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SPACE SUSTAINABILITY AND WHY IT MATTERS

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ABSTRACT

In order to preserve critical space-based services and economic opportunities for current and future generations, we need internationally fair, scientifically appropriate, and commercially viable environmental oversight to secure future options in space, reduce costs, reassure investors, and sustain development.

AUTHOR

Jessica Wahl is a senior in Georgetown University's Science, Technology and International Affairs program. Her thesis research explores planetary protection and how scientists involved in the search for life beyond Earth balance competing scientific, ethical, social, and institutional factors in their astrobiology research. She is interested in combining her passions for environmental sustainability and space exploration.

*This piece was originally intended as a lengthy but informal blog post introducing the concept of sustainability in space; please excuse the lack of footnotes. The sources used are hyperlinked throughout the text and are listed at the end of the paper.

INTRODUCTION

As emerging technologies lower financial barriers to space access and expand the range of feasible activities, a growing number of nations and private companies are planning near-future enterprises in orbit and beyond. These activities range from mining asteroids, the Moon and other celestial bodies, to developing communications and energy infrastructure, to tourism and military applications, to searching for extraterrestrial life.

But the space policy and law communities are not adequately assessing or regulating the potential environmental impacts of these endeavors. As George Profitiliotis writes, "the current regulation of lunar activities, indeed all the environmental provisions of international space law, has been extensively criticized, in all respects, as being inadequate." Ehrenfreund, Race, and Labdon likewise observed in 2013 that "there are no widely accepted agreements about commercial exploitation or use of resources on the Moon, Mars, asteroids, or other celestial bodies, and no environmental management framework."

WHY SPACE SUSTAINABILITY?

Should we be concerned about this? I would argue that we should. We have seen the result of environmental negligence in the high concentration of space debris jeopardizing our use of Earth orbit, which we depend on for everything from communication and navigation to climate science, medical technologies and security. But environmental concerns extend beyond LEO and GEO and the forward and backward contamination that planetary protection policies seek to prevent. For example, Ehrenfreund et al. (2013) write that:

> "An NRC report on the scientific exploration of the Moon argues that human lunar exploration that encompasses landings, lift-offs, and extravehicular activity (EVA) will inject tons of non-native gas into the atmosphere and transform the Moon's pristine environment. Environmental disturbances and destruction from dust raising, seismic disturbance, site destruction, electromagnetic interference, and radioactive and biological contamination have been evaluated as well."

Irresponsible exploration could preclude scientific study (e.g., in the case of biological contamination), limit access to resources, decrease safety, and increase the costs and inefficiencies of space ventures for current and future generations.

This should come as no surprise; these are just some of the same results we see from negative environmental impacts on our home planet. Especially as the United States and Luxembourg have legalized ownership and exploitation of outer space resources and private involvement grows, these risks are increasingly urgent, and a handful of companies, such as HDR, Inc., are already looking to hire analysts to assess potential environmental impacts of space ventures. Furthermore, environmental consequences in space will likely be far more permanent than on Earth, where natural systems such as ice flow, tectonic movements and biogeochemical cycling make landscapes relatively resilient; more than fifty years after Apollo 11, footprints are still visible on the Moon, and are predicted to remain so for another 10-100 million years. Dr. William Kramer sums the situation up well: "Without formal analyses of extraterrestrial environmental impacts, space projects may produce the unintended consequences of environmental degradation, lost opportunity, and the inefficiencies experienced here on Earth."

SUSTAINABILITY AND EQUITY

A failure to effectively regulate our space environment could also negatively affect economic and social equity, as we have seen again and again with climate change and other terrestrial environmental issues. The 1967 Outer Space Treaty affirms "that the exploration and use of outer space should be carried on for the benefit of all peoples irrespective of the degree of their economic or scientific development." But just as the United States, China, and other wealthy, industrialized countries are driving sea level rise and other global environmental catastrophes through GHG emissions before many developing nations even have a chance to reap the benefits of industrialization (an imbalance that contributed to the Common But Differentiated Responsibilities climate framework), new space entrants and non-spacefaring nations may be especially impacted by a failure to preserve the space environment—and with it, space-based services and resources—even though they are *not* the ones responsible for polluting it.

For instance, there are a limited number of "spaces" in which to park a satellite in geostationary orbit. Although the International Telecommunications Union regulates orbit allocation in GEO, it is essentially on a first-come, first-serve basis, giving established spacefaring nations a huge advantage in an environment already cluttered by orbital debris of their making. Or, take the Israeli robotic lunar mission that crash-landed on the Moon in 2019, potentially contaminating it with thousands of tardigrades and even human DNA samples. For emerging nations such as Kenya,

which launched its first satellite in 2018 using the Japanese ISS module, opportunities in space may be constrained by the irresponsible behavior of their neighbors. The need for more equitable access has been recognized by the Space Applications Section of the United Nations Office for Outer Space Affairs and the UN Access to Space for All Initiative, which aim to bring the benefits of space technologies and applications to non-spacefaring and emerging spacefaring nations. But this objective will prove difficult without a robust and equitable environmental governance regime.

RESOURCE SCARCITY, ABUNDANCE, AND CONFLICT

I would guess that many people might find the notion of space sustainability slightly ridiculous; after all, the universe—or even our solar system, which is the part of it we can currently access—is immense. How could we "run out" of resources? How could we "use up" all that space? But we've heard these arguments time and again on Earth. Regulating the world's oceans, for example, was thought unnecessary until at least the 17th century, in part because marine resources seemed inexhaustible. But as technologies made previously unexploitable resources profitable, and as more nations gained access to the seas, those assurances melted away. Today, we have not only tremendously polluted the oceans and nearly exhausted many of their resources, but must also contend with international conflict over the seas. And although some people perceive space as an infinite resource, it does not bode well that within a few decades, we have already polluted, to our own detriment, the narrow ring of it we can access.

In any case, the overall quantity of resources is rarely the determining factor in peace and prosperity; here on Earth, we experience extremely unequal distribution of resources and even resource conflict in contexts of both scarcity and abundance. Consider food insecurity and hunger; millions starve even though we produce enough food to nourish 10 billion people. And in certain circumstances, abundance can even engender conflict and strife, for example by breeding predatory rentier states, stark inequalities, and scarcity itself. In fact, space displays multiple characteristics that have proved conducive to international resource conflict on Earth—most importantly: ill-defined to non-existent resource sovereignty and allocation, rapid technological and resource environment changes that outpace institutional capacity, and a rapidly increasing number of stakeholders. If Earth is any guide, then even for elements of space that are in abundance, how we manage and distribute those resources will be more important to equity and sustainability than the aggregate supply.

LOOKING AHEAD – WE CAN STILL TURN THINGS AROUND

While the proliferation of space actors poses challenges to cooperation and sustainable development, it also presents opportunities to embed responsibility in future space engagement; recent entrants are exploring new ways to enact regulations and laws that bolster national enterprises and engage new ventures. As Dr. Cassandra Steer has written, in the political space race, "there are more opportunities for positive disruption as the number (and type) of entrants into the space sector continues to increase."

Finally, I would argue that in order to create an effective environmental space regime, we would do well to encourage more professionals with environmental expertise to enter the space law and policy community. Currently, space policy experts and space lawyers tend to have backgrounds in fields such as security, international law and physical sciences. Only a very small handful have studied and worked in disciplines like environmental and energy policy, environment and development, environmental law and even wildlife biology—and this in spite of the fact that frameworks for regulating various global commons, such as the United Nations Convention on the Law of the Sea and the Antarctic Treaty System, are frequently cited as potential (though imperfect) models for an environmental space regime. We need to elevate and incorporate environmental perspectives in space governance. For insights on other next steps, please read here.

CONCLUSION

We have an opportunity right now to rethink how prosperity, sustainability, and security can coexist before vested interests entrench disadvantageous policies and precedents. It is still possible to demonstrate that humankind has learned from the catastrophic environmental degradation that threatens our own planet, and to reshape our future on and beyond Earth for the better. Looking ahead, we need to manage the risks of space engagement without stifling social benefits and scientific research—and to anticipate the impacts of commercial and other activities. Bringing environmental expertise into the space community and creating a thoughtful and fair environmental governance regime will be crucial to preventing irresponsible behavior and resource conflict in space and more evenly distributing the benefits of space exploration on Earth.

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