Forum: General Assembly I

Issue: Developing frameworks for the safe and sustainable utilization of space resources for socioeconomic benefit by private and national space programs

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Introduction

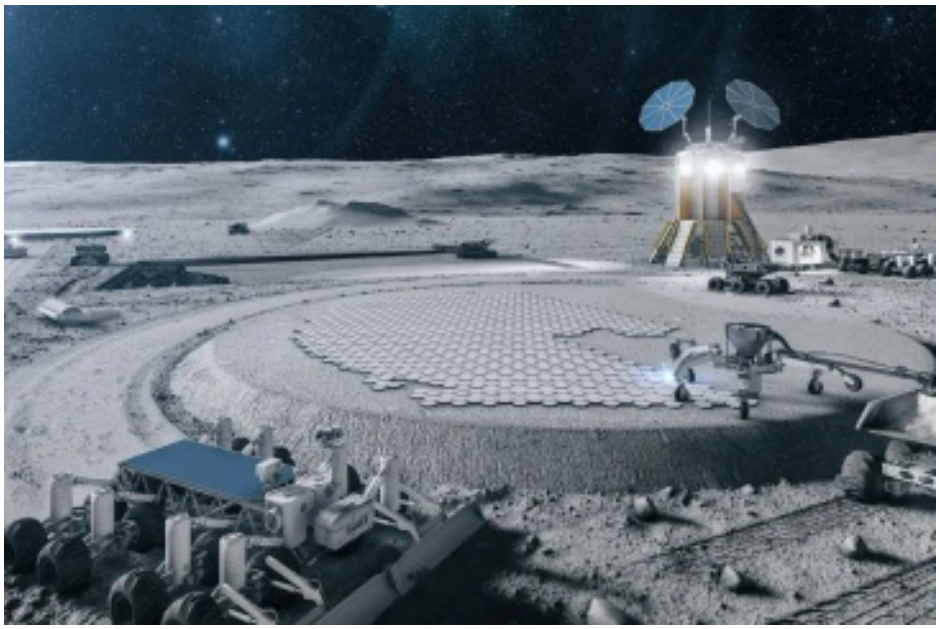

Image 1:Image of discarded pieces of rockets, satellite fragments, and debris(University of New Hamsphire)

The Moon, asteroid, and other celestial bodies hold enormous amounts of resources such as water, rare elements, and metals, which could reduce the burden on Earth. As global population numbers are expected to hit 9.7 billion in 2050, with the scarcity of the resoruces, which are the very basis of humanity, it cannot be considered only an opportunity bu a necessity for redemption.

The space economy is likely to reach $1 trillion by 2040, due to the private sector investments and numerous technological advancements. The extent of the growth supports the case for globally operative comprehensive frameworks that regulate the exploitation and use of these resources. If we do not have such frameworks in place, there is a risk of repeating the mistakes of terrestrial resources use, which included the environmental destruction and geopolitical complications. The United Nations office for Outer Space Affairs has pointed out the value of international partnerships to keep outer space a domain for peaceful exploration and development. However, the technology used for space resources extraction is imperative, which is also difficult. Existing missios, such as NASA's Artermis program, which aims to return humans to the Moon, will cause the enactment of future endeavors aimed at resources extraction. Space mining implementation, however, requires

dramatically improved technology, safety measures, and regulations that are highly developed so as to eliminate the hazards challenging the mining operations. These overlooked problems calls for further vigorous efforts to address the challenges of creating equitable, sustainable, and legally binding frameworks that balance economic ambitions with environmental protection and international cooperation. Without such efforts, the exploitation of space resources may lead to conflict, inequality, and irreversible damage to celestial ecosystems, mirroring the pitfalls of Earth's historical resource mismanagement.

Definition of Key Terms

In Situ Resource Utilization

The practice of extracting and using resources found in space, such as water, minerals, and gases, directly from their natural environment rather than transporting them from Earth.

International Spce Law

A body of laws governing the activities of states in outer space, ncluding treaties lie the Outer Space Treaty of 1967 tht establish pricniples for peaceful exploration and resource utilization.

Lunar Regolith

The layer of loose material covering the Moon’s surface, composed of dust and broken rocks, which can be processed for resources like oxygen and construction materials.

Planetary Protection

Policies and practices aimed at preventing contamination of celestial bodies by Earth organisms during exploration missions and protecting Earth’s biosphere from potential extraterrestrial contamination.

Space Debris

Non-functional spacecraft, spent rocket stages, and other fragments resulting from collisions or disintegration in orbit that pose risks to operational satellites and future missions.

Space Economy

The economic activities related to the development and utilization of space resources, including manufacturing, research, telecommunications, and tourism that contribute to global economic growth.

Space Governance

A framework of laws, policies, and guidelines that regulate activities in outer space to ensure peaceful exploration, sustainability, and equitable access to resources.

Sustainable Space Exploration

The approach to space missions that prioritizes environmental protection, resource conservation, and the long-term viability of extraterrestrial environents while maximizing socioeconomic benefits.

Background

The Outer Space Treaty (1967)

The Outer Space Treaty, formally known as the *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies,* was established in 1967

amidst escalation of Cold War tensions. Cureently, this treaty acts as a significant element of international space law, which is directed at regulating the use of outer space for peaceful purposes by maintaining the principle of non-militarization of space. Drafted mainly by the United States, Soviet Union, and United Kingdom, which are the three superpowers, the treaty was a response to the concerns about the potential for nuclear weapons being deployed in outer space. This treaty was also created during the time of the Space Race, when the two superpowers not only fought for whom had the better technologies but also militarily. With the gorwing support of member states, the treaty was signed on January 27, 1967, and became effective on October 10, 1967.

The treaty emphasizes that outer space shall be for the benefit and in the interest of all mankind. It states tjat activities in space must be conducted in conformity with international law and states are responsible for any damages caused by their space objects. Furthermore, the treaty mentions that astronauts are representatives of humanity, which as a result, strengthens the sense of responsibility towards the peaceful exploration of outer space. The Outer Space Treaty explicitly prohibits 1) The introduction of nuclear weapons or any kind of WMD into the outer space or replacement of such weapons on the celestial bodies' surface. 2) No state has the right to claim outer space or celestial bodies as a property through occupation or any other means except for scientific exploration. 3) The employ of the space for the military aims, i.e., for testing the weapons and establishing the military bases.

While the treaty has a flexible framework, it does not forbid all military activities. Allowing military personnel to provide support to the space activities have raised the question of how the treaty is addressing current challenges, where satellite warfare has arose. Dspite some professionals doubting the effectiveness of the treaty, since the implementation of The Outer Space Treaty, it has become a great source of inspiration for a variety of agreements with the purpose of fin-tuning the international standards concerning space affairs. These include treaties on matters such as smace damage liability and protocols on rescue of astronauts. By 2024, 115 countries are parties to this treaty, demonsdtrating the treaty's impact in space exploration for the past more than 50 years.

The Moon Agreement (1979)

The Moon Agreement was adopted by the United Natioins General Assembly on December 5, 1979. The key purpose of the agreement was to restrict the exploration and uses of the Moon to the gain of humankind. Such principle plays a crucial role to the international cooperation between countries related to space affairs, and will help avoid conflicts for lunar resources. The agreement states that Moon activities can only be used for peaceful purposes; hence, it bans the construction of military bases and the testing of weapons in its expanse.

One area the Moon Agreement defines is resource management. It urges the enactment of some international standards for governing the extraction of the Moon's resources whenever they are practically feasible. Devloped by developing countries, this system has a mian mission of promoting the fair usage of advantages coming from the resources of such case. Scientists from different nations would be able to conduct unrestricted research and investigation, especiallyin an increasingly competitivate era for lunar exploration. However, the Moon Agreement has not received so much endorsement. Human regulations that are narrowly limited, such as the ones in this agreement, are often deemed inffective. As of 2024, only 18 countries have ratified it, yet it is worth mentioning that it is not signed by any of the main space-travelling nations like the United States, Russia, and

China. While the Moon Agreement's main purpose is to establish legal frameworks that enhance cooperation in lunar exploration, its limited adoption signifies the current situation in outer space is no yet completely compliant.

The Artemis Accords (2020)

The Artemis Accords, established in October 2020, was the basis for international cooperation in space exploration, especially focusing on lunar exploration. The Accord was promoted by NASA, collaborated with the US Department of State, and received recognition from eight partner nations including Australia, Canada, Italy, Japan, Luxembourg, the United Arab Emirates, the United Kingdom, and the United States. Currently, the Accord has been accepted by 39 countries.

The Accord emphasizes the need that all space activities must be affected in a way that can only be for peaceful purposes, giving room for solely scientific programs in space, and prohibiting all usage of space for militarization. The Accord brought up the concept of transparency, hence all countries are obliged to share their plans and results. The Accord also require countries' space systems to work together in case of a joint mission or medical supply crisis in space. The signorties can not abandon their astronauts under emergency cases if occurred and need to cooperate to provide medical supply under certain circumstances. Unlike scientific space competions, Artemis Accords brings nations to the same page to work jointly and make sure space programs are safe. However, it is believed that the Accords might be in favor of certain countries, while excluding major space-faring nations; thus, other member states raise questions.

Key Issues

Increased Access to Space Technologies

The problem of setting up frameworks for the safe and sustainable use of space resources by naions and individuals persists due to the gorwing accessibility of space technologies. With the growth of commercial and national space programs, there is a risk that space will not have a single vaue system for everyone as a resource, while the commercial mining of celestial bodies is still unregulated. The raised activity also brings forth the problems of environmental degradation and the preservation of scientific sites of space bodies. While not making it clear, countries may enter into negotiations with the aim of competing with one another, leading to the over-exploitation of resources that would threaten the economy. The progress of digital technologies in this sense can be too fast for law and ethical standards and cause disputes over the right supply and use of resources between different countries and companies. The lack of unambiguous guidelines poses a risk of conflicts among states and private entities, which will further complicate international cooperation. Besides, when many participants are part of the space industry, the possibility of space debris becomes higher and blights both satellites in orbit and missions in the future.

Economic and Environmental Pressures on the Earth

One of the major constraints to terrestrial mining for rare earth elements, which are crucial for the manufacturing of a variety of advanced systems, is the increasing demand for these essential minerals. Such extraction results in habitat destruction, soil erosion, and water pollution on a considerable scale.

Consequently, an increased desire to mine elsewhere has led to the idea of off-Earth mining as a more environmentally safe alternative. Mining celestial bodies would not only serve to fill the gap in the global supply but also to ensure that adverse effects on the environment associated with land mining are avoided. On the other hand, pursuing such a policy without a solid international framework is expected to be a problem. The absence of precise norms and incentivizing in order to be applied is quite the difficult task to ensure that these mining operations are consistent with environmentally sustainable practices because of the potential of the celestial areas becoming damaged, which is not acceptable for private companies and national space programs.

Monopolization of Space Resources

The pontential monopolization of space resources by private and national entities raises concerns about equitable and sustainable utilization. With the rapid growth of the space industry, particularly through companies like SpaceX, issues of power concentration and resource control have emerged. For instance, SpaceX's Starlink program has launched thousands of satellites, dominating low Earth orbit and limiting access for competitors. Legal frameworks governing space resource utilization are often inconsistent and lack comprehensive international oversight. While some countries have implemented national laws to encourage private investment in space mining, these regulations can create disparities among nations, allowing technologically advanced countries to monopolize valuable resources.

Major Parties Involved

United States

The United States is actively involved in the creation of guidelines for the secure and sustainable use for space-related resources principally via NASA and private firms such as SpaceX. SpaceX is a prime example. U.S. government has established policies such as Executive Order 13914 that supports international collaboration to ensure the use and recovery of space resources. The order states that space itself is not considered to be a "global commons." The policy aims to encourage commercial exploration as well as the extraction of natural resources such as water as well as minerals from the celestial space bodies.

Luxembourg

Luxembourg is one of the major parties involved in the use of space resources by launching its SpaceResources.lu initiative in 2016. This initiative creates frameowkrs for private firms for the extraction of materials from celestial bodies by guaranteeing property rights to material harvested. The government have also been actively participating in groups like the United Nations Committee on the Peacful Uses of Outer Space (COPUOS). Furthermore, Luxembourg has made initiatives that diversify the economy and encourage collaboration to set standards for manageing resources within the increasingly competitive space market.

China

Though China does not have as many private programs as some other countries with strong space programs, it has played a significant role in the mining of space resources. The Chinese government has laid out a roadmap aiming for a comprehensive space resource system by 2100, which includes mining asteroirds and utilizing lunar resources. This initiative, named *Tiangong Kaiwu*, aims to establish gravitational points between the Earth, Moon, and other planets to cailitate resource extraction.

Russia

Russia has veen focusing on lunar exploration and the potential extraction of materials from the Moon. The Russian space agency, Roscosmos, has plans to estabsh a long-term lunar base and has expressed intentions to explore Mars soon. The recent failure of its Luna-25 mission, which crashed during a landing attempts, shows that there needs to be advancements made to continue investigations.

United Nations Office for Outer Space Affairs (UNOOSA)

The United Nations Office for Space Affairs (UNOOSA) works to ensure the sustainability of space resources. The committee also establishes guidelines that promote peaceful exploration of space. UNOOSA is mainly concerned about the rising amount of national and private space-related programs that are engaged in the extraction of natural resources. As a partner of its members in the COPUOUS, UNOOSA's main objective is to make sure every nation are able to benefit from the space resources equally while minimizing the environmental impact.

International Institute of Space Law (IISL)

The"International Institute for Space Law (IISL) is a non-governmental organization that promotes rules of law that are relevant to outer space. Established in 1960, IISL has members representing more than 50 nations that are focused on research, education, and diplomacy in space law. The IISL has made efforts in debates regarding legal frameworks to govern the usage of space resources, and hthe institute has also organized workshops, conferences, and competitions that deal with questions of law in space.

Timeline of Events

This timeline shows some major events that have occurred between the 1950s to the present. These events have made an impact on the development of frameworks for the past 70 years. These efforts reflect an evolving understanding of the importance of responsible practices in a gradually increasing competitive space environment. Please keep note that the events that occurred in the "Background" section are not mentioned here but all events have contributed greatly to the development of space.

Date	Description of event

October 4 1957	The Soviet Union launches Sputnik 1, marking the beginning of the space age and the space race.
April 12 1961	Yuri Gagarin becomes the first human in space, which shows the potential for human activities in outer space and sets the base for future exploration and resource utilization.
January 28 1986	The Challenger disaster occurs, leading to increased scrutiny over safety protocols in space missions.
February 14 2000	The US Near Earth Asteroid Rendezvous (NEAR) spacecraft begins transmitting images of asteroid Eros.
October 4 2004	The US Commerical Space Launch Amendments Act is enacted. The act allowed private companies to conduct suborbital flights which sets a path for later extraction initiatives.
November 25 2015	The US Congress passes the Space Act, granting private companies rights to resources extracted from asteroids and other celestial bodies.
June 2016	The United Nations adopts guidelines on the long-term sustainability of outer space activities, addressing issues related to space debris and responsible resource utilization.
Decmber 2017	NASA announces plans for the Deep Space Gateway, aimed at establishing a sustainable lunar presence that includes resource utilization strategies.
March 25 2024	The sixth edition of Space Resources Week takes place in Luxembourg, gathering participants to discuss advancements in In-Situ Resource Utilization (ISRU).
March 26 2024	The United Nations Office for Outer Space Affairs hosts an Expert Meeting alongside Space Resources Week.

Previous Attempts to Resolve the Issue

- **Space2030 Agenda: Space as a Driver of Sustainable Development, 2021 (Resolution A/RES/76/3)**

Link:https://www.unoosa.org/res/oosadoc/data/resolutions/2021/general_assembly_76th_session/ares763_html/A_RES_76_3_E.pdf

The Space2030 Agenda, adopted by the UN in 2021 focuses on space activities as a means of helping to achieve the Sustainable Development Goals. The agenda asks countries to include space science and technology in their plans for national development, which then increases the capacity for areas like disaster management, climate change control, and food security in those countries. It reduces the gap of under-usage of satellite data and services, empowering them towards good health services, efficient management of resources, and foster resilience in the face of natural disasters. Moreover, it creates opportunities for countries to cooperate internationally by stressing the need for partnerships between developed and developing countries so that everyone, especially the disadvantaged, can benefit from the technological progress.

- **Guidelines for the Long-term Sustainability of Outer Space Activities, 2021 (Resolution A/RES/73/6)**

Link: https://www.un.org/en/ga/73/resolutions.shtml

The Guidelines for the Long-term Sustainability of Outer Space Activities (A/RES/73/6), adopted in June of 2019, develops based on which organizations starting their activities in outer space will be conducted in modes that are both secure and sustainable. These guidelines comprise of basic principles that include the promotion of international cooperation, sharing of best practices, and taking measures to mitigate space debris. The consequence of the regulations is very important as they not only bring the government forces but also the private sector motivation to obey certain standards in their space activities. These regulations help them to make movements toward advanced technologies to track and manage space debris as minimization of the risks associated with relation of the larger objects in space. Along with that, they construct the atmosphere where nations can work together on the areas they have something in common, like the best possible conditions for safe satellite operations or conducting joint missions. This not only makes people safer but also enables innovation as through the pooling together of ideas and resources, say, applicable in an organization.

- **Access to Space for All Initiative**

The Access to Space for All Initiative is a continuing task intended to respond to the needs of developing countries, enhancing their presence among space activities. This initiative, both bringing forth providing training, technical assistance, and building partnerships from the countries that already are in space-faring activities, aims at capacity building. Through launching remote satellite technology and motivating local ingenuity, this endeavor strives to assist those unable to develop capabilities or try space exploration for themselves.

Possible Solutions

Firstly, In-Situ Resource Utilization (ISRU) is a way to deal with the main issue of space exploration by finding a more interesting and comfortable way of using local materials to supplement the needed resources that had been flown in from earth. New tech refers to the process of getting and modifying materials found in space bodies to make products useful such as water and oxygen as well as building materials. For instance, water ice existing on the Moon or Mars may be collected and converted into hydrogen and oxygen for life support and rocket fuel. The use of ISRU, which allows supplies to be launched with less frequency from Earth, is one of the main drivers of cost and expense reduction in space missions, and it adds zenith to the environmental sustainability of the space missions. The economic ramifications are quite heavy; ISRU allows missions to be of longer duration and to establish colonies ultimately by providing resources close to home and, in the end, keeping local logistics problems at bay. Likewise, ISRU technologies stimulate the development of new lunar or Martian soil processing technologies (e.g., sintering regolith into construction goods). Apart from being a building block of habitat creation, this practice also promotes the circular economy in space, the economy where unwanted materials are recycled instead of being thrown away. As space agencies and private corporations become increasingly oriented on Mars and the Moon, we should be highlighted that we are able to invests in ISRU technology to guarantee sustainability and economic viability of human presence in space.

Soaring activities in space, therefore, require robust global law regimes to be drawn and beput in place that will govern the utilization of outer space resources. This, at the moment, is quite the contrary situation because there are no directive laws regarding ownership and environmental controversies, such as conflict resolution in space resource saturation. By engaging in international forums populated by interested parties, including the

governments, private sector, and science centers, states are in a better position to create binding treaties on sustainable natural resource exploration while avoiding potential conflicts over celestial resources. An effective regulatory framework would include guidelines for minimizing space debris generation during resource extraction processes and ensuring that activities do not adversely affect existing satellite operations or future missions. In addition to this, the policy frameworks should comprise of technology as well as capacity-building ventures for the developing nations that are aimed at ensuring equal distribution of the space resources among the country partners. Other than peace maintenance, such rules also ensure that sustainable practices are adopted borrowed from the nations being engaged in the outer space activities.

To reduce the negative effect of space activities on the environment, it is necessary to integrate "green" launches and "smart" satellites. Outdated launch methods work in the opposite way - creating huge amounts of greenhouse gases and generating one-time waste products. Shifting to reusable rocket systems, for example, SpaceX's models, will lead to significant reduction in rocket launch costs and environment pollution prevention. Besides, choosing electric propulsion systems set from renewable energy sources will improve fuel utilization, and emissions will be lower during space voyage. Another aspect of satellite design is achieving campaign superiority by using lightweight materials, compact designs, and cutting down on the size deployment, therefore, needing fewer launches to accomplish one mission. Effective sequential approaches like clustering satellites can boost orbital coverage while at the same time reducing collision risks. These technology-based improvements utilize a more sustainable approach to the space sector operations and increase the operational profitability as launches can be undertaken frequently with low costs. Focusing on sustainability only in the case of launch systems and satellite construction sounds less significant. However, this considerate approach can clean the path towards the environmentally friendly space exploration that is economically sustainable as well due to lower operational costs.

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