge of global powers to disregard the space law if it came in the way of national development⁴².

Mega-Constellations, Spectrum Competition & the Multiplication of Stakeholders in Space

This growing proliferation of numerous actors in outer space has also consequently witnesses the rise of commercial actors. A variety of stakeholders are now involved in space operations with plans of deploying a range of satellites in the LEOs⁴³. Be it the parties who are directly engaged in space operations to commercial launch service providers to corporate ventures offering space tourism and then there are the traditional satellite broadband networks. These stakeholders are offering cost-effective services⁴⁴, thereby enabling ambitious mega-

⁴⁰ Cassandra Steer, 'The Militarisation of Outer Space: The Dual-Use Dilemma' (2019) 45(3) *Air and Space Law* 341; UNGA, *Prevention of an Arms Race in Outer Space* GA Res 36/97C (9 December 1981); UN Office for Disarmament Affairs, *Transparency and Confidence-Building Measures in Outer Space Activities* (2013) UN Doc A/68/189

⁴¹ Jana Robinson, 'Space Security and the Role of Transparency and Confidence-Building Measures' (2010) 26 *Space Policy* 129, esp 130-133

⁴² Michael Listner, 'China's 2007 ASAT Test: A Precedent for Norms in Space' (2018) 34 *Space Policy* 3; Rajeswari Pillai Rajagopalan, 'India's ASAT Test: An Analysis' (2019) 35 *Space Policy* 46; Cassandra Steer, 'Legal Challenges of Military Activities in Outer Space' (2020) 51 *Georgetown Journal of International Law* 417, 425-430.

⁴³ UN Committee on the Peaceful Uses of Outer Space (COPUOS), *Report of the Scientific and Technical Subcommittee on its Fifty-eighth Session* (19 April 2021) UN Doc A/AC.105/1238 (noting LEO congestion and mega-constellations); Daniel Porras, 'The Role of Private Actors in Outer Space Security' (2020) 46 *Journal of Space Law* 97.

⁴⁴ Henry R Hertzfeld and Frans von der Dunk, 'Bringing Space Law into the

constellations of thousands of satellites. Private companies have also pioneered innovative practices like launching launch systems, lunar landers, and commercial crewed missions.

While these initiatives look extremely promising on paper and as a project and will also have a far-reaching consequence on the development of a nation, however, there is a need to examine and mitigate its irreversibly damaging consequence on space operations as well. Such unregulated operations have a corresponding straining impact on orbits and its ability to carry satellites thereby leading to complications in space traffic management.

Parallely they also present challenges in space governance, specially, from the perspective of orbital congestion, spectrum allocation, and light pollution affecting ground-based astronomy⁴⁵. Both international space law and international telecommunication laws lack appropriate remedies and enforcement mechanisms thereby allowing de facto 'first mover' advantages.

Commercialization v. National Non-Appropriation

While the national non-appropriation remains one of the critical standpoints of space operations, yet, state parties have constantly deviated and such a deviation is no longer a deviation in practice, but also, in laws. Domestic space laws of numerous space faring nations expressly grant the private companies a regulated access to the space resources, permit them to explore, extract and exploit the resources found on celestial bodies, thereby challenging the national non-appropriation principle⁴⁶. These laws explicitly recognize property rights over extracted space resources.

This unprecedented involvement of the private stakeholders in outer space activities, an arena which was subjected or dominated by governmental agencies has become a clear stand-point of commercial

Commercial World: Property Rights without Sovereignty' (2015) 6 *Chicago Journal of International Law* 81; OECD, *The Space Economy in Figures: How Space Contributes to the Global Economy* (OECD Publishing 2019) ch 2

⁴⁵ UN COPUOS, *Report of the Scientific and Technical Subcommittee on its Fifty-seventh Session* (2 March 2020) UN Doc A/AC.105/1224

⁴⁶ Frans G von der Dunk, *International Space Law* (Springer 2015) 180–200; Fabio Tronchetti, 'National Space Legislation and the Artemis Accords: Reconciling OST Principles with Commercial Exploitation' (2021) 47 *Journal of Space Law* 105.

and national space operations, thereby not only altering the technical and economic landscape of space governance but also raising numerous critical question marks on space governance. While the Outer Space Treaty, assigns responsibility on the state parties for private activities under their jurisdiction⁴⁷, nonetheless, there is no internal or international mechanism to enforce the same.

While the innovative practices and a nuanced understanding of space operations as identified by private space operators has been a welcome change in space governance, but at the same time, it has also created a regulatory gap especially when viewed across jurisdictions. National registration and licensing regimes constantly and widely vary across national borders permissive environments to attract investment thereby giving rise to the problem of '*forum shopping*' in space law.

The allocation of government contracts and corresponding subsidies to private sector⁴⁸ have also diluted the public private divide. Governments are constantly turning to the private sector to carry out their activities either wholly or partially. Such a public-private partnership has worked wonders in numerous infrastructural sectors and is often witnessed in the technological progress it makes, nonetheless, the risks associated with such ventures cannot be blind sided to, especially, while engaging in space activities which is anyway a risky avenue and both governmental and non-governmental agencies lacking experience and expertise in fully comprehending the implications of such activities. Furthermore, it is frequently regarded with suspicion when corporate objectives are allowed to influence public space agendas without sufficient transparency or democratic supervision.

Lastly, this also has looming concerns over liability and insurance claims. While the Liability Convention holds the state parties '*internationally liable*' for damages caused by governmental and non-governmental agencies including the private sector, the law's focus on inter-state claims, does not cater to the business dispute settlement or private cross-

⁴⁷ Outer Space Treaty, n (2), art VI

⁴⁸ NASA, *Commercial Crew Program Overview* (NASA.gov, 2021) <https://www.nasa.gov/exploration/commercial/crew/index.html>; NASA, *Commercial Resupply Services (CRS) Program Overview* (NASA.gov, 2021) https://www.nasa.gov/mission_pages/station/structure/launch/commercial_resupply.html;

claims, which leaves investors and insurers in the dark⁴⁹.

Fragmented Domestic / Bilateral / Regional Space Governance Frameworks

The concern is not only with respect to the manner in which private sector is slowly gaining an unfettered access to outer space; the concern is also with how various nations through their respective domestic laws and bilateral agreements have started diversifying the international legal regime governing outer space. For instance, the Artemis Accord, a US led initiative promotes cooperative exploration under shared principles⁵⁰, but countries like Russia and China have implemented their own policy framework i.e., *International Lunar Research Station*⁵¹. Such a diverging policy framework at bilateral and regional levels also carries the potential of emergence of competing governance blocs, undermining the universality of space law. The lack of a uniform legal framework at international level focusing on utilization of outer space resources ultimately risks emergence of fragmented domestic legal order with some states aligning with such practices and some states detesting the same, yet no resolution – neither in paper nor in practice.

Orbital Debris and the 'Tragedy of the Commons': The Core of Environmental Concerns

Such a proliferation of a variety of space objects, like satellites – both active & defunct, whether in whole or fragmented form, the spent rocket stages has also led to crowding of the most potent lower earth orbit (LEOs) which is said to have approaching its saturation mark. Numerous studies have observed reasons like collisions in outer space, abandonment of space objects in outer space and unprecedented increase in the quantum of space activities has consequently led to an exponential growth in space and particularly, orbital debris. The European Space Agency has estimated that at present, there are over “36000 trackable pieces of debris larger than 10 cm, with millions of smaller fragments posing

⁴⁹ Fabio Tronchetti, 'Liability for Commercial Space Activities: Gaps in the Liability Convention' (2012) 38 *Journal of Space Law* 121; Henry Hertzfeld, 'Insurance and Liability in Outer Space Activities' (2010) 36 *Space Policy* 23.

⁵⁰ Artemis Accord, n (8)

⁵¹ China National Space Administration (CNSA), *China-Russia International Lunar Research Station (ILRS) Roadmap* (CNSA, 2020)

<http://www.cnsa.gov.cn/english/n6465652/n6465653/c6815877/content.html>

*significant collision risks*⁵².

The “Kessler Syndrome” which is identified as the risk of cascading collisions⁵³ and was considered as a theoretical notion has turned into a practical reality and consequently threatens both operational satellites and long-term space access⁵⁴. Despite the looming danger, there are no international law that mandates removal of space debris or at least propose a long-term solution to mitigate the risk of collision. Such risk mitigation is now largely dependent on voluntary guidelines issued by international & regional agencies.

The environmental footprint of space activities has failed to garner the much-needed attention of the international community. While a wide-spread acknowledgement is uniformly accepted, but differences start arising when resolutions are discussed. Many of the data particularly relating to climate access is discussed and many states have access to such an information refrain from sharing the same thereby creating a dual pressure for both the countries. The conundrum of protecting orbital ecosystems while guaranteeing all states, particularly those in the Global South, fair access to climate-related data⁵⁵. These developments and the consequent risks expose the inadequacy of the existing regime to manage space sustainably and equitably.

RE-IMAGINING SPACE GOVERNANCE WITH SUSTAINABILITY & DEMOCRATICE GOVERNANCE AT ITS CORE

The domain of outer space is constantly reimagining itself – from being recognized as a *common heritage of all mankind* under the international legal instruments on space law to be treated as a fragile and finite domain whose long-term viability depends on conscious stewardship by the

⁵² European Space Agency (ESA), *ESA Space Debris by the Numbers* (2025) https://www.esa.int/Safety_Security/Space_Debris/Space_debris_by_the_numbers; NASA Orbital Debris Program Office, *Orbital Debris Quarterly News* (2025) vol 29, issue 2; Moriba Jah, *Space Traffic Management and Orbital Debris* (Springer 2020) 45–70; Liou J-C and Johnson N, ‘Risks in Space from Orbital Debris: Collisions and Fragmentation’ (2009) 45 *Acta Astronautica* 719.

⁵³ Kessler DJ, ‘The Kessler Syndrome: Implications to Future Space Operations’ (2009) 45 *Acta Astronautica* 1–9.

⁵⁴ Moriba Jah, *Space Traffic Management and Orbital Debris* (Springer 2020) 50–65; Joseph N Pelton and Ram Jakhu, *Handbook of Cosmic Hazards and Planetary Defense* (Springer 2019) 130–135

⁵⁵ Joanne Gabrynowicz, ‘The Role of Space Law in Promoting Global Equity in Earth Observation Data’ (2018) 44 *Journal of Space Law* 67

governments & their shadow stakeholders.

The founding principles of space law, while still remain pertinent, however, the implementation of these principles are often overshadowed by domestic priorities and commercial interests of the respective nations. Hence, to ensure that these principles continue to remain relevant in today's context and be respected and implemented in the day, it is important that these principles should be re-looked from a fresh perspective of sustainability and equitable democratic governance which can give it a longer shelf life. Otherwise, these principles risk erosion in the light of the challenges identified above. The idea that this paper is proposing is not to replace these fundamental principles but to incorporate within itself a governance system that integrates both sustainability and democratic participation at its core.

At present, the implementation of international space law is largely dependent upon political good will and evolving geo-political dynamics. The generic and open-ended language of these treaties makes the implementation even more chaotic and subject the political willpower of the space faring nations. The paper argues for supplementing these fundamental principles with a dynamic, enforceable governance model that can adapt itself to the contemporary practices and challenges posed by technological advancement and growing commercial and dual use operations in space.

Case in point being international environmental law that focusses on institutionalization as a key tool in addressing numerous concerns like climate change and biodiversity loss. Precedents in the form of Antarctic Treaty System or for that matter, the law of the seas, embedded in UNCLOS is a clear indicator of how with sustainable development as a guiding principle, these regimes have reimagined the application of the fundamental principles⁵⁶. Their renewed focus on sustainable & equitable democratic governance has led the regimes to incorporate tools like environmental safeguards, cooperative management, and benefit-sharing mechanisms. Similarly, sustainability as a key cornerstone of planetary protection is a crucial part of the COSPAR Planetary Protection

⁵⁶ Antarctic Treaty, opened for signature 1 Dec 1959, 402 UNTS 71 (entered into force 23 June 1961), arts I-IV; United Nations Convention on the Law of the Sea (UNCLOS), opened for signature 10 Dec 1982, 1833 UNTS 3 (entered into force 16 Nov 1994), arts 136-140; Tanja Masson-Zwaan, 'Applying Lessons from the Law of the Sea to Space Governance' (2015) 41 *Journal of Space Law* 55.

Guidelines⁵⁷. However, voluntary nature of the guidelines, its application is often ignored when bigger interests and stakes are involved.

It is equally important to acknowledge that sustainability is a critical segment of democratic governance and from that perspective it is more of an institutional mechanism to support foundational principles rather than a substantive principle of its own. When viewed from the lens of space governance, a democratic approach would ensure that critical aspects of space operations like slot allocation, spectrum management, and resource exploitation are not captured by a few powerful actors⁵⁸.

A sustainable space governance model will also promote responsible innovative ventures and practices in outer space. By incorporating the foundation of sustainability and democratic governance in outer space operations, one can preserve the foundational principles and the intention behind the international space law, while ensuring adaptability to future realities. Its about time that space governance should evolve from static declarations to a living framework, thereby meeting the inevitable demands of growing space operations.

POLICY RECOMMENDATIONS FOR A SUSTAINABLE AND DEMOCRATIC SPACE GOVERNANCE REGIME

The rapidly evolving nature of space operations from a emblematic '*final frontier*' into a centre stage of geopolitical, profitable, and scientific global interests certainly demands a model of governance that focuses upon and is built upon three intertwined imperatives: sustainability, equity, and democratic legitimacy. This part of the paper, attempts to propose certain critical aspects on which the future of space governance can be constructed. This approach draws its inspiration from not only the existing space law, that invariably remains at the core of such proposition, but also, borrows from the shared experiences under international environmental, particularly focusing upon multistakeholder governance in an emerging global commons regime.

⁵⁷ Committee on Space Research (COSPAR), *COSPAR Planetary Protection Policy* (2021) <https://cosparhq.cnes.fr/scientific-structure/ppp> (accessed 10 August 2025).

⁵⁸ Joanne Gabrynowicz, 'The Role of Multi-stakeholder Consultation in Global Space Governance' (2018) 44 *Journal of Space Law* 55–70.

Integrating Sustainability Metrics into Space Law

This is inspired by the Sustainable Developmental Goals which advocates *responsible consumption and production*⁵⁹ stringent '*climate action*⁶⁰' and '*strong institutional mechanisms promoting peace & justice*'⁶¹. This paper argues for incorporating measurable indicators while designing and drafting obligations pertaining to licensing and registration of space projects as a means to operationalize sustainability. This may include, but is not limited to, setting restrictive limits on the total number of satellites that can be actively operated from the LEOs, or affixing accountability on the state parties for removing defunct space objects from outer space to avoid Kessler Syndrome⁶². Plans may also include plans of de-orbiting and a detailed compliance mechanism prior to launch operations. Another key metric of sustainability is to prepare the outer space for future operations which would require the state parties to remove the space debris caused by their existing satellite. Similar limitations can also be placed on the resource extraction from celestial bodies. Another key metric would be to require operators to offset greenhouse gas emissions associated with rocket launches.

Embedding Democratic Accountability

To protect, preserve and implement the principles of equitable access in the ethos of 'global space commons' it is imperative that the principle of democratic accountability should be internalized and institutionalized within the prospective space governance frameworks. This mandates adoption of formal mechanisms that should not only seek participation and authoritative say from governmental but also some non-governmental entities like private stakeholders, civil society representatives, academia and industry representatives who can participate through a structured multistakeholder consultation forums for the drafting and review of space regulations both internationally and domestically⁶³. It can also review major space projects either through

⁵⁹ United Nations, *Transforming our World: The 2030 Agenda for Sustainable Development* UN Doc A/RES/70/1 (2015), SDG Goal 12

⁶⁰ Ibid. SDG Goal 13

⁶¹ Ibid. SDG Goal 16

⁶² UN Committee on the Peaceful Uses of Outer Space (COPUOS), *Guidelines for the Long-term Sustainability of Outer Space Activities* (2019) UN Doc A/74/20, Annex II

⁶³ Joanne Gabrynowicz, 'The Role of Multi-stakeholder Consultation in Global Space Governance' (2018) 44 *Journal of Space Law* 55; European Space Policy Institute, *Space Governance: Multi-stakeholder Approaches for Equitable Access* (ESPI Report 72, 2020).

open consultation or otherwise prior to granting the requisite approvals. This will ensure transparency and societal oversight on key projects.

Such a structured body can also be supplemented and supported by technical advisory groups or citizen associations who can also deliberate on the ethical, environmental, and societal implications of space activities, providing a legitimate voice for global public interest. A similar grievance redressal mechanism can also form a part of this structured interface. A well-built, comprehensive democratic accountability structure can form the backbone of a structured space governance models which can held the world community to avoid the pit-falls of exclusivity and truly uphold the principle of common heritage of mankind.

Institutional Architecture for Global Space Governance

The fragmented and selective application of space law is also impacted the effectiveness of one of the only institutional mechanisms in outer space i.e., United Nations Committee on the Peaceful Uses of Outer Space which is nothing than a deliberative body moving at a snail speed whereas sectoral institutions like International Telecommunication Union, look into specific areas concerning space operations i.e., spectrum allocation. Thus, this paper further argues for having a sustainability model with a strong institutional interface. This institutional mechanism needs to have stronger, decisive and authoritative foothold in space operations like resource extraction, orbital slot allocation, and debris mitigation. It can operate on a two-tier level with a bicameral governance format with governmental representatives can form the top tier and scientist, private & civil society stakeholder forming the second tier. Such a format can be supported by an Independent Advisory Board which can provide independent technical advise on proposed space operations. These authorities to operate on the principles of transparency and ensuring state accountability for space operations.

Regulating Private and Non-State Actors

While private and non-state actors can be made a part of the decision-making process, it is all the more important that they should be directly subjected to a strict regulatory framework at international level. This is pertinent against the backdrop of growing commercial operations in space. Stringent governance framework must prohibit non-state actors

particularly, private enterprises from prioritizing profit-making over collective interest of mankind. Ensuring and exercising this due diligence should be affixed on the respective state parties, something that the current regime also advocates for, so that international responsibility and liability can be appropriately affixed on the defaulting party.

Incorporate Benefit Sharing Mechanisms

A critical standpoint of *common heritage of mankind* principle is to share the benefits of exploration and exploitation of outer space with all. It is thus proposed to design and develop benefit sharing mechanism through which the fruits of space research, exploration and exploitation can be appropriately shared with all the members of the world community. This is not advocating for serving the fruits of someone's labour on a platter to everyone concerned. However, a proper mechanism or a channel can be designed through which the world community benefits at large from the space research.

This may include bringing ventures on resource extraction including asteroid mining and lunar exploitation to operate under a structured mechanism. State parties involved in such activities may direct a part of their profit towards an international fund which can be dedicated towards conducting scientific research or towards a common infrastructure development in outer space and foster capacity building initiatives countries that wishes to advance in this field. Safeguards like these, may seek to preserve the much-needed balance between innovation, sustainability, and equitable benefit distribution, ensuring that space remains a shared domain for the advancement of all humanity rather than a frontier captured by the few.

Enhancing Transparency and Data-Sharing

The success of the international regimes' rests heavily on the principles of transparency. This principle should not only be viewed as a substantive principle calling for transparency in laws and regulations governing space operation, but it should also become a cornerstone of the institutional and regulatory mechanism prescribed above. Transparent operations is one of the key pillars on the basis of which a sustainable and equitable space governance regime is built.⁶⁴ Thus, in the

⁶⁴ Brian Weeden and Victoria Samson, *Global Space Situational Awareness: Reducing Risk*

institutional mechanism prescribed above, it is also recommended to establish a centralized authority which can document, record, monitor and evaluate compliance by state parties and non-state actors. This will go a long way in ensuring uniform enforcement of obligations.

State parties can come together to develop orbital data-sharing protocols both at domestic and international level. This will also go a long way in mitigating damages enabling coordinated collision avoidance and more effective space debris tracking⁶⁵. Major space projects can be approved subject to their necessary declarations on the objectives of the mission, potential environmental assessment reports and its long-term feasibility plans. Necessary disclosures prior to launch as well as during the mission will aid in developing a secured and predictable space operations. By offering open-access orbital activity monitoring, some of these systems can lower the chance of unintentional or intentional collisions⁶⁶. This framework will improve safety, discourage hazardous behaviour, and guarantee that space activities continue to be in line with the interests of mankind as a whole by instituting transparency at every level, from license to end-of-mission.

Equitable Access

This stems from the fundamental principle of '*common heritage of mankind*' which treats outer space as the common heritage or property of all mankind. Following this idea, the principle of equitable access advocates for developing and least developed nations having a greater say in space activities specially in benefit sharing. This also advocates capacity building initiatives of such nations, who seek handholding while developing space technology. Similarly, it also promotes equitable access in space operations like equitable distribution of spectrum and orbital slots to prevent monopolies.

CONCLUSION

The engagement of the mankind in outer space activities has undergone an unprecedented transformation in the past few decades. The

Through Transparency (Secure World Foundation, 2020) 15–30.

⁶⁵ Ibid 11, n (51)

⁶⁶ European Space Agency, *Space Situational Awareness and Open-access Data Initiatives* (ESA, 2023) https://www.esa.int/Safety_Security/Space_Situational_Awareness (accessed 16 August 2025).

international space law regime was formed with the objective of preserving space and its resources as a '*common heritage of mankind*' thereby implying that space can never be subjected to territorial sovereign claims or seen as a potential battlefield for future or can be commercially exploited for unilateral gains. However, the contemporary practices have manifested these fears into reality. This frontier was meant for collective scientific advancement and peaceful cooperation based on the principles of sustainable development, democratic accountability and equitable access. However, a combination of technological, economic, and geopolitical advancements has gradually undermined vision by changing the governing paradigm from collaborative stewardship to competitive exploitation.

These developments have exposed the inadequacy of international space laws to deal with the challenges posed by such an exponentially growing field. This coupled with the absence of a stringent and structured institutional governance framework has created a regulatory vacuum wherein the domestic interests and corporate imperatives have completely taken over the collective good.

Taking reference from its global counterparts, the paper argues realigning the fundamental principles of international space law in practices and provisions that are sustainable, fosters democratic governance and provides equitable access. These principles are no longer just fancy jargons but a structural necessity. The core idea is to reorient space governance towards a framework that not only resonates with the contemporary practices but also can cater to the compounding challenges so faced with ethical imperatives.

Ultimately, it is not the question of how the scientific community should go about exploring and utilizing the abundant resources of outer space. It is equally pertinent to address the kind of voices that should be a part of this decision-making process, the methodology through which the community progresses together as a whole and not as individual nation following a cut-throat competition.

This so-called final frontier carries an abundant potential to uplift the mankind in every form. The existential challenges posed by the rampant terrestrial exploitation can be reversed if these outer space resources are sustainably and optimally utilized. Hence, it is all the urgent to ensure that this frontier does not become another breeding ground for mindless,

rampant and endless exploitation. Instead, it must serve as a proving ground for our capacity to govern the global commons in ways that balance innovation with restraint, ambition with responsibility, and sovereignty with solidarity.