



Legal nexus between Celestial Exploration and Exploitation

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ABSTRACT:

The exponential economic and technological advancement through outer space exploration and the inclusion of private companies in extra-terrestrial ventures have made people delve into the scope of environmental contamination of celestial bodies. This article delves into the legal vacuum regarding such pollution which has been ignored ever since the inception of Space Missions, critically analysing the existing generic framework, including the Outer Space Treaty and highlighting national inadequacies in addressing environmental harm beyond the planet. A reconceptualization of environmental responsibility in outer space is proposed by elaborating on a principle like *sic utere tuo ut alienum non laedas* (use your own property in such a way so as not to injure that of another), in the context of celestial bodies.

Through analogous differences and similarities drawn from the United Nations Convention on the Law of the Sea (UNCLOS), this article suggests an application of maritime environmental safeguards to space activities, thereby advocating for a shared model in governance. The role of private organisations has also been scrutinised, especially via the absence of binding liability mechanisms which could effectively hold them accountable for such contamination, despite the presence of the 1972 Convention. It is also noted how the International Court of Justice and many other dispute resolution forums could offer practicable solutions for adjudicating public and private space oriented environmental disputes.

The article concludes upon the need for an enforceable international framework to preserve celestial environment and prevent further exploitation. For ensuring the future of space exploration sustainably, it must depend not only on technological advancement but also, the legal commitment of Earth's inhabitants and concerned bodies to prevent irreversible damage.

Keywords: Outer Space Law, Celestial Pollution, Outer Space Treaty, Environmental Liability, Polluter Pays, UNCLOS, ICJ.

Introduction:

The international community was abuzz about possibilities for space exploration to endanger the biosphere on Earth and damage the ecosystem of other planets even before Sputnik, the first artificial satellite, was sent into orbit.

Planetary protection is a sustainable development practice that involves a system of agreed principles which aims to protect earth and other celestial bodies from forward contamination (from earth) and backward contamination (to earth) caused by the space missions. It is a discipline that promotes responsible exploration of space by tackling the potential transfer of biological matter to and from Earth and other objects in the Solar System.

The history of planetary protection has been interwoven with space exploration since the 1950s. The Committee on Space Research (COSPAR) sets guidelines for planetary protection in accordance with international space use agreements outlined in the Outer Space Treaty (OST), whereas planetary protection is adopted by individual space agencies on a national level.

The “exploration and use of outer space... shall be carried out for the benefit and in the interest of all countries and shall be the province of all mankind,” according to Article I of the Outer Space Treaty.

Although the emergence of tardigrades is undoubtedly an identifiable form of pollution, it is yet unclear what harm they have caused. Bags of human droppings from earlier lunar missions have led some scientists to speculate that they may have brought microbiological life to the once-sterile lunar surface. Since terraforming would intentionally alter the biosphere, it would most likely be a hazardous contaminant. Instead, harming the human interests that have historically been at the centre of human-centric Anglo-American property law, the injury would be to the natural planet itself. According to the concept of environmental personhood, the cosmic body must be protected from harm in the same way that any human body would be.

Through scientific research, the outer atmosphere and celestial entities are regarded as global structures for the benefit and progress of every person on earth. As a result, states have an ethical obligation to safeguard the celestial bodies and outer space from emissions due to space missions.

Legal Provisions

The United Nations Committee on the Peaceful Uses of Outer Spaces (COPUOS) oversees the United Nations Office for Outer Space Affairs (UNOOSA) and conceived the idea of the five U.N. treaties covering outer space. They are The Outer Space Treaty, The Rescue Agreement, The Liability Convention, The Registration Convention and The Moon Agreement.

The five space treaties were all introduced between 1967 and 1979, with no substantive development of an international regulatory regime in the subsequent years.

The Outer Space Treaty enunciates broadly upon regulating outer space activity; whereas subsequent treaties sought to work on its loopholes and need for amendments. The Space Liability Convention created the deeper legal framework and The Rescue Agreement set forth the visionary path in Article V of the Outer Space Treaty. The Moon Treaty despite not being much ratified served as an explanatory document for the framework that the signatories of the Outer Space Treaty had envisioned.

The main body that oversees international laws and regulations relating to space is the United Nations. The organisation strives to execute the five adopted space accords and monitors satellites orbiting the planet through the UNOOSA.

The Outer Space Treaty and the Space Liability Convention can cooperate to offer a route for a case to be reviewed in the ICJ if the court decides to endorse an environmental personhood reading of specific treaty articles, even though the Moon Treaty was not as extensively ratified. A compelling illustration of where the international law community may have progressed if clashing objectives had been eliminated, is the Moon Treaty.

The Outer Space Treaty

The maiden initiative to establish an international regime for outer space was The Treaty on Principles Governing Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (Outer Space Treaty), ratified just 10 years after Sputnik and two years before the Apollo 11 landing by 110 parties, including all major spacefaring nations. Its certain sections were later clarified by subsequent agreements such as the Rescue Agreement and Registration Agreement.

The preamble of the Outer Space Treaty recognizes “the common interest of all mankind in the progress of the exploration and use of outer space for peaceful purposes.” It would have looked logical to assign the legal system that governed Earth's property to space as there was no fundamental law for space.

The Outer Space Treaty's extensive jurisdiction is established in Article I. According to Article II, space, including the Moon and other celestial bodies, cannot be appropriated by a nation through usage, occupation, sovereignty claims, or any other method. As for resources, multiple scholars have questioned whether they are similarly unclaimable after extraction.

Article IX lays down a mechanism to elaborate upon research incentives and initiatives to pursue studies about celestial bodies, their formation and the science surrounding their protection, and conduct technical explorations so as to prevent pollution.

The major loophole of this treaty is that it lacks enforceability and does not have the real power to provide remedy to the parties that face the harm. Further only some of the parties have agreed to the compulsory jurisdiction of the International Court of Justice including Australia, Canada, Denmark, India, Germany, U.K., etc.

The Space Liability Convention

Following the Outer Space Treaty, the U.N. enacted the Convention on International Liability for Damage Caused by Space Objects (Space Liability Convention) in 1972. The Space Liability Convention provided clarification on the definitions pertaining to damages resulting from space flight. Much of the treaty is still applicable for “damage being caused elsewhere than on the surface of the earth,” even though its primary focus seems to be on compensation for damages resulting from an object falling from space.

Detail of the Space Liability Convention has been covered under the ambit of Safety and Liability hereinafter mentioned.

The Moon Treaty

The Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (Moon Treaty) was the final of the five U.N. space treaties. Since its adoption in 1979, the Moon Treaty has been less ratified than the Outer Space Treaty, with only 18 states parties. Despite being the most progressive on environmental issues, the Moon Treaty is rendered to be a ‘toothless tiger’ due to its lack of widespread implementation.

India is the only Moon Treaty signatory to also have a significant national space program thus far.

The slow pace of adoption has left a “vacuum” of international law over the Moon, but the Moon Treaty still serves an important role as the best expression of the international objectives for a legal framework to govern the Moon.

Most of the opposition to the Moon Treaty by the spacefaring powers at the time, the U.S. and the Union of Soviet Socialist Republics, was based upon reaction to the potential requirement to share extracted mineral wealth with other nations.

Article 1 of the Moon Treaty states that the treaty applies to the Moon as well as other celestial bodies within our solar system, except Earth. The Moon Treaty recognises that outer space law is a segment of the framework of global law, as every operation carried out on the moon, including discovery and application, must comply with international law, specifically the United Nations Charter. According to this view, space parties' actions are still governed by broader international legal structures such as the International Court of Justice and the Security Council.

Article 7 § 1 states that in the course of exploring and employing the Moon, Member States seek to avert the disturbance of the present balance of its environment, whether by introducing adverse consequences in that environment, by its harmful invasion through the emergence of extra-environmental matter or otherwise.

The moon and its natural resources are deemed as common heritage of mankind. The word 'province' under the Outer Space Treaty has been replaced by the word 'heritage', implying a stronger stance on Planetary Protection via a humanised approach towards nature. By acknowledging the Moon's divulged archival worth to all human beings, the Moon Treaty could widen an avenue for a plaintiff to file a claim for the depletion of the lunar environment. The Moon's common heritage allows third parties to act as guardian ad litem for the Moon, an environmental person.

Article 11 § 5 requires States Parties to develop an international framework and procedures to control the utilisation of the Moon's natural resources when they become viable.

Article 11 § 7 states the main purposes of the international regime to include that the Moon's natural resources should be developed in a safe and orderly manner, managed rationally, and expanded for usage.

There is no specific entity or regime yet to specifically carry out the vision and provisions of this treaty, except the generality under UNOOSA.

NASA Policies

NASA's Procedural Requirement Policy classifies missions according to the planetary protection goals of each extra-terrestrial solar system body and the mission plan. The lunar surface and comets are examples of celestial bodies in Category I and II that are not at risk of contamination from terrestrial sources. Categories III and IV, on the other hand, comprise bodies that are critical to the process of chemical evolution/or the beginning of life and may be contaminated by spacecraft. These categories include Jupiter's moon Europa, Saturn's moon Enceladus and Mars. Category V includes all "Earth-return missions".

In light of the large number of space missions intended, NASA established a Planetary Protection Independent Review Board in 2019. The board recommended that NASA reconsider mission categorisation from a planetary-protection perspective because the current system appears to be overly comprehensive and obsolete. NASA has also developed modernised rules based on the PPIRB recommendations. However, they have not yet been officially released by COSPAR.

Dispute Resolution

For dispute resolution, Article 3 of the Outer Space Treaty states that all the parties of the treaty shall carry its activities related to exploration and outer space in consonance with international law, including the UN Charter. However, the UN Charter has undertaken a narrow approach by promoting negotiation, enquiry, mediation, conciliation, arbitration, judicial settlement, resort to regional agencies or arrangements, or other peaceful means of their own choice by parties to any dispute likely to affect and endanger the maintenance of international peace and security. Where such an approach remains unsuccessful, then Article 36(3) allows for the dispute to be referred to the International Court of Justice.

This Liability Convention Treaty settles disputes by stating the liability of states launching space objects and the procedure thereof. Article 1 defines 'damage' as loss of life, personal injury and damage to property. It does not expressly include other losses such as loss of profits. Article 2 provides that a "launching State shall be absolutely liable to pay compensation for damage caused by its space objects on the surface of the earth or to aircraft". Article 4 deals with the procedures that where damage is caused "elsewhere than on the surface of the earth. Article 5 deals with the procedure where two or more state launch a space object and any damage caused results in joint and several liability. However, like the OST, the claim procedure under LCT is again state led, with claims having to be presented "through diplomatic channels" under Article 9 which states that such channels shall serve as medium through which a claim for compensation for damage shall be presented to a launching state. The claim can also be presented through Secretary-General of the United Nations, provided other claimant state and launching state are members of United Nations. Ultimately, the process is subject to the parties agreeing to the final decision being binding; otherwise, the parties shall consider in good faith the Claim Commissions recommendatory award, as per Article 19. Claim Commissions' decision shall be binding if agreed by the parties or otherwise a fail and recommendatory award shall be passed which shall be made public the time period for the same is one year from the date of its establishment unless an extension is granted.

There are some agreements which have been signed between states to form forums of dispute resolution including arbitration. These are as follows:

The International Telecommunications Satellite Organisation (ITSO) is an intergovernmental organisation established to make available communication

by means of satellite available to the nations on a global and non-discriminatory base. It was preliminarily called as INTELSAT. These Agreement set out the demand for parties to submit all legal controversies for arbitration under article 18(a).

The Convention establishing the European Telecommunications Satellite Organization – EUTELSAT (1982) sets out the demand for parties to submit all legal controversies for arbitration under Article 20(a).

The Convention on the International Maritime Satellite Organization - INMARSAT (1979) sets out the demand for parties to submit all legal controversies to either the International Court of Justice or some other procedure for agreement, which may (subject to concurrence) be arbitration under Article 31(1).

There also lies legal remedy for private institutions when they are parties to dispute and it is done through international arbitration which serves as a medium for cross order and terrestrial disputes. Arbitration refers to a form of dispute resolution where the parties come into an agreement in order to settle disputes and the agreement consists of seat of arbitration etc. The relevant regulations are designed to prevent disagreements on these matters before they occur, or at the very least, to provide a way to settle them in the event that an agreement cannot be reached. Other modes of alternative dispute resolution include mediation and conciliation. Permanent Court of Arbitration, the world's oldest international arbitral organisation, provides us with these services. PCA has amended 2010 UNCITRAL Arbitration Rules for the space laws and published its Optional Rules for Arbitration of Disputes Relating to Outer Space Activities and were released in 2011.

PCA and other arbitral institutions deals with strict handling of confidential material and decisions made in respect of law by various experts. It even provides for flexibility in procedural timetables as in comparison to court proceedings. Arbitral awards are final and binding, giving a degree of certainty. However, parties have the option to rely upon the Convention on the Recognition and Enforcement of Foreign Arbitral Awards (1958) (the New York Convention) to enforce the decisions if not honoured voluntarily. In addition to various benefits provided, jurisdiction serves a fundamental hurdle.

Past Space Missions

Astronomers have been concerned about interplanetary pollution since the 1970s, when the Viking Project became the first US mission to successfully land a spacecraft on Mars' surface. To disinfect the spacecraft, it was roasted at high temperatures before leaving, killing any germs that may adhere themselves to it and corrupt the results. After over 13 years of circling Saturn, the Cassini spacecraft was destroyed in 2017. The spacecraft's demise was orchestrated to guarantee that Cassini never crashed with one of Saturn's moons, such as Enceladus or Titan, contaminating potentially habitable worlds. NASA's Perseverance Mars rover, launched on July 30, 2020, is the first interplanetary sample-return mission. While the expedition is an impressive achievement for scientists, the potential of interplanetary contamination cannot be overlooked. This mission came after the launch of China's Tianwen-1, which would land on Mars' surface, and the UAE's Al Amal (Hope), an orbiting mission to research Mars' atmosphere.

ESA has also embraced the "Zero Debris approach", which was initially proposed in Agenda 2025, with the goal of dramatically reducing debris production in Earth and lunar orbits by 2030 for all of the Agency's future missions, programs, and operations.

According to analysts, one of the most recent operations that might represent a threat to the solar system is the launch of the Starship vessel by SpaceX, Elon Musk's private space-faring enterprise. Even if SpaceX has stringent planetary preservation policies in place, there is no mention of such a policy on their website or in the public domain, implying that the corporation is more concerned with the repercussions of exploration than the exploration itself.

Private Companies

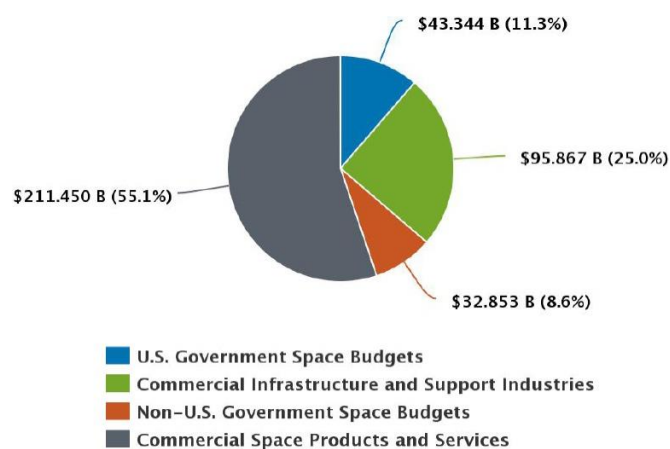


Fig 1. The gross make-up of the global space economy.

Source: The Space Foundation; 2018

Finding: Current planetary protection policy and requirements do not mandate significant actions beyond documentation and inventory of organic

materials for the vast majority of ongoing and planned private-sector space activities.

A legal vacuum raises concerns under the OST regarding private-sector space programs that pose planetary preservation issues, such as robotic or human expeditions to Mars. The treaty compels the United States to authorise and continually oversee nongovernmental entities' space operations, including those that pose potential forward or backward contamination hazards. This commitment also compels the United States to "adopt appropriate measures" to safeguard the planet. As a result of the treaty's planetary protection requirements, government and commercial space operations must achieve identical criteria and behave similarly. In addition to legislative power, the agency with this jurisdiction will need necessary technical and scientific skills or access to such expertise.

NASA is not a regulatory body; thus, it cannot authorise or continuously monitor private-sector space activity. However, NASA is where the federal government's planetary protection expertise is concentrated. Possible regulating authorities include the Department of Commerce and the Department of Transportation, which have the authority to control private-sector space activity. However, they lack the scientific and technological skills required to lead the formulation of planetary protection legislation for the private sector. Any strategy to closing the regulatory gap must guarantee that NASA's knowledge in planetary preservation informs the application of regulatory authority.

Few companies have obtained Associated Supporter status, and few private-sector employees are listed as COSPAR associates. The absence of private-sector engagement in COSPAR's planetary protection policy formulation stems mostly from firms' failure to undertake space activities that include planetary protection.

Addressing Liability in Space

The liability Convention of 1972 specifies the responsible state's absolute liability for harm caused by its space objects on Earth's surface or to aircraft in flight (Article II). However, its scope is less obvious when it comes to harm that may occur in the context of human settlements on celestial worlds or within space-supporting constructions. Articles II and III cover the intricate details of blame and the mechanisms for state claims, but they do not go into depth on the complicated possibilities that may develop from long-term human settlement on another planet or moon.

Article IV details that the agreement applies to harm inflicted other than on the Earth's surface, but it does not go into detail on how this would be applied to communities, since the environment is unlike anything envisaged by the original drafters.

The large number of entities participating in space settlements exacerbates the complexities of liability. Disputes over damage or mishaps in space habitats may include private persons, companies and governments from other countries. The Convention's Article VIII establishes a claims mechanism through diplomatic channels, although how this would work in a heavily inhabited interplanetary environment is unknown.

On Earth, court rulings can be enforced by the coercive power of nations, but there is currently no equivalent method in space. While Article IX of the Liability Convention mentions dispute resolution, the practical execution of such agreements remains an unsettled subject, made much more problematic by the presence of human colonies in space.

international agreement on liability provisions, the implementation of safety measures, and the construction of a system for enforcing legal norms in the space environment are required for addressing these gaps.

The inception of conceptual clarity on liability issues in space stems from the Liability Convention, but there is no detailed solution for the grave challenges posed by potential human settlements.

Need for National Instruments

The formation of unique national legislation is not always advantageous to the preservation of celestial ecosystems. Given the large number of resources and money at play, national regulation may result in a race to the bottom, allowing local space firms to engage in riskier but more profitable operations than foreign competitors. National governments will have little incentives to control their own space businesses if it reduces their competitiveness in the larger market. Even if national governments were prepared to design and implement an effective environmental system, the lack of consistency across national standards necessitates an international approach.

The establishment of autonomous national laws is not always beneficial for the protection of celestial ecosystems. Given the large number of resources and money at play, national regulation may result in a race to the bottom, allowing local space firms to engage in riskier but more profitable operations than their foreign counterparts. National governments will have little incentives to control their own space industry if it undermines their competitiveness in the larger market. Even if national governments were prepared to develop and implement a functional environmental system, the lack of consistency across national norms necessitates an international approach.

COSPAR

The consequences of planetary protection were apparent long before space travel became feasible and human civilisation quickly caught pace. Following Sputnik, the International Council of Scientific Unions (ICSU; now known as the International Council for Science) established quarantine standards in 1958, and the US National Academy of Sciences issued recommendations for non-contaminating spaceflight practices in their 1958-1960 studies.

By 1967, most spacefaring nations agreed that interplanetary pollution should be managed. In 1958, ICSU established an interdisciplinary Committee on Space Research (COSPAR), which became the focal point of most of the worldwide discussion and consensus on planetary preservation problems.

COSPAR and the International Astronautical Federation interact with the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS) on Outer Space Treaty issues. COSPAR created and maintains a planetary protection strategy, which is recognised as the international consensus norm for biological pollution under the Treaty. Current COSPAR planetary protection policy, as well as NASA and ESA policy, define five distinct types of space missions based on the nature of the mission and the target body to be researched. COSPAR's planetary protection policy is amended on a regular basis.

Recent Developments

A sub-committee was established by the COSPAR Panel on Planetary Protection to lay down and create a new version of the COSPAR Policy on Planetary Protection. It was approved by the COSPAR Bureau on 20 March 2024.

Relevant changes to the COSPAR Planetary Protection Policy include:

- Revision of the Preamble and Chapters (1 and 2) to improve grammatical clarity and expand references to Articles VI and IX of the Outer Space Treaty. The revised version emphasises the policy's status as a voluntary worldwide standard and includes a more objective-driven and adaptive approach to contamination management recommendations based on growing scientific understanding.
- Chapter 3 (function of the COSPAR Panel on Planetary Protection) has been added, which focusses on the function of the COSPAR Panel on Planetary Protection, as well as the formulation of the policy, guidance, and implementation assistance.
- Chapter 4 (essential Assumptions) has been added, which highlights the essential assumptions that serve as the foundation for the technical guidelines, as well as the rationale and background references.
- Chapter 5 (Categorisation) has been added, which gathers all of the main parts and factors for categorisation into a single chapter, including the categorisation process's logic.
- Chapter 6 (Guidelines) was revised to include an objective paragraph at the beginning of each sub-chapter, offering extra context to the end user.
- The addition of Chapter 7 (Reporting on Mission operations), which specifies terms for the reporting of planetary protection operations to COSPAR by organisations conducting activities in outer space.
- A complete reworking of Chapter 8 (References) to include references to contemporary, peer-reviewed articles that serve as the basis for the Panel's recommendations.

Polluter Pays applicability

The Polluter-Pays Principle can be utilised to address environmental pollution issues produced by space debris, particularly space debris that causes damage and contamination on the Earth's surface. As a result, if space debris falls on Indonesian territory and causes environmental harm and contamination, this concept may apply. The offended party may seek compensation under the Liability Convention and Article 7 of the Outer Space Treaty. According to the Liability Convention, the launching State is solely liable for compensating for damage caused by space objects on Earth's surface or aircraft, as well as for harm caused by his error in space.

Recommendations and solutions

1. Establishment of a lunar authority is authorized under Article 11 of the Moon Treaty. The authority could oversee permitting, conservation, and contamination prevention protocols along with being an authority which protects the celestial bodies for its establishment it is required that we address concerns of nations that have the capacity to exploit celestial resources along with the nations still developing space technology. But it faces the shortcoming that the adoption of Moon Treaty is limited which becomes a prohibition for creation of such an authority.
2. There should be an establishment of an international regulatory organization dealing specifically with space activities. This organization would supervise and control the use of space resources, ensuring that operations are carried out sustainably, fairly, and in accordance with the OST's tenet that space is the "province of all mankind". There can be establishment of a judicial or arbitration body under the authority of the UN or another global organization.
3. There should be mechanisms for sharing the benefits derived from space resources. This could take the form of monetary donations, technological exchanges, or programs to increase the capacity of nations who lack the resources to freely explore or use space. The monopolization of space resources by a few of highly technologically advanced corporations should be prevented by policies and regulations. This can entail imposing restrictions on the kind or quantity of resources that one organization is permitted to use. Furthermore, promoting public-private collaborations with well-defined standards can aid in striking a balance between corporate interests and the shared nature of space resources. In order to ensure compliance with ethical norms and international law, governments can serve as a ridge in monitoring and controlling these collaborations.

Learnings from ITLOS (Law of the Sea)**1. Precautionary Principle-Southern Bluefin Tuna Cases (New Zealand v. Japan; Australia v. Japan)**

In this case, ITLOS emphasized the use of the precautionary principle in marine environmental protection. This can serve as a guide for us to as to how we should approach unknown or potentially harmful biological contamination in outer space. There should be strict pre-launch sterilization protocols to avoid forward contamination under this principle. E.g., this can be used for preventing Earth microbes from contaminating Mars.

2. Due Diligence Obligations

ITLOS has given Advisory opinion of the Seabed Disputes Chamber on the responsibilities and obligations of States sponsoring persons and entities with respect to activities in the Area which is a report of the Secretary-General and states that due diligence must be exercised by states to ensure that activities under their jurisdiction do not cause environmental harm. This should also be inculcated in space missions where States or private institutions launching missions must ensure planetary protection protocols are followed, drawing parallels to how deep-sea mining is regulated.

3. Environmental Impact Assessments (EIA)

ITLOS supports mandatory EIAs for activities potentially harmful to the marine environment. An important learning that can be taken is that EIAs should also be made mandatory for space missions to planets or moons to assess the impact on extra-terrestrial environments.

Learnings from the Environmental Chambers of the ICJ**1. Recognition of Environmental Harm as a Legal Issue**

In *Pulp Mills on the River Uruguay (Argentina v. Uruguay)* (2010) ICJ acknowledged the obligation to conduct environmental impact assessments under international law. Planetary protection must also involve legal obligations for assessments before space exploration missions.

2. Intergenerational Equity and Sustainable Development

Advisory Opinion on the Legality of the Threat or Use of nuclear weapons (1996) emphasized protection of the environment for future generations. This principle can be integrated into space governance in order to protect celestial bodies.

Conclusion

As we step into a new realm of space law and cosmic reality, it is required that a proper framework with regulatory bodies is fostered in the arena of International Law. The Outer Space Treaty has become inadequate in regard to the extra-terrestrial settlements. We need to derive from ITLOS and ICJ and take stringent actions in order to prevent forward and backward contamination. Environmental protection requires an intentional body to oversee the space activities undertaken along with formulation of a comprehensive treaty and sustainable development. Environmental Impact Assessment should be considered on priority basis to check the impact of the mission on the celestial body. The future of space law should be inclusive, adaptive along with a legal framework which provides authority to take strict actions.

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