THE CONUNDRUM OF SPACE DEBRIS AND ITS SUSTAINABLE REMEDIATION BY POLLUTER PAYS PRINCIPLE

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Abstract

The reach and advancement of humans in the technical fields and the scientific achievements have been profound in past few decades. The same can be witnessed in the field of exploring and traversing the space and the results have been nothing but extremely impressive. We have not just been able to travel to different planets and explore them but also speculate existence of life or the possibility of supporting life on these planets, intercept collision of meteorites and even talk about buying lands on the Moon! However, each coin has two sides to it and example of such brilliance has come with certain cons as well. In order to carry out the explorations, satellites and spacecrafts are sent to outer space, but what happens to these space objects when they become inactive? These inactive space objects end up remaining in the outer space and give rise to the growth of space debris. However, other than Outer Space Treaty, there is no such international or national legal framework to address the problem of space debris and therefore the question as to who would be responsible and liable for the debris creation and remediation remains unanswered. The proposed paper would, thus, examine the existing legal frameworks, identify the policy gaps and study whether the environmental principles of Rio Declaration, 1992, will be applicable in order to answer the questions related to the responsibility and liability for space debris. It would especially try and determine whether Countries can rely upon the Polluter pays principle in order to attach liability with any organisation in case of state funded or privately funded space missions. Thus, the author will attempt to provide solutions to the policy gaps and offer a workable remedy.

Keywords: Outer space, remediation, space debris, space-faring, sustainability.

Introduction

How many of us remember the movie "Gravity"? Yes, it is the 2013 movie by Alfonso Cuarón where everything on a NASA mission goes completely wrong when a defunct satellite is struck by a Russian missile. It involuntarily causes a chain of reactions- explosions and multiplication of space debris- which in turn were travelling at an extremely high speed. In no time, the said NASA Space Shuttle gets hit by the debris and an irreversible damage is caused to the shuttle

which resultantly leaves only two survivors- "*Dr. Ryan Stone*" and Mission Commander "*Matt Kowalski*"- abandoned in space with no communication with their Mission Control.

This seems to be an engaging plot for a science fictional movie, right? However, this story line may not be as speculative as one might prefer it to be. On 10th February, 2009, one of Russia's "old military satellites happened to collide with the then functioning Iridium communications satellite" and the collision in turn created more than "200,000 pieces of debris" and this event marked the "first collision of two intact satellites in space".[1]

Humans have been exploring the space for decades now and their activities have given rise to an escalating amount of space debris which is also gravitating in orbit. Sputnik I, launched in 1957, burned up in 1958, thus becoming the first piece of space debris.[2] In 2007, January 11th, China purposely knocked down one of its satellites- weather satellite (Fengyun 1C)- thereby increasing the number of traceable space objects by 25%[3] and subsequently, upto that point, it marked the largest new creation of debris in history.[4] India too performed a similar test in 2019. Through "mission Shakti",[5] after the United States, China, and Russia, India became the fourth nation, to have conducted such a test.[6] Thus, it is evident that since the time of Sputnik I, in 1958, the extent of space debris has seen a considerable growth.

The European Space Agency, in 2020, estimated the number of space debris present in the orbit and it includes more than "*128 million objects, ranging from one millimetre to one centimetre, and 9,00,000 objects from one centimetre to ten centimetres, and 34,000 objects measuring more than ten centimeters*".[7] Scientists have predicted that the statistics and numbers are expected to go up exponentially, even if nothing new is put in the orbit and this is known as the Kessler Syndrome. The threat that lurks with this growth in space debris is not only limited to space environment and satellites, but also to human explorers in space and also to life on

[1] Megan Ansdell, *M. Active space debris removal: Needs, implications, and recommendations for today's geopolitical environment,* Journal of Public and International Affairs, 2010 (Oct. 25, 2022, 10:20 am) https://jpia.princeton.edu/sites/g/files/toruqf1661/files/space-debris-removal.pdf.

[2] Nicholas L. Johnson., *Orbital Debris: The Growing Threat to Space Operations*, American Astronautical Society, 2010 (Oct. 25, 10:30 am) http://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20100004498.pdf.

[3] National Aeronautics and Space Administration, *Space Debris*, (Oct. 25, 10:35 am). https://www.nasa.gov/centers/hq/library/find/bibliographies/space_debris.

[4] Mike wall, *Huge dead satellite may be space junk for 150 years*, (Oct. 25, 10:36 am) https://www.space.com/15640-envisat-satellite-space-junk-150years.html.

[5] *India's mission Shakti: Can we leave space out of earthly conflicts?* (Oct. 25, 10: 40 am) https://qz.com/india/1584560/indias-mission-shakti-lets-leave-space-out-of-earthly-conflicts/.

[6] The Hindu, *P.T.I. Narendra Modi announces success of mission Shakti, India's anti-satellite missile capability*, 2019 (Oct. 25, 10:10am) https://www.thehindu.com/news/national/narendra-modi-announces-successof-mission-shakti-indias-anti-satellite-missile-capability/article26651731.ece.

[7] European Space Agency, *Space Debris by the Numbers*, 2020 (Oct. 25, 10: 05 am) https://www.esa.int/Safety_Security/Space_Debris/Space_debris_by_the_numbers.

Earth. "The issue of space debris is of major concern and it requires an immediate and competent reaction from all the States. Only then, it will be possible to fight the effects of such space pollution and also to make sure that space-faring can be carried on while protecting and preserving the outer space environment."[8] Nevertheless, though not an easy task to combat such a pressing issue, it surely will not be the first time when the international community is facing such a real problem. Time and again they have come together to take action to save the environment. Without an ounce of doubt, the problem at hand involves a series of complex political, economical and geopolitical interests which cannot be ignored, however, the focal point of this article will be to pay attention to the legal aspects and consider that the conduct of the States can be standardized by employing legal principles and conventions. Over the past few decades, the international environmental law has evolved by leaps and bounds, with sustainable development and fundamental principles at its core.[9] Therefore, this article proposes to understand as to how can these international environmental law principles can be implemented in regulating the nations and thereby addresses the problem of dealing with space debris.

What is space debris?

The debate on space debris is pertinent and pressing at both national and the international level, however, there is still no legally sound international framework that defines "*space debris*". However, there is one definition that is available. It has been given by the "Inter-Agency Space Debris Coordination Committee (IADC)" which has also been endorsed by the "United Nations Committee on Peaceful Uses of Outer Space",[10] which is regarded as the main forum where "countries assemble to discuss problems related to activities in outer space".[11] The said definition defines space debris as "*all man-made objects including fragments and elements thereof, in Earth orbit or re-entering the atmosphere, that are non-functional*".[12]

[8] Scientific and Technical Subcommittee of the UNCOPUOS, *Active Debris Removal – An Essential Mechanism for Ensuring the Safety and Sustainability of Outer Space: A Report of the International Interdisciplinary Congress on Space Debris Remediation and OnOrbit Satellite Servicing*, 2012 (Oct. 25, 10:15 am) https://www.unoosa.org/pdf/limited/c1/AC105_C1_2012_CRP16E.pdf.

[9] Eloise Scotford, *Environmental Principles and the Evolution of Environmental Law*, Oxford: Hart Publishing, 2017 (Oct. 25, 11:00 am) https://media.bloomsburyprofessional.com/rep/files/9781849462976sample.pdf.

[10] United Nations Office For Outer Space Affairs, *Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space*, (Oct. 25, 10: 17 am) https://www.unoosa.org/pdf/publications/st_space_49E.pdf.

[11] General Assembly Official Records, *Report of the Committee on the Peaceful Uses of Outer Space*, 2007, Sixty-second session, Supp. No. 20, A/62/20 (2007), Annex IV (Oct. 25, 11:00 am) https://www.unoosa.org/pdf/gadocs/A_62_20E.pdf.

[12] Inter-Agency Space Debris Coordination Committee, *Space Debris Mitigation Guidelines*, section 3.1, (Oct. 26, 10:00 am) https://orbitaldebris.jsc.nasa.gov/library/iadc-space-debris-guidelines-revision-2.pdf.

Space debris, further, has been categorized to have been formed from four sources, namely:

- Inactive payloads- Also known as inoperative payloads, these are "the satellites that have been abandoned and cannot be controlled or operated from Earth".[13]
- Operational debris- As the name suggests, this kind refers to "the debris that are released during any space operation and have been discarded since they are not in use anymore". Example, debris created during the launch of a satellite.[14]
- Fragmentation debris- "Any break ups that takes place in-orbit, whether due to explosions, accidents or collisions", give rise to fragmentation debris.[15]
- Micro-particulate matter- The environment in outer space is exceptionally aggressive and this causes the in-orbit objects and the manned spacecrafts to shed their exterior, thereby, creating micro-particulate matter.[16]

Thus, it can be said that space debris includes objects as diverse as "*satellites that are no longer in use, parts of space objects which have been ejected or fragments resulting from explosions and collisions, tools used during space walks, garbage dumped by manned missions, or even flakes of paint*".[17]

Orbital debris and its issues

Space debris is extremely treacherous to both space and the Earth. In relation to the space, the debris present can cause collision, thereby, endangering both existing and future space missions. It has been noted by NASA that these debris can reach speeds almost near to "*8,046.72 meter per second- almost 7 times faster than the speed of bullet- and it is fast enough to cause grave harm to spacecrafts or satellites*".[18] Mankind, as a technologically advanced race, heavily depends upon satellite technologies and applications for a lot of essential activities- "communications, photograph and mapping, remote sensing and Geographic

[13] Committee on the Peaceful Uses of Outer Space, Scientific and Technical Subcommittee, *Towards Long-term Sustainability of Space Activities: Overcoming the Challenges of Space Debris: A Report of the International Interdisciplinary Congress on Space Debris*, 2011 (Oct. 26, 10:30 am) https://www.unoosa.org/pdf/limited/AC105_C1_2011_CRP14E.pdf.
[14] *Id*. at p. 12.
[15] Committee on the Peaceful Uses of Outer Space, *supra* note 13, at p. 12.
[16] Committee on the Peaceful Uses of Outer Space, *supra* note 13, at p. 12.
[17] Lotta Viikari, *The Environmental Element in Space Law: Assessing the Present and Charting the Future,* IDC Publishers, Martinus Nijhoff Publishers and VSP, Leiden and Boston, 2008, p. 31-32 (Oct. 26, 12:00pm) https://books.google.co.in/books?hl=en&lr=&id=026wCQAAQBAJ&oi=fnd&pg=PR5&dq=+Lotta+V.+The+Environmental+Element+in+Space+Law:+Assessing+the+Present+and+Charting+the+Future.+IDC+Publishers,+Martinus+Nijhoff+Publishers+and+VSP,+Leiden+and+Boston,+2008.&ots=GMvTvc7JlZ&sig=1t-AYGr00lN2ssMi-tGwfX39x9E&redir_esc=y#v=onepage&q&f=false.
[18] National Aeronautics and Space Administration, *supra* note 3.

Information System (essential to geographical studies), weather forecast, global positioning system, and even the defense sector".[19] Increase in debris population not only poses an alarming threat to the path of these satellites but also to the functional aspect of these satellites.

Further, there are a lot of human activities in the space- be it manned missions or space missions for tourism[20]- and presence of debris affects the safety for such life in the space. Furthermore, the "International Space Station (ISS), which at present is space manned mission, it is constantly considered to be risking debris situation and it has been recorded by NASA that ISS has already managed to maneuver and avoid three collisions in 2020 alone".[21]

As has been mentioned above, the danger from this debris situation is not exclusive to space. It extends beyond that and poses a threat to Earth and life on Earth as well. "A Soviet satellite fell to Earth in 1978, scattering radioactive particles over northern Canada; this crash required extensive cleanup of the area."[22] Further, in April, 2000, "different places in South Africa experienced space debris crashes".[23] Similarly, on May 13, 2020, a "Chinese rocket falling back to Earth uncontrollably may have dropped debris in two nearby Ivorian villages".[24] These events are not some isolated events and it can be deduced from these accidents that "large items from space can re-enter Earth successfully without totally burning up in the atmosphere and this can result in nuclear contamination of Earth's surface."[25] These accidents can end up hurting human life on Earth and it is need of the hour that some steps are taken in light of the abovementioned risks.

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[19] Tipper D. Satellite application. (Oct. 26, 12:10 pm) www.pitt.edu/~dtipper/2720/2720_Slides17.pdf.

[20] Sheetz M. How SpaceX, Virgin Galactic, Blue Origin and others compete in the growing space tourism market, 2020 (Oct. 26, 12:15 pm) https://www.cnbc.com/2020/09/26/space-tourism-how-spacex-virgin-galactic-blue-origin-axiom-compete.html.

[21] Mike Wall, *Astronauts take shelter as space station dodges orbital junk*, 2020 (Oct. 26, 12:30 pm) https://www.space.com/space-station-dodges-debris-astronauts-soyuz-shelter.

[22] Committee For the Assessment of NASA's Orbital Debris Programs, National Research Council, *Limiting future collision risk to spacecraft: An assessment of NASA's Meteoroid and Orbital Debris Programs,* 2011, p.60 (Oct. 28, 10:00 am) https://books.google.co.in/books?hl=en&lr=&id=sj5aTqhNVjkC&oi=fnd&pg=PR1&dq=+Comm.+For+the+Assessment+of+NASA%27s+Orbital+Debris+Programs,+Nat%27l+Research+Council.+Limiting+future+collision+risk+to+spacecraft:+An+assessment+of+NASA%27s+Meteoroid+and+Orbital+Debris+Programs+(2011).+www.nap.edu/catalog.php%3Frecord_id%3D13244+(last+accessed+&ots=cc06YXinhK&sig=a0_QsI_EuijF604Diuwao3k0vbA&redir_esc=y#v=onepage&q&f=false.

[23] CBC. *Space debris falls on South Africa* (Oct. 28, 10:30 am) https://www.cbc.ca/news/technology/space-debris-falls-on-south-africa-1.197698.

[24] Forbes, *O'Callaghan J. Chinese rocket debris may have fallen on villages in the ivory coast after an uncontrolled re-entry* (Oct. 27, 7:30 pm) https://www.forbes.com/sites/jonathanocallaghan/2020/05/12/parts-of-a-chinese-rocket-may-have-fallen-on-an-african-village/#7ee8988d65a2.

[25] Committee For the Assessment of NASA's Orbital Debris Programs, *supra* note 22, at p. 60.

Existing legislations on debris removal and prevention

Till now, there have been "multiple guidelines, policies, pieces of legislation, and regulations" which have been formulated to reduce and eliminate space debris, if possible. One such relevant and illustrious guideline is the *"Space Debris Mitigation Guidelines"*, IADC. The guidelines contain "preventative practices" which are intended to manage the amplification of "*space congestion in popular orbital regions such as low Earth orbit (LEO) and geostationary orbit"* in order to "preserve the commercial and scientific value", while maintaining the "use of and access to space by future space users".[26]

Similarly, the UN Guidelines on "*Space Debris Mitigation"* is also one of the key instruments, engaged in curbing the issue of space debris.[27] The said guideline has in turn seven guidelines to mitigate the problem: "*Limit debris released during normal operations; Minimize the potential for break-ups during operational phases; Limit the probability of accidental collision in orbit; Avoid intentional destruction and other harmful activities; Minimize potential for post-mission break-ups resulting from stored energy; Limit the long-term presence of spacecraft and launch vehicle orbital stages in the low-Earth orbit (LEO) region after the end of their mission; and Limit the long-term presence of spacecraft and launch vehicle orbital stages in the low-Earth orbit (LEO) region after the end of their mission*".[28]

Road blocks in effective dealing of space debris

The current space legal treaties and guidelines, as mentioned above, are causing major problem as these are outdated and are not able to deal with the issue of space debris. Other than the IDAC definition of space debris, there is no other legal and uniform definition and all the instruments which are addressing the said issue are "soft laws" and do not have a binding effect on states *per se*.

Therefore, it is important to have a "working definition" to enforce an effective remediation regime. Without a uniform definition, it becomes difficult and illegal to remove any space objects without the launching State's authority, since the concept of salvage rights is not acknowledged in space by neither the Outer Space Treaty nor the Registration Convention.[29] On the other hand, had there been a definite definition as to what space debris would include,

[26] Inter-Agency Space Debris Coordination Committee, *supra* note 12, Section 5.
[27] United Nations Office For Outer Space Affairs, *supra* note 10.
[28] United Nations Office For Outer Space Affairs, *supra* note 10, at Section 4.
[29] 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), Article VIII (Oct. 26, 9:00 pm) https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/outerspacetreaty.html.

maybe the international bodies could come up with a distinguished framework to deal with and remediate space debris.

Furthermore, the existent space laws which are binding upon the Party States are too ambiguous regarding the of space debris. However, remarkably, Article IX of the Outer Space Treaty commands States to "*abstain from harmfully contaminating the outer space*" but fails to provide for what amounts to "harmful contamination", nor does it ascertain any machinery to make the States liable for a violation of the said article.[30] Additionally, there is the Article III of Liability Convention which is mirroring Article VII of Outer Space Treaty and it 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 and liable for damage due to its faults in space.*"[31] It also provides for "*settlement of claims for damages for dispute resolution*" under the Liability Convention, however, "*decisions are final and binding only if agreed upon by the parties*."[32] Vague nature of these laws enables States to create intentional debris like that of Fengyun and there has been no urge to take relevant legal steps.

These laws are extremely State centered and have failed to take cognizance of the private segment involved in space exploration. The national laws which are leading space explorations are leaning towards "*entrepreneurial innovation*" and it is amplified by the concept of US privatization of outer space activities by way of "*public-private partnership arrangements*".[33] Hence, it is of importance that the liability factor be extended to include the private sector to take part in curbing and reducing space debris.

However, there are a lot of issues that are involved in the absence of any definite legal framework. The most important problem is that the launching state's security interest is vested in the space objects and even in the debris. While cleaning up the debris, sensitive and classified information might be leaked and technologies built for clearing up the debris might even incapacitate the functional space objects[34]. These issues can give rise to doubt and lack of

[30] *Id.* 29, Article IX.
[31] Convention on International Liability for Damage Caused by Space Objects, Article III (Oct. 27, 9:15 am) https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/introliability-convention.html
[32] *Id*. 31, Article XIX.
[33] Khushi Kapoor, Keshav Todi, *The Privatisation of Space Exploration*, FIC SRCC, 2021(Oct. 27, 7:00 pm) https://ficsrcc.com/the-privatisation-of-space-exploration/.
[34] Ward Munters, Jan Wouters, *The road not yet taken for defusing conflicts in active debris removal: A multilateral organization*. KU LEUVEN Working Paper No. 183, 2017, p. 23-24 (Oct. 26, 6:00 pm) https://ghum.kuleuven.be/ggs/publications/working_papers/2017/183munters.

assurance in debris removal programs amongst states, particularly in cases of "unilateral national implementation of removal technologies".[35]

Further, another problem which can be identified is the issue of funding of remediation steps. It can be agreed upon that there are "levels of space faring and contribution to debris". It was three countries which were the major players in debris contribution- "China (~42%), United States (~27.5%) and Russia (~25.5%)".[36] Therefore, the questions that arise are:

- "What is the manner in which the international community will fund the debris remediation action?"
- "Whether it is to be borne by the space-faring states, if yes, how is the cost be computed amongst the states?"

No matter what perception is agreed upon, the major setback related to space debris reduction and elimination is undoubtedly the "absence of a binding and comprehensive international legal framework". The international framework should not only give a definition of space debris but also reflect upon including the private sector and individuals under the liability regime. Further, it should focus upon providing a regime that would provide "funding for the debris remediation and space traffic management", a clear understanding of "fault, negligence and causation" in order to make a party liable and most importantly incorporate the "application of environmental law principles in space".

It is to be noted that for protection of the environment, we have well defined international principles which have been agreed upon by states and is also implemented nationally from time to time. Therefore, the same may be applied in case of space and space law. It is extremely important that the development is sustainable in nature and hence, the article will focus on implementing the existing environmental law principles in the context of space debris and how it may be managed and remediated over time.

Application of environmental law principles

Time and again, while advocating the need to protect the environment, it has come across that certain parts and elements of the environment are common heritages of mankind. For instance, the Oceans- "Preamble" of the "UN Convention on the Law of the Seas" states that "*the seabed, subsoil, and its resources beyond the territorial jurisdiction of states are the common heritage*

[35] *Id.* 34, at p. 23-24.
[36] James M. Buchanan, *What should economists do?* Southern Economic Journal, Vol. 30, No. 3 (Jan., 1964), pp. 213-222 (Oct. 27, 7:15 pm) https://www.jstor.org/stable/1055931?seq=6#metadata_info_tab_contents.

of mankind"[37]. This signifies that such stretches of the oceans are owned by all mankind jointly thus the usage should be such that it is sustainable for the future generations as well. The same logic can be extended in case of space as well- the space surrounding Earth is a limited resource and should be used sustainably- for it is a common heritage of all mankind.

In order to recognize such a notion, a proper legal framework needs to be in place and while applying the international environmental law regime, principles like precautionary principle, environmental impact assessment and polluters-pay principle should be included amongst others. These principles have been enshrined in the Rio Declaration on Environment and Development, 1992[38] whose central theme is sustainable use of the environment. Therefore, the article hereunder defines the relevant environmental law principles in order to formulate a sustainable way of space use and debris remediation.

The precautionary principle

It is human nature that when a particular resource is given to man, he uses it to its fullest, without considering the negative effects. However, since this is not the way to go about the resources available to man, the concept of sustainable use was developed. One such aspect of this concept is "Precautionary Principle" and Article 15 of the Declaration advocates for the same.[39]

As can be understood from the name, this principle requires mankind to take precautionary measures whenever an activity seriously threatens or causes irreversible damage human health or the environment even if the adverse effects have not been fully established scientifically. This principle is based on the notion of "precaution is better than cure". The moment there is possibility that the new activity may have negative impacts on the environment, the burden is shifted to the State responsible, for such introduction of new activity, to take precautionary measures to protect the environment.

Although the said principle is an established part of "international customary law", its application to space beyond Earth is difficult in the absence of a framework. It is therefore important to note that all states involved in the activity of space faring are also involved in creation of debris as it would be next to impossible to explore space with zero debris formation.

[37] United Nations Convention on the Law of the Sea, Preamble (Oct. 27, 9:15 am) https://www.un.org/depts/los/convention_agreements/texts/unclos/unclos_e.pdf.
[38] Rio Declaration on Environment and Development, 1992, hereinafter mentioned as the Declaration (Oct. 26, 4:00 pm) https://www.cbd.int/doc/ref/rio-declaration.shtml
[39] *Id.* 38, Article 15.

However, what can be done is there can be threshold or benchmark created for permissible creation of space debris. Creation of any debris beyond the permissible limit would be held in violation of the precautionary principle.

The environmental impact assessment

Before taking the precautionary measures, one needs to gauge the impact of a particular project and thereafter take decisions. Whenever a project is proposed to be undertaken, before any activity is carried out, any significant adverse effects of the project on the environment is assessed and thereafter, the project is sanctioned by competent national authority. This is the principle of "environmental impact assessment" which is contained in Principle 17 of the Declaration[40] and should also be extended to the outer space.

In relation to outer space, whenever a space faring activity is to be undertaken, the launching state should provide with a mandatory environmental impact assessment, which would help the authorities to understand the exact effects if may have on the outer space and how it may affect the debris situation. Further, it should be mandated for the launching states to provide a disposal regime whereby it will allow the states to remove the spacecraft from outer space once its purpose is served in order to reduce debris formation.

The polluter-pays principle

The precautionary principle will help the states to safeguard certain activities in order to prevent any environmental mishap to take place and the environment impact assessment report only allows the authorities to decide upon the viability of a project and whether it would have any adverse effect on the environment or not. However, these principles do not provide the authorities with any framework to deal with the debris that is formed after a project (or launch) is carried out. There requires a mechanism that would hold the launching states responsible for the pollution created in outer space.

"If engaged in an activity which involves usage of inherently dangerous substance, one shall be liable to pay for the damages so caused to human and nature".[41] The basic rule that a State is responsible for guaranteeing sufficient damages for any hazardous and unsafe exercises carried on by it, was established in the landmark judgment of "*Trail Smelter Arbitration*"[42] case that was between US and Canada.

[40] Rio Declaration, *supra* note 38, Article 17.
[41] Indian Council For Enviro-Legal vs Union Of India & Ors, 1996 AIR 1446.
[42] Trail Smelter Arbitration (U.S. v. Canada), 3 R.I.A.A. 1905 (1941).

Article 16 of the Declaration lays down the polluter-pays principle[43] and as the name suggests, it means whoever is responsible for polluting the environment- the polluter- shall be held liable by the national authorities to bear the cost of the pollution- prevention, control, and repair of damage caused - and there is a dire need to extend this principle in outer space too in relation to debris creation- whoever creates the space debris shall be responsible for cleaning such debris. A proper framework is required to allocate the liability as it would help is having a better space environment in two ways. First, it would act as a deterrent regime as states would be more vigilant of the debris being created in space exploration and second, it would create a legitimate way of creating funds to remediate space debris in an equitable manner.

As already stated above, it is almost impracticable for a space mission to not generate space debris. Therefore, by applying the polluter-pays principle, every launching state will be required to pay a certain sum for debris creation. There are a number of legal precedents which will help in enforcing this principle as polluter-pays principle is a well established and celebrated principle, both nationally and internationally.

This regime is very much possible if it can be ensured that each launch contributes to a particular amount of money in the form of solidarity contribution which can thereafter be employed to fund the removal of space debris.

A Workable Remediation Regime

Once the international communities come together and provide with a working regime of space debris and its related issues along with management of space traffic, they can focus on framing a funding regime for remediation. It is important for the launching states to know all about the past launches and therefore, states need to re-register the space objects and determine whether such space objects are still functioning or not, thereby identifying the debris. The states may also be allowed to give consent to third parties for removal of the non-functioning objects and even demand the return of any such debris, if the launching state is not participating in cleaning up. This can help avoid the impediment posed by "Article VIII of the Outer Space Treaty and Article II of the Registration Convention".

Further, on re-registration, the competent authorities too will be aware as to all launches- that have been made in the past, being made in the present and to be made in the future. Thereby, it will be of immense help for the authorities to implement the environmental law principles to such launches- precautionary principle, environmental impact assessment and polluter-pays

[43] Rio Declaration, *supra* note 38, Article 16.

principle. Of all these principles, polluter-pays principle is the most important one to be recognized and implemented as the identified state or agency can be held liable to bear the cost of debris remediation. It would therefore provide with the much needed funds for the debris removal operations.

Conclusion

As the problem related to space debris is becoming evident every day, an increase in growth in awareness in relation to outer space and it being a limited resource is also visible amongst researchers and scientists. The current space treaties have proven to be inefficient in tackling the issue and the space to be used sustainably, a proper and uniform legal regime is very much necessary to be legislated. The legal framework must not only limit itself to mitigation but also try and curb further creation of debris. It has to define debris and its management guidelines, provide for funding regime to clean the debris and include the application of existent international environmental principles.

Since the Outer Space Treaty is state centric, the new framework should also consider involving the private sector in the process of removing debris and to incentivize the process, commercialization of debris removal can also be thought of. If the debris removal can be done according to a well structured plan whereby states and private bodies can aim at removal of certain number of debris from the orbit, we may even succeed at reducing the threat posed by Kessler Syndrome.

It is therefore the need of the hour that all existing efforts be unified, structured and standardized with the help of a legal framework at remediation of space debris, so that states and private bodies can be made liable for adversely affecting the outer space. The community, worldwide, is expected to come together and assume certain obligations to deal with this issue and develop arrangements to forestall the production of debris in large amounts.

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