

OUTER SPACE TREATY REFORM AND THE LONG-TERM SUSTAINABILITY OF SPACE EXPLORATION**

Abstract. *The challenge of ensuring the space environment's long-term sustainability in the context of the exploration and commercialisation of outer space raises several important issues and dimensions with respect to both international environmental law and sustainable development. The research question analyses the extent to which such exploration benefits humanity and expands the province of all humankind. In this article, historical achievements of the international legal framework governing the area of space exploration are presented. Opportunities for further developing and strengthening this framework to ensure the cooperative, transparent, inclusive and equitable development of space exploration are deliberated, notably those that do not limit the interests and opportunities of space-faring countries. The key finding and proposition of this article is that while discussing the need to improve and strengthen the international regulatory framework, developing countries' needs and interests should also be effectively incorporated. More equitable, inclusive and sustainable development is as much in the interest of developed countries as it is of developing countries.*

Keywords: *The Outer Space Treaty, space law, UNCOPUOS, space commercialisation, Sustainable Development Goals, inclusive and balanced development, international environmental law*

Introduction

The challenge of ensuring the space environment's long-term sustainability in the context of its exploration and commercialisation raises several important issues and dimensions from the perspectives of both international environmental law and sustainable development.

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These international legal challenges and issues could become overshadowed by the heightened geopolitical competition, which today increasingly encompasses competition in outer space (Broad, 2021). As established by the Outer Space Treaty, adopted in 1967¹, and the Moon Treaty, a UN multilateral agreement negotiated in the 1970s, the exploration and use of outer space is to be carried out for the benefit and in the interests of all countries and to be the province of all humankind. States should avoid the harmful contamination of space and celestial bodies (Tronchetti, 2017: 791).

Support for the commercialisation of outer space as part of the near-future expansion of space exploration should not become a goal in itself. This would replicate a similar strategic confusion seen with the liberalisation of international trade in the past few decades as a goal in itself. Today, we understand much better that the real goal of international trade and economic integration should be to facilitate more equitable, sustainable and inclusive international development. To overcome the WTO impasse and avoid further populist backlash against free trade even from some of the world's leading economies, an institutional and policy reimagining on the national and international level is necessary.

The reconceptualising of development policies should be a priority in all domains of international law, from trade, finance and the environment to fishing and outer space exploration. The most difficult part of such efforts is not reimagining instruments, tools and policies within the reformed regulatory framework on the international and the national levels. Instead, the most difficult part is ensuring that the leading global actors recognise and are aware that such reconceptualisation involves a Pareto-efficient approach which serves the true interests of humanity. It does not jeopardise the legitimate goals, interests and strategies of the major powers. Such opportunities are extended to other parts of the world currently excluded from the benefits of global developments.

A discouraging example is the most recent experience with the lack of universal access to the COVID-19 vaccine, with the leading countries having mostly succumbed to vaccine nationalism despite the strong international public interest and scientific evidence that only sufficient global inoculation can stem the pandemic. Not only may this situation further deepen inequalities between the global North and global South, but it might also prolong and complicate the pandemic containment efforts. The lack of global coordination of the production, distribution and access to vaccines mirrors the

¹ *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (usually referred to as the Outer Space Treaty or OST), ratified in Slovenia, Zakon o ratifikaciji Pogodbe o načelih, ki urejajo dejavnosti držav pri raziskovanju in uporabi vesolja, vključno z Luno in drugimi nebesnimi telesi (MPRUV), Official Journal of the Republic of Slovenia, no. 1/2019.*

absence of global leadership and short-sighted and narrow interests of the leading international powers, together with weakness of many international organisations and international programmes, such as the Covax programme.

The experience with the global commitments to the Paris Agreement on Climate Change is similar. Rich countries, that for many decades were also the largest contributors of global emissions, have committed themselves to allocating funding to the developing countries to ensure their transition from fossil fuels. The funding for such support should be around EUR 100 billion. Yet, 10 years later, the rich countries have not stood behind their pledges, thereby leaving the developing countries to their own devices (Hook, 2021). Moreover, although most developing countries have only been negligibly responsible for global emissions, many developing countries are the most exposed to extremes of weather like disastrous droughts, floods, and land erosion. This is seeing both global inequalities and structural inequities growing, instead of a globally sustainable, inclusive and diverse framework for overall development being secured.

Fortunately, there are several encouraging good practice examples and a more inclusive regulatory framework. These examples include sharing information about deforestation of the Amazon rainforest to develop more sustainable policies; information about land erosion along the rivers in Bangladesh to develop safer housing policies; and enabling access to telecommunication via satellites. The opportunities to apply space exploration and technologies to the developing countries' agricultural, environmental, health, educational and other policies are practically limitless, as a recent UNCTAD study shows (2021).

Opportunities exist on both the global level and level of various forms of regional cooperation. For example, according to an UNCTAD study, Brazil has signed an agreement with the European Union on the Copernicus programme that gives Brazil access to images to help monitor fragile eco-systems, tropical forests, and spills in the ocean and other areas. Another example is a UN Office for Outer Space Affairs' memorandum of understanding with the National Space Administration of China, which enables the provision of imagery for disaster management, monitoring the effect of climate change, and supporting efforts to attain the Sustainable Development Goals (SDGs). In 2018, for instance, NASA shared data from its satellites for forecasting cholera in Yemen, which worked with an accuracy rate of 92%. Thanks to space data and tools, future health and development workers may be both more efficient and effective in their campaigns against disease outbreaks (UNCTAD, 2021: 4).

The process of space commercialisation could become another example of the global race to the bottom because certain privileged companies and individuals can benefit from the vast public investments, research, and

development of technologies (Mance, 2021). In contrast, the creation of stricter, coherent and transparent international legal governance tailored to the needs of humanity, sustainable development and global public goods in the new era of space exploration and commercialisation could lead to development that would benefit all.

Leaving aside that relatively few countries have ratified the Moon Treaty (just 18 countries) and that space exploration has accelerated in recent decades in only a small number of leading countries, including the participation of a handful of non-state actors, one research question for discussion should concern the extent to which these explorations benefit humanity and expand the province of mankind. In this sense, the discussion is a continuation of the challenges in providing a general framework for improved responsibility for sustained legal and environmental protection beyond national jurisdictions. Governing common spaces requires that international cooperation be strengthened (Crawford, 2019: 331–335). The ethics and politics of space should go hand in hand with the common vision of inclusive global developments. The most recent experience concerning the access to, production and distribution of vaccines against COVID-19 shows that such a common international vision is missing, while the international legal rules of patent protection have been prioritised over international public health needs.

More specifically, the research question for discussion should be oriented to the challenge of how to link space exploration with benefits for all of humankind.

A partial analogy arises from the arrangements for deep-sea mining within the regulatory framework developed by UNCLOS and the International Seabed Authority. It may offer an example of a more balanced approach where the interests and capabilities of leading countries and multinational companies are balanced against the interests of the entire international community on the premise of preserving the province of all humankind. Perhaps this is not an ideal example, but it is at least an attempt to protect global public goods without hindering the legitimate interests of advanced countries and their multinational companies.

On the other hand, “asymmetries of information can adversely affect different market actors, if shared unequally, in which case some users of satellite data can exploit fish reserves or negotiate unfair mining contracts” (UNCTAD, 2021: 12).

In this context, the space environment’s long-term sustainability is simply a further dimension of unresolved issues in providing a more inclusive, sustainable, participatory and experimental international legal framework that will serve the needs of all humankind and beyond the global tragedy of the commons.

Like in other areas of international environmental law, the conceptual and normative arguments should go beyond the usual calls for international solidarity, responsibility, accountability and transparency. International scholarship should strive to espouse an institutional reimagining of inclusive and sustainable development that embraces the legitimate needs, concerns and interests of developed and developing countries, existing and aspiring global superpowers, elites, technocrats and of ordinary men and women from around the world.

This article proceeds in the following way: in the next section, the technological possibilities of space exploration and commercialisation are briefly discussed. A section follows on the existing legal framework, highlighting the need to clarify, strengthen and improve the framework to secure inclusive and sustainable development. The next section considers the need to advance international cooperation in space exploration in a way that fully embraces the Sustainable Development Goals. Concluding remarks are then presented with respect to where and in which ways the activities of the UN Committee on the Peaceful Uses of Outer Space (UNCOPOUS) should develop.

The normative premise for the discussion assumes that the ethics and politics of space for the Anthropocene can acquire the form of meaningful multilateral cooperation that will benefit all without undercutting the legitimate interests of the main actors and stakeholders in space exploration (Valtonen et al., 2020). As shown by Elain Ostrom, there is always more than one way possible to develop a framework to govern the commons and overcome the collective action problem (Ostrom, 2009). A commitment by every participant to the cooperative strategy can be equally a plausible outcome as the alternative fragmentation/privatisation of the common space. Similar to climate change, only the cooperation of all participants can lead to meaningful and structural improvements for all stakeholders.

A new era of space exploration and commercialisation

It is clear that a new era of the exploration and potential commercialisation of space is emerging fast (Weinzierl and Sarang, 2021). New actors from both public and private spheres have been launching various attempts and experiments in different orbital layers. Private sector initiatives have benefitted and developed on the basis of public investments, developments, support and in some cases also direct cooperation.

In so doing, it is vital that a new race to the bottom does not occur whereby private actors become ever more skillful at privatising the public benefits and socialising the private risks. We saw this development pattern in many other domains of international law, like in the area of environmental

protection with weak enforceability against the leading polluters; in the area of the international taxation of multinational companies; in the area of sharing protected intellectual property; and in the area of global public health.

Space exploration, the advancement of basic science, telecommunications, the gathering and dissemination of relevant information about the earth's patterns of weather, environment and other crucial information all belong to the important progress of human activities in outer space. The extent to which complementarity exists between public and private interests in space exploration seems unclear. There are two main ways of exploring space. By far the most dominant way is space-for-earth exploration, still, the recent rapidly emerging way is space-to-space exploration. Both approaches to exploration are becoming increasingly commercialised. Space-for-earth exploration includes telecommunications, Internet infrastructure, earth observation, and national security. Revenues deriving from this type of space exploration are estimated at USD 366 billion according to a study mentioned in the Harvard Business Review (Weinzierl and Sarang, 2021). For the time being, space-for-earth revenues account for 95% of the space exploration sector. On the other hand, space-for-space exploration includes "goods and services produced in space for use in space, such as mining the Moon or asteroids for material with which to construct in-space habitats or supply refueling depots" (id.) It is the sector that has attracted considerable attention over the last decade, envisaging the developing of an economy in space and for space. NASA's approach has thereby shifted from "using cost-plus contracts to fixed-price contracts" to stimulating more risk and burden sharing with the private sector in the hope of future rewards from expanding the commercialisation of space (id.) A shift to a more risk-taking private sector in expectation of high future rewards is also characterised as the emergence of "New Space" development featuring the private sector's stronger involvement. It is reasonable to expect that many other countries around the world may follow suit.

More important achievements of "New Space" development over the last decade include several successes. The manufacturing of a wrench with the help of a 3D-printer on board the International Space Station is one - "in space, for space". High-quality fibre-optic cable manufactured in zero gravity for potential terrestrial customers is another (id.)

Axiom Space announced the "first full private commercial mission to space" in 2022 on board SpaceX with the aim to start "building and operating space infrastructure such as habitats, laboratories, and factories". Other corporations like Maxar Technologies plan to develop robotic construction and a variety of construction and repair tools as part of the future stages of the space economy (id.)

Not all experts and astute observers of "New Space" development believe

that such a “New Space” era should be endorsed and that the benefits flow for all humanity. Mariana Mazuccato, for example, is critical of this development. From the perspective of international law and otherwise, she is convinced that privileged extremely wealthy individuals are riding on the back of public investments without proper accountability. Her criticism builds on extensive research of the Apollo mission, namely “one of the riskiest public sector projects in the last 100 years and it involved a great deal of experimentation” (Mazuccato, 2021: 64). Many important institutional, structural and organisational differences on the national and international levels from the period of the Apollo mission through to the period of successful international cooperation in the International Space Station context need to be considered seriously before the “New Space” era takes off.

One of Mazzucato’s important insights is that the existing rules and enforceability of corporate social responsibility are too limited to guarantee proper levels of accountability, let alone benefit all of the stakeholders in the enterprise. Even the current corporate governance reforms, such as the adoption of environmental, social and governance guidelines (ESG), cannot secure structural changes without a broader redefinition of the interaction between governments, markets and businesses (Mazuccato, 2021: 24).

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There are other broader issues that deal with the challenges, opportunities and limitations of space commercialisation. The nature and character of corporate short-termism is only one important structural impediment. More important is understanding the role of the proactive public sector in stimulating and supporting market and business activities. The proactive role of the public sector should aim at delivering benefits and opportunities to all citizens and businesses and enhancing public goods by strengthening the economy and society’s overall capabilities. In the current setting, sometimes labelled as “winner-takes-all”, such a dissemination of new technologies, discoveries, benefits and opportunities is precluded by the many structural impediments in place. Unlike the Apollo-mission era, when not only the “technological, social, organizational and political innovations” were part of the entire enterprise, today we live in an era of strong hierarchical segmentation of markets and business. The gap between the advanced sectors of the economy with access to new technologies, finance, skills and capabilities, as well as all other necessary resources, and the rest of the stagnating economy and society is growing. The period of secular stagnation, with the public sector’s weak role in securing broadly based and inclusive development, might simply be expanded the “New Space” with the after-effect of only further deepening the divisions between advanced and backward spheres of the economy and society at large. Economic and social dualism of this nature characterises many developing countries and is increasingly characteristic of many developed countries.

Public and international support, including adequately regulated international space law, could decisively shape the future development of space exploration. Strategic cooperation between public and private sectors on the national and international levels could deepen opportunities for all stakeholders and disseminate benefits to them all. As emphasised by Mazzucato and other insightful scholars, markets, corporations and businesses, and the market economy itself are not the natural outcome of spontaneous economic development; they are the outcome of a deliberate regulatory design (Mazuccato, 2021: 55–56).

Therefore, national and international markets can be shaped and reshaped in substantially different ways. More markets for more people and their businesses would be a step toward more inclusive and sustainable socio-economic developments than we are witnessing at present. The “New Space” era should become an era of an inclusive knowledge economy for both developed and developing countries. It should spur the transformation of the work of modern economies and societies toward more innovative, sustainable and inclusive ways than we are currently witnessing in the developed and developing countries.

The challenges, opportunities and constraints of an inclusive knowledge economy assume the structural changes and institutional innovations that mirror the pioneering age of space exploration. They should be put in the context of other challenges humanity is facing: climate change, global public health protection, global inequalities, depletion of resources, and biodiversity. “New Space” exploration, if properly organised and supported, can greatly help address other common challenges faced by humanity. International law, international legal scholarship and international institutions can contribute considerably to strengthening and improving the existing international normative framework to ensure that “New Space” exploration genuinely benefits all of humanity.

International legal framework: the current state of development and opportunities for future sustainable development

Article I of The Outer Space Treaty (OST) of 1967 is clear and straightforward:

The exploration and use of outer space, including the moon and other celestial bodies, shall be carried out for the benefit and in the interest of all countries, irrespective of their degree of economic or scientific development, and shall be the province of all mankind.

Other key provisions of the OST are similarly clear. The moon and other celestial bodies cannot belong to a state but are for the benefit of the international community. There are provisions on international cooperation in the peaceful exploration and use of outer space. Others express international responsibility for national activities in outer space, whether such activities are carried out by governmental agencies or by non-governmental entities. Article 2 of the OST stipulates that “outer space, including the moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means”.

The OST was developed during a period when states were playing the chief role in space exploration (Isnardi, 2019; Mallick and Pillai, 2019; Doshi, 2016). Hence, the focus was directed at states’ role in space exploration. The virtue of the OST was a generally acceptable international legal framework for space exploration, allowing sufficient room for national legislation to build upon the commonly agreed international framework. Some OST provisions were abstract and held general meaning, allowing different countries to interpret particular provisions differently. However, so long as technological progress and the entry of private corporations did not occur too rapidly, these open-texture provisions were not a potential cause of international disagreement like we may witness in the near future. International legal expertise in space law has also developed along with technological progress, the increased interest in space exploration and the main international powers’ renewed strategies concerning space exploration.

The OST is one of five treaties that lay international legal foundations for space exploration. The others are the Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space (1968); the Convention on International Liability for Damage Caused by Space Objects (1972); the Convention on Registration of Objects Launched into Outer Space; and the Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (1979).

Especially the last treaty, the “Moon Agreement”, helps clarify some of the OST provisions. For example, paragraph 3 of Article 11 stipulates that

Neither the surface nor the subsurface of the moon, nor any part thereof or natural resources in place, shall become property of any State, international intergovernmental or non-governmental entity, national organization or non-governmental entity or of any natural person.

Other important provisions have further clarified and expanded the OST since 1967. However, the difficulty from an international law perspective is that only a few countries have ratified the “Moon Agreement”. According to the international database, just 18 countries have ratified the treaty. Despite

clarifying some important ambiguity from the OST and adding to the international legal infrastructure to facilitate space exploration, the Moon Agreement indicates current limitations in regulating this important area of international activities.

It is thus not surprising that, in absence of a global agreement on how to move forward in regulating, supervising and enforcing international space law, certain leading space-faring powers have opted to proceed unilaterally based on their own national legislation. The United States, for example, in 2015 adopted the US Commercial Space Launch Competitiveness Act that grants “space resource” and “asteroid resource” rights to US citizens: “A US citizen engaged in commercial recovery of an asteroid resource, or a space resource shall be entitled to any asteroid resource or space resource obtained”. American lawmakers are convinced that such a national legislative step will provide certainty for commercial space pioneers and strengthen the USA’s leading role in the space commercial sector (Mallick and Pillai, 2019).

Luxembourg followed suit and adopted similar legislation, which grants mining companies the “right to keep the plunder”, while going one step further. Specifically, the Luxembourg legislation does not require a company’s major shareholder to be based in the country (id.). Many other countries around the world, real space powers, prospective space powers, and countries with commercial interests without having developed real space programmes may adopt legislation that will suit their own (commercial) interests more than comply with the international norms of preserving and maintaining space as a province of all humankind.

It is not a purpose of this section to more deeply discuss the national legislation adopted in the absence of an international consensus on the future development of international space law. Some international legal scholars like Michael Listener are convinced that it is impossible to grant rights to someone to harvest resources without having ownership of those resources (Davies, 2016). Other space lawyers, such as Frans von der Dunk, argue that the loopholes in the international treaty rules enable countries to authorise companies to claim exclusive ownership over resources extracted (Mallick and Pillai, 2019).

The normative analysis in this section stems from the conviction that developing collective solutions to collective challenges and opportunities is preferable to the unilateral approaches taken by the space powers. This approach is not only advisable from the conceptual perspective, but could ultimately benefit the leading space powers themselves.

Space lawyer Joanne Gabrynowicz disagrees with the US lawmakers and contends that the US legislative approach is not a step in the right direction. She was the only space lawyer to testify during the congressional hearings.

The legislative act does not solve certain basic issues, such as the legality of mining under international law (Kelvey, 2014). Even if Congress provides a certain interpretation of the OST, other space powers may hold their own substantially different interpretation of the same treaty. Such an approach may bring geopolitical consequences and may encourage similar steps in other domains, like in the Arctic pole. Disagreements over space could trigger international disputes on earth. This is one reason she advocates an internationally agreed approach to any further space exploration.

Based on the premises of the OST, other experts disagree with the notion of needing to discuss and adopt a new layer of international agreements primarily due to the complexity, divergent opinions, and interests, as well as the potentially long time that might be needed to reach a new international consensus (id.) On the other hand, space exploration is so extensive and expensive that even billionaires cannot provide all of the money needed to facilitate future development, despite many promises and hopes of anticipated revenue. Better still, a transparent, well-regulated international approach in place would bring certainty and clarity for all participants and stakeholders, and a new opportunity for international cooperation and fair competition, notwithstanding the growing geopolitical tensions. An international approach of this nature might ultimately work better for the space powers, for the new actors, and for all of humanity.

In this section, we presented some of the OST's virtues across the several decades of its history and experience. A major weakness of the OST from today's perspective, however, is the lack of mechanisms to enforce its key provisions. Perhaps at the outset such a regulatory approach allowed for the OST to be generally accepted, but with rapid technological progress and the emergence of new actors new solutions are required from the international law standpoint.

The international body dealing with space exploration for the benefit of humanity was established by the General Assembly of the UN in 1959. The United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS) is a committee for advancing international cooperation, research, and legal and technical issues regarding outer space, with a view to encouraging national, regional and global space exploration efforts. In 2018, for example, UNCOPUOS became dedicated to the legal issues arising with the exploration of space resources (COPUOS, 2018). The deliberation is also continuing within the Hague Space Resources Working Group.

Many new legal proposals have been developed by these bodies, as well as by groups of space legal experts, to solve the existing legal issues in a collective way that will reach a new international consensus, strengthen the international legal framework and expand its enforceability to the new actors. One such proposal is to establish an international regime analogous

to the International Seabed Authority, which is responsible for organising, carrying out and controlling all activities on the seabed. Fiscal benefits derived from seabed mining must be shared among all State parties, while State parties must obtain authorisation before beginning resource exploitation (Mallick and Pillai, 2019; Škrk, 2016: 89). Another proposal deals with adopting an Additional Protocol to the OST to make UNCOPUOS not only a forum for discussion and exchange, but a body with its own enforcement and legal powers to adjudicate procedures for different categories of violations of space laws (Ishola et al., 2021). Potential solutions to force private actors to comply with space laws have also been contemplated (Isnardi, 2019).

This section does not intend to discuss in more detail a variety of legal proposals to strengthen the existing international legal infrastructure. The aim is to show that many valuable and elaborated proposals have been offered to build upon the OST and other existing international treaties to support and develop space exploration for the benefit of all stakeholders and all of humanity. Such an approach may show that international law can be enabling and not only a negative instrument. It can even decrease certain geopolitical tensions without harming the legitimate interests of various stakeholders. Partial solutions, such as the Artemis Accords or establishment of the Dubai's Courts of Space, might in the absence of a coherent international approach only further fragment space exploration without ensuring clear benefits for all mankind.

In so doing, the proposal of this article is to contemplate the possibility of effectively incorporating certain Sustainable Development Goals (SDGs) into the new layers of international space law. Such an effort would not merely strengthen international solidarity but increase opportunities for all. The SDGs are ultimately not an instrument of solidarity, but for facilitating more inclusive, sustainable and diverse global development that may benefit not only the developing but also the developed parts of the world. The reinforced international legal infrastructure for space exploration should become part of broader international legal, economic, social and political efforts to develop an international legal infrastructure conducive to more inclusive, equitable and sustainable global development than we have experienced in the last few decades.

Space exploration and the SDGs

Space exploration, including “New Space” commercialisation, should remain faithful to the original idea expounded in Article 1 of the OST, namely, to serve “the benefit and in the interests of all countries”. To put the stated commitment into operation, the strengthening of the international

space treaties should include specific commitments to implementing the SDGs by all stakeholders participating in space explorations in all stages of current and future progress.

A variety of possibilities exist to apply space science, technology and data for the realisation of the SDGs. A recent study by UNCTAD on space technologies and sustainable development deserves to be analysed at length to show the unexploited opportunities for disseminating the benefits for humanity in the context of the SDG commitments. Space technologies provide valuable information and data to facilitate high-quality policy decisions about the SDGs. Even some of the least developed countries in the world have launched their own satellites, such as Bangladesh and Bhutan (UNCTAD, 2021: 1).

Several of the most important areas of the application of space science and technology for the developing countries and implementation of the SDGs relate to food and agriculture, health applications, access to telecommunications, disaster risk reduction and humanitarian crises, natural resources and management, and poverty reduction. All of these areas are crucial for achieving or failing to achieve the SDGs. For example, in agriculture, accurate information about the soil, snow cover, drought and crop development can help improve agricultural innovation and precise agriculture as already practised by the most advanced countries in the world (UNCTAD, 2021: 2). In the health area, information and data provided by remote-sensing technologies can predict and monitor disease patterns, understand environmental triggers for the spread of diseases, predict risk areas, and define regions that require disease-control planning.

According to UNCTAD, public health services are a “prime example of a sector in which the use of satellite communication and remote sensing is vital” (UNCTAD, 2021: 4). In the introductory section, the outbreak and spread of cholera in Yemen is mentioned as an example. The campaigns against outbreaks of the disease can be made more efficient with the help of space technologies and international collaboration. During the COVID pandemic, there has been no need to emphasise the global importance of such use of science, technologies and international cooperation. On top of the value and importance of space science and technologies for public health in the developing countries, the use of space science to advance medical research that would be difficult to conduct in the terrestrial environment can add to medical treatment in diseases that very often affect people in the developed world, such as Parkinson’s disease and cancer (UNCTAD, 2021: 4).

Access to telecommunications by developing countries that have extensive rural areas and poorly developed network technologies is another important opportunity for the developing countries to reduce the

digital divide. The telecommunication satellite launched by Bangladesh is an attempt to improve access to network technologies, including the Internet in the near future, telemedicine, and distance learning facilities (UNCTAD, 2021: 4–5).

Space technologies, often integrated with other technologies for gathering information in sensitive local, regional and national sites, can help reduce disaster risks and humanitarian crises, while significantly expanding the ability to collect, analyse and disseminate relevant data. For example, volcano hazards, drought hazards, flooding, and other natural, technological and biological disasters can be monitored and analysed to provide critical information to public safety authorities (UNCTAD, 2021: 5–6).

Another important area of applying space technologies and space science concerns natural resources and environment management as a highly relevant and noteworthy area for monitoring and achieving the SDGs. Information relevant to agricultural production, fisheries, freshwater and forestry belong to some of the most important SDGs. The recent establishment of an early warning system to detect illegal deforestation in Brazil in cooperation with the local Brazilian authorities is as an example of opportunities for space technologies to help make development of the Amazon rainforest more sustainable (UNCTAD, 2021: 7).

Another interesting and potentially useful example is the use of space technologies to support education, especially the e-education initiatives. Even the mapping of sites of poverty and analysing and monitoring the spread of poverty can help public authorities prepare more adequate and more efficient measures that may help achieve the SDGs (UNCTAD, 2021: 8).

We have seen some concrete examples of how space technologies and space exploration can meaningfully benefit humanity, and which SDGs stand to win the most if proper collaboration among science, technologies, policymakers and citizens is effectively established. Some of the described space exploration activities are perhaps not initially commercially interesting, and some forms of application might never become commercially interesting, yet they can bring vast improvements to large parts of the world and populations.

Still, apart from disseminating the benefits of space technologies and space exploration, some important bottlenecks must be considered. The most important limitation is obviously the cost of participating in space exploration. It was a substantial burden on Bangladesh to launch its own telecommunication satellite. Also important, but perhaps less obvious, is the risk of space debris. Developing countries have again contributed very little to the already full array of debris that could hamper future progress in space exploration, but it could limit even more their own resource-demanding

attempts to join in space exploration. Lack of awareness and lack of education in space science and space technologies could impose another important structural impediment in developing countries' efforts to join in space exploration and to use its potential to secure more inclusive and sustainable development, including realisation of the SDGs and beyond (UNCTAD, 2021: 10–12; David, 2021).

Mariana Mazuccato is correct to point out that certain current global challenges, such as climate change, the transition toward a global and equitable new green deal, and implementation of the SDGs, require the globally coordinated and sustained efforts of all stakeholders across the world (Mazuccato, 2021: 109). They call for a comprehensive structural reimagining of the economy and society in terms of reshaping the markets, coordination between public and private sectors in participatory, experimental and innovative ways to enhance public and private capabilities, organisational improvements to secure the fair and equitable sharing of the risks and rewards among all stakeholders, and many other structural improvements. Structural improvements should be made on the local, regional, national and international levels. International law, including the regulation of outer space activities, is not a neutral tool, but creates distributive effects among several stakeholders. The biggest concern with all space law improvements should be to not exacerbate the inequalities between countries that already exist in the area of space exploration.

It is hoped that the working groups within UNCOPUS and in other settings, such as the Hague Space Resources Governance Working Group (HSRGGWG), comprising stakeholders from governments, business, academia and civil society, will be able to bring the OST closer to well-regulated, sustainable, inclusive and balanced space research exploration in the future. Early analysis of improvements to the existing regulatory framework, called the Building Blocks, reveal certain signs of encouragement, as analysed by the Hague Space Resources Governance Working Group (2019). The proposed guidelines seek to establish a balanced approach to the commercial incentives. They specifically recognise that “without proper governance, commercial incentives may lead to a number of problems, such as inequality among actors, overexploitation of resources, and environmental degradation” (Xu et Su, 2020: 2). Still, the risk remains that the guidelines are not sufficiently precise, leaving countries with an opportunity to lower the standards and begin a “race to the bottom” (id.: 2).

Risks are similar with other guidelines proposed, such as the guidelines dealing with property rights, resource rights, common benefit and interests, environmental protection, sustainable development and the sharing of monetary and non-monetary benefits (id.: 4). All of these regulated areas might establish a cooperative international framework or further exacerbate the

international divisions, depending on the exact details of individual guidelines, the mechanisms for implementation, and the overall commitment of all stakeholders to pursue space exploration as part of the province of all humankind.

From the perspective of developing countries and the accomplishment of the SDGs, an important milestone would be establishing an international fund to “support space resource capacity building for developing countries”, as suggested by Xu and Su (*id.*, 6). The importance of such funding would not only lie in providing necessary financial resources to the developing countries, but also in disseminating knowledge, technologies and know-how to the developing countries within the UNCOPUS framework. These vital elements are missing in other international legal frameworks, such as the framework of international trade and intellectual protection. Perhaps the reform of the OST gives an opportunity to bring the international legal rules and international legal regimes closer to a more sustainable and equitable framework that may serve the real needs of humanity without jeopardising the legitimate interests of the leading space-faring countries in the world.

Conclusion

In this article, we have seen the achievements of the current international legal framework in the area of space exploration and future opportunities for development, and discussed several possibilities and how to further develop and strengthen the international legal framework to ensure the cooperative, transparent, inclusive and equitable development of space exploration while preserving the interests and opportunities of the space-faring countries.

The key finding and proposition of this article is that, while discussing the need to improve and strengthen the international regulatory framework, the needs and interests of developing countries should be incorporated. This step would not be only consistent with Agenda 2030 and the efforts to implement the SDGs, but would ultimately also serve the interests of the developed countries. More equitable, inclusive and sustainable development is as much in the interest of the developed countries as it is of the developing countries. It will expand technological, economic and development opportunities not merely in the developing countries, but also in the developed parts of the world.

Proper reform of the international norms and institutions and the mechanisms for implementation could substantially help in achieving such equitable and sustainable development. The present article argues that by meaningfully and effectively incorporating the SDGs into the reform of the

OST, the reform could become a model for the reform of international legal regimes, most notably in the areas of trade and preserving global public goods.

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