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Reconciling Private Resource Extraction with the Outer Space Treaty and the Moon Agreement: Critical Analysis of Domestic Space Laws and Bridging the Gaps between International and Domestic Space Law

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Reconciling Private Resource Extraction with the Outer Space Treaty and the Moon Agreement: Critical Analysis of Domestic Space Laws and Bridging the Gaps between International and Domestic Space Law

ABSTRACT

This paper discusses about the reasons for space exploration and the steps involved in extraction of resources. It talks about how initially State organizations played an active role in exploitation of space resources and the shift brought in by the private entities. It highlights the importance of the Outer Space Treaty and the Moon Agreement in the modern era of globalization by stating some of the principles laid down by them and its benefits on the member states. It provides a critical analysis of the domestic space laws by six spacefaring nations namely US, UK, Luxembourg, UAE, Japan and India on how these laws are adhering with the principles of international space law and where are the divergences. It examines the similarities between the law of seas and the space law particularly the common heritage principle. It points out how both the law of seas and space law are different from each other by criticizing the direct application of law of sea in space law. It concludes by providing suggestions on maintaining a balance between the commercialization of space resources by domestic laws and principles of outer space treaty and moon agreement to fill in the gaps between the national and international space law.

KEYWORDS

Space Exploration, Outer Space Treaty, Moon Agreement, Domestic Space Laws, Law of Sea, UNCLOS.

INTRODUCTION

Space exploration is defined as the investigation of the universe beyond Earth's atmosphere using crewed and uncrewed spacecraft, with the goal of increasing knowledge of the cosmos and benefiting humanity[1]. This endeavour encompasses the discovery of celestial bodies and phenomena, scientific understanding derived from space-based observations, and the application of this knowledge for human purposes[2]. There have been many significant milestones in this field[3].

[1] Encyclopædia Britannica, Space Exploration (2026).
[2] Id.
[3] Encyclopædia Britannica, History of Technology: Transport and Communications

Initially, there were three reasons behind space exploration[4]. First, the surface of outer space has very less gravity and extreme temperature due to which various chemical and manufacturing processes, microgravity research experiments, agricultural production facilities and crystal formations can be created thereby providing a great potential for space-based research projects[5]. Second, the resources on moon can be used for multiple purposes like extracting oxygen, polar ice for life support and hydrogen as a fuel in various industrial processes along with abundance of several minerals like iron, aluminium for construction of space aircrafts and lunar tourism with the help of low-cost, safe orbital passenger spacecrafts[6]. Third, the lunar materials can be used to build solar power stations which can collect the sun's energy thereby reducing the dependence on non-renewable source of energy like coal and petroleum in order to achieve pollution free power generation[7].

The nascent space mining industry is quickly becoming a viable reality[8]. Many estimate that extracting and utilising water in space which is the first step to creating a space mining economy, could be achieved within a decade[9]. However, there remains significant legal uncertainty about how mining the moon and asteroids can and should proceed under existing international and domestic law[10].

At present, sending humans to a Near-Earth Asteroid (NEA) as part of a manned asteroid mining endeavour is not feasible[11]. Asteroids are the 4.6-billion-year-old remnants of our solar system's formation[12]. Most have odd, non-spherical shapes and irregular rotations, "sometimes tumbling quite erratically" as they orbit the Sun[13]. Most asteroids orbit in the main asteroid belt between Mars and Jupiter, but this belt is so far away that utilizing its resources is extremely difficult with existing technology[14]. Fortunately, Near-Earth Asteroids (NEAs) orbit closer to Earth, defined as having an orbital distance from Earth of 1.3 astronomical units (au)—equivalent to about 120 million miles—or less[15].

(2026).
[4] Hogan Lovells, The Development of Natural Resources in Outer Space 1 (2018).
[5] Id. at 3.
[6] Id. at 4.
[7] Id. at 5.
[8] Id. at 6.
[9] Id.
[10] Id.
[11] Id. at 8.
[12] Id.
[13] Id.
[14] Id.
[15] Id.

For that reason, current mining proposals are focused purely on robotic flights[16].

With these goals in mind, companies and governments interested in space mining are considering a variety of approaches to identifying and harvesting space resources[17]. Much like leveraging resources on Earth, there are four basic steps to exploiting asteroid resources: (1) prospect, (2) extract or harvest, (3) process, and (4) utilize[18].

1. **Prospecting**: Prospecting for asteroids involves assessing their "orbital economics"—determining how easy an asteroid is to access in relation to how much revenue could be derived from mining it[19]. In 2015, Planetary Resources successfully deployed its first prospecting spacecraft, known as the Arkyd-3 Reflight, on a 90-day mission to test its technologies[20]. Planetary Resources has also considered using a single rocket launch to deploy multiple prospecting spacecraft, referred to as Arkyd-301s, to gather data and physical samples from pre-selected asteroids in search of water and other valuable resources for potential mine sites[21]. Furthering this effort, Planetary Resources launched its Arkyd-6 spacecraft on an Indian rocket in January 2018[22]. During this test, the Arkyd-6 satisfied all mission requirements, demonstrating its distributed computing system, communications, attitude control system, power generation, storage with deployable solar arrays and batteries, star tracker, reaction wheels, and the first commercial mid-wave infrared (MWIR) imager operated in space[23].

2. **Extracting**: As with prospecting, private and governmental entities are developing a variety of extraction techniques depending on circumstances such as the type and location of the resource, as well as the characteristics of the asteroid itself[24]. Where an asteroid has significant rubble, one idea is to use magnets—perhaps in the form of a magnetic rake—to skim over the surface, lifting off metal grains[25]. Another technique being developed by a team led by TransAstra Corporation, operating through a NASA grant, is "optical mining.[26]" Using highly concentrated sunlight inside a containment bag, this process can drill holes, excavate, disrupt, and shape an asteroid[27]. As a final example, in 2016, NASA launched a mission to collect materials

[16] Id.
[17] Id. at 9.
[18] Id.
[19] Id. at 10.
[20] Id.
[21] Id.
[22] Id. at 11.
[23] Id.
[24] Id. at 12.
[25] Id.
[26] Id. at 13.
[27] Id.

from the asteroid Bennu using the OSIRIS-REx spacecraft[28]. The spacecraft rendezvoused with Bennu, surveyed it, and collected samples using a robotic arm that shot nitrogen gas into the asteroid's surface to stir up rocks and grab a few ounces of material[29].

3. **Processing**: As on Earth, processing extracted materials will likely occur relatively close to the mine site, with processing centres placed in near-Earth orbit rather than returning raw material to Earth[30]. However, because the industry is currently focused on prospecting, detailed operational information remains sparse[31]. Because purifying water and other volatiles is significantly easier than refining metals, these materials are likely to be targeted as the first candidates for extraction and processing[32]. Refining metal ores would require sophisticated refining centres in Low Earth Orbit (LEO), the technology for which is not yet well defined[33].

4. **Utilizing and Manufacturing**: Scientists quip that Earth's orbit, though a small relative distance compared to the rest of the solar system, is "halfway to anywhere[34]." Launching a spacecraft from Earth to LEO requires a velocity of about five miles per second, whereas launching from LEO to an NEA requires approximately three and a half miles per second[35]. Launching directly from Earth is inefficient; launching smaller craft from space stations already in orbit will allow entities to send more spacecraft using less fuel[36]. Moreover, returning space resources in large quantities is unlikely for many years, as returning just two ounces of material currently carries an enormous cost[37]. Given these challenges, most proposals focus on *In-Situ Resource Utilization (ISRU)*—the practice of recovering space resources on-site for human consumables, spacecraft propellant, and other needs[38]. Using space resources in space increases the longevity and decreases the cost of space exploration, marking the first step toward a robust commercial space mining industry[39]. As an early proof of concept for in-space manufacturing, the International Space Station's (ISS) 3D printer produced its first product in 2014 through a collaboration between NASA and Made in Space[40]. While the project confirmed that 3D

[28] Id. at 14.
[29] Id.
[30] Id. at 15.
[31] Id.
[32] Id.
[33] Id.
[34] Id. at 16.
[35] Id.
[36] Id.
[37] Id. at 17.
[38] Id.
[39] Id.
[40] Id. at 18.

printers can function in microgravity, the ongoing challenge remains developing materials strong enough to withstand space's vacuum[41].

SHIFT FROM STATE TO PRIVATE ENTITIES

Initially the major role in space exploration was performed by state owned agencies like NASA as private enterprises failed due to undercapitalisation, lack of talent and reliance on poor technology[42]. However, this is not the situation now[43]. The dynamics of space exploration has undergone a tremendous change with the increasing role and significance played by the private enterprises in the space sector[44]. In 2004, SpaceShipOne, a privately funded spacecraft rocketed into suborbital space and came back home[45]. Rutan-Branson duo is another example of space exploration by the private sector against another American firm SpaceAdventures Ltd[46]. Burt Rutan's spacecraft won the $ 10 million Ansari X prize and Richard Branson, the founder of Virgin Galactic is confident that the first reliable commercial spaceliner with schedule flights will be built before the end of the first decade of the twenty-first century[47]. Initially only wealthy business executives have been able to fly on this mission to the outer space which is now being aimed to carve out by the Rutan-Branson duo and SpaceAdventures[48].

Elon Musk, an internet tycoon, runs Space Explorations Technology Corp. (SpaceX) which he funded with more than $20 million of his own money is into building reusable rockets and hopes to reduce the price of payloads into the orbit[49]. Robert Bigelow, founder of Budget Suites of America has poured $75 million through Bigelow Aerospace for planning to launch inflatable orbital habitats which can be expanded and pieced together into scientific posts and industrial workshops[50]. In 2009, Planetary Resources was formed by Peter Diamandis and Eric Anderson with the goal of mining asteroids for metals and water[51]. The company's goals are to one, provide fuel and raw materials that will be integral to any long-term sustainable and scalable missions to the moon, Mars and beyond, two, harvest water from asteroids to be used as fuel for spacecraft and satellites life support for a space workforce, radiation shielding and to grow food and third, extract metal from asteroids to be

[41] Id.
[42] Hogan Lovells, The Development of Natural Resources in Outer Space 19 (2018).
[43] Id.
[44] Id. at 20.
[45] Id.
[46] Id.
[47] Id. at 21.
[48] Id.
[49] Id. at 22.
[50] Id. at 23.
[51] Id.

3D printed for structures and components needed in space[52]. Moon Express was founded in 2010 by Bob Richards, Naveen Jain and Barney Pell[53]. The company plans to harvest the moon's water and other resources[54]. Moon Express was the first commercial enterprise to receive authorisation from the United States for a private robotic spacecraft trip to the moon[55]. Prior to its authorisation, the only spacecraft to travel beyond Earth's orbit were government-owned, and were therefore compliant with the Outer Space Treaty by default[56]. However, the Treaty's requirement that private missions be authorised and supervised by the appropriate state meant that, in order to fly to the moon, Moon Express would need governmental permission[57]. The company overcame the regulatory gap, discussed below, through in-depth consultations with relevant agencies in an ad hoc mission authorisation process[58]. It supplemented its payload review process for the Federal Aviation Administration (FAA) with voluntary disclosures about its mission, in a process not unlike the current proposed authorisation frameworks[59]. Deep Space Industries was formed in 2013[60]. DSI has previously planned to launch a network of small, low-cost scouting spacecraft[61]. Its 'Prospector series were small spacecraft designed to locate, land on and assess the value of asteroids[62]. At present, DSI has a more general goal of using its technology to 'employ our technology to conduct asteroid science and exploration, support activities such as manufacturing in space, and enter other lucrative vertical markets'[63].

The above paragraph deals with examples of increasing role of development played by the private sector in the field of space exploration[64]. Apart from technical and financial challenges, there are legal divergences too in certain domestic countries laws from the international treaties on space law[65].

[52] Id. at 24.
[53] Id.
[54] Id. at 25.
[55] Id.
[56] Id.
[57] Id.
[58] Id.
[59] Id. at 26.
[60] Id.
[61] Id.
[62] Id.
[63] Id. at 27.
[64] Hogan Lovells, supra note 1, at 28.
[65] Id.

INTERNATIONAL TREATIES ON SPACE LAW

The space law is based on five international treaties among which this paper will address the two most important treaties relevant to space mining[66]. The first part of the discussion will be on the Outer Space Treaty and the second part will be on the Moon Treaty[67].

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 and was adopted by the UN General Assembly in 1967[68]. This treaty is the constitution of international space law[69]. Although it was adopted in 1967, many of the principles stated in this treaty are relevant to the modern era of space exploration which will be discussed further[70]. The Outer Space Treaty consist of seventeen articles among which this paper will be examining few of the articles in detail[71].

Article 1 of the Outer Space Treaty deals with the principles of benefit for all and free exploration[72]. It states that the exploration and use of outer space shall be carried out for the benefit and in the interests of all countries, free for exploration and use by all States, and free access to all areas of celestial bodies and freedom of scientific investigation to facilitate and encourage international co-operation[73].

Article 2 of the Outer Space Treaty deals with the non-appropriation principle whose interpretation is being construed differently by various nation which will form the later part of our discussion[74]. It states 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[75].

[66] United Nations Office for Outer Space Affairs (UNOOSA), Outer Space Treaty, https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/outerspacetreaty.html.
[67] United Nations Office for Outer Space Affairs (UNOOSA), Moon Agreement, https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/intromoon-agreement.html.
[68] Id.
[69] Id.
[70] Id.
[71] Id.
[72] Id.
[73] Id.
[74] Id.
[75] Id.

Article 3 of the Outer Space Treaty deals with the principles of peace and international co-operation[76]. It states activities in the exploration and use of outer space will be done by maintaining international peace, security, promoting international co-operation and understanding[77].

Article 4 of the Outer Space Treaty deals with principle of prohibition of nuclear and other weapons in outer space[78]. It states that States Parties to the Treaty will not place any objects carrying nuclear weapons or any other kinds of weapons of mass destruction in outer space in to ensure that the moon and other celestial bodies are used exclusively for peaceful purposes[79].

Article 6 of the Outer Space Treaty deals with the principle of international responsibility by the States for national activities in the outer space[80]. It states that member states shall bear international responsibility for national activities in outer space, including the moon and other celestial bodies, whether such activities are carried on by governmental agencies or by non-governmental entities and international organizations for assuring that national activities are carried out in conformity with the provisions set forth in the present Treat and the activities of non-governmental entities, shall require authorization and continuing supervision by the appropriate State Party to the Treaty[81].

Article 7 of the Outer Space Treaty deals with the principle of absolute liability for damage caused by one State to the other[82]. It states that each State Party to the Treaty that launches or procures the launching of an object into outer space, and each State Party from whose territory or facility an object is launched, is internationally liable for damage to another State Party to the Treaty or to its natural or juridical persons by such object or its component parts[83].

Article 8 of the Outer Space Treaty deals with the principle of jurisdiction over objects launched by a State into the outer space[84]. It states that a member state on whose registry an object launched into outer space is carried shall retain jurisdiction and control over such object, and over

[76] Id.
[77] Id.
[78] Id.
[79] Id.
[80] Id.
[81] Id.
[82] Id.
[83] Id.
[84] Id.

any personnel thereof, while in outer space or on a celestial body[85]. This article is supplementary to article 7 which deals with absolute liability stating that both ownership and liability exists with the concerned State[86].

Article 9 of the Outer Space Treaty deals with the principle of co-operation and mutual assistance[87]. It states that in the exploration and use of outer space, States Parties to the Treaty shall be guided by the principle of co-operation and mutual assistance and shall conduct all their activities in outer space with due regard to the corresponding interests of all other States Parties to the Treaty, avoid their harmful contamination and adverse changes in the environment of the Earth and harmful interference with activities of other States Parties in the peaceful exploration and use of outer space[88].

Article 11 of the Outer Space Treaty deals with the principle of disclosure[89]. It states that in order to promote international co-operation in the peaceful exploration and use of outer space, States Parties to the Treaty conducting activities in outer space shall agree to inform the Secretary-General of the United Nations as well as the public and the international scientific community, the nature, conduct, locations and results of such activities[90]. This article is supplementary to article 3 which deals with peace and international co-operation stating how these principles can be achieved[91].

Article 12 of the Outer Space Treaty deals with the principle of reciprocity[92]. It states that All stations, installations, equipment and space vehicles on the moon and other celestial bodies shall be open to representatives of other States Parties to the Treaty on a basis of reciprocity[93].

Article 13 of the Outer Space Treaty deals with the application of this treaty[94]. It states that the provisions of this Treaty shall apply to the activities of States Parties to the Treaty in the exploration and use of outer space, including the moon and other celestial bodies, whether such activities are carried on by a single State Party to the Treaty or jointly

[85] Id.
[86] Id.
[87] Id.
[88] Id.
[89] Id.
[90] Id.
[91] Id.
[92] Id.
[93] Id.
[94] Id.

with other States, including cases where they are carried on within the framework of international intergovernmental organizations[95].

The above-mentioned 13 articles of the Outer Space Treaty form the foundation of space exploration[96]. Apart from this, the Moon agreement formally known as the Agreement Governing the Activities of States on the Moon and Other Celestial Bodies was adopted in the year 1979 and came into force in 1984[97]. The Moon agreement consists of twenty-one articles among which this paper will be examining a few of them in detail[98].

Article 1 of the Moon Agreement deals with applicability[99]. It states that the provisions of this Agreement relating to the moon shall also apply to other celestial bodies within the solar system, other than the earth, except in so far as specific legal norms enter into force with respect to any of these celestial bodies[100].

Article 2 of the Moon Agreement deals with the principles of peace and international co-operation[101]. It states that All activities on the moon, including its exploration and use, shall be carried out in accordance with international law in the interest of maintaining international peace and security and promoting international co-operation and mutual understanding, and with due regard to the corresponding interests of all other States Parties[102].

Article 3 of the Moon Agreement deals with the principle of prohibition of nuclear and any other type of weapons on moon[103]. It states that the moon shall be used by all States Parties exclusively for peaceful purposes[104]. Any threat or use of force or any other hostile act or threat of hostile act on the moon is prohibited[105].

[95] Id.
[96] Id.
[97] United Nations Office for Outer Space Affairs (UNOOSA), Moon Agreement Introduction, https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/intromoon-agreement.html.
[98] Id.
[99] Id.
[100] Id.
[101] Id.
[102] Id.
[103] Id.
[104] Id.
[105] Id.

Article 4 of the Moon Agreement deals with the principles of sustainable development, co-operation and mutual assistance[106]. It states that the exploration and use of the moon shall be the province of all mankind and be carried out for the benefit and in the interests of all countries and due regard to be paid to the interests of present and future generations as well as to the need to promote higher standards of living and conditions of economic and social progress and development guided by the principle of co-operation and mutual assistance in all their activities concerning the exploration and use of the moon[107].

Article 5 of the Moon agreement deals with the principle of disclosure[108]. It states that States Parties shall inform the Secretary-General of the United Nations as well as the public and the international scientific community, of their activities concerned with the exploration and use of the moon[109].

Article 6 of the Moon Agreement deals with the principle of freedom of scientific investigation[110]. It states that States Parties to the Agreement shall conduct their exploration and use of the moon in accordance with international law, in the interest of maintaining international peace, security and promoting international co-operation and mutual understanding[111]. States Parties shall have the right to collect on and remove from the moon samples of its mineral and other substances[112]. This article plays a very significant role as it has been interpreted in multiple ways by different nations[113].

Article 8 of the Moon Agreement deals with the principle of free movement and non-interference[114]. It states that States Parties may pursue their activities in the exploration and use of the moon anywhere on or below its surface, subject to the provisions of this Agreement[115].

Article 11 of the Moon Agreement deals with the principle of common heritage of mankind[116]. It states that the moon is the province of all mankind and its exploration and use shall be carried out for the benefit and in the interests of all countries, regard shall be paid to the interests

[106] Id.
[107] Id.
[108] Id.
[109] Id.
[110] Id.
[111] Id.
[112] Id.
[113] Id.
[114] Id.
[115] Id.
[116] Id.

of present and future generations[117]. The moon is not subject to national appropriation by any claim of sovereignty, by means of use or occupation, or by any other means[118]. This article plays an important role in understanding the objective behind the enactment of this agreement and how its interpretation is being changed by certain countries by enacting their domestic laws which will be discussed later in this paper[119].

Article 12 deals with the principle of jurisdiction[120]. It states that All stations, installations, equipment and space vehicles on the moon shall be open to other States Parties[121]. Such States Parties shall give reasonable advance notice of a projected visit, in order that appropriate consultations may be held and that maximum precautions may be taken to assure safety and to avoid interference with normal operations in the facility to be visited[122].

Article 15 of the Moon Agreement deals with the principle of absolute liability and dispute settlement mechanisms between the member nations[123]. It states that Each State Party to the Agreement may assure itself that the activities of other States Parties in the exploration and use of the moon are compatible with the provisions of this Agreement and all space vehicles, equipment, facilities, stations and installations on the moon shall be open to other States Parties[124]. Such States Parties shall give reasonable advance notice of a projected visit[125]. A State Party which has reason to believe that another State Party is not fulfilling obligations incumbent upon it pursuant to this agreement or that another State Party is interfering with the rights which the former State Party has under this Agreement may request consultations with that state and such state receiving such a request shall enter into such consultations without delay[126]. If such consultations do not lead to a mutually acceptable settlement which has due regard for the rights and interests of all the States Parties, the parties concerned shall take all measures to settle the dispute by other peaceful means of their choice appropriate to the circumstances and the nature of the dispute[127].

[117] Id.
[118] Id.
[119] Id.
[120] Id.
[121] Id.
[122] Id.
[123] Id.
[124] Id.
[125] Id.
[126] Id.
[127] Id.

Article 16 of the moon Agreement deals with the principle of adherence towards the requirements mentioned in this agreement[128]. It states that references in this Agreement to States shall be deemed to apply to any international intergovernmental organization conducting space activities if the organization declares its acceptance of the rights and obligations provided for in this Agreement and if a majority of the States members of the organization are States Parties to this Agreement and the Outer Space Treaty[129]. This article clearly states that the provisions of the agreement will apply if the member state is a party to the Outer Space Treaty[130].

Both the outer space treaty and the moon agreement are supplementary to each other and has to be read together to obtain a clear view as to the enactment of certain principles in international space law[131]. As per the UNTC, only 22 nations have signed the moon agreement and out of those, 18 nations have ratified for the same. Whereas, for the outer space treaty, 118 nations have ratified it. The data shows that the most of space-faring nations have not signed and ratified the moon treaty due to disagreement with some of its principles and have enacted their domestic laws[132]. The paper will be discussing about the domestic laws made by six space faring nations India, US, UK, Japan, UAE and Luxembourg, how some of these laws violate the principles stated in the outer space treaty and the moon agreement and how some of these domestic laws maintain a balance between the sovereignty and international space law principles[133].

CRITICAL ANALYSIS OF DOMESTIC LAWS BY SPACEFARING NATIONS

1. United States

Title I of the U.S. Commercial Space Launch Competitiveness Act is Spurring Private Aerospace Competitiveness and Entrepreneurship Act of 2015 also known as the SPACE Act. It deals with implementation of this act, independent evaluation assessment, licensing report, space authority, orbital traffic management, space surveillance and situational

[128] Id.
[129] Id.
[130] Id.
[131] United Nations Office for Outer Space Affairs (UNOOSA), Status of International Agreements Relating to Activities in Outer Space, https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/status/index.html.
[132] United Nations Treaty Collection (UNTC), Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, https://treaties.un.org/pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XXIV-2&chapter=24&clang=_en.
[133] Id.

awareness data, definitions relating to government astronauts, launch services, state commercial launch facilities, space support vehicles study, space launch system etc. Title II is commercial remote sensing which deals with annual reports and statutory update reports. Title III is office of space commerce which deals with functions of office of space commerce. Title IV is space Resource Exploration and Utilization Act. It deals with the definitions of asteroid resource, space resource, us citizens, commercial exploitation and commercial recovery, asteroid resource and space resource rights and disclaimer of extraterritorial sovereignty[134].

The U.S. Commercial Space Launch Competitiveness Act consists of both positive and negative factors. The positive factors include the provisions dealt by the first three titles as it is aligning with the principles of the outer space treaty specifically article 8, 6, 4, 3 which deal with jurisdiction, absolute international responsibility and liability, prohibition against non-peaceful purposes and international co-operation[135]. However, the negative factors overshadow the positive factors. Firstly, Sec 51303 of the Act titled as asteroid resource and space resource rights which states that a US citizen who is engaged in commercial recovery of either an asteroid or space resource has the right to possess, own and sell the resource, is a clear violation of Article 1 of the Outer Space treaty which states that all resources in the space shall be free for exploration. It is also violative of Article 2 of the Outer Space Treaty which states that no country can claim sovereignty over any of the resources in space[136]. Secondly, US has neither signed nor ratified the moon agreement and article 16 of the moon agreement clearly states that the provisions of the agreement will apply if the member state is a party to the Outer Space Treaty. Art 11 of the moon agreement which states that the moon and other celestial bodies are common heritage of mankind is being violated by enacting Sec 51303 of the US domestic law. Art 6 of the moon agreement which provides the right to collect samples of minerals and other substances from moon has been misinterpreted as right to ownership over the entire resource[137]. Thirdly, Sec 403 of the Act which states denial of extraterritorial sovereignty is contrary to Sec 51303, outer space treaty and moon agreement principles[138].

[134] U.S. Commercial Space Launch Competitiveness Act of 2015, Pub. L. 114-90, 129 Stat. 704 (codified as amended in scattered sections of 51 U.S.C.).
[135] Id.
[136] Id.
[137] Id.
[138] Id.

2. United Kingdom

The domestic legislation enacted by the UK is the Space Industry Act of 2018. It consists of seventy-two sections which deals with duties and supplementary powers of the regulators, prohibition of unlicensed spaceflight, range control services, grants and conditions of licenses, safety regulations, investigation of accidents, powers, offences, regulations etc. It consists of eight schedules which deals with training and safety regulations, offences against the safety of spacecraft, powers appeals etc[139].

As compared to the US domestic laws, UK domestic law provides a complete view of international space law by including definitions related to space activity, sub-orbital activity, functions to be performed by the regulator, meaning of operator license and spaceport, exemptions from license requirement, grant of license, range control services, safety regulations in detail governing launch vehicle, satellite, spaceport and accident investigations, environmental effects on air , water and soil, consent requirements and eligibility regarding training, fitness, directions and enforcement authorisation, liabilities and indemnities by operators and regulator, by operators and regulator, insurance , power related to land including appeals and compensation, offences created by regulations and by body corporate and partnerships, civil sanctions etc. Schedule 4 deals with offences against spacecraft, 5 security regulations and 7 to 9 powers relating to land. This shows utmost compliance with the principles stated in the outer space treaty and the moon agreement[140]. However, one major drawback is the UK has neither signed nor ratified the Moon agreement. Article 16 of the moon agreement clearly states that the provisions of the agreement will apply if the member state is a party to the Outer Space Treaty[141].

3. Luxembourg

There are two domestic legislations enacted by Luxembourg. One is the Law of July 20th 2017 on the exploration and use of space resources and other is the Law of 15 December 2020 on space activities.

The law of July 20th 2017 on the exploration and use of space resources consists of eighteen articles which deals with ownership of space resources, written authorisations for space missions, eligibility criteria and conditions, liabilities and penalties[142]. There are several drawbacks

[139] Space Industry Act 2018, c. 5 (UK).
[140] Id.
[141] Id.
[142] Law of July 20th 2017 on the Exploration and Use of Space Resources (Luxembourg).

in this legislation. Firstly, Article 1 of this Act states that the space resources can be owned which is violative of Article 1 and 2 of the outer space treaty which states the principles of free exploration and non-appropriation respectively. It is also violating Art 11 of the Moon Agreement which states the common heritage mankind principle[143]. Secondly, the act does not cover all the aspects of international space law, it only deals with ownership and authorisation. Nowhere the act talks about maintaining of peace and other principles stated in the outer space treaty and the moon agreement which leads to gaps in the domestic law[144].

The law of 15 December 2020 on space activities consists of eight chapters which are divided into eighteen articles. Chapter 1 deals with scope of application and general provisions which is mentioned from articles 1 to 4. Chapter 2 deals with authorisation of space activity which is mentioned from articles 5 to 10. Chapter 3 deals with supervision of space activities which is mentioned in article 11. Chapter 4 deals with transfer of space activities which is mentioned in article 12. Chapter 5 deals with change of control which is mentioned under article 13. Chapter 6 deals with sanctions which is mentioned in article 14. Chapter 7 deals with registration of space objects launched which is mentioned in article 15. Chapter 8 deals with amending, transitional and final provisions which is mentioned from articles 16 to 18[145]. This legislation consists of both positive and negative factors. The positive factors include elaborate definitions, supervision of activities, registration of space objects launched which is following the principles mentioned in Articles 6, 7, 8 of the Outer Space Treaty namely absolute international responsibility, liability for damages and jurisdiction[146]. The negative factors are that the Act does not cover all the aspects of international space law and that Luxembourg has not signed and ratified the Moon Agreement. Article 16 of the moon agreement clearly states that the provisions of the agreement will apply if the member state is a party to the Outer Space Treaty[147].

4. United Arab Emirates

UAE has enacted the Regulation of the Space Sector in 2023. It consists of forty articles which deals with definitions, objectives, scope of application, permits for space activities, exploration and exploitation of space resources, space debris migration, liabilities and compensation,

[143] Id.
[144] Id.
[145] Law of 15 December 2020 on Space Activities (Luxembourg).
[146] Id.
[147] Id.

insurance and guarantees, registration of space objects, intellectual property rights, import and export controls, investigation of accidents and penalties[148]. The law consists of both positive and negative factors. The positive factors include firstly, elaborate definitions, regulated activities and permits for them, liability clauses in detail including compensation, registration of space objects which adheres to the principles mentioned in the outer space treaty and the moon agreement namely Art 8, 6, which states the principles of jurisdiction and absolute international responsibility respectively[149]. Secondly, the law gives intellectual property rights protection to the results of activities by space objects which is not mentioned in the outer space treaty or the moon agreement and many of the domestic laws enacted by various countries have not covered this[150]. The negative factors include firstly, Article 7 of the law which allows the use of nuclear energy sources in the outer space upon obtaining permission from the agency. Nuclear energy is highly risk even if it is used for peaceful purposes as it can cause severe damages. This is a clear violation of Art 4 of the Outer Space Treaty which prohibits nuclear weapons or any weapons which cause mass destruction to be used or placed in the outer space. It is also violative of Art 3 of the Moon Agreement which prohibits the use of any act, force or threat which is hostile to the earth, moon, spacecraft, personnel or man-made space objects[151]. Secondly, Article 8 of the law allows acquisition, purchase, sale, trade, transportation, storage of space resources as part of space exploration and exploitation. This is a clear violation of Art 1 and 2 of the Outer space treaty which states the principles of free exploration and non-appropriation respectively. It is also violative of Art 11 of the Moon Agreement which states the common heritage of mankind principle[152].

UAE has also enacted the Space Resources Regulations in 2025. It consists of ten articles which deals with definitions, obligations of operators, considerations for granting authorization, space resources database, property rights over space resources and executive resolutions[153]. The law consists of both positive and negative factors. The positive factors include firstly, Art 3 of the law stating the obligations of the operators in detail which is adhering with Art 7 of the Outer Space Treaty which states the principle of absolute liability for damages caused[154]. Secondly, Art 4 of the law stating the considerations for authorisation which is adhering with Art 6 of the Outer Space Treaty which states the principle

[148] Regulation of the Space Sector (UAE, 2023).
[149] Id.
[150] Id.
[151] Id.
[152] Id.
[153] Space Resources Regulations (UAE, 2025).
[154] Id.

of absolute international responsibility by means of supervision and authorization[155]. Thirdly, Art 5 of the law stating space resource database adheres with Art 8 of the Outer Space Treaty which states the principle of jurisdiction[156]. The negative factors include, firstly, Art 6 of the law which granting property rights of ownership, purchase, sell, trade, transport, store, use, or disposal of space resources subjecting them to the position of tangible property. This is a clear violation of Art 2 of the Outer Space Treaty and Art 11 of the Moon agreement which states the principles of non-appropriation and common heritage of mankind respectively[157]. Secondly, UAE has neither signed nor ratified the moon agreement. Article 16 of the moon agreement clearly states that the provisions of the agreement will apply if the member state is a party to the Outer Space Treaty[158].

5. Japan

Japan has enacted two legislations on space law. First is the Basic Space Act of 2008 and second is the Act on the Promotion of Business Activities for Exploring and Developing Space Resources of 2021.

The Basic Space Act of 2008 consists of four chapters which are divided into thirty-five articles. Chapter 1 deals with purpose of the act, peaceful use of outer space, international co-operation, considerations on the environment, responsibilities of the national government from articles 1 to 12. Chapter 2 deals with independent launch of satellites, use of outer space by private providers, developing human resources, managing information concerning use of outer space from articles 13 to 23. Chapter 3 deals with basic outer space plan which is mentioned in article 24. Chapter 4 deals with outer space development strategy headquarters, its functions, members from articles 25 to 34. Chapter 5 deals with establishing legislation concerning outer space activities which is mentioned in article 35[159]. The law is very comprehensive in nature and adheres with various principles mentioned in the outer space treaty and the moon agreement specifically the principle of free exploration, non-appropriation, international peace and co-operation, common mankind and sustainable development[160]. The only negative factor is that Japan has neither signed nor ratified the moon treaty. Article 16 of the moon

[155] Id.
[156] Id.
[157] Id.
[158] Id.
[159] Basic Space Act, Act No. 14 of 2008 (Japan).
[160] Id.

agreement clearly states that the provisions of the agreement will apply if the member state is a party to the Outer Space Treaty[161].

The Act on the Promotion of Business Activities for Exploring and Developing Space Resources of 2021 consists of 8 articles which deals with purpose, definitions, license for control of spacecraft, ownership of space resources and technical advice[162]. This law is also very comprehensive in nature and adheres with the principles stated in the outer space treaty and the moon agreement. Art 5 of the law which gives right to ownership over the resources mined is at par with the principle of freedom of scientific investigation mentioned under Art 6 of the Moon Agreement[163]. The only negative factor is that Japan has neither signed nor ratified the moon treaty. Article 16 of the moon agreement clearly states that the provisions of the agreement will apply if the member state is a party to the Outer Space Treaty[164].

6. India

India has enacted the Indian Space Policy of 2023. It consists of list of abbreviations, definitions, preamble, vision, strategy, non-governmental entities, IN-SPACe, Indian Space Research Organization (ISRO), New Space India Limited, Department of Space and applicability and implementation[165]. The law consists of both positive and negative factors. The positive factors include firstly; elaborate definitions related to space law and authorities associated with it which is adhering with Art 6 of the Outer Space Treaty which states the principle of absolute international responsibility by means of authorization and supervision[166]. Secondly, the preamble, vision and strategy adheres with the principle of peaceful purposes, international peace and co-operation, sustainable development mentioned in the outer space treaty and the moon agreement[167]. Thirdly, creation of IN-SPACe, an autonomous Government organization, the roles played by ISRO and NewSpace India Limited in promoting research, development and domestic manufacturing, leasing of space technologies and by the Department of Space in providing critical remote sensing satellite data for disaster management efforts to ensure safe and sustainable space operations ensures adherence with the principle of peace, international co-operation, free exploration mentioned in the outer space treaty and the

[161] Id.
[162] Act on the Promotion of Business Activities for Exploring and Developing Space Resources, Act No. 32 of 2021 (Japan).
[163] Id.
[164] Id.
[165] Indian Space Policy, Department of Space, Government of India (2023).
[166] Id.
[167] Id.

moon agreement[168]. Fourthly, India is one of the few space-faring nations that has signed the Moon agreement[169]. The negative factors include firstly, Art 4 of the law gives rights to non-governmental entities to possess, own, transport, use, and sell asteroid resource or space resource which is violative of the principles of non-appropriation and common heritage of mankind stated under Art 2 and 11 of the outer space treaty and the moon agreement respectively. Art 6 of the moon agreement which provides the right to collect samples of minerals and other substances from moon has been misinterpreted as right to ownership over the entire resource[170]. Secondly, India although has signed the moon agreement but not ratified it yet. Article 16 of the moon agreement clearly states that the provisions of the agreement will apply if the member state is a party to the Outer Space Treaty[171].

After critically analysing the domestic space laws of various countries, this paper will be examining the common heritage principle stated in the law of sea and to what extent can they be applied to international space law.

COMMON HERITAGE PRINCIPLE UNDER LAW OF SEAS

The United Nations Convention on the Law of the Sea (UNCLOS) was adopted on 10 December 1982[172]. The principle of common heritage is mentioned under Article 136 of the UNCLOs which states that the Area and its resources are the common heritage of mankind[173]. Article 137 of the UNCLOS states that No State shall claim or exercise sovereignty or sovereign rights over any part of the Area or its resources, nor shall any State or natural or juridical person appropriate any part thereof. No such claim or exercise of sovereignty or sovereign rights nor such appropriation shall be recognized. All rights in the resources of the Area are vested in mankind as a whole, on whose behalf the Authority shall act. These resources are not subject to alienation. The minerals recovered from the Area, however, may only be alienated in accordance with this Part and the rules, regulations and procedures of the Authority. No State or natural or juridical person shall claim, acquire or exercise rights with respect to the minerals recovered from the Area except in accordance with this Part. Otherwise, no such claim, acquisition or exercise of such rights shall be recognized[174]. Article 133 of the UNCLOS defines the term

[168] Id
[169] Id
[170] Id
[171] Id.
[172] United Nations Convention on the Law of the Sea, Dec. 10, 1982, 1833 U.N.T.S. 3.
[173] Id. art. 136.
[174] Id. art. 137.

resources as all solid, liquid or gaseous mineral resources in situ in the Area at or beneath the seabed, including polymetallic nodules. Resources, when recovered from the Area, are referred to as "minerals"[175]. Article 87 of the UNCLOS states that the high seas are open to all States, whether coastal or land-locked. Freedom of the high seas is exercised under the conditions laid down by this Convention and by other rules of international law[176]. Article 89 of the UNCLOS states that No State may validly purport to subject any part of the high seas to its sovereignty[177]. Article 90 of the UNCLOS states that Every State, whether coastal or land-locked, has the right to sail ships flying its flag on the high seas[178]. All the principles together state that the resources in the sea belong to all and cannot be claimed by any single member state. An analysis of these articles shed light upon the two doctrinal legal concepts- res communis and res nullius. Res communis means that the property belongs to the entire community and is not owned by a single person. This is applicable to the high seas. Res nullius means that the property does not have an owner. This is applicable to the fishes in the sea which belong to no one. As per Art 87(e) of UNCLOS, freedom of fishing is granted to all and hence, the fish harvested and secured by the vessel of a State fall within the State's jurisdiction[179].

Res communis is similar to the common heritage of mankind principle stated in Art 11 of the Moon agreement and free exploration principle stated in Art 1 of the Outer Space Treaty[180]. Res nullius is similar to the non-appropriation principle stated in Art 2 of the Outer Space Treaty and freedom of scientific investigation principle which is stated in Art 6 of the Moon Agreement[181].

Many research scholars have given their suggestions as to how these principles of law of seas can be applied to the international space law along with critiques on the existing treaties and conventions. According

[175] Id. art. 133.
[176] Id. art. 87.
[177] Id. art. 89.
[178] Id. art. 90.
[179] Division for Ocean Affairs and the Law of the Sea (DOALOS), United Nations, The United Nations Convention on the Law of the Sea (A historical perspective), https://www.un.org/depts/los/index.htm.
[180] Agreement Governing the Activities of States on the Moon and Other Celestial Bodies art. 11, Dec. 5, 1979, 1363 U.N.T.S. 3; Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies art. 1, Jan. 27, 1967, 18 U.S.T. 2410, 610 U.N.T.S. 205.
[181] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, supra note 9, art. 2; Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, supra note 9, art. 6.

to Gershon Hasin[182], there is a doubt whether the Outer Space treaty is an appropriate instrument considering modern technological, social, and geopolitical perceptions of participants in a globalized world. He states that the international law must adapt to the changing realities or be abandoned. I feel that abandoning the outer space treaty as a whole will be a disastrous solution. Many principles stated in the outer space treaty continue to have relevance in the modern era of space resource exploration. Without the treaty, there will be no regulation and control over space activities and the space resources will get converted into space colonies by the nations which can afford to conduct research activities on the space. Another statement made is there is disagreement between commentators on whether this provision provides for a moratorium on space resource extractions. I feel that the Moon agreement in no way is a moratorium for space resources extractions. It ensures that all the countries have the right to explore the space and that the surface of the moon is not claimed by any single nation. Also, the prohibition regarding use of nuclear weapons or others which cause mass destruction is to ensure that countries who are having nuclear energy sources do not use moon or its surface as a means to create a war-like situation to other nations. The provisions of the Moon Treaty aid in the interpretation of the Outer Space Treaty. The alternative method of allocation of space resources on a first come and first serve basis is not feasible as I feel this will lead to unequal access of space resources and only the spacefaring nations will be able to reap the benefits of space exploration leaving very less for space incapable or less capable nations. According to Abigail D Pershing[183], one of the methods to allocate space resources is creation of a credit system where a member state or an international body can establish a set quantity of minerals and other resources from outer space that can be brought to Earth in total, and then each country would be allocated a right to a share. Space-faring nations could exploit their shares directly. Those nations that are as of yet unable to exploit space resources themselves could sell their mineral mining rights to nations that are both able to exploit the resources and willing to pay the price of the share. I feel that this system will not be feasible as there are multiple concerns regarding the equitable division of credits, place where the minerals will be mined by the nations. Also, this system will create an imbalance between the spacefaring nations and space incapable nations as there are higher chances of monopoly and control over the space

[182] Gershon Hasin, Reflections on the Adequacy of the Outer Space Treaty in the Modern Era, 42 Air & Space L. 125 (2017).

[183] Abigail D. Pershing, Interpreting the Outer Space Treaty's Non-Appropriation Principle: Customary International Law from 1967 to Today, Yale Law School Open Access Repository, https://openyls.law.yale.edu/server/api/core/bitstreams/53f751d8-60f8-41bc-a263-26bff3fd375f/content.

resources by the spacefaring nations. Another alternate method is renting of space land to national governments through a lease. I feel in this method only the spacefaring nations will be able to explore the space resources as they will be able to pay the lease amount. Similarly, the logic that the outer space treaty should be at par with the UNCLOS especially the International Seabed authority through which States and private companies can legally exploit ocean resources, including mining of the deep seabed will not work in the long run as it will lead to depletion of space resources in the same way in which the non-renewable sources of energy like fossil fuels and coals are being depleted. As correctly pointed out by Scot W Anderson, Korey Christensen & Julia LaManna[184], outer space is not the sea, and an asteroid is not an island or a distant land. Also, I feel if the space law applies the freedom of fishing principle exactly as given under the UNCLOS to the space resources, it will lead to a haphazard situation where all the countries will be in a race to grab most of the space resources which will benefit no one and may lead to a war. Unlike law of seas, outer space cannot be measured and divided into national sovereign limits like exclusive zones and open areas like high seas.

SOLUTIONS AND SUGGESTIONS

First method is to incorporate the specific parts of the domestic laws by various countries and add them in the Outer Space Treaty and the Moon Agreement. The provision of granting intellectual property rights for results generated by space activities as per the Concerning the Regulation of the Space Sector, 2023 domestic legislation enacted by UAE should be incorporated in the outer space treaty. This way both the entities can protect their rights and the same can be licensed by space faring nations to space incapable nations avoiding monopoly and ensuring that everyone can reap the benefits. The provision of commercialising, manufacturing and leasing space components, technologies and platforms as per the Indian Space Policy, 2023, domestic legislation enacted by India should be incorporated in the outer space treaty. This way international peace and co-operation among all the members for peaceful exploration of the space resources can take place which pave the way for common benefit for all and ensures that the space resources are being used considering the environmental effects. Provisions as to licensing, investigation of accidents, liability and insurance clause can be incorporated in detail as done in the domestic laws of UK and Japan. Second method is to remove all the provisions

[184] Scot W. Anderson, Korey Christensen & Julia LaManna, Outer Space is Not the Sea: Reassessing Analogies in Space Resource Law, Georgetown Journal of International Law, https://www.law.georgetown.edu/international-law-journal/wp-content/uploads/sites/21/2021/03/DEVELOPING-A-GLOBAL-ORDER-FOR-SPACE-RESOURCES-A-REGIME-EVOLUTION-APPROACH.pdf.

from the domestic laws which violate the principles of the Moon agreement and the Outer Space treaty so that there is no divergence between national law and international treaties. Third method is to generate awareness about the significance of outer space treaty and moon agreement in the modern era of globalisation. This will ensure that more countries ratify to the moon agreement. Fourth method is to realise that the dimensions of law of seas and outer space is different and the rights given under the law of seas cannot be directly applied to the outer space.

CONCLUSION

This paper starts with the discussion on the reasons and the steps involved in space exploration. It focuses on the shift from state playing an active role in space exploration to the private entities. It examines the Outer Space Treaty and Moon Agreement in detail showcasing its significance in the modern era of globalisation along with a critical analysis of domestic laws enacted by various legislation. It states the similarities and differences between the law of seas and outer space along with a critical analysis on suggestions given by various research scholars. It suggests the methods in which the parity between the domestic laws and international space laws can be reduced along with the benefits of those suggestions.