

Sustainable Space Development - Need for a Change in the Liability Regime

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Introduction

The entry into outer space by surpassing the earth's gravitation is undoubtedly the greatest achievement of the twentieth century. It has cherished the dream of tremendous technological development in various fields, such as telecommunications, direct television broadcasting, remote sensing of the earth, advance warning of climatic changes, space transportation etc. However these benefits are not available free of cost. Apart from huge expenditure involved in launching the satellites, cost is also paid in terms of pollution of the space environment. Such environmental harm resulting from space activities may occur not only in the outer space *stricto sensu* but also in the near earth orbit. Just like the pollution of the earth's environment, the pollution of space environment is a matter of great concern since the preservation of the space environment is the pre-requisite for the continuation and expansion of the space ventures. Therefore the question of prevention of adverse impact on the overall success of space activity needs to be responded by avoiding undue harm to the natural environment of the outer space.

Though the scientific and the legal community are late to recognize and address the issue, the problem of space pollution started along with the launching of first space object, Sputnik - I.¹ Now it is well-known that the dangers resulting from the gradual pollution of the space environment can no longer be ignored.² The remedy to the problem of space pollution has to be addressed by

finding out the sources of pollution and subsequently by attempting to find out the scientific and legal ways to block such sources. The major sources of space pollution are the space debris, chemical effluents, biological and radiological contaminants.

Space Debris

Space debris³ stands as an important obstacle in the expansion of the space activities. Since the beginning of the space age, thousands of objects have been launched into the outer space and they are revolving in the orbit even after they have become inactive. In addition, the explosions and break-ups of active and inactive spacecrafts have added more debris to the outer space. The first break-up of the satellite occurred in 1961, when an Ablestar rocket exploded due to an unknown cause, releasing hundreds of pieces of debris. Since then a number of explosions of spacecrafts have been recorded. There are also a number of intentional explosions in the form of Anti-satellite Tests by the former Soviet Union, United States and recently by China.⁴

The space debris is also increasing rapidly by the collisions between the orbiting objects. As the number of spacecrafts and debris produced by them is increasing fast, the probability that two objects meet and generate more debris is increasing. These debris remain in the orbits until the natural forces cause them to decay into the atmosphere, which is a lengthy process. The fifty years of operation of spacecrafts has deposited thousands of

inactive play loads, tens of thousands of traceable objects of measurable size and millions of smaller fragments into the earth's orbit.⁵

The space debris carries the risk of damage from collision with spacecraft or astronauts. What makes them extremely dangerous is the speed with which these objects travel. As their average speed ranges from 11,000 to 35,000 kms per hour, impact of even a very small object with a spacecraft may cause serious damage. The debris can rip through the spacecrafts,⁶ kill astronauts, and render orbits for satellites so dangerous as to be unusable. The problem of collision with the debris has resulted in the 1986 Challenger disaster and the 2003 Columbia disaster, each taking away the valuable lives of seven astronauts. There are also examples of falling of inactive spacecrafts on the earth polluting the earth's atmosphere.⁷ Moreover, the orbiting debris hinders the observation of faraway celestial bodies.

Chemical Effluents

The release of chemical effluents during the launch and operation of spacecraft have adverse impact on scientific observations and can provoke changes in the natural state of the space environment. The chemicals may be intentionally released for scientific purposes or might result from the exhaust of rockets which burn fuel to achieve propulsion. The release of carbon dioxide by the exhaustion of the rocket fuel plays a significant role in the greenhouse effect. The use of chlorine based compounds as rocket fuels have harmful effect on the ozone layer. Similarly the Aluminum based fuels are contributing to the hazards of orbital activities.⁸ As these chemicals remain in the outer space for a long period of time,

they trigger series of changes in the space environment.

Biological Contamination

The possibility of biological contamination is a problem which attracted the attention of the world community since the beginning of the space exploration.⁹ The life forms found on the earth and if found in the outer space including the moon and other celestial bodies are different in nature. The introduction of organisms from the earth to the outer space¹⁰ or vice-versa¹¹ leads to biological contamination. The outer space missions carry the risk of biological contamination due to the fact that it is highly impossible to disinfect the spacecrafts entirely before launch as well as before return to the earth. The forward contamination is a matter of greater concern than back contamination, as the life forms are yet to found in the outer space. However the possibility of the mutation of the organisms in the course of forward contamination and their return to the earth by back contamination can not be ruled out.

Radioactive Pollutants

The emission of electromagnetic waves by the radioactive materials used in the space missions is also a matter of serious concern. The powerful radio transmitters located on the earth or in space generate electric and magnetic fields over large areas, which disturb satellite telecommunications and radio astronomy observations. The use of nuclear power sources in the orbiting satellites needs a special concern, as it has the potential to cause severe environmental damage in the outer space as well as in the earth's environment when it re-enters the atmosphere. The re-entry of Soviet satellite Cosmos - 954 on

24 January 1978 resulting in damage to Canada is a glaring example of such pollution.

Regulation of Space Environmental Pollution

The problem of pollution of space environment is addressed by both scientific and legal community. According to Wassenbergh, the protection of the space environment is more a scientific/technical problem than a legal problem.¹² The scientists have devised a debris removal program, popularly known as 'Orion', which uses laser and earth-bound sensors to detect, track and eliminate the debris by removing the fragments from the orbit to burn up in the earth's atmosphere. However the economic feasibility of de-orbiting the debris has come into question, as the process of de-orbiting requires too much fuel. This has resulted in devising a plan to bring the debris to an orbit where the automatic drag would cause it to de-orbit after some years. Such a plan was successfully performed with the French Spot - I satellite at the end of 2003. It is expected to re-enter the atmosphere in approximately 15 years.¹³ Another substitute proposed is to bring the debris to a graveyard orbit where no operational satellites are present.¹⁴ In addition to these plans, steps are also taken to minimize new debris emissions by preventing the explosion of energy storage devices within satellites, reducing the number of mission related objects and by developing reusable launch components.¹⁵

On the other hand the legal fraternity is also involved in finding a viable solution to the problem of space pollution. Though the solution is to be found more in scientific/technical terms, the appropriate legal framework to

supplement the technical aspects was always found necessary. These legal regulations are by no means negligible, but on the contrary, are of great importance. They are directed towards the much needed sustainable development¹⁶ of the outer space.

*The Outer Space Treaty*¹⁷

Article IX of the Outer Space Treaty deals generally with the prevention of pollution of space environment. It obligates the states to cooperate and assist mutually and also conduct the activities in outer space with due regard to the corresponding interests of other States Parties. The States Parties must pursue studies and exploration of outer space including the moon and other celestial bodies so as to avoid their harmful contamination and also adverse changes in the environment of the earth as a result of contamination by extraterrestrial matter and, where necessary, adopt appropriate measures for that purpose. The Article also obligates the states to undertake consultations if they have reason to believe that their space activities will potentially cause harmful interference to the space activities of other States Parties.

However Article IX suffers from several loopholes. As the terms harmful interference, harmful contamination and adverse changes remain undefined, the states are left with the power to interpret them in different ways. The Article prohibits the harmful contamination of the outer space but fails to deal with the adverse changes in the existing balance of the space environment. It is more oriented towards the prevention of back contamination rather than forward contamination. It is important to note here that there is a close link between the

contamination of space environment and the earth's environment. Because as mentioned earlier, the source of the first can be at the same time the source of the other.

In addition to Article IX, Article VI indirectly relates to the environmental pollution. It fixes the responsibility on the states for national activities, governmental or private, in outer space including the moon and other celestial bodies. This means that the state incurs responsibility for damaging the space environment provided there is breach of an international obligation.¹⁸ However it is a more general provision oriented towards remedying the breach of an international obligation and not directly related to the protection of the space environment.

*The Moon Agreement*¹⁹

An attempt to rectify the failure of the Outer Space Treaty to address the issue of forward contamination is made in the Moon Agreement. Article 7 of the Moon Agreement obliges the States Parties to prevent the disruption of existing balance of the environment of the moon and other celestial bodies by introducing adverse changes in the environment, by harmful contamination or otherwise. The measures to avoid harmfully affecting the environment of the earth through the introduction of extraterrestrial matter or otherwise are required to be taken by the states. Such measures adopted by the states and the information about the radioactive materials placed by them must be given to the Secretary-General of the United Nations. There is also scope for the designation of areas of the moon and other celestial bodies having special

scientific interest as international scientific preserves.

Article 7 of the Moon Agreement is undoubtedly a marked improvement over the provisions relating to environmental protection under the Outer Space Treaty. However the binding nature of this provision is in question due to the fact that the Moon Agreement is signed and ratified by only a handful of states.²⁰ Moreover Article 7 lacks the much needed sanction mechanism to assign penalties and mandate repatriation for any damage caused.²¹ The Article also fails to impose an outright ban on the placing of radioactive materials on the moon and other celestial bodies.

Article 11 of the Moon Agreement, which speaks about the concept of common heritage of mankind (CHM) incorporates the protection of the environment of the moon and other celestial bodies as well as the principle of sustainable development of the resources found in the moon and other celestial bodies. The concept of CHM is advocated and strongly supported by the Third World countries. However the concept has not been accepted by the developed countries in the governance of the moon and the other celestial bodies. Unless it is accepted by the space faring nations, the relevance of the concept in the protection of the space environment seems to be in question. Moreover, the provisions of the Moon Agreement are applicable only to the moon and other celestial bodies and not to the outer space as a whole. Therefore Articles 7 and 11 of the Moon Agreement, though may be useful in the protection of the moon and other celestial bodies, are not useful in the protection of the outer space in its entirety.

Question of Liability for Polluting the Space Environment

At the outset Article VII of the Outer Space Treaty and the provisions of the Liability Convention²² seem to cover the entire area of liability for conducting the outer space activities. Article VII of the Outer Space Treaty fixes the liability on state launching an object into outer space for injuries caused by such object to another state or to natural or juridical persons, whether on earth, in airspace or in outer space. The provisions of the Liability Convention supplement the above Article. It imposes an absolute liability on the launching state to pay compensation to any damage caused by its space object on the surface of the earth or to an aircraft in flight.²³ In addition, the state incurs a fault based liability for any damage caused elsewhere than on the surface of the earth to a space object or to persons or property on board such a space object.²⁴

Though wide-ranging provisions on liability for space activities are mentioned in the Outer Space Treaty and the Liability Convention, the question of liability for damage to space environment remains unanswered. The launching state incurs liability only for damage caused on the surface of the earth, to aircraft in flight, to space object in orbit and to persons or property on board such object. Moreover the Liability Convention defines damage as "loss of life, personal injury or other impairment of health; or loss of or damage to property of states or of persons, natural or juridical, or property of international intergovernmental organizations".²⁵ The outer space is not the property of any state or organization.²⁶ Therefore the damage caused to the environment of the outer space *per se* is not subject to the liability

regime. As a result the launching state can not be compelled to pay compensation for the damage caused to space environment by creating debris, or by introducing chemical, biological or radiological contaminants.

In addition, the provision of fault based liability for damage caused in outer space by the space objects suffer from several loopholes. Though the definition of space object under the Convention covers space debris,²⁷ it is quite difficult to identify the state to which the debris belongs. Keeping record of each debris is not an easy task. Moreover the provision also contains a difficult task of ascertaining fault in outer space.²⁸

Thus the above discussion shows that the space liability regime needs a rethinking in the light of liability for causing damage to the space environment. The damage caused to the space environment constitutes much serious damage than other damage addressed under the Convention, as it affects the right of all the states to freely explore and use the outer space. Such damage also deprives the right of future generation over the outer space including the moon and other celestial bodies and neglects the "maximum sustainable yield"²⁹ permitted under the concept of sustainable development. Therefore a system of absolute liability for polluting the space environment needs to be adopted to keep the outer space unpolluted for the benefit of present as well as future generation.

Conclusion

The legal considerations on the protection of the space environment revolve around the concept of sustainable development. It is well-known that the means used for the

exploration, use and exploitation of the outer space and the resources therein materially impede maximum gains, unless properly regulated. The provisions of existing treaties are vulnerable to varying interpretations by the states. This being the fact, the provisions are not strong enough to protect the outer space environment from the clutches of pollution. Therefore it is necessary to reformulate the provisions relating to the protection of space environment by transcending the vagueness of the existing treaty provisions and incorporating the concept of sustainable development. Holding the states liable for the damage caused to the space environment is the most important step in this direction.

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¹ The space age began with the launching of Sputnik - I by the former Soviet Union on 4 October 1957.

² Nicolas M. Matte, 'Environmental Implications and Responsibilities in the Use of Outer Space', *Annals of Air and Space Law*, Vol. XIV, 1989, pp. 419 - 447 at p. 419.

³ Space debris includes the fragments of the space objects and non-functional objects. See Vladimir Kopal, 'Issues Involved in Defining outer space, space object and space debris', *Proceedings of the Thirty-fourth Colloquium on Law of the Outer Space*, pp. 38 - 43 at pp. 41 - 43.

⁴ The Chinese anti-satellite weapon test conducted on 11 January 2007 is the largest space debris production incident in the history. The event created more than 1900 pieces of traceable debris of baseball size or more, over 35,000 pieces of 1cm or larger and over 1 million pieces of 1mm or larger debris. See

http://en.wikipedia.org/wiki/space_debris
(Accessed on 13 July 2007, 5:25 pm)

⁵ Robert C. Bird, 'Procedural Challenges to Environmental Regulation of Space Debris', *American Business Law Journal*, Vol. 40, Spring 2003 (www.westlaw.com)

⁶ A debris as small as 1cm in diameter has enough kinetic energy to disable a medium-sized spacecraft.

http://www.windows.ucar.edu/tour/link=/headline_universe/space_debris_update.html&edu=high
(Accessed on 13 July 2007, 5:28 pm)

⁷ In 1978, Soviet Satellite Cosmos 954 fell on Canada's Northwest Territory.

⁸ Carl Q. Christol, 'Protection of the Space Environment - Debris and Power Sources', in Chia-Jui Cheng (ed.) *The Use of Airspace and Outer Space for All Mankind in the 21st Century*, (The Hague, London, Boston: Kluwer Law International, 1995) pp. 253 - 274 at p. 260.

⁹ John A. Johnson, 'Pollution and Contamination in Space', Maxwell Cohen (ed.), *Law and Politics in Space*, (United Kingdom: Leicester University Press, 1964) pp. 37 - 53 at p. 45.

¹⁰ The phenomenon is referred to as forward contamination.

¹¹ Popularly known as back contamination.

¹² As quoted in Juan Manuel de Faraminan Gilbert, 'Space Debris: Technical and Legal Aspects', in Gabriel Lafferranderie and Daphne Crowther (ed.), *Outlook on Space Law Over the Next 30 Years*, (Hague, London, Boston: Kluwer Law International, 1997) pp. 305 - 318 at p. 306.

¹³ *Supra* note 4.

¹⁴ *Ibid.*

¹⁵ *Supra* note 5.

¹⁶ Sustainable development strikes a balance between the rights of present and the future generations by allowing the present generation to utilize the resources to the maximum extent, without affecting the rights of future generations over such resources.

¹⁷ Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space Including the Moon and Other Celestial Bodies, 1967.

¹⁸ State responsibility arises only in case of breach of an international legal obligation resulting in injury. See Katherine M. Gorove, 'International Responsibility for Endangering the "Space Commons": Focus on a Hypothetical Case', *Proceeding of Thirty-third Colloquium on Law of the Outer Space*, 1990, pp. 297 - 304 at pp. 298 & 299.

¹⁹ Agreement Governing the Activities of the States on the Moon and Other Celestial Bodies, 1979.

²⁰ Only 11 states have signed and ratified the Moon Agreement. 5 others have signed but not ratified.

²¹ *Supra* note 2, p. 431.

²² Convention on International Liability for Damage Caused by Space Objects, 1972.

²³ Article II of the Liability Convention.

²⁴ Article III of the Liability Convention.

²⁵ Article I (a) of the Liability Convention.

²⁶ Article I of the Outer Space Treaty.

²⁷ Article I (d): The term 'space object' includes component parts of a space object as well as its launch vehicle and parts thereof.

²⁸ Pirre M. Martin, Liability Issues on Space Debris: The Opinion of a Teacher in International Law', *Proceedings of the Thirty-sixth Colloquium on Law of the Outer Space*, 1993, pp. 405 - 414 at p. 408.

²⁹ Exploration of the resources to the maximum level while maintaining a sufficient basis of resources for the future use.