SPACE DEBRIS AS AN ENVIRONMENTAL POLLUTANT: CONCEPTUALISING RAMIFICATIONS AND SOLUTIONS

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This is a two-part blog. The authors discuss the ramifications of space debris as an environmental pollutant in the first part. The second part discusses the international legal framework with recommendations.

Key Words: Cosmos 2251 – Iridium 33 – Liability Convention – Space station – Stray satellites

Part I: Ramifications of Space Debris as an Environmental Pollutant

Introduction

From the failed launch of the Thor-Ablestar that got dismantled over Cuba and ended up butchering the famous cow "Ruhina" to the relatively recent crash of a Chinese March 3B rocket Booster which crashed into a village, spreading toxic fumes and destroying homes, accidents caused by falling space debris are in abundance. These unfortunate events are not rare occurrences. In May 2020, debris from a Chinese Rocket's failed re-entry fell into villages on the Ivory Coast. More recently, in July 2022, debris crashed into the Indian Ocean. Though the exact repercussions of the crash are yet to be quantified, subsequent pieces of said debris were found dangerously close to villages in Borneo. With over 630 explosions, collisions, and other unplanned events since 1957, more than 100 million objects have been categorised as space debris that can cause serious unforeseen damage.

The UN Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space has set the first internationally accepted definition of space debris as "all man-made objects, including fragments and elements thereof, in Earth orbit or re-entering the atmosphere, that are non-functional". Johnson argues that the definition also encompasses leaking fuel and coolant droplets since they can be extremely dangerous at such high speeds. We face a plethora of legal and social problems when it comes to space debris management. The lack of a universally agreed upon definition of environmental pollutant makes it difficult to classify which forms of space debris could be classified as a pollutant. The fact that we have not yet formed cohesive jurisprudence on debris management adds to the problem. As of now, a majority of the debris management task is left upon the Earth's atmosphere, which naturally pulls orbiting debris downward and incinerates it into the thicker lower atmosphere. However, increasing carbon dioxide levels are lowering the density of the upper atmosphere, which may diminish this effect, creating an increased need for human intervention in space debris management.

Ramifications of Space Debris on the environment

With an increasing quest for scientific breakthroughs, nations across the globe are constantly competing. Space research is one such area that attracts both developed and developing countries. Unlike earlier times, space research is being commercialised, and according to the Global Risks Report published in 2022, this has created crowding and competition in space. For comparison, one could understand the Low Earth Orbit ('LEO') as a market space and the satellites (communication, expeditionary or otherwise) as the product choices available for consumer consumption. Here, consumer consumption could be equated with the benefits satellites provide, such as communication, television and broadcasting, and weather prediction. The more satellites a country launches, its control over the space market grows stronger. With an increasing number of developing countries launching satellites successfully, developed countries have also resorted to competitive multi-satellite launches. With more than one satellite being launched at one time, the LEO is now heavily crowded. Many of these satellites fail to return to the Earth's surface and stray in the LEO or the orbit and enter the non-LEO zones. In both cases, satellites are contaminants in space. The United States Space Surveillance Network has tracked more than 15,000 pieces of space debris measuring larger than 10 cm and 20,00,000 pieces measuring between 1 and 10 cm. As of 2021, they estimate a potential presence of a million debris pieces lesser than 1 cm in size. The Department of Defence's Space Surveillance Network has tracked 27,000 particles of "spacejunk" till 2022.

A 1 cm object can penetrate the pressurised crew module of a space station, kill the crew and cause the station to break up, pierce the window of a craft, and disable or destroy a satellite. In contrast, 0.5 mm fragment can puncture a suit and kill an astronaut. Given the threats such space debris particles pose, it is important to determine the scope and extent of the launching state's liability. This is particularly important when such objects contribute to pollution in both space and Earth's atmosphere. For instance, when the Russian navigation satellite Cosmos1934 collided with debris from another Russian rocket body, both objects belonged to the same state. The impact of the collision was such that it created thousands of new debris pieces in space. These debris pieces pose a potential collision threat to future objects launched by Russia as well as other countries. In this case, since the satellite that was destroyed and the object that caused its destruction belonged to the same country, the question of liability and compensation was in the backseat. In 2009, a US-owned satellite Iridium-33 collided with a defunct Russian military satellite, Cosmos 2251. This collision resulted in hundreds of pieces of larger, traceable debris and is considered the worst satellite breakup, the effects of which continue to be felt. Situations like this demand determination of liability of the launching state for harm sustained by space objects of other states. Internationally, this is governed by the Convention on International Liability for Damage Caused by Space Objects 1971 (Liability Convention).

Article II of the Liability Convention recognises an absolute liability of the launching state to pay compensation for the "damage caused by its space object on the surface of the earth or to aircraft flight." However, the Convention is silent on the liability of the launching state when it's space object damage another *natural* space object, with resultant debris particles causing potential threats in both outer space and Earth's atmosphere. The

authors suggest that besides requiring one state to compensate the other, there should also be a determination of state responsibility and consequential liability for creating pollution. Closely investigating the reasons for such collisions would be helpful in concluding the proportion of each state's contribution and resultant liability to clean up such pollution.

Article III of the Liability Convention stipulates liability determination on the basis of fault when the damage is caused by space object of one launching state to a space object of another launching State elsewhere than on the surface of the Earth or, to persons or property on board such a space object. However, it is important to note that the Convention does not clarify whether space debris pollution would be considered a *fault* in space for the purpose of liability determination. Moreover, the liability for damage is confined to space objects and person or property of other States. The consequential damage to outer space environment due to collision of space objects is not addressed under this provision.

In the absence of liability for abandoning the satellites after they become defunct, the number of stray satellites is increasing. This leads to an increased risk of their collision with active satellites, other stray satellites as well as natural space objects. Such collisions contribute not only to pollution in terms of emissions but also in terms of light pollution. Intense light is emitted by such collisions that would not have happened but for the stray satellites. This causes hindrances for scientists who are observing space from the Earth.

Besides being a space contaminant, a stray satellite also acts as a creator of more such contaminants. Stray satellites without any way to steer onto a steadier orbital path have an increased chance of careening into other orbiting objects, be it another satellite or a piece of debris. This catalyses the cycle of debris generation. Furthermore, the remains of such objects, after a collision, might get accumulated in the lower space sphere, with the possibility of their escape into the upper atmosphere, resulting in reduced capacity of the upper atmosphere to absorb the harmful solar radiations. From a commercial perspective, such continued competitive launching by countries would result in a potential monopoly on the LEO, which would severely hamper the continuation of scientific research for the sole purpose of benefit of humankind.

In summary, even though space debris has not been recognized as an environmental pollutant, its interaction with other objects could potentially lead to pollution in outer space as well as on the Earth surface. Therefore, it is important to have a legal regulation in place in this regard. In the next part, the authors will critically analyses the existing legal frameworks on outer space while presenting recommendations to reduce the impact of space debris pollution.

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