

Outer Space Commercial Mining: Ownership Rights and Contemporary Legal Issues

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Abstract

Prior to the beginning of the Cold War, exploration of outer space by explorers was majorly for scientific discoveries of new planets. But as time went by, governments and private entities began to explore further for natural resources that could be beneficial to the existence of man on earth. Such minerals that could be found in asteroids include iron, iridium, nickel, magnesium, gold, platinum, and palladium, among others. Although every nation of the world is believed to have equal right to outer space and the resources discovered therein, the commercialisation of space mining activities have seemingly restricted the control of these resources to world leading governments such as, the United State, China, Russia, Japan, France and some private enterprises who have the financial power for such activities. The goal of the article was to examine commercialisation, property rights and contemporary legal issues concerning outer space mining. Can private or non-governmental entities operate in the outer space without governmental authorisation and continuing supervision? How best could ensuing space mining disputes and environmental concerns be addressed? Doctrinal research method was adopted for this study to discuss fundamental issues and resolve questions raised by the article. This entailed the examination of available literature in the area plus existing international and domestic laws regulating outer space mining activities in order to give in-depth analysis of the subject matter and to support the position reached in the article. In concluding the article, the authors proffered some suggestions on the identified contemporary issues.

Keywords: Outer Space Commercial Mining; Outer Space Resources; Ownership Rights; Principle of Common Heritage of Mankind; Treaty.

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I. INTRODUCTION

Generally speaking and in the absence of a clear global agreement on the definition of “outer space,” the phrase could be described as relating to the whole area outside the earth’s atmosphere in which there are stars and planets [1]. But in a narrower and legal perspective, the term has been considered as referring to that region of the universe where human activities are virtually likely or feasible [2]; though apparently some activities that are conducted on the earth are also fundamentally connected to outer space

activities [3]. In an attempt to clear the uncertainties regarding the delimitation of the outer space and to provide a clear-cut borderline for the area, “non-space faring states” have joined in demanding for the determination of a well-defined boundary between the earth and the outer space [4].

¹ See “Definition of Outer Space”, *The Britannica Dictionary*; retrieved from, <https://www.britannica.com/dictionary/outer-space> (accessed on 3 March 2023).

² Thomas Neger and Edith Walter, “Space Law- An Independent Branch of the Legal System” in Christian Brunner and Alexander Soucek (eds.), *Outer Space in Society, Politics and Law* (New York: Springer Wien, 2011), 234-245 at p. 238.

³ Neger and Walter have identified such activities to include those operations that could be deemed as “facilitating access to and from outer space, like all kinds of launching and return facilities” as well as operations that regulate the activities and control of human conduct in outer space, such as activities relating to the functioning of satellites and other outer space systems- see Thomas Neger and Edith Walter, “Space Law- An Independent Branch of the Legal System,” *ibidem* at pp. 238-239.

⁴ Gbeng Oduntan, “Imagine There are No Possessions: Legal and Moral Basis of the Common Heritage Principle in Space Law” (2005) 2(1) *Manchester Journal of International Economic Law*, 30-59. See also

Von der Dunk argues that when it turns on defining the crux of global space law, it reflects upon a degree of lack of political determination to create “any rigid delimitation and definition ahead of technical or other developments which may tend to ignore such legal borderlines.” But the fact remains that even among those requiring a concrete definition and delimitation, there are significant divergent views regarding where the borderlines should be drawn [5]. This may explain why domestic space legislation, particularly in such situations of key actors in space endeavours, represent “state practice and *opinio juris*” essential for the development of international customary law [6]. Thus, national governments have addressed the issue of borderline between the earth and the outer space in their respective national laws even though such independent delimitations clearly lead to fragmentation and legal ambiguity [7].

Notwithstanding the absence of a uniform interpretation, definition and delimitation of outer space, it is however, pertinent to point out that since

Bin Cheng “International Responsibility for Launching Activities” (1995) 20(6) *Air and Space Law*, 297-310; DOI: <<https://doi.org/10.54648/aila1995041>> (accessed on 3 March 2023).

⁵ Fans G. von der Dunk, “The Delimitation of Outer Space Revisited- The Role of National Space Laws in the Delimitation Issue”, (1998) *Proceedings of the 41st Colloquium on the Law of Outer Space* (1998), 254-264; retrieved from <<https://digitalcommons.unl.edu/spacelaw/51>>(accessed on 3 March 2023).

⁶ Fans G. von der Dunk, “The Delimitation of Outer Space Revisited- The Role of National Space Laws in the Delimitation Issue”, *ibidem* at p. 256. In fact, Bin Cheng has identified three schools of thought on the delimitation and definition of outer space, namely: (a) the *spatialists*-who posits that logically, there should be legally defined delimitation of the end of domestic airspace and the commencement of the outer space; (b) the *functionalists*-who contend against the necessity of a determined delimitation since the legitimacy or illegitimacy of such space operations should, in their opinion, be decided purely by the nature of the activity or the space vehicle; and (c) the “you-don’t-need-to-know” school-which considers the determination of the borderline between airspace and outer space as being irrelevant or unnecessary- see generally Bin Cheng, “International Responsibility and Liability for Launch Activities,” *op.cit* at p. 298.

⁷Frans G. von der Dunk, “The Sky is the Limit- But Where does It End?” *Proceedings of the International Institute of Space Law at the Forty-Eighth Colloquium on the Law of Outer Space* (2005), 84-94; retrieved from <<https://digitalcommons.unl.edu/spacelaw/34>>(accessed on 3 March 2023).

inception of human history and existence, human civilisation and its gradual evolution have been characterised and driven by utilisation of natural resources for the production of tools to increase the productivity of each unit of the society [8]. The early launch of man into space in October 1957 by the former Union of Soviet Socialist Republic (USSR) *Sputnik 1* [9] and the Russian cosmonaut, Yuri Gagarin, becoming the first human in orbit in April 1961 via his *Vostok 1* spacecraft [10], did not only stimulate space competition but also caused technological advancement in outer space commercial activities. The competition for the exploration and use of discovered resources have existed among the world powers like the United State of America, Russia and China. Thus, the present emphasis on private commercial use of outer space cannot hide the fact that, to date, the governments of USA, Russia, Europe and Japan are among the leading entities in the exploration of outer space [11].

In statistical terms, as at 2022, the international government expenditure for space programmes was stated as being approximately \$103 billion, with the USA leading with expenditure of nearly \$62 billion on its space programmes; China was recorded with about \$12 billion; Russia spent about \$3.42billion; Japan \$4.9 billion and France- \$4.2 billion [12]. On the other hand, according to a 2020 African Space Industry Annual Report, the African continent spent about \$4 billion on satellite development and launch with an estimation that by 2024, at least 19 African nations would have launched satellites thereby bringing the total number of African satellites to about 110 in the outer space, from

⁸ Ricky J. Lee, *Law and Regulation of Commercial Mining of Minerals in Outer Space* (First Edition, Springer Science & Business Media, 2012).

⁹ National Aeronautics and Space Management, “NASA Space Science Data Coordinated Archive: Sputnik 1;” retrieved from <<https://nssdc.gsfc.nasa.gov/nmc/spacecraft/display.action?id=1957-001B>> (accessed on 3 March 2023).

¹⁰ Gregory McNamee, “This Soviet cosmonaut was the first human in orbit- fueling the space race,” (Updated 12 April 2021) *CNN*; retrieved from <<https://www.cnn.com/2021/04/12/world/space-race-yuri-gagarin-scen/index.html>>(accessed 3 March 2023)

¹¹Ricky J. Lee, *Law and Regulation of Commercial Mining of Minerals in Outer Space, op. cit.*

¹² Statista Research Department, “Government Space Programme Spending of the Leading Countries in the World 2020-2022;” retrieved from <<https://www.statista.com/statistics/745717/global-governmental-spending-on-space-programs-leading-countries/>> (accessed on 3 March 2023). Among the leading countries in outer space programmes are USA, China, Japan, France, Russia, Germany, India, Italy, United Kingdom, South Korea and European Union.

the current 41 satellites [13]. Indeed, Nigeria is one of the developing African countries directing her limited resources at a minimal but considerable scale towards outer space programmes for socio-economic gains as well as national pride. In the 2020 national annual budget of Nigeria, about \$59.26 million was allocated to space activities; the National Space Research and Development Agency (NASRDA) got \$44.18 million, representing about 75 per cent of the entire budget allocated for space programme, while the Nigerian state-owned satellite operator (NigComSat) was allocated \$9.54 million, accounting for about 16 per cent of the released funds [14].

As a result of outer space activities by countries, there was need for adoption of treaties to guide exploration and mining of outer space resources. Through the efforts of the United Nations Committee on the Peaceful Uses of Outer Space and its Legal Subcommittee (UNCOPUOS Legal Subcommittee), a number of considerable contributions in the area of outer space framework have been recorded, including the adoption of relevant treaties and resolutions. The initial step towards providing a global cooperation towards formulation of necessary global rules to regulate the outer space led to the adoption of the 1963 Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space.

Other subsequent multilateral global instruments that were similarly adopted by the UN included the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies 1967 (Outer Space Treaty or OST) [15]; Agreement on the Rescue of Astronauts and the Return of Objects Launched into Outer Space 1967 [16]; Convention on International Liability for Damage Caused by Space Objects 1971 [17]; Agreement Governing the Activities

of States on the Moon and Other Celestial Bodies [18]; Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space [19]; and Declaration on International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interest of All States, Taking into Particular Account the Needs of Developing Countries 1996 [20], among others.

At the time when the OST was adopted, along with other allied United Nations General Assembly (UNGA) resolutions, the outer space was mainly dominated by the political interests of the two significant space powers, namely, the USA and the then USSR. Even though countries have remained the major players in controlling the exploitation of outer space, but the scope or role in which private entities would later become engaged in exploration activities of the outer space was not contemplated at the material time [21]. Thus, the growth of private companies' involvements in outer space exploration activities has further introduced some complications to the conventional understanding of the ban on national sovereignty in outer space and the concept of the common heritage of all mankind and property rights in the outer space [22].

It is worth noting that some countries and individuals do not recognise some of these existing treaties and rights to exploration of natural resources in the outer space because it is believed that these rights are reserved for certain nations. Further, it has been acknowledged that the existing body of space laws is very ill-adapted to the world's commercial realities in the space industry today [23], considering the level of

¹³ See African Space Industry Annual Report, 2020 Edition; retrieved from <<https://africanews.space/despite-ongoing-pandemic-africa-is-investing-more-in-space-and-satellite-industry/>> (accessed 3 March 2023).

¹⁴ Chukwuma Muanya and Victor Uzoho, "How far with Nigeria's Space Dream" (14 January 2021) *The Guardian*; retrieved from <<https://guardian.ng/features/how-far-with-nigerias-space-dream/>> (accessed on 3 March 2023).

¹⁵ UNGA Resolution 2222(XXI) adopted on 19 December 1966; entered into force on 10 October 1967.

¹⁶ UNGA Resolution 2345(XXII) adopted on 19 December 1967; entered into force on 3 December 1968.

¹⁷ UNGA Resolution 2777(XXVI) adopted on 29 November 1971; entered into force 15 September 1976.

¹⁸ UNGA Resolution 34/68 adopted on 5 December 1979; entered into force on 11 July 1984.

¹⁹ UNGA Resolution 1962 (XVIII) adopted on 13 December 1963.

²⁰ UNGA Resolution 51/122 adopted on 13 December 1996.

²¹ Anel Ferreira-Snyman, "Challenges to the Prohibition on Sovereignty in Outer Space- A New Frontier for Space Governance" (2021) 24(1) *Potchefstroom Electronic Law Journal* (PELJ), 1-50; DOI: <<http://dx.doi.org/10.17159/17273781/2021/v24i0a8685>> (accessed on 3 March 2023). See also, Ezra J. Reinstein, "Owning Outer Space" (1999) 20(1) *Northwestern Journal of International Law & Business* (NWJILB), 59-98.

²² Anel Ferreira-Snyman, "Challenges to the Prohibition on Sovereignty in Outer Space- A New Frontier for Space Governance," *ibidem* at p.3; see also, Eric Husby, "Sovereignty and Property Rights in Outer Space", (1994) 3 *Journal of International Law & Practice*, 359.

²³ Nina Tannenwald, "Law Versus Power on the High Frontier: The Case for a Rule-Based Regime for Outer Space" (2004) 29(2) *The Yale Journal of International Law*, 363-422; Andrew T. Park, "Incremental Steps for

technological development of certain countries of the world. The reality of commercial mining in outer space in 1960s was unconceivable or envisaged for the nearest future [24]; hence, the absence of a robust legal framework. However, with the level of exploration in outer space now, commercial activities are inevitable. Consequently, having legal framework to address outer space mining operations and other contemporary legal issues arising out of such activities, based on the vacuum in international and domestic law, become imperative in the circumstances.

II. RESEARCH METHOD

The article adopted conceptual-analytical legal research methodology through which library-based doctrinal method was used to critically examine both primary and secondary sources of information. The primary sources of information included some global treaties and national instruments. The secondary sources were the available literature and other related global, regional and national reports, among others. The method adopted aided in supporting the study and the conclusion arrived at.

III. RESULTS AND DISCUSSION

1. Outer Space Mining and the Principle of Common Heritage of Mankind

A fundamental omission in the body of laws governing space-related activities is the neglect to attempt a definition of outer space mining. This has expanded the frontiers of space mining, thereby delimiting the settled principles of space law which are based on two basic principles: the right of states to scientific exploration of outer space and its celestial bodies; and the prevention of unilateral and unbridled commercial exploitation of outer-space resources. Many ethical questions arise from the difficulty of defining the term “space.” Scholars not only debate its geographical definition (i.e. upper and lower limits), but also whether or not it also encompasses various objects within it (i.e. celestial objects, human beings, man-made devices).

The lower limits are generally identifiable, but difficulties arise trying to define the upper bounds of “space,” as it would require more inquiry into the demarcation between airspace and outer space, nature of the universe and the role of earth [25]. Providing a solution to the issue of demarcation is vital because it will help in determining which activities could be classified as space activities under international law and

what activities are to be regulated by other legal regimes. Unlike airspace which comes within the purview of the territorial sovereignty of the underlying state [26], international law on the hand enjoins that the outer space is not a subject of national sovereignty [27]. The growing need for a clear-cut definition so as to prevent ambiguities and conflict situations is therefore, inescapable [28].

Outer space mining involves the exploration and extraction of space minerals by government or private organisations for financial or developmental purpose and to benefit all irrespective of the degree of their economic or scientific development. The implication of this is that the purposes to which space minerals are explored and extracted may differ according to interests of the parties involved. In balancing these differences, it was proposed that the deep seabed and celestial bodies should be a common heritage of mankind (CHM) [29]; however, the industrialised and developing states took different views as to the content of this doctrine. The industrialised state saw the concept as providing that all states shall have access to the benefit derived from the resources contained in those spatial areas and nothing more [30]. The developing states on the other hand believed that industrialised countries would be required to share their profits from these spatial areas. This acclaimed right by the industrialised and developing states did not envisage rights of individuals and corporations in the mining industry under the Moon Agreement [31].

As a matter of fact, the Moon Agreement also recognises the phraseology, “province of all mankind” in addition to the CHM concept. While Article 11(1) of the Agreement provides: “[t]he moon and its natural resources are the *common heritage of mankind*,” Article

²⁶ See for instance, the Convention on Civil Aviation 1944, (1944) UNTS 295.

²⁷ Thomas Neger and Edith Walter, “Space Law- An Independent Branch of the Legal System” in Christian Brunner and Alexander Soucek (eds.) *Outer Space in Society, Politics and Law* (New York: Springer Wien, 2011), 234-245 at p. 239.

²⁸ Gbenga Oduntan, “The Never Ending Dispute: Legal Theories on the Spatial Demarcation Boundary Plane Between Airspace and Outer Space” (2003) *Hertfordshire Law Journal*, 64-84 at p. 66.

²⁹ Actually, the Outer Space Treaty, 1967 uses the phrase, “province of all mankind”- see Article I.

³⁰ H. S. Rana, “The Common Heritage of Mankind and the Final Frontier: A Revaluation of Values Constituting the International Legal Regime for Outer Space Activities” (1994) 26(1) *Rutgers Law Journal*, 225-250 at p. 231; Grier C. Raclin, “From Ice to Ether: The Adoption of a Regime to Govern Resources Exploitation in Outer Space” (1986) 7(4) *Northwestern Journal of International Law & Business*, 727-761.

³¹ Moon Agreement 1979, Article 11(2).

Achieving Space Security: The Need for a New Way of Thinking to Enhance the Legal Regime for Space” (2006) 28 *Houston Journal of International Law*, 81.

²⁴ H. Reis, “Some Reflection on the Liability Convention of Outer Space” (1978) 6 *J.SP.L* 161

²⁵ J. Arnould, *Icarus' Second Chance: The Basis and Perspectives of Space Ethics* (First Edition, Springer Wien, 2011).

4(1) requires that the “exploration and use of the moon shall be the *province of all mankind*.” The simultaneous use of both phrases in the Moon Agreement tend to suggest that both terms emphasis different things though they are directed towards the accomplishment of the same objective. While Article 4(1) stresses the collaboration of state parties in all their activities in relation to the moon and other celestial bodies, a community reading of Articles 11 and 5 suggest that the CHM principle is further clothed with legal teeth [32]. The principle of CHM has been recognised in various other UN agreements as relating to the common regions of Antarctica, outer space, the high seas and the seabed [33] and consequently, cannot be dominated by any country or assemblage of countries other than for the benefit and in the interest of all mankind [34], including those countries without technological knowledge for the exploration of natural resources in the outer space [35]. But it is uncertain whether the idea of “benefit-sharing” responsibility implies fiscal compensation or if technological expertise must be transferred and shared pragmatically or if it only entails that the outer space must be utilised in a non-injurious manner [36].

In this connection, it is vital to mention that the Declaration on International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interest of all States, Taking into Particular

Account the Needs of Developing Countries (the Declaration on Space Benefit) 1996 [37] gives states the liberty to decide all facets of their involvement in global collaboration in the exploration and utilisation of the outer space on an “equitable and mutually acceptable basis” and that where such involves contractual terms, such should be in “full compliance with legitimate rights and interests of the parties concerned [38].” Consequently, Ferreira-Snyman argues that there seems to be no common responsibility on space-faring states to offer benefits obtained from their space operations to non-space-faring countries [39]. This position is further strengthened by Hobe who contends that the Declaration on Space Benefit “makes it clear that it remains the sovereign and free decision of any state to decide with which country to cooperate and which country to support [40].” In fact, the USA, through her Executive Order 13914 of April 2020 expressly stated that the outer space is “a legally and physically unique domain of human activity, and the United States does not view it as a global commons [41].”

These opinions may not be unconnected with the arguments advanced by developed countries that it would be innately inequitable for states that did not contribute financially or technologically towards outer space exploration activities to benefit from such exploitative or explorative operations purely on the “benefit-sharing” basis and that such approach would not encourage even the less-developing states to “develop technology or fund exploration” activities in the outer space [42]. This makes the developed nations to assume that anyone can exploit the natural resources

³² Gbeng Oduntan, “Imagine There are No Possessions: Legal and Moral Basis of the Common Heritage Principle in Space Law” (2005) 2(1) *Manchester Journal of International Economic Law*, 30-59 at pp. 33-34.

³³ C. Q. Christol, “Evolution of the Common Heritage of Mankind Principle” (1981) *Western State University International Law Journal*, 63-75; Carl Q. Christol, “The Common Heritage of Mankind Provision in the 1979 Agreement Governing the Activities of States on the Moon and Other Celestial Bodies,” (1980) 14(3) *The International Lawyer*, 429-483.

³⁴ Y. Schmidt, “International Space Law and Developing Countries” in Christian Brunner and Alexander Soucek (eds.) *Outer Space in Society, Politics and Law* (New York: Springer Wien, 2011), 690-725 at p. 696; L. M. Fountain, “Creating Momentum in Space: Ending the Paralysis Produced by the Common Heritage of Mankind Doctrine” (2003) 35 *Connecticut Law Review*, 1753-1788 at p. 1759.

³⁵ Christopher C. Joyner, “Legal Implications of the Concept of the Common Heritage of Mankind,” (1986) 35(1) *The International and Comparative Law Quarterly*, 190-199 at p. 197.

³⁶ Anel Ferreira-Snyman, “Challenges to the Prohibition on Sovereignty in Outer Space- A New Frontier for Space Governance,” *op. cit.* at pp.7-9; Melissa K. Force, “The Paradox of United States’ Position on Regulation of Space Resource Extraction” (2016) *Proceedings of the International Institute of Space Law*, 259-277 at p. 271.

³⁷ UNGA Resolution 51/122, UN Doc A/RES/51/122 (1996).

³⁸ *Ibidem*, para.2.

³⁹ Anel Ferreira-Snyman, “Challenges to the Prohibition on Sovereignty in Outer Space- A New Frontier for Space Governance,” *op. cit.* at p.9.

⁴⁰ S. Hobe, “Article 1” in S. Hobe, B. Schmidt-Tedd and K. U. Schrogl (eds.) *Cologne Commentary on Space Law*, Volume 1 (Carl Heymanns Verlag Koln, 2009), 25-43 at pp. 41-42.

⁴¹ See Presidential Executive Order 13914 of April 6, 2020, “Encouraging International Support for the Recovery and Use of Space Resources”, section 1, (2020) 85(70) *Federal Register*, April 10, 2020; retrieved from <https://www.federalregister.gov/documents/2020/04/10/2020-07800/encouraging-international-support-for-the-recovery-and-use-of-space-resources#print> (accessed on 23 April 2023).

⁴² Carol R. Buxon, “Property in Outer Space: The Common Heritage of Mankind Principle vs. the First in Time, First in Right, Rule of Property” (2004) 69(4) *Journal of Air Law and Commerce*, 689-707 at p. 693. See also Stephen D. Mau, “Equity, the Third World and the Moon Treaty,” (1984) 8 *Suffolk Transnational Law Journal*, 221 at 232-233.

found in the area of the so-called “common heritage of all mankind” as no particular country can claim exclusive sovereignty over it [43]. In fact, the concept of CHM entrenched in the OST and the Moon Agreement has been identified as a significant contributor towards the delay in commercialisation and growth of outer space [44]. Thus, Ferreira-Snyman, relying on Joyner [45], posits that the CHM, like the outer space, is to be considered as “an inheritance passed on to future generations, and a failure to protect the interests of these generations would result in breaching the obligation implicit in managing and protecting such heritage” as the resources in the region are susceptible to disastrous state of competition, overexploitation and degradation [46]; particularly in the outer space with its abundant untapped resources which is a major attraction to both state actors and private entities [47].

2. Exploration and Ownership Rights of Outer Space Resources

It is the exploration and extraction segment of mining operations that often encounter most of the legal obstacles, particularly rights to resources; and they are more complex to resolve [48]. As earlier noted, the various adopted space law treaties and principles stress the notion that the outer space, the activities conducted therein and whatever benefits might be accrued from the outer space, must be dedicated to promoting the welfare of all countries and humanity with emphasis on enhancing global collaboration. The treaties also cover issues of non-appropriation of outer space by any given

nation, autonomy of exploration, prevention of injurious interference with space activities and the environment [49] and that activities carried out in the outer space must not only conform with international law but that the nations undergoing such activities must accept responsibility for the governmental or non-governmental agency involved [50].

The freedom of access and non-appropriation found in Articles I and II of the OST 1967 in particular, make mining activities on celestial bodies difficult, if not impossible to lay patent claim to in law. This is because some degree of exclusionary rights in the area of asteroids being mined is seen as contrary to those legal principles set out in the OST [51]. Without the ability to exclude third parties and protect the legal rights of a miner, a commercial miner would have no protection for its financial investments as he would be unable to prevent a third party from extracting mineral resources from the same site [52]. The tension created by prohibiting exclusive property right is a symptom of the conflict between the principle of international space law and contemporary commercial application of space law [53].

The ability to grant exploitation and property rights over natural resources is normally an attribute of a state’s sovereign power over the territory in question. Unfortunately, the OST does not directly address resources exploitation and property rights in outer space. While some writers have stated that Article II of the OST disallows only national appropriation and not private appropriation, others submit that in view of the fact that states must approve private appropriation, then, it invariably means that such endorsement of private appropriation is indeed state appropriation which renders private appropriation difficult within the contemplation of the OST. By necessary implications, it means therefore, that neither state nor private entities can exercise absolute claim or sovereignty over the outer space, the moon and other celestial bodies[54].

⁴³ Mary E. Schwind, “Open Stars: An Examination of the United States Push to Privatise International Telecommunications Satellites” (1986) 10 *Suffolk Transnational Law Journal*, 93 at p. 97.

⁴⁴ L. M. Fountain, “Creating Momentum in Space: Ending the Paralysis Produced by the Common Heritage of ‘Mankind Doctrine’,” (2003) 35(4) *Connecticut Law Review*, 1753-1787 at p. 1760., F. Lyall and P. B. Larsen, *Space Law: A Treatise* (Second Edition, London: Routledge, 2017), 182.

⁴⁵ Christopher C. Joyner, “Legal Implications of the Concept of the Common Heritage of Mankind,” (1986) 35(1) *The International and Comparative Law Quarterly*, *op.cit* at p. 195.

⁴⁶ Anel Ferreira-Snyman, “Challenges to the Prohibition on Sovereignty in Outer Space- A New Frontier for Space Governance,” *op. cit* at p.12.

⁴⁷ Hope M. Babcock, “The Public Trust Doctrine, Outer Space, and the Global Commons: Time to Call Home ET,” (2019) 69 *Syracuse Law Review*, 191-262 at pp. 237-239. See also Sheila R. Foster and Christian Iaione, “The City as Commons,” (2016) 34 *Yale Law & Policy Review*, 281 at pp. 285-287.

⁴⁸ R. Lee, “Creating Practical Legal Framework for the Commercial Exploitation of Mineral Resources in Outer Space” (Published Thesis Work, Murdoch University, 2010).

⁴⁹ *United Nations Office for Outer Space Affairs*, “Space Law Treaties and Principles”; retrieved from <<https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties.htm>> (accessed on 3 March, 2023). See also

⁵⁰ Fabio Tronchetti, “Current International Legal Framework Applicability to Space Resource Activities”, IISL/ECSL Space Law Symposium 2017, Vienna, 27 March 2017; retrieved from <<https://www.unoosa.org/documents/pdf/copus/lsc/2017/symp-01.pdf>> (accessed on 3 March, 2023).

⁵¹ Outer Space Treaty, Article 1(3); see also Moon Agreement, Article 11.

⁵² *Ibidem*.

⁵³ *Ibidem*.

⁵⁴ L. M. Fountain, “Creating Momentum in Space: Ending the Paralysis Produced by the Common Heritage of Mankind Doctrine” (2003) 35 *Connecticut Law Review*, 1753-1788 at p. 1754., F. Lyall and P. B.

On the other hand, the Moon Agreement is the only global instrument arguably prohibiting private ownership over lunar natural resources [55]. It is argued that by the provision of Article 11(3), the Moon Agreement does not preclude any modality of exploitation, by public or private entities, or prohibit the commercialisation of such resources, provided that such exploitation is compatible with the principle of CHM [56]. Slipping conveniently through the loophole in the OST, both the USA and Luxembourg have authorised private entities to claim exclusive ownership over extracted resources (but not of the asteroid itself) [57].

The US Commercial Space Launch Competitiveness Act 2015 (US CSLCA 2015) provides for private ownership over the extracted space resources in the following terms: “[a] United States citizen engaged in commercial recovery of an asteroid resource or a space resource under this chapter shall be entitled to any asteroid resource or space resource obtained, including to possess, own, transport, use, and sell the asteroid resource or space resource obtained in accordance with applicable law, including the international obligations of the United States [58].” However, with regards to the mineral resources extracted for commercial purposes, investors should enjoy at least a level of exclusive property right on space resources, so as to protect patent rights, inventions and discoveries. It is evident that at some point, national governments and/or private companies will clash over the right to exploit a given mineral deposit [59]. As such a development regime which

provides some form of property rights will become increasingly necessary as space develops [60].

The essence of this real property rights regime is to provide legal and political certainty, such that investors and settlers would be able to predict the outcome of a conflict with greater certainty by analogising to terrestrial property law. Also, settlers and developers would be reassured, knowing that other nations would respect their rights to retain specific resources [61]. No doubt, these rights may not be found in all domestic legal regimes; the source of such rights, if they exist, must therefore, be found in the international law framework [62]. Once there is a robust legal framework to protect public or private exploration and mining rights, conflict as to ownership of outer space and its extracted minerals would be addressed and resolved.

3. Commercialisation of the Outer Space Resources

As pointed out earlier, the United Nations Office for Outer Space Affairs (UNOOSA), created in 1958 finalised five primary space treaty instruments between 1967 and 1979. All these treaties were concluded during the Cold War era and mirrored Cold War concerns and aspirations, with substantially not as much emphasis on modern day anxieties about space resources, commercialisation and production [63]. For instance, one major worry during the period was the need to prevent countries, especially the super powers, from claiming ownership of the space and the other celestial bodies and employing them for weaponisation against other nations. So, the issue of addressing emerging challenges which the body of space laws is confronted with in contemporary times regarding the obtainment and claiming resources from outer space and other celestial bodies was not a priority then [64].

Larsen, *Space Law: A Treatise* (Second Edition, London: Routledge, 2017), 171.

⁵⁵ Moon Treaty, 1979, Article 11(3).

⁵⁶ *Ibidem*, Article 11(1); Article 11(4) reflects the wordings of Article I(2) of the OST which complements the provisions of Article 6(1) of the Moon Agreement by expressly addressing the right of exploration and use. These provisions in the Moon Agreement confirm the right to freedom of exploration, use and scientific investigation on the moon and other celestial bodies without discrimination of any kind, on the basis of equality and in accordance with international law.

⁵⁷ Senjuti Mallick and Rajeswari Pillai Rajagopalan, “If Space is ‘the Province of Mankind’, Who Owns its Resources?: An Examination of the Potential of Space Mining and its Legal Implications in The Potential of Space Mining and its Legal Implications,” *Observer Research Foundation Occasional Paper No. 182*, January 2019, p. 6; retrieved from <https://www.orfonline.org/wp-content/uploads/2019/01/ORF_Occasional_Paper_182_Space_Mining.pdf> (accessed on 15 March 2023).

⁵⁸ Space Act, 2015, section 402§51302.

⁵⁹ Wayne N. White, “Real Property Rights in Outer Space”, A paper delivered at the International Institute of Space Law’s 40th Colloquium on the Law of Outer Space, 1998; published by the American Institute of

Aeronautics and Astronautics, Inc; retrieved from <https://www.space-settlement-institute.org/Articles/research_library/WayneWhite98-2.pdf> (accessed on 15 March, 2023).

⁶⁰ *Ibidem*.

⁶¹ *Ibidem*.

⁶² Sarah Jane Fox, “Space: The Race for Mineral Rights, ‘The Sky is No Longer the Limit’ Lessons from Earth!” (2016) 49 *Resources Policy*, 165-178 at p.174.

⁶³ Sarah Coffey, “Establishing a Legal Framework for Property Rights to Natural Resources in Outer Space” (2009) 41(6) *Case Western Reserve Journal of International Law*, 119-147 at p. 120; Kevin MacWhorter, “Sustainable Mining: Incentivizing Asteroid Mining in the Name of Environmentalism,” (2016) 40(2) *William & Mary Environmental Law and Policy Review*, 645-676 at p. 652.

⁶⁴ Joanne Irene Gabrynowicz, “Space Laws: Its Cold War Origins and Challenges in the Globalisation,” (2004) 37(4) *Suffolk University Law Review*, 1041 at p. 1043.

The moon and other celestial bodies, such as Mars and asteroids, contain exceptionally valuable minerals that are now scarce or simply non-existent on earth and the exploration of the outer space will greatly assist in increasing the limited mineral resources on the planet earth. This discovery has made outer space a potentially high profit industry for easy commercialisation, to the extent that countries are substantially involving private entities in space operations like exploration and transportation [65]. Aside from the economic gains associated with the commercialisation of the outer space, research findings have also noted that space activities can assist in minimising detrimental environmental consequences of terrestrial mining as well as lower overpopulation on earth [66].

With regard to the exploitation of space resources, it is worth reiterated that OST 1967 does not bar private actors from accessing the space for activities but imposes obligations on state parties with respect to activities, including requiring state parties to take global responsibility for acts of its nationals [67]. Besides, the provision of Article VI is not self-executing as it requires an explicit national law applying it to a private space activity and conveying right over that precise activity to an appropriate national agency [68]. As it is, the OST does not expressly refer to commercial activities nor does it explicitly state that non-state

enterprises are also beneficiaries of the freedoms the treaty provides [69].

The non-inclusion of commercial activities in OST has therefore, not prevented sovereign states from adopting national statutes permitting exploration and exploitation of outer space for commercial purposes. For example, the United State Congress passed the US CSLCA 2015; Title IV of the statute covers commercial exploration and commercial recovery of space resources by the US citizens [70]. Accordingly, the president of the USA, acting through relevant federal agencies, is empowered by the statute to promote the right of US citizens to engage in commercial exploration for and commercial recovery of space resources free from injurious intrusion in compliance with global duties of the US and subject to approval and continued supervision by the US federal government [71].

The US national law however, recognises minimum governmental intervention in the sense that governmental barriers should not discourage “the development in the United States of economically viable, safe, and stable industries for commercial exploration for and commercial recovery of space resources” in a way that is consonance with the global obligations of the US [72]. In actual fact, the US has made it sufficiently evident that it should have the legitimate right to engage in commercial exploration, recovery, and use of resources in outer space, consistent with appropriate law [73]. This implies, for instance, that it has become part of the US space policy to encourage global collaboration towards public and private recovery and utilisation of resources in outer space in a manner that is consistent with relevant law.

It is worthy of note that Luxembourg became the second country after the US and the first European country to provide a national legal regime on exploration and utilisation of space resources. Article 1 of Law of 20th July 2017 on the Exploration and Use of

⁶⁵ Hope M. Babcock, “The Public Trust Doctrine, Outer Space, and the Global Commons: Time to Call Home ET,” (2019) 69 *Syracuse Law Review*, 191-262 at p. 198.

⁶⁶ *Ibidem*, at p. 202. See also Linda Billings, “How Shall we live in Space? Culture, Law and Ethics in Spacefaring Society”, (2006) 22(4) *Space Policy*, 249-255; Martyn J. Fogg, “The Ethical Dimensions of Space Settlement” (2000) 16(3) *Space Policy*, 205-211.

⁶⁷ OST 1967, Article VI. See also Laura Montgomery, “US Regulators May Not Prevent Private Space Activity on the Basis of Article VI of the Outer Space Treaty,” *Mercatus Working Paper*, Mercatus Centre at George Mason University, Arlington, 2018; retrieved from

<<https://www.mercatus.org/publications/regulating-private-space-activity-outer-space-treaty>>(accessed on 15 March 2023); Frans G. von der Dunk “The Origins of Authorisation: Article VI of the Outer Space Treaty and International Space Law” in Frans G. von der Dunk (ed.) *National Space Legislation in Europe: Issues of Authorisation of Private Space Activities in the Light of Developments in European Space Cooperation, Studies in Space Law*, Volume 6 (Leiden, The Netherlands: Martinus Nijhoff Publishers, 2011), 3-28 at pp. 4-8.

⁶⁸ Laura Montgomery, “US Regulators May Not Prevent Private Space Activity on the Basis of Article VI of the Outer Space Treaty,” *ibidem*.

⁶⁹Stephan Hobe *et. al*, *Cologne Commentary on Space Law- Outer Space Treaty*, Vol.1 (Carl Heymanns Verlag KG, 2009).

⁷⁰U.S. Commercial Space Launch Competitiveness Act 2015, §51302; retrieved from <<https://www.congress.gov/114/plaws/pub190/PLAW-114pub190.pdf>> (accessed on 15 March 2023).

⁷¹ *Ibidem*, §51302(a)(3).

⁷² *Ibidem*, §51302(a)(2).

⁷³ See Presidential Executive Order 13914 of April 6, 2020, “Encouraging International Support for the Recovery and Use of Space Resources”, section 1, (2020) 85(70) *Federal Register*, April 10, 2020; retrieved from <<https://www.federalregister.gov/documents/2020/04/10/2020-07800/encouraging-international-support-for-the-recovery-and-use-of-space-resources#print>> (accessed on 23 April 2023).

Space Resources [74] undoubtedly recognises property rights for space resources by boldly asserting that “[s]pace resources are capable of being owed.” This provision among other things, offers private operators certainty regarding their rights on resources extracted from the space. The Luxembourg law equally stipulates regulations for the approval and management of private space exploration mission, inclusive of both exploration and utilisation of space resources. By its Article 2, the exploration or use of space resources is prohibited without relevant prior ministerial authorisation for such mission. Akin to the position of the US, not only is Luxembourg not a party to the Moon Agreement but the Luxembourg legislation also failed to indicate the purpose or result of paving the way for national appropriation of outer space, including the moon or any other celestial body except that it “clarifies Luxembourg’s national position on the status of the resources that can be extracted from those celestial bodies and in space in general [75].”

Under the *res communis* regime, outer space is open to all countries for access and use on the basis of equality and is not subject to appropriation [76]. Consequently, states are free to conduct commercial activities in outer space, including the moon and other celestial bodies, without having to seek prior permission to other governments [77]. As we stated previously, Babcock [78] and Ferreira-Snyman [79] have posited that apprehensions over space colonisation were the primary catalyst for the concept of non-appropriation in the OST which was developed in the midst of the Cold War space competition between the US and the defunct USSR. Thus, the formulation of legal regulations to deal with the privatisation and commercialisation of outer space resources was not of foremost concern to the drafters of the treaty. Consequently, while Article I

of the OST encourages the exploration and use of the outer space by creating the principle of free use and access, Article II of the treaty goes further to qualify the extent of such exploration.

4. Some Global Legal Framework on Outer Space Activities

Through the efforts of the United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUS) and its Legal Subcommittee (UNCOPUS Legal Subcommittee), a substantial volume of global treaties and rules have been formulated to regulate the harmonious use of the outer space. Some of the body of rules codified to regulate global relations in outer space’s exploration and exploitation of activities would be examined briefly in this sub-head:

a. *The Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies 1967 (The Outer Space Treaty or OST)* [80]

At the time when the OST entered into force in 1967, space exploration was still in its cradle; only ten years had elapsed since the Russian government successfully launched the first satellite into space and merely 6 years after the first human orbited the earth [81]. The OST 1967 therefore, provided a common legal foundation for peaceful uses of outer space for the interest of all countries regardless of the extent of their economic or scientific advancement as it laid down vital framework and principles on development of global space law [82]. Based on the premise of *res communis*, the treaty acknowledged the outer space as the “province of all mankind” and forbids national appropriation by claim of sovereignty of outer space or

⁷⁴The English version of the legislation is available at <https://space-law.keio.ac.jp/pdf/datebase/each_countries/luxembourg/space_resources.pdf> (accessed on 15 March 2023).

⁷⁵ Luxembourg Space Agency, “Legal Framework- International Space Law”; retrieved from <<https://space-agency.public.lu/en/agency/legal-framework.html>> (accessed on 15 March 2023).

⁷⁶ Fabio Tronchetti, “The Moon Agreement in the 21st Century: Addressing its Potential Role in the Era of Commercial Exploitation of the Natural Resources of the Moon and Other Celestial Bodies,” (2010) *Journal of Space Law*, 498-524 at p. 496.

⁷⁷Stephan Hobe *et. al*, *Cologne Commentary on Space Law- Outer Space Treaty*, Vol.1 (Carl Heymanns Verlag KG, 2009), p.35

⁷⁸ Hope M. Babcock, “The Public Trust Doctrine, Outer Space, and the Global Commons: Time to Call Home ET,” *op cit*. at pp. 208-209.

⁷⁹ Anel Ferreira-Snyman, “Challenges to the Prohibition on Sovereignty in Outer Space- A New Frontier for Space Governance,” *op. cit* at p.12.

⁸⁰ Adopted 19 December 1966 and entered into force in October 1967; 610 U.N.T.S. 205; 19 UST 7570. The treaty which was initially opened for signature by the three depository governments- the Russian Federation, the United Kingdom and the United States of America in January 1967 has at present about 113 State Parties. See United Nations Office for Outer Space Affairs, “Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies”; retrieved from <<https://www.unoosa.org/oosa/SpaceLaw/outerspt.html>>(accessed on 15 March 2023).

⁸¹ Sarah Coffey, “Establishing a Legal Framework for Property Rights to Natural Resources in Outer Space,” (2009) 41(6) *Case Western Reserve Journal of International Law*, *op. cit* at p. 120.

⁸² United Nations Office for Outer Space Affairs, “Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies”; retrieved from <<https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/introouterspacetreaty.html>> (accessed on 15 March 2023).

any celestial body through the medium of use or occupation and/or by other process [83].

It is mostly a non-armament treaty but offers insufficient and ambiguous regulations to newer space activities such as lunar and asteroid mining [84]. Article I, explicitly provides that states are free to explore and use outer space and to access all celestial bodies based on parity and in accordance with international law but failed to mention mining activities [85]. The inference of this is that exploration of outer space may or may not include mining activities. If it includes mining activities, then mining in outer space is legal and if exploration of outer space does not include mining, then mining activities in space become illegal, although not explicitly stated.

The property rights of private entities over mined resources in the moon is yet unresolved resulting in a growing discussion within scientific, entrepreneurial and policy circles and which is further complicated by evolving landscape of stakeholders in space [86]. However, both the United States and Luxembourg authorise non-governmental entities to claim exclusive ownership over extracted resources. While the US commercialisation space statute offers firm right to its citizen involved in commercial recovery of an asteroid resources or space resources to be entitled to the extracted resources obtained from the outer space (including to possess, own, transport, use and sell the obtained resources) [87], the Luxembourg statute is a bit different in that it does not entail a company's key investors to be domiciled in the country; it is enough if

the company has the registered office in the country [88].

It has been posited that since no sovereign nation is asserting rights or claim over an area of outer space, instead, it is only a private unit claiming rights over singular resources, the provisions of the OST concerning "national appropriation by claim of sovereignty," is not being breached [89]. In essence therefore, the fact that legally speaking, no country can lay claim to any part of the outer space as a national territory does not necessarily imply that a private enterprise cannot mine resources therefrom [90].

b. The Agreement Governing the Activities of States on the Moon and Other Celestial Bodies 1979 (The Moon Agreement 1979) [91]

The Moon Agreement was reflected on and developed by the UNCOPUS Legal Subcommittee between 1972 and 1979 before it was later adopted by UNGA. The Agreement reiterates and amplifies on some of the clauses of the OST 1967 as relevant to the moon and other celestial bodies, establishing a basic legal framework for the exploration and exploitation of the moon and other celestial bodies [92]. The freedom of exploration and the use of moon and other celestial bodies to encourage scientific investigation thereof was a major consideration in drafting the Agreement. The Moon Agreement permits governmental as well as private entities to explore and use the moon and other celestial bodies wholly for peaceful reasons [93]. It specifically establishes the right to collect and remove samples from the moon and other celestial bodies for

⁸³ Outer Space Treaty 1967, Articles I & II.

⁸⁴ Senjuti Mallick and Rajeswari Pillai Rajagopalan, "If Space is 'the Province of Mankind', Who Owns its Resources?": An Examination of the Potential of Space Mining and its Legal Implications in The Potential of Space Mining and its Legal Implications," *Observer Research Foundation Occasional Paper No. 182*, January 2019, p. 11; retrieved from <https://www.orfonline.org/wp-content/uploads/2019/01/ORF_Occasional_Paper_182_Space_Mining.pdf> (accessed on 15 March 2023).

⁸⁵ *Ibidem*.

⁸⁶ Leonard David, "Mining the Moon? Space Property Rights still Unclear, Experts Say" (25 July 2014) *Space Insider*; retrieved from <<https://www.space.com/26644-moon-asteroids-resources-space-law.html>> (accessed on 15 March 2023); S.W Anderson and K. Christensen and J. LaManna, "The Development of Natural Resources in Outer Space" (2018) 1 (1) *Journal of Energy and Natural Resources Law*, 1-15; Jinyuan Su, "Legality of Unilateral Exploitation of Space Resources under International Law" (2017) 66(4) *International and Comparative Law Quarterly*, 991-1008.

⁸⁷ See section 402 §51303 of the statute.

⁸⁸ See Law on the Exploration and Use of Space Resources 2017, Article 4.

⁸⁹ Senjuti Mallick and Rajeswari Pillai Rajagopalan, *op. cit* at pp. 11.

⁹⁰ Mark Kaufman, "Luxembourg's Asteroid Mining is Legal Says Law Expert," *Inverse* (2 August 2017); retrieved from <<https://www.inverse.com/article/34935-luxembourg-s-asteroid-mining-is-legal-says-space-law-expert>> (accessed on 15 March 2023).

⁹¹ Adopted in December 1979 through UNGA Resolution 34/68; opened for signature on 18 December 1979 and entered into force on 11 July 1984 after the fifth country, Australia ratified the Agreement; see United Nations Office for Outer Space Affairs, "Agreement Governing the Activities of States on the Moon and Other Celestial Bodies;" retrieved from <<https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/intromoon-agreement.html>> (accessed on 15 March 2023).

⁹² Antonella Bini, "The Moon Agreement: Its Effectiveness in the 21st Century," *European Space Policy Institute (ESPI)*, No. 14 of October 2008, 1-7; retrieved from <https://www.files.ethz.ch/isn/124689/espi_%20perspectives_14.pdf> (accessed on 15 March 2023).

⁹³ Moon Agreement 1979, Article 3(1).

scientific intentions [94], but also proscribes commercial exploitation of the planet and asteroids by states and entities unless an international regime is established to govern such activities for rational management, equitable sharing and expansion of opportunities in the use of these resources [95].

The Moon Agreement resonates the OST by asserting in its Article 11(2) that the “moon is not subject to national appropriation by any claim of sovereignty, by means of use or occupation, or by any other means” and that “[n]either the surface nor the subsurface of the moon, nor any part thereof or natural resources in place, shall become the property of any State, international intergovernmental or non-governmental organisation, national organisation or non-governmental entity or any natural person [96].” Unlike the OST that ostensibly restricts the ban on property rights to states, the Moon Agreement expressly expands the non-appropriation concept to cover private entities. Apart from the right to collect and remove resources from outer space, the agreement aims at ensuring that all nations enjoy equal rights in exploiting and benefiting from space resources without any form of bias [97].

Some critics have argued that a nation should not be allowed to benefit from resources to which she is not physically or financially committed. Equality can only be achieved by an international regime developed by nations of the world who are parties to the Moon Agreement [98]. The issue of equal right and resource sharing to nations around the world has remained an issue for debate. It is arguably believed that the global regime will recognise the equitable sharing of benefits derived from any resources in space, and special consideration will be given to the effort of nations which contributed either directly or indirectly to the exploration of these resources as well as the interest and needs of developing countries [99].

Moreover, Freeland and Jakhu have argued that the appropriation ban in the Moon Agreement would not stop public and private entities from securing “extraterrestrial exploitative rights” as long as they observe the relevant space treaties, customary global law, the rules and procedures of the envisioned global regime to be created by states parties in accordance with the requirement of Article 11(5) [100]. But Ferreira-

Snyman reasoned that the exact extent of the non-appropriation idea of Article 11 of the Moon Agreement may, among other things, have to be ascertained on the basis of subsequent state practice as determined by the Vienna Convention [101]. Mainly, due to the incorporation of the principle of “common heritage of humankind” as a central theme, the Moon Agreement has to date been ratified only by a limited number of states [102]; this explains the reason for the current minimal state practice on the interpretation of the treaty [103].

c. *Convention on International Liability for Damage Caused by Space Objects 1972 (Space Liability Convention 1972)* [104]

The Space Liability Convention was established to define liability for damages caused by space objects [105]. The preambular paragraph to the

al. (eds.) *Cologne Commentary on Space Law*, Vol. 1 (Carl Heymanns Verlag Koln, 2009), 44-63.

¹⁰¹ Anel Ferreira-Snyman, “Challenges to the Prohibition on Sovereignty in Outer Space- A New Frontier for Space Governance,” *op. cit* at p.17; see also Vienna Convention on the Law of Treaties (1969) 1155 UNTS 331, Article 31.

¹⁰² The Agreement has about 11 signatory states and 18 state parties as at January 2022- see United Nations Office for Disarmament Affairs, “Agreement Governing the Activities of States on the Moon and Other Celestial Bodies;” retrieved from <<https://treaties.unoda.org/t/moon>> (accessed on 15 March 2023). Major space key players like the USA and Russia are not parties to the Moon Agreement. In the African continent, Nigeria and South Africa are among the countries that are not parties to the Moon Agreement.

¹⁰³ Christopher C. Joyner “Legal Implications of the Concept of the Common Heritage of Mankind”, (1986) 35(1) *International and Comparative Law Quarterly*, 190-199 at p. 198; Carol R. Buxton, “Property in Outer Space: The Common Heritage of Mankind Principle VS. The First in Time, First in Right, Rule of Property ” (2004) 69(4) *Journal of Air Law and Commerce*, 689-707 at p. 699; Werner Scholtz, “Common Heritage: Saving the Environment for Humankind or Exploiting Resources in the Name of Eco-Imperialism ” (2008)41(2) *The Comparative and International Law Journal of Southern Africa*, 273-293 at p. 282; Fabio Tronchetti, “The Moon Agreement in the 21st Century: Addressing its Potential Role in the Era of Commercial Exploitation of the Natural Resources of the Moon and the Other Celestial Bodies” (2010) *Journal of Space Law*, 498-524 at pp. 491-492 and 518-519.

¹⁰⁴ Adopted 29 November 1971; opened for signature on 29 March 1972 and entered into force on 1 September 1972; 961 UNTS 187; 24 UST 2389.

¹⁰⁵ Yun Zhao, “The 1972 Liability Convention: Time for Revision” (2004) 20 (2) *Space Policy Journal*, 117-122.

⁹⁴ *Ibidem*, Article 6; Antonella Bini, “The Moon Agreement: Its Effectiveness in the 21st Century,” *op. cit.*

⁹⁵ *Ibidem*, Article 11(3) and (7).

⁹⁶ *Ibidem*, Article 11(3).

⁹⁷ *Ibidem*, Article 11(4).

⁹⁸ *Ibidem*, Article 11(5); Article 18; Article 19(1).

⁹⁹ *Ibidem*, Article 11(7).

¹⁰⁰ Steven Freeland and Ram S. Jakhu, “Article 11” in Stephan Hobe, B. Schmidt-Tedd and K U. Schrogl *et.*

convention recognises the “common interest of all mankind in furthering the exploration and use of outer space for peaceful purposes.” This is premised on the increasing level of activities taking place in space regularly along with the trend towards commercialisation of space activities, which indeed require attention [106]. In fact, building on Article 7 of the OST and taking into account that irrespective of preventive steps to be adopted by states and global intergovernmental bodies engaged in space activities, harm may still take place, the Space Liability Convention provides that a launching state shall be completely responsible in paying compensation for harm occasioned by its space objects on the earth’s surface or to aircraft as well as accountable for damage due to its faults in space [107]. The convention equally set out procedures for the settlement of claims for damages.

A critic of this convention is that apart from states, it did not provide a clear definition of a private entity’s liability for damages caused by space activities to another state or entity. It is notable that in each case, it is a particular state or number of states that are being made liable [108]. The operation of the convention’s regime in cases of private liability at the international level has remained unsettled. However, some states have resolved this problem at the national level by enacting national laws specifically dealing with space and space activities of private entities [109]. Thus, international liability of private entities for space activities and juridical effects therefore, entirely rests with the state [110].

¹⁰⁶ Frans G. von der Dunk, “The 1972 Liability Convention: Enhancing Adherence and Effective Application” *Proceedings of the 48th Colloquium on the Law of Outer Space* (American Institute of Aeronautics and Astronautics, 1998), 366-373; retrieved from <<https://digitalcommons.unl.edu/spacelaw/50/>> (accessed on 15 March 2023).

¹⁰⁷ Space Liability Convention 1972, Articles II-VI.

¹⁰⁸ *Ibidem*. See also Frans G. von der Dunk, “The 1972 Liability Convention: Enhancing Adherence and Effective Application,” *op cit* at p. 370.

¹⁰⁹ For example, the United States, Sweden, United Kingdom, Russia and South Africa- such laws generally include provisions for reimbursement by the private entity licensed under the national law of any compensation paid out by the states by virtue of global liability claims. See Frans G. von der Dunk, “The 1972 Liability Convention: Enhancing Adherence and Effective Application,” *op cit* at p. 371.

¹¹⁰ Frans G. von der Dunk, “The 1972 Liability Convention: Enhancing Adherence and Effective Application,” *ibidem* at p. 370.

d. *Agreement of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space (Rescue Agreement)* [111]

The Rescue Agreement was considered and negotiated by the UNCOPUS Legal Subcommittee from 1962 to 1967 [112] and later adopted following global realisation of the significance of the OST which had called for the rendering of all practicable support to astronauts in the event of the occurrence of accident, distress or emergency landing, for the immediate and safe return of astronauts, including the return of objects launched into outer space and with the aspiration of developing additional definite expression to the obligations created under the OST 1967 towards the promotion of worldwide collaboration in the peaceful exploration and utilisation of the outer space [113]. Consequently, expounding on the fundamentals of Articles V and VIII of the OST 1967, the Agreement provides that states shall adopt all possible mechanism towards rescuing and assisting astronauts in distress and without delay return them to the launching state, and that states shall on request, provide help to the launching states in recovering space objects that return to earth beyond the territory of the launching state [114].

Criticisms against the Rescue Agreement include the fact that some of its provisions are vague, particularly in relation to the definition of who is entitled to be rescued and what amounts to a spacecraft within the contemplation of the Agreement. In this respect, while the OST and the title of the Rescue Agreement make reference to “astronauts”, the text of the Rescue Agreement itself speaks of “personnel” of a spacecraft, which signifies inclusion of other individuals, thereby expanding the notion. Also, although the Agreement saddles the expenses for recovering and returning a crashed spacecraft into another state’s territory on the launching state [115], it failed to explicitly indicate the party that incurs the expenses on the rescued astronauts. The Agreement is also mute on the kind of “accident” that the spacecraft personnel must have suffered from or the state of distress which they must have encountered or the types of emergency situation or accidental landing they must have made. However, it stands to reason that any form

¹¹¹ Adopted 19 December 1967, opened for signature 22 April 1967 and entered into force on 3 December 1968; 672 UNTS 119; 19 UST 7570.

¹¹² United Nations Office for Outer Space Affairs, “Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space;” retrieved from <<https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/introrescueagreement.html>>(accessed 15 March 2023).

¹¹³ The Rescue Agreement, preambular paragraphs 1-3.

¹¹⁴ *Ibidem*, Articles 1-5.

¹¹⁵ *Ibidem*, Article 5(5).

of accident, distress or emergency landing which would ordinarily or reasonably require external help should come within the compass of the provisions of the Agreement [116]. Thus, the inherent lacunae in the Agreement are capable of giving room to multiple interpretations or speculations regarding the respective issues.

e. *Convention on Registration of Objects Launched into Outer Space 1975 (Registration Convention 1975)* [117]

The Registration Convention is built upon the aspiration by states in the OST [118], the Rescue Agreement [119] and the Liability Convention [120] to provide for a mechanism that enables states to assist in the identification of space objects. The Registration Convention expands the scope of the United Nations Register of Objects Launched into the Outer Space that was created by resolution 1721B (XVI) of December 1971 and further addresses issues concerning state parties' obligations relating to their space objects. State parties to the Registration Convention and worldwide intergovernmental bodies that have agreed to comply with the clauses of the convention are enjoined to create their own national registries and provide data on their space objects to the Secretary-General to be integrated into United Nations Register [121], which is maintained by the Secretary-General through the UN Office for Outer Space Affairs [122].

The essence of registration of space objects is to ensure that identified state accepts worldwide responsibility and liability for space objects considering the level of activity going on in space [123]. It is also believed that the obligatory system of registering objects launched into outer space would *inter alia*, aid in their easy identification in addition to contributing to the application and development of international law

¹¹⁶ Stephen Gorove, "Legal Problems of the Rescue and Return of Astronauts," (1969) 3(4) *International Law*, 898-902.

¹¹⁷ UNGA Resolution 3235(XXIX), adopted on 12 November 1974, opened for signature 14 January 1975 and entered into force 15 September 1976; 1023 UNTS 15; 28 UST 695.

¹¹⁸ See preambular para. 3 of the Registration Convention; OST 1967, Article VIII which gives a state party on whose registry a space object launched into the space is registered or carried retains the control and jurisdiction over the object and any of the object's personnel while in the outer space or on a celestial body.

¹¹⁹ *Ibidem*, preambular para. 4.

¹²⁰ *Ibidem*, preambular para. 5.

¹²¹ *Ibidem*, Articles II & IV.

¹²² *Ibidem*, Article III.

¹²³ L. Matignon, "The 1976 Registration Convention" (2019); retrieved from <<https://spacelegalissues.com>> (accessed on 15 March, 2023).

regulating the exploration and utilisation of outer space [124]. Thus, a major improvement of this convention is the fact that it does not only regulate launching states but also private or non-governmental entities who intend to launch objects into space for commercial purposes [125]. It is however, important to note that it is only a state party to the convention that is entitled to formally assert legal claims in the event that another party to the convention neglects to comply with its obligations. This is because it is a general rule of public international law that only state parties to a treaty may deem their rights to be breached by another party who fails to fulfill the pertinent responsibilities [126]. At the moment about 88% of all satellites, probes, landers, crewed spacecraft and space station flight elements launched into Earth orbit or beyond have been registered in the register [127].

5. Some National Outer Space Laws

Growth in private enterprises' involvements in outer space operations remains one of the significant advancements pertinent for global space legislation. The ensuing legal consequence of such private participation is the inevitability of enacting national or domestic space statutes to regulate space activities at the national level because of the global duties that arises under obligation and liability for a state concerning the effects of such private operations [128]. In addition to the previously discussed US CSLCA 2015 and the Luxembourg's Exploration and Use of Space Resources Law, attempt would be made under this heading to briefly examine some domestic space laws in Nigeria, Norway, South Africa, and Russia, which *inter alia*, authorises and supervises private space activities.

a) Nigeria:

Nigeria is a party to the OST 1967, the Liability Convention, the Rescue Agreement and the Registration Convention, which were developed by UNCOPUOS and these global instruments have

¹²⁴ See the Registration Convention, preambular paragraph.

¹²⁵ *Ibidem*, Article VI (1).

¹²⁶ Frans G. von der Dunk, "The Registration Convention: Background and Historical Context," *Proceedings of the 46th Colloquium on the Law of Outer Space*, (American Institute of Aeronautics and Astronautics, 2003), 450-453 at p. 451; retrieved from <https://digitalcommons.unl.edu/spacelaw/32> (accessed on 15 March 2023).

¹²⁷ United Nations Office for Outer Space Affairs, "United Nations Register of Objects Launched into Outer Space"; retrieved from <<https://www.unoosa.org/oosa/en/spaceobjectregister/index.html>> (accessed on 15 March 2023).

¹²⁸ Frans G. von der Dunk, "Two New National Space Laws: Russia and South Africa" (1995) *Proceedings of the Forty-Eighth Colloquium on the Law on Outer Space*, 251-261 at p. 251.

corresponding implications for Nigeria as a party [129]. Nigeria became the second country in the African continent after South Africa and the second foremost space-faring nation from the developing countries after Brazil to enact a domestic statute to regulate space activities [130]. In line with its global commitments to the above mentioned space treaties, the Nigerian government created the National Space Research and Development Agency (NASRDA) in 1999; formulated the first National Space Policy and Programme in 2001 and followed up with a legislative framework, the National Space Research and Development Agency Act in 2010 [131].

The objectives of this federal statute include *inter alia*, the encouraging of capacity building in space science technology improvement and supervision in order to strengthen human resources development needed for execution of national space programmes; developing satellite know-how for diverse applications and functioning of indigenous system; promoting the coordination of space application programmes, and evolving national policies for the exploration of the outer space and make these aspect of the total national

¹²⁹ For instance, first, Nigeria becomes globally accountable for national activities in outer space as well as if such activities are conducted by private enterprises, as Nigeria is under an obligation to authorise and supervise such activities for the purpose of complying with global space law as required by OST, Article VI. Second, Nigeria will be held answerable for damages occasioned by such private space operations to the extent that Nigeria might be eligible as a launching state of the space object causing such injury as envisaged under OST, Article VII, Liability Convention, Articles 1(c), II & III; and third, Nigeria would be required to register any space to be eligible as a launching state except another state is equally qualified for such registration and that other state accepts to operate as the registration state- Registration Convention, Articles 1(a), II, III & IV. See, Irmgard Marboe, "National Space Law," in Frans G. von der Dunk (ed.) *Handbook of Space Law* (First Edition, Edward Elgar Publishing, 2015), 127-204 at pp.131-135, chapter 3; Frans G. von der Dunk, "Scoping National Space Law: The True Meaning of "National Activities in Outer Space" of Article VI of the Outer Space Treaty," in P. J. Blount, et. al. (eds.) *Proceedings of the International Institute of Space Law, 2019*, (The Hague, Netherlands: Eleven International Publishing, 2020), 227-237.

¹³⁰ Frans G. von der Dunk, "The Second African National Space Law: The Nigerian NASRDA Act and the Draft Regulations on Licensing and Supervision," *Proceedings of the International Institute of Space Law, 2016*, Vol. 59 (American Institute of Aeronautics and Astronautics, 2017), 547-559.

¹³¹ Act No. 9 of 2010; *Federal Republic of Nigeria Official Gazette*, No. 98, Vol. 97, pp. A1249-1268 of 30 August 2010.

growth strategies as well as implement schemes for enhancing private sector involvement in space industry. The statute empowers the relevant agency to collaborate with global research centres, non-governmental organisations, academic institutions, industries and other related national and universal space agencies and authorities to achieve its stated goals [132]. The established agency is also authorised to grant licence to any individual or corporate entity for activities set out in section 6(k) of the statute [133]. The authorised activities shall not however, endanger public health, the safety of individuals or property. Recently, the Nigerian government has also enacted a Regulation on Licensing and Supervision of Space Activities in 2021, which among other things, empowers NASRDA to licence all space activities, including space objects and their control or management [134].

b) *Norway*:

The Act on Launching Objects from Norwegian Territory into Outer Space 1969 [135] prohibits, unless with the authorisation from the Norwegian Ministry of Trade and Industry, the launching of any object into outer space from Norwegian territory, including Svalbard, Jan Mayen, Norwegian external territories, Norwegian vessels, aircrafts, areas that are not subject to the sovereignty of any state when the launching is embarked upon by a Norwegian national or individual with consistent residence in Norway [136].

c) *South Africa*:

The country has about 5 laws relating to the outer space, namely, South African National Space Agency Act (SANSAA) 2008 [137]; National Space Policy of South Africa 2008; Astronomy Geographic Advantage Act 2007; and the Space Affairs Act (SAA) 1993 [138]. The goal of enacting the SANSAA 2008 was geared towards the promotion and peaceful use of space and cooperation in space-associated activities, encourage research in space science, advance scientific engineering through human capital, support the establishment of an environment conducive for industrial development in space technologies with the

¹³² *Ibidem*, section 6.

¹³³ *Ibidem*, section 9.

¹³⁴ Federal Government Notice No. 158, Vol. 108, No. 106, pp. B4209-4235 of 28 September 2021.

¹³⁵ Act No. 38 of 13 June 1969.

¹³⁶ *Ibidem*, section 1.

¹³⁷ Act No. 36 of 2008.

¹³⁸ Act No. 84 of 1993. This statute was later amended by the Space Affairs Amendment Act No. 64 of 1995. The main essence of the amendment was to make provision for the appointment of a vice-chairperson to the South African Council for Space Affairs; make additional provision for the delegation of specific powers and obligations; and to delete an obsolete clause as well as provide for matters connected therewith.

framework of national policy and the fostering of global assistance in space-allied operations [139].

On the other hand, the SAA 1993 (as amended) was primarily enacted to address the emerging issues raised by the involvement of private enterprise in space activities [140]. The statute defines “space activities” as the activities which directly contributes to the launching of spacecraft and the operation of such craft in outer space [141] and other space-allied activities, such as supporting, or sharing mutual technologies with space activities [142]. With respect to licensing regime under the law, it is structured in such a way that no launching activities, both launches from the territory of South Africa and launches carried out somewhere else by or on behalf of a juridical individual of South African nationality shall be undertaken without issuance of a licence by the Council created under the statute [143]. Concerning other space activities, it is clear from the provisions of the law that it is only such space operations executed or participated in by juristic individuals of South African nationality which involves South Africa’s global responsibilities or affects other national interests that automatically prompts applicability of the statute [144].

In essence therefore, overseas enterprises operating satellites for telecommunications purposes from South African territory would appear not to come within the contemplation of the legislation [145]; though the Ministry of Trade and Industry has discretionary power to apply the statute to such space and space-connected activities as it considers proper [146]. Section 14 of the legislation contains the duties and liabilities of a licensee. It should be added that the South African law covers circumstances where it might be held globally accountable for space activities which were actually or partly privately undertaken. As long as the relevant private enterprises are either of South African nationality or operate from the territory of South Africa, the SAA would become applicable; apart from that, South Africa jurisdiction would become inapplicable and its likely liability can only be dealt with by way of relevant contract [147].

¹³⁹ Act No. 36 of 2008, section 4.

¹⁴⁰ De Villers Lessing, “South Africa: Recent Developments in Space Law” (1994) 1 *Telecommunications & Space Journal*, 139-142.

¹⁴¹ SAA 1993, section 1, definition xix.

¹⁴² SAA 1993, section 1, definition xxii.

¹⁴³ *Ibidem*, section 11(1)(a) and (b).

¹⁴⁴ *Ibidem*, section 11(1)(d).

¹⁴⁵ This is because the law talks only of a juridical person “incorporated or registered in the Republic (of South Africa).”

¹⁴⁶ SAA 1993, *op. cit.*, section 11(1)(e).

¹⁴⁷ Frans G. von der Dunk, “Two New National Space Laws: Russia and South Africa,” *Proceedings of the 48th Colloquium on the Law of Outer Space* (American

d) *Russia*:

The enactment of Law of the Russian Federation on Space Activities 1993 [148] was to a larger extent, due to its desire to deal with private or semi-private enterprises’ involvements in outer space [149]. The law expands the scope of “space activities” to encompass any activity linked with direct “conducting of work of exploration and use of outer space including the Moon and other celestial bodies” as well as other forms of activities performed with the aid of space technology apart from space communications, space remote sensing, manned space flights, space research and the manufacture of products on outer space [150]. Also included within the scope of space activities are the creation, use and transfer of space equipment, materials, space technologies and rendering of other services essential for conducting space activities in addition to other global partnerships of the Russian Federation in the area of the exploration and use of outer space [151].

Article 9 states that space activity shall be liable to licensing in accordance with the law of the Russian Federation; while Article 18(4) requires that space activity of organisations of the Russian Federation concerning the exploitation of space infrastructure above the limits of the control of the Russian Federation shall be executed in compliance with global agreements of the Russian Federation and this legislation. It is noteworthy that Russia, like other countries, is globally accountable not merely for its own governmental space activities, but also as regards certain private space activities as recognised under OST, Article VI. This covers both Russian obligations for any private “national activities” in outer space and Russian liability for private space activities involving a space object launched from the Russian soil [152].

Institute of Aeronautics and Astronautics, 1995), 251-261 at pp. 253-255; retrieved from <<https://digitalcommons.unl.edu/spacelaw/47>> (accessed on 20 March 2023).

¹⁴⁸ Act No. 5663-11 of 20 August 1993; with the Amendments and Addenda of 29 November 1996, 10 January 2003, 5 March 2003, 22 August 2004, 2 February 2004, and 18 December 2006.

¹⁴⁹ *Ibidem*, preambular para. 3. See also E. Kamenetskaya, V. Vereshechetin & E. Zhukova, “Legal Regulation of Space Activities in Russia,” (1993) 9(2) *Space Policy*, 121-123.

¹⁵⁰ See generally Article 2(1) of the Russian law.

¹⁵¹ *Ibidem*, Article 2(2).

¹⁵² Frans G. von der Dunk, “Two New National Space Laws: Russia and South Africa,” *Proceedings of the 48th Colloquium on the Law of Outer Space*, *op. cit* at p. 253; see also Frans G. von der Dunk, “Liability versus Responsibility in Space Law: Misconception or Misconstruction?” *Proceedings of the 34th Colloquium on the Law of Outer Space* (American Institute of Aeronautics and Astronautics, 1992), 363-371, retrieved

6. Contemporary Issues in Outer Space Mining

The commercialisation of space activities have led to the emergence of new level of challenges, some of which would be discussed under this heading:

i) *Ownership of Space Resources and Conflict of Laws*

The Moon Agreement establishes the right to collect and remove samples from the moon and other celestial bodies for scientific purposes [153]. It further ensures that all nations and their citizens enjoy equal rights to extracted space resources [154]. However as seen earlier, many space-faring nations have argued that a state or private entity that does not contribute either directly or indirectly to the exploration of the space resources should not have equal right of ownership over such resources. On the other hand, the language of the OST 1967 restricting appropriation of celestial resources creates some confusion as to whether a space mining company can achieve the security of tenure necessary to move forward with its investment in space mining.

Specifically, Article VI of the OST posits that the activities of non-governmental entities, including the moon and other celestial bodies, shall require authorisation and continuing supervision. This provision has introduced some element of uncertainty for some space-faring states like the USA and for private companies that have plans to operate in outer space utilising non-conventional enterprises such as satellite servicing or asteroid mining [155]. Since Article VI of the OST is not self-directing, a number of interested parties hold the opinion that the provision implies that private enterprises may not operate without governmental authorisation and enduring supervision. In fact, the OST does not explicitly outlaws private activities; rather, it imposes responsibilities on state parties concerning those activities, inclusive of the

from <<https://digitalcommons.unl.edu/spacelaw/21>> (accessed on 20 March 2023); Frans G. von der Dunk, "The Illogical Link: Launching, Liability and Leasing," *Proceedings of the 46th Colloquium on the Law of Outer Space* (American Institute of Aeronautics and Astronautics, 1993), 349-359 at pp.351-352, retrieved from <<https://digitalcommons.unl.edu/spacelaw/45>> (accessed on 20 March 2023).

¹⁵³ Moon Agreement 1979, Article 11.

¹⁵⁴ *Ibidem*.

¹⁵⁵ Laura Montgomery, "US Regulators May Not Prevent Private Space Activity on the Basis of Article VI of the Outer Space Treaty," *Mercatus Working Paper*, Mercatus Center at the George Mason University, Virginia, USA, 2018 at p. 2; retrieved from <<https://www.mercatus.org/publications/regulating-private-space-activity-outer-space-treaty>>(accessed on 20 March 2023).

requirement that state parties owe global obligations for acts of its nationals [156].

Thus, in a country like the USA that is not a party to the Moon Agreement and the fact that Article VI of the OST is not self regulating [157], in the absence of an explicit national legislation applying it to a private space activity and assigning authority over that specific activity, the provision of Article VI would not be considered as an impediment to private space activity regardless of the treaty's call for authorisation and long-lasting supervision. It bears repeating that national laws like the US CSLCA 2015 and the Luxembourg Exploration and Use of Space Resources Act [158] have provisions for securing and recognising the right of ownership to extracted resources in space. It is doubtful if the stipulation of the OST requiring state parties to conduct space exploration activities and use outer space in compliance with international law and the UN Charter can curtail such rights [159].

ii) *Outer Space Mining Dispute Resolution*

The issue of dispute resolution is at the center of every legal system, whether at the national, sub-national or at global level and space law disputes should not be seen to be different [160]. It is not in doubt that outer space activities sometimes cause damage to or affect other space users resulting in disputes between the adverse parties. One of the key areas where dispute may arise as commercialisation of outer space continues is collision liability from space debris striking an

¹⁵⁶ On the issue of authorisation as seen in Article VI of the OST, von der Dunk has argued that it is apparent that beyond the vital level of positing the requirement, a number of vital issues remain far from being explained at the global level. See Frans G. von der Dunk, "The Origins of Authorisation: Article VI of the Outer Space Treaty and International Space Law," in Frans G. von der Dunk (ed.) *National Space Legislation in Europe: Issues of Authorisation of Private Space Activities in the Light of Developments in European Space Cooperation, Studies in Space Law* (Leiden, The Netherlands: Martinus Nijhoff Publishers, 2011), 1-28.

¹⁵⁷ Implying that the provision does not have a direct enforceability within the territory of the USA.

¹⁵⁸ Luxembourg Exploration and Use of Space Resources Act, Article 1.

¹⁵⁹ OST, Article III.

¹⁶⁰ Frans G. von der Dunk, "Space for Dispute Settlement Mechanisms-Dispute Resolution Mechanisms for Space? A Few Legal Considerations," *Proceedings of the 44th Colloquium on the Law of Outer Space*, (2001), 442-452 at p. 442; also in (2001) *Space, Cyber, and Telecommunications Law Program Faculty Publications*; retrieved from <<https://digitalcommons.unl.edu/spacelaw/38>> (accessed on 20 March 2023);

operating satellite [161]. The affected parties in such a situation may be regulated by different laws. For instance a private company carrying on commercial mining activity in space may be regulated by a national law, while the affected state or entity may be regulated by a public international law. The differentiation in normative framework governing the contending parties therefore, constitute a serious challenge regarding how such outer space dispute could be resolved by or among the contending parties.

Apparently, the International Court of Justice (ICJ) appears as a natural forum for a decision on any such disagreement. Arbitration was also perceived as an alternative option either in the perspective of the Permanent Court of Arbitration (PCA) or ad hoc. However, neither of these bodies always became involved in resolving space law disputes on the merit [162]. Specific dispute resolution mechanisms are at time incorporated into space law instruments like Claims Commission under the 1972 Liability Convention; dispute settlement mechanisms of the International Telecommunication Union (ITU) within the corpus of the ITU Convention and the ITU Constitution [163], among others.

But the momentous growth of political, economic and commercial interest of a broadened spectrum of stakeholders, inclusive of an increasing number of private entities, created a challenge to the “viability and of effectiveness of the classics systems, largely based on state-to-state- and sometimes politicized-mechanisms for settling international disputes [164].” In this way, the Optional Rules for Arbitration of Disputes Relating to Outer Space Activities (Outer Space Rules), drafted by an Advisory Group of Experts in the framework of the PCA [165]

¹⁶¹ It is estimated that the number of break-ups, explosions, collisions, or anomalous events resulting in fragmentation is more than 640 - see European Space Agency, “Space Debris by Numbers;” retrieved from <https://www.esa.int/Space_Space_Debris/Space_debris_by_the_numbers> (accessed on 20 March 2023).

¹⁶² Maureen Williams, “Dispute Resolution Regarding Space Activities” in Frans G. von der Dunk (ed.), *Handbook of Space Law* (First Edition, Edward Elgar Publishing, 2015), Chapter 19, p. 995.

¹⁶³ *Ibidem*.

¹⁶⁴ *Ibidem*.

¹⁶⁵ The Outer Space Rules was adopted in December 2011 based on the UNCITRAL Arbitration Rules 2010 which are mostly adopted by disputing parties in commercial global arbitration, but in the instant case, are fashioned out to reflect “the particular characteristics of disputes having an outer space component involving the use of outer space by States, international organisation and private entities.” See the introductory para (i) to the Outer Space Rules 2011. A text of the Rules may be retrieved from

are very illuminating. The Outer Space Rules provide, *inter alia*, for specialised panels of arbitrators [166] and scientific and technical experts that may be appointed by the arbitral tribunal as expert witnesses [167]. Other closely related instruments to the PCA Rules on Outer Space Disputes are the 2010 UNCITRAL Arbitration Rules and the PCA Rules on Environmental Dispute [168]. Ostensibly, there is absence of enforceable dispute resolution mechanisms in the UN treaties regulating outer space unless for the 1972 Liability Convention, which envisions the establishment of a Claims Commissions, but it has so far not materialised. Besides, the awards of the Commission are merely recommendatory except the disputing parties have beforehand agreed otherwise [169].

It has been hinted that the alternative dispute resolution (ADR) mechanism has a vital function to play in settling outer space conflicts, especially via the umbrella of investor-state dispute settlement (ISDS) structure and also through the adoption of obligatory arbitration and mediation [170] referral powers relating

<<https://docs.pca-cpa.org/2016/01/Permanent-Court-of-Arbitration-Optional-Rules-for-Arbitration-of-Disputes-Relating-to-Outer-Space-Activities.pdf>> (accessed on 20 March 2023).

¹⁶⁶ Outer Space Rules 2011, Articles 8-10.

¹⁶⁷ *Ibidem*, Article 29.

¹⁶⁸ Frans G. von der Dunk, “About the New PCA Rules and their Application to Satellite Communication Disputes,” in Mahulena Hofmann (ed.) *Dispute Settlement in the Area of Space Communication: 2nd Luxembourg Workshop on Space and Satellite Communication Law* (Barden-Barden, Germany: Nomos Verlagsgesellschaft and Hart Publishing, 2015), 93-125.

¹⁶⁹ See generally, Mythili Srinivassamurthy, “International Arbitration of Quixotic Outer-Space Disputes under PCA Optional Rules, 2011” (2021) II(X) *International Journal for Legal Research and Analysis*; retrieved from <<https://ssrn.com/abstract=3865128>>(accessed on 20 March 2023). See also Fabio Tronchetti, “The Permanent Court of Arbitration Rules for Dispute Settlement in Outer Space: A Significant Step Forward” (2013) 29(3) *Space Policy*, 181-189; <https://doi.org/10.1016/j.spacepol.2013.06.007>.

¹⁷⁰ See for example, the United Nations Convention on International Settlement Agreements Resulting from Mediation (the Singapore Convention on Mediation); adopted on 20 December 2018, opened for signature on 7 August 2019; and entered into force on 12 September 2020. Principally, the convention creates a harmonised legal framework for the right to invoke settlement agreements as well as for their enforcement (Article 1). As at 2023, there are 56 signatories to the Convention and 11 ratifying countries. A text of the Singapore Convention on Mediation can be retrieved from

to private entities [171]. Though in practice, there seem to be no overtly acknowledged arbitration that has been settled through the application of the Outer Space Rules [172], yet the fact remains that a robust global dispute settlement machinery that is fashioned to deal with a vastly specialised, technologically multifaceted and developing area of activities in the outer space that involves varied global, national and private actors is highly vital [173].

iii) *Environmental Challenges*

The OST requires state parties to avoid harmful contamination and adverse changes to the earth's environment arising from the introduction of extraterrestrial matter; and where it is clear that such planned outer space activity or experiment would result in a likely injurious intrusion with activities of other state parties in the peaceful exploration and use of the outer space, it is obligated to undertake appropriate global discussion prior to embarking on the activity [174]. Exploration and exploitation of outer space, including the moon and other celestial bodies, by sovereign states or private entities is a major activity that produces orbital debris or wastes. Indisputably, the problem associated with space debris is one of the reasons why it becomes critical to provide environmental protection in outer space. Several years of space flights have left more than 36,500 pieces of space debris of sizes bigger than 10 centimeters; 1,000,000 space debris objects that are more than 1 centimeter to 10 centimeters and about 130 million space debris objects that are greater than 1 millimeter to 1 centimeter; with a possibility that this figures will keep increasing as the years go by given the rising number and volume of commercial satellite constellation in low-Earth orbit [175]. These pieces of

debris are on the whole unsafe since no protection against them is feasible [176].

It is therefore, not in doubt that orbital wastes or debris is ultra-hazardous and poses serious threat to the existence of mankind if not properly disposed. The Liability Convention made elaborate provisions for the liability caused by space objects as well as its launch vehicle [177], but failed to determine the extent of the liability of states or private entities with regards to indiscriminate dumping or failure to properly dispose orbital debris got from space mining activity. This further constitutes a challenge to the sustainability of space mining activity on how and where space debris should be disposed. Should it be disposed in the outer space where it may affect other celestial bodies or on earth where it could cause more environmental and health hazard to humans? Incontrovertibly, the planet earth is already overwhelmed with environmental pollution arising from various sources, including contamination and greenhouse gasses from petroleum refineries and other related oil and gas operations; and dumping such outer space waste substances on earth would further worsen the situation.

Perhaps, in an attempt to address some of the environmental concerns raised by outer activities, some instruments have been put in place such as: the PCA Optional Rules for Arbitration of Disputes Relating to the Environment and/or Natural Resources 2001 (the PCA Environmental Rules) - which empowers arbitral tribunal to order interim measures to preserve the rights of any party or to stop severe damage to the environment falling within the subject matter of the dispute [178]. There is also the PCA Optional Rules for Conciliation of Disputes Relating to the Environment and/or Natural Resources which was adopted in 2002. Both Rules provide the most comprehensive set of environmentally tailored dispute resolution procedural rules presently available; and the PCA has been regularly included as the forum for dispute settlement under bilateral and multilateral treaties, contracts, and

<https://uncitral.un.org/sites/uncitral.un.org/files/singapore_convention_eng.pdf> (accessed on 20 March 2023).

¹⁷¹ Scott Atkins, "Dispute Resolution and Restructuring in Outer Space: Using ADR to Drive Efficiency and Better Outcomes for Creditors;" retrieved from <<https://www.nortonrosefulbright.com/en/knowledge/publications/5bf5d3bb/dispute-resolution-and-restructuring-in-outer-space>> (accessed on 20 March 2023).

¹⁷² *Ibidem*.

¹⁷³ Caroline Arbaugh, "Gravitating Towards Sensible Resolutions: The PCA Optional Rules for the Arbitration of Disputes Relating to Outer Space," (2014) 42 *Georgia Journal of International and Comparative Law*, 825-850.

¹⁷⁴ Outer Space Treaty, Article IX; see also Moon Agreement 1979, Article 7.

¹⁷⁵ The European Space Agency (ESA) estimates that there are currently about 15,760 satellites orbiting the earth in outer space- see European Space Agency, "Space Debris by Numbers;" retrieved from <https://www.esa.int/Space_Space_Debris/Space_debris_by_the_numbers> (accessed on 2 May 2023).

¹⁷⁶ Stephan Hobe, "Environmental Protection in Outer Space: Where we Stand and What is Needed to Make Progress with Regard to the Problem of Space Debris," (2012) 8 *The Indian Journal of Law and Technology*, 1-10; retrieved from <<https://www.ijlt.in/journal/environmental-protection-in-outer-space%3A-where-we-stand-and-what-is-needed-to-make-progress-with-regard-to-the-problem-of-space-debris>>(accessed on 2 May 2023).

¹⁷⁷ It is significant to note that while Article II of the Liability Convention set out absolute liability, liability under Article III thereof is based upon fault- see Stephan Hobe, "Environmental Protection in Outer Space: Where we Stand and What is Needed to Make Progress with Regard to the Problem of Space Debris," *ibidem*, at p. 10

¹⁷⁸ PCA Environmental Rules, Article 26.

other instruments relating to natural resources and the environment [179].

IV. CONCLUSION

Outer Space mining is a recent technological development and a novel area for commercial activities. Not only nations, but also determined private ventures, are involved in the drive for commercialisation of the outer space. With the primary goal of possibly regulating space activities, some treaty instruments such as OST, the Moon Agreement, the Rescue Agreement, the Liability Convention, and the Registration Convention, among others, have been put in place. Unfortunately, some of these instruments have not been ratified or signed by major space-faring nations. The global instruments are in addition to a number of other laws enacted at the national level, such as in the USA, Luxemburg and Russia, to provide solutions to their outer space commercialisation needs. However, as the study reveals, at least the initial major five outer space treaties were adopted before private entities actively ventured into outer space activities, and accordingly these instruments did not sufficiently address sensitive subjects bothering on contemporary issues like outer space property rights, unfairness in benefit sharing of outer space resources, dispute settlements and environmental concerns, among others.

As a means of encouraging sustainable exploration and utilisation of the outer space resources for the benefit of all mankind, it is essential that the various criticisms against extant framework on outer space activities should be properly addressed and if practicable, all existing international laws on mining activities in outer space should be codified into a unified international law to prevent contradictions in existing laws on the subject. Moreover, as regards environmental concerns, there is need for strict adherence to outer space security set of laws by strengthening supervision compliance, implementation of space debris mitigation, prevention of on-orbit break-ups, orbital removal of space objects and de-orbiting satellites that have reached the conclusion of their mission operation from the closely populated orbit areas, among others.

Both space-faring national governments and private entities involved in space activities should also be encouraged to take active part in the activities of the Inter-Agency Space Debris Coordination Committee (IADC), the United Nations Committee on the Peaceful Uses of Outer Space (UN COPUOS) and other relevant global bodies to formulate pertinent laws and policies so as to supplement international collaboration for the protection of the global environment. In fact, the major

goals of the IADC include, *inter alia*, the exchange of data on space debris research activities between member space agencies; facilitation of opportunities for cooperation in space debris research; reviewing of the progress of continuing supportive operations and identifying debris mitigation options [180].

As clearly shown in the article, there has been an increasing concern regarding space sustainability and the need to address issues of outer space environmental conservation so as to ensure that it is not harmfully contaminated. This is quite understandable because the planet earth is already susceptible to pollution arising from many sources. For instance, the petroleum sector constitutes one of the key causes of global environmental contamination as many countries of the world rely heavily on petroleum products for transportation, fueling, heat, electricity generation, plastics to global consumers and maintenance of worldwide industrial civilisation. Oil and gas sector is also of critical concern to many nations because it sustains their economy. Unfortunately, emissions from the extractions, flaring, refining, transportation and consumption of petroleum products have *inter alia*, contributed to complications in human health, air pollution, climate change, acid rain, ocean acidification as well as disturbed land and marine ecosystems. Therefore, in order not to continue worsening the present condition of the global environment, protecting the outer space environment becomes imperative as it will not only contribute to sustainable space operations but will equally engender a healthy and pollution-free universal environment.

Conflict of Interests Statement

The authors have no financial conflict of interest to declare in relation to this article.

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¹⁷⁹ See Permanent Court of Arbitration, "Environmental Dispute Resolution;" retrieved from <<https://pca-cpa.org/en/services/arbitration-services/environmental-dispute-resolution/>> (accessed on 2 May 2023).

¹⁸⁰ See Inter-Agency Space Debris Coordination Committee, "IADC Space Debris Mitigation Guidelines", Issued by Steering Group and Working Group 4, Item No. 22.4; retrieved from <https://www.unoosa.org/documents/pdf/spacelaw/sd/IADC-2002-01-IADC-Space_Debris-Guidelines-Revision1.pdf> (accessed on 2 May 2023).

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