International Journal of the Commons

Governing Outer Space as a Commons is Critical for Addressing Commons on Earth

COMMONS IN SPACE (GUEST EDITORS: M. JANSSEN AND XIAO SHAN YAP)

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ABSTRACT

Editorial for the special issue on “Commons in Space”.

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KEYWORDS:
Space governance; global commons; sustainability transition

TO CITE THIS ARTICLE:
Janssen, M. A., & Yap, X.-S. (2024). Governing Outer Space as a Commons is Critical for Addressing Commons on Earth. *International Journal of the Commons*, 18(1), pp. 32–38. DOI: https://doi.org/10.5334/ijc.1378

1. INTRODUCTION

In recent years, the space sector has experienced rapid development with increased participation of private actors and technological innovations – a phenomenon often referred to as 'New Space' (Paikowsky, 2017; Robinson and Mazzucato, 2019). The reduction of costs in space activities, especially satellite launching, provides new opportunities for a broader range of actors in particular private and commercial actors. Unfortunately, the arguably weak global space governance has led to an unregulated growth of the space industry that negatively impacts the environment and the global society in various negative ways. More importantly, the development of space activities has become increasingly intertwined with sustainability challenges on Earth (Galli and Losch, 2019), and scholars have recently called for addressing 'earth-space sustainability' in an integrative way (Yap and Truffer, 2022; Yap and Kim, 2023). Modern society can no longer dissociate from uses of space, as they increasingly depend on space-based infrastructures for communication, Earth observation, and navigation services (Georgescu et al., 2018). In our daily lives, we use global navigation systems to navigate traffic, get information transmitted from the other side of the world via satellites, derive weather predictions, and enhance our security via monitoring from space. The use of space infrastructures furthermore becomes increasingly prevalent in the context of the conservation of traditional commons, especially in monitoring human activities and environmental change (e.g. Hamman (2019), Slough et al. (2021) and Taloor et al. (2022)).

The rapid expansion of human activities in space and the growing interest in using space resources for purposes on Earth raises new scientific, policy, and governance challenges. In particular, new conceptual and methodological tools are required to unpack the growing complexities of uses in space and the associated environmental and social implications. A critical departure point is to more clearly conceptualize the current expansion of space activities as a development trend that involves the whole of humanity, either due to the capability of some to alter the future of global equity or environmental sustainability on a planetary scale, or the incapability of some in preventing themselves from suffering the negative consequences. As such, the aim of this special issue is to advance the existing debates on the topic from the perspective of commons scholarship, which offers useful considerations for the mentioned challenge. In doing so, the special issue contributes to the emerging topic of 'earth-space sustainability', by focusing on how the governance of space commons interrelates with the sustainability of commons on Earth. It presents a series of articles that address a scope of prominent issues on the commons in space. In the following section, we elaborate on three major themes of commons in space and their conceptual challenges. Subsequently, we explain in section 3 how the manuscripts in this special issue contribute to addressing those challenges, including the tragedy of space debris, the extraction of minerals in outer space, and the impact of space activities on vulnerable populations. We will show that commons in space is a topic relevant to our governance of traditional commons on Earth and requires attention from our community of commons scholars.

2. CONCEPTUALIZING COMMONS IN SPACE

The 1967 Outer Space Treaty defines resources in outer space to be subject to ambiguous collective rights by referring to as "the exploration and use of outer space [...] shall be carried out for the benefit and in the interests of all countries [...] and shall be the province of all [hu] mankind" (Article 1). The provisions in international space treaties have increasingly become a matter of contention due to growing political and commercial interest in the exploration and exploitation of various space resources including orbital slots, radio frequencies, and minerals in space as mentioned above. In particular, politicians, policymakers, lawyers, and scientists debate about under which conditions the provisions in those treaties may subject outer space as 'global commons' (Goehring, 2021). Given the lack of specificity in international agreements, the basic question of who can appropriate outer space resources remains unresolved.

The term global commons is not well defined which leads to different interpretations in space law (Tepper, 2019; Goehring, 2021). Goehring (2021) refers to two different interpretations, namely as enabling and constraining concepts. The enabling concept basically sees global commons as open access not regulated by any nation or jurisdiction. Proponents of this interpretation of the commons therefore note that the Outer Space Treaty guarantees all States the right to use space and freely access celestial bodies. The constraining concept focuses on property rights and the commons as collective ownership. They refer to the use of "province of all mankind" in the Outer Space Treaty, as evidence of collective ownership. It might be problematic to use the term commons as collective ownership for such an immense scale as outer space. Moreover, the Outer Space Treaty prohibits ownership over space resources "in place" but does not prohibit ownership

by nations or private entities over resources that have been removed from their place on or below the surface of celestial bodies (Goehring, 2021).

In April 2020, President Trump signed an executive order declaring outer space not being a global commons and affirmed the right of commercial space mining. In September 2020, the U.S. National Aeronautics and Space Administration (NASA) announced the plan for bilateral Artemis Accords with countries supporting the U.S. interpretation of international space law, allowing for commercial exploitation of celestial bodies. At the time of writing this editorial more than 30 nations have signed the Artemis Accords. Basically, the Artemis Accord creates conditions for uncontrolled exploitations with negative consequences for a sustainable development of space exploration (Boley and Byers, 2020).

Whatever the interpretation of the commons, resources in outer space are highly contested. Our perspective of the commons in space is in line with the interpretation of the commons as a constraining concept. The question of who may have access to different uses of outer space is not resolved with the limited focus of the Artemis Accord. This is why looking at outer space from a commons scholars' perspective might provide some new insights into the governance of different types of shared resources in outer space.

There is increasing recognition that the expansion of space exploration is an extension of human colonization (Young, 1987; Milligan, 2023). Understanding outer space as a form of commons requires acknowledging indigenous knowledge about space and includes indigenous communities in space activities so that the expansion of human activities in space does not reinforce social injustice or exclusion. In fact, outer space has played an important role in human societies for thousands of years. Our knowledge of the stars assisted our navigation before satellites existed and the origin stories of many cultures around the world relate to space. In addition, the changing night sky with increasing light pollution as a result of more satellites will have an impact on humans and other organisms, especially nocturnal ones (Lintott and Lintott, 2020; Gaston et al., 2023). It may impact navigation, cultural, and astronomy activities (Venkatesan et al., 2020; Witze, 2020; Kocifaj et al., 2021). In response to these rising challenges, there have been active dark sky movements in recent years including the ones led by the International Dark Sky Association (2023), which aims to reduce the impact of satellites on the night sky. Conceptualizing outer space as a commons therefore requires embracing the diversity and pluralism of the global society as far as possible in terms of knowledge, cultural values, etc., as well as considerations for all life forms impacted by space activities.

Outer space resources are perceivable as common-pool resources, with an important example being the Earth's orbital space that hosts critical infrastructures for modern society across places on Earth. With lower entry barriers to rocket launching, there has been a rapid increase in space activities in low Earth orbit (LEO) with limited regulations. For example, the use of small satellites to create internet access via space has led SpaceX to deploy more than 10,000 satellites in a matter of a few years through its internet satellite project Starlink. These developments have caused increasing concerns among scientists, policymakers, and industry practitioners regarding the long-term sustainability of space infrastructures as a result of increasing space congestion and space debris (Krag, 2021). Space debris are man-made objects that do not serve a purpose but remain in LEO and furthermore accumulate over time from past and present space activities such as launches and collisions between existing space debris. These space debris can travel at an orbital speed of ~7.5 km/s, posing harm to other functioning satellites. There are currently more than a million objects between 1 and 10 cm in size (European Space Agency, 2023) and more than 36,000 objects of larger size in orbit, collisions of which can lead to major damage. The space debris problem can grow into a critical, uncontrollable problem if the Kessler syndrome (Kessler and Cour-Palais, 1978) takes place, which refers to the chain reactions of colliding objects leading to more debris and more colliding objects. The Earth's orbital space is thus recognizable as a type of commons for the global society, given that the self-propagating character of Kessler syndrome could prevent future generations from accessing space and thus limit their use of space infrastructures.

Different technological options have been proposed in recent years. In particular, active removal of space debris has been discussed as a potential solution for which prototypes have been developed and experimented with, but the option remains expensive and only suitable for high-risk space objects (Maclay and McKnight, 2021). A recent discourse network analysis points out that the effectiveness of these technological options remains to be seen, given that there is no global consensus on what the governance or regulatory framework should look like to facilitate the diffusion or industry uptake of such technologies (Yap et al., 2023a). Failure to address space debris in the future could therefore be seen as a typical illustration of the tragedy of space commons (Morin and Richard, 2021), as spacefaring actors continue to exploit the Earth's orbit even though they are confronted with major sustainability challenges with no practical solutions in sight.

Beyond the Earth's orbit, the exploration and exploitation of mineral resources in space could impact the use of mineral resources for sustainability transitions on Earth. In recent years, the global transition to a low-carbon economy has propagated a shift in industry and policy attention from the extraction of fossil fuel to one of a diverse set of about 30 minerals (Hund et al., 2020), such as lithium, aluminum, cobalt, copper, graphite, manganese, nickel, and platinum. To meet the global net zero emission target by 2050, technical experts predict that the production of those minerals will have to increase to multiple times the current levels. More than half of those mineral resource bases are located on or near the lands of Indigenous and peasant peoples causing disputes on access (Owen et al., 2023). The rapid increase in demand and the vulnerability of the mining locations therefore causes a gap between demand and supply (Haddad et al., 2023). Meanwhile, deep seabed mining has been argued as an alternative to land-based extraction but is also controversial due to potential environmental risks and the lack of regulatory frameworks in international waters (Kim, 2017; Levin et al., 2020). Subsequently, space mining has been argued as a solution given the commercially lucrative metals in asteroids such as cobalt, nickel, platinum, iron, nickel, rare earth elements, and precious metals (Deberdt and Le Billon, 2023). In recent years, spacefaring nations and private companies began exploring the possibility of extracting resources from the Moon and asteroids with the hope to transport them back to Earth (Moore et al., 2022; Yarlagadda, 2022). These developments have raised concerns in relation to benefit sharing for the global society, as there is no proper governance framework in place that mandates such practice (Jakhu et al., 2017; Butkeviciene and Rabitz, 2022). Overall, the rapid expansion of human activities in space brings about a variety of new governance issues, which warrants more research on addressing outer space as commons.

3. ADVANCING THE DEBATE WITH THIS SPECIAL ISSUE

This special issue brings together six contributions by twenty scholars from different disciplinary backgrounds with a mixture of research methods. Each of them contributes to the above-mentioned challenges by focusing on a specific theme or empirical scope. Nomura et al. (2023) in this special issue presents a simple dynamics model to study the conditions of a run-away Kessler syndrome and analyze the tradeoffs between actively removing space debris and reducing satellite launches. The authors found that space debris removal might be the more efficient way out if implemented within the next few decades 200 years compared to the latter. This points to the urgency for promoting international cooperation in defining an appropriate and feasible framework for enabling the uptake of technological options such as debris removal.

Contributing to the debate on space as 'global commons', Pic et al. (2023) analyzes 1,042 space arrangements on how that concept was addressed. The term global commons and related language were found to be rarely used especially in recent arrangements by major spacefaring actors, which might be a consequence of the drive to commercialize space resources. The authors concluded that approaching outer space as a global commons remains a project to be continuously constructed and institutionalized. Meanwhile, Rabitz (2023) discusses the potential formation of multilateral regimes for space resources and articulates why the prospects of just, effective, and efficient solutions are limited based on our current knowledge of governance of global commons. These articles demonstrate the need and urgency for international agreements for dealing with the rapid rise in satellite activities or before the mineral rush in space takes off.

Using an anthropological approach, Korpershoek (2023) in this special issue discusses Earth-based space infrastructures by focusing on the case of Europe's spaceport located at Kourou, French Guiana. Earth-based space infrastructures such as launch sites and ground-based telescopes are often located in remote areas but entangled with Indigenous land. Governing outer space as global commons therefore has to consider governance of related space infrastructures grounded on Earth. In addition, as Tabas (2023) discusses in this special issue, outer space is not science fiction but has been part of our lives since the dawn of history with impact on our culture, religion, and identity. In particular, he elaborates on the concepts of terrestrial bias and the nightscape, and how the two shape the ways in which we may associate with outer space commons especially through the use of ordinary language.

Finally, the dramatic changes in space exploration and exploitation following New Space leads to various questions about how we govern those activities. Given their potential impact on a planetary scale, future earth-space sustainability becomes highly uncertain. Using a commons perspective, Yap et al. (2023b) in this special issue explore four alternative scenarios of how environmental and social challenges in space may interrelate with the challenges on Earth in the next 50–100 years. Would intense competition for space resources among the rich and powerful lead to a tragedy of the space commons (such as the uncontrolled

growth of space debris) and hinder human access to space in the future? Or, would thoughtful space activities facilitate the whole of humanity to transition to an environmentally sustainable and socially just future on planet Earth?

4. CONCLUSION

The rapidly increasing activities in space are not just a topic for engineering and business considerations. Whether and how we use outer space, and the distribution of the benefits generated from space activities and infrastructures, will impact the whole of humanity. Moving forward, it would be important for studies on the commons in space to provide a more nuanced understanding of the different types of shared resources in space, their governance regimes, and how they impact shared resources on Earth. More robust methodologies are also required to better anticipate challenges in the future, including modeling tools, discourse analysis, and scenario-building approaches. Furthermore, as illustrated through this special issue, addressing earth-space sustainability requires broadening the analytical scope to include equity for vulnerable populations in particular indigenous peoples, as well as the protection of knowledge, cultural values, and astronomical activities. As showcased in this special issue, the application of the commons concept to addressing challenges arising from space activities facilitates such an expansion.

With this special issue on commons in space we hope to have provided an overview of the current discourse on the governance of shared resources in a domain that may appear unconventional or even exotic to many. However, the governance challenges in space are critical for the successful governance of shared resources or commons on Earth, be it in terms of resources needed for energy transition, ground-based infrastructures, atmospheric monitoring, or access to dark skies. As such, it will be important to have more commons scholars involved in this domain of investigation.

FUNDING INFORMATION

This work has been supported by the United States National Science Foundation under Grant award 2049553.

COMPETING INTERESTS

The authors have no competing interests to declare.

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TO CITE THIS ARTICLE:
Janssen, M. A., & Yap, X.-S. (2024). Governing Outer Space as a Commons is Critical for Addressing Commons on Earth. *International Journal of the Commons*, 18(1), pp. 32–38. DOI: https://doi.org/10.5334/ijc.1378

Submitted: 04 January 2024 **Accepted:** 04 January 2024 **Published:** 18 January 2024