Lunar Exploration - *The Road Ahead*[▲]

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Abstract:
The renewed global interests in lunar exploration in the recent past open up many new opportunities for scientific explorations as well as resources exploitations. In this second phase of exploration, the space - faring nations including those in Asia Pacific Region, seek more prominent roles than seen before. The paper begins with a survey of the lunar missions of the past and the very recent past based on their technical abilities and chronological development. It is argued that the present legal regime has enabled everything that a space scientist could ask for. It is inferred that the Moon Treaty is an enabling regime rather than a prohibitive one as is widely perceived. A critical examination of the Moon Treaty suggests that the authors of the treaty nursed lingering doubts about its long term applicability due to rapidly changing technological scenario. A provision is therefore made in the treaty itself for its review with a kind of emphasis not seen in the earlier space treaties. The provisions of the treaty which are considered to be controversial and contentious are re-examined. This paper persuasively argues that these provisions are not as bad as they are perceived to be. The present paper makes a case for an urgent review by all concerned with a view to re-engineer the treaty as envisaged by the authors of the original treaty. The paper suggests that a first step towards this would be to strengthen the regime with wider acceptance in terms of renewed pursuit towards ratifications and accessions. In view of the impending technological onslaught on the moon for commercial exploitations, there is an urgent need to rework the treaty lest the legal regime becomes irrelevant. The paper concludes with a plea - 'Let us Re-Engineer the Moon Treaty - Together, Quickly'.

▲ *All the opinions expressed herein belong to the authors and do not represent those of their employer or their country. Any errors contained herein remain entirely the authors'.*

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1. Introduction:

Moon has always fascinated the humanity. Desire to reach moon is probably the oldest. But apart from the emotional reasons to reach moon, there are many credible scientific reasons for it. Moon is a planetesimal building block of the planets. It is believed that through the scientific study of moon, we can learn much more about our solar system and in turn about our own earth.

The journey of lunar exploration started way back in 1959, which witnessed the many successful accomplishments till 1976, including human landings on the Moon. The exploratory missions had revealed volumes of scientific data on the lunar surface, its formation and also hinted on the possible exploitation of the lunar resources and its commercial potential. The prospects for commercial exploitations of moon offer yet another economically satisfying reason for the same. In the second phase of exploration, many space - faring nations including those in Asia Pacific Region, seek more prominent roles than seen before. These renewed global interests in lunar explorations of this decade throw open many new opportunities for scientific explorations as well as resources exploitations.

The present legal regime for Moon exploration, namely, *'Agreement governing the activities of States on the Moon and other celestial bodies'* hereinafter referred to as 'Moon Treaty', has been supportive for all explorations based on scientific objectives. While providing an equitable basis for scientific explorations on one hand, the treaty makes ample provisions, to guard against parochial appropriation of resources on the other hand. Nonetheless, it shows the way for resources exploitations based on the principle of Common Heritage of Mankind (CHM), on an equitable manner, at an appropriate time through a review based on technological developments and application of the treaty.

It is to be agreed that the efforts and investments made by the space - faring nations needs to be accorded due priority. At the same time the principle of CHM needs to be respected keeping in mind the overall benefits to the mankind. The possibility of commercial exploitation is not too far. Hence, it certainly calls for a review of the treaty, which has already been a built-in provision of the treaty, as foreseen by its authors.

What follows is a review of the various aspects of lunar exploration including its objectives, past and current missions, critical analysis of the Moon Treaty and the need to re-engineer it in the light of the current attempts of commercial exploitations.

2. Lunar exploration - History and Trend:

Soon after the beginning of the space age, the historic quest for reaching the moon began with the launch of successful missions viz., Luna 1 of the then USSR, followed by the Pioneer 4 of USA, both of which passed the moon at closer distances, in 1959. The scope of lunar missions progressed successively in the cold war era, which manifested in varied missions such as hard impact probes, soft landers, unmanned orbiters, sample return missions, manned mission landings during this period. Nevertheless, the first phase of lunar exploration thus pursued by the then space powers came to a virtual halt in 1976. However, these missions raised the scope for use and exploitation of the moon and its natural resources than exploration, and thus gave sufficient momentum to the negotiations, which started way back in 1970, towards concluding an agreement. But, when the Moon Treaty was concluded and adopted in UN General Assembly in 1979, practically there were no lunar missions. The second phase of lunar missions started in the 90s, wherein Japan too joined the lunar mission race. Further, the dawn of the new millennium ushered in a new era of lunar exploration with renewed interests for exploration and exploitation. Major space - faring nations in Asia Pacific region such as China, Japan and India too initiated independent lunar missions, while USA announced its big plans of lunar explorations under the banner *'return to the Moon, '* as part of its 'Vision for Space Exploration, 2004'. Even under the current trend of initiatives for commercial exploitations including certain erratic attempts for appropriation of lunar surfaces by some private entities, the zeal for exploration of Moon with high end scientific objectives has been immensely shown off by the international space science community, through the type of lunar missions being currently pursued by various nations.

3. Scientific Importance of Exploration of Moon:

Space scientists attach a close correlation to the formation of Earth and Moon, as their

rocks are so similar, excepting the missing iron component in the moon rocks, and the high angular momentum of the Earth and Moon System. Though Moon has been studied by most missions than any other planetary bodies, the concept of origin and evaluation continues to be inconclusive. While various theories have been formulated on the evolution of the Earth and the Moon system such as *Simultaneous formation, Capture, Fission and Giant-impact,* the last one proves to be most promising[1].

Compared to the Earth, the presence of atmosphere and its interaction with the water system and the solar energy leads to geophysical processes in the Earth, which mask the trace of the events that caused these. On the contrary, absence of such a system records and reveals the sign of the events of the past and hence this makes the study of moon far more revealing than on the Earth for these purposes. Further, chemical and mineralogical mapping of the surface and sub-surface of moon would provide very valuable information on the formation of moon. The possible presence of water and ice on the moon as indicated by the studies through the past lunar missions such as Clementine, Lunar Prospector etc., adds strength to the scope for lunar habitation.

It is predicted that the mineral deposits on the lunar surface and sub-surface contain many useful materials in significant concentrations. For example, the Mare basalts have high concentrations of oxygen, silicon, ion, magnesium, titanium and the lunar highlands have significant amounts of aluminum and calcium and it is possible that these minerals can be utilized to provide resources such as oxygen to sustain an extended human presence on the Moon[2].

The measurements on the lunar environments for energetic particles, electromagnetic field and plasma, around the Moon are scientifically significant and would also provide important information for the future human activity on the Moon[3]. Also, the topographic study of the polar region will also provide the basic information of future construction of the astronomical observatory on the lunar surface. As, the lunar exploration depicts a spectrum of scientific objectives, it is attempted to make brief survey of the past lunar missions, mostly performed the USA and the then USSR.

4. Various International Lunar Missions of the Past:

Starting from the Luna 1, the first spacecraft, which passed by the Moon at a distance of 5,600 km, launched by the then USSR on January 2, 1959, which was closely followed by the US spacecraft viz., Pioneer 4 launched on March 3, 1959, quite a number manned and unmanned missions were realized by the then USSR and USA up to 1976, which included few unsuccessful missions too.

This lunar exploration race proved a variety of missions, starting from simple impact probes, orbiters, soft landing spacecrafts, sample return probes to advanced robotic rover landing cum operation and manned landing cum safe crew return missions. While each type of mission has got its own advantages, the technology was graduated from mission to mission. For example, orbiting missions provide synoptic view of large area and are very suitable for topography, chemistry and mineralogy studies; whereas landing missions provide more intense information about local regions and are very appropriate for seismic experiments to study internal structure and core. Two kinds of landing missions have been performed in the past - Soft landing and Impact probes / penetrator. In soft landing, the instrument keeps functioning for a long time and keeps transmitting data back to earth. In case impact probes / penetrators, instruments are usually destroyed but during the process of penetration, it collects very valuable information and transmits them back to earth. Sample Return probes is yet another typical mission which enjoys the privilege of returning back with lunar samples and thus offers the opportunity of subjecting them to extensive laboratory testing for Dating, Minor and trace element chemistry, & Isotopic effects.

Technologically complex robotic rover landing missions offers very unique opportunities of navigating on lunar surfaces

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[1] *Chandrayaan web page- http://www.isro.org/chandrayaan/htmls.htm; accessed on August 15, 2007*

[2] *Congressional Testimony of Donald B. Campbell: 'Lunar Science & Resources: Future Options'- Available at http://www.moontoday.net/news/viewsr.html?pid=12417, accessed on August 20, 2007*

[3] *Selene web page – http:// www.selene.jaxa.jp/en/index.htm; accessed on August 20 , 2007*

and conducting in-situ experiments besides providing other functions of taking pictures on lunar surfaces at very close distances and transmitting back to Earth.

Human landing programme was considered to be the most challenging ones, as it mandates the safe return of the crew and thereby demand the realization of complex technologies such as human life support system, advanced thermal protection system for reentry and precise control and navigation system etc.

An attempt to categorize the missions achieved by the then USSR and USA gives the following summary[4]:

The Luna 1 of then USSR and Pioneer-4 of USA were the first successful flyby attempts in 1959. The Soviets' Luna series 2, 3 & 4 in 1959-60 and Luna 5, 6 & 8 in 1965 and the USA's Ranger series 4,6, 7, 8 & 9 during 1962-65 fall under the impact and hard landing category. These followed by the orbiter missions with advanced attitude control system to maintain orbits. Luna 10, the first orbiter, Luna 11 & 12 in 1966 and Luna 18, 18 & 22 during 1971-74 and USA's Lunar Orbiters 1,2 3 & 4 during 1966-67 were orbiters fall under this category. Luna 9, the first soft landing mission of USSR in 1966 and its immediate successor Luna 13 were closely matched by USA's Surveyor 1 & 2 in 1966. Subsequently Surveyor 3, 4, 5 & 6 in 1967 and Surveyor 7 in1967 and Luna 23 were also soft landed. The purpose of the photography experiments on these lunar landers was to obtain close-up images of the lunar surface for use in lunar studies and determination of the feasibility of manned lunar landings. The Soviet missions Zond 6, 7, and 8 during 1968 – 69, circled the Moon and returned to Earth and were recovered in uninhibited places.

Next chapter was the historic dream fulfilling missions- *the human landing on Moon*. The Apollo programme initiated in 1961 was successfully realized on July 20, 1969 through Apollo 11. Through six human landing missions, the last one being the Apollo 17 in 1972, USA performed a number of experiments and gathered quite useful information and also brought back lunar samples in sufficient quantity. Whereas, Soviets mastered on robotic rover landing missions in preference to human landing missions, to fulfill the same scientific objectives on lunar surfaces. Luna 15 & 17 were launched in 1969 -70 brought back lunar samples in required quantity. Through Luna 17 & 21, the Luankhod 1 & 2 rovers were operated on lunar surfaces for scientific experimentations.

The debate on the choice of human landing missions *vs* robotic missions was lingering among the scientific community. While, the advantage of adding up human intelligence to the artificial intelligence for experimental purposes and maneuvers onboard lunar surfaces was considered to be a positive factor, the cost factor was prohibitive to sustain more number of human missions. Nonetheless, the rover landing missions proved to be the pre-requisites for embarking on human landing missions.

With successful accomplishment of Luna 24, a sample return probe in 1976, the first phase of lunar exploration, which has witnessed more than 50 missions, had been given a pause.

5. Second phase of Lunar Exploration:

After 14 years of abeyance, the elite lunar exploration club was joined by a new partner from the Asia Pacific region. Japan, launched its first-ever lunar flyby, lunar orbiter, and lunar surface impact mission, Hiten (Muses A) on Jan 24, 1990. By this time, USA too rejuvenated its quest on lunar exploration through orbiting its Clementine -1 mission in 1994, which mapped most of the lunar surface at a number of resolutions and wavelengths from UV to IR. Subsequent mission of USA, the Lunar Prospector (1998) designed for a low polar orbit investigation of the Moon, enabled the construction of a detailed map of the moon's surface composition and possible ice deposition. After 19 months of orbital performance, on July 31, 1999 Lunar Prospector impacted the Moon near the South Pole in a controlled crash to look for evidence of water ice on moon, but none was observed.

The European Space Agency, for the first time embarked on a lunar mission, SMART-1, an orbiter, launched in 2003 had reached the lunar orbit in 2004. The primary scientific objectives of the mission were to return data on the geology, morphology, topography, mineralogy, geochemistry, and exospheric environment of the Moon in order to answer

[4] *NASA Moon website – http://nssdc.gsfc.nas.gov/planetary/lunar; accessed on September 20, 2007*

questions about planetary formation accretional processes, origin of the Earth-Moon system, the lunar near/far side dichotomy, long-term volcanic and tectonic activity, thermal and dynamical processes involved in lunar evolution, and water ice and external processes on the surface. The SMART-1 spacecraft impacted the Moon as planned on September 3, 2006[5]

The Vision for Space Exploration announced by NASA in 2004, included specific objectives of lunar exploration such as - to undertake lunar exploration to support sustained human and robotic exploration of Mars and beyond, to perform a series of robotic missions to Moon by 2008 to prepare for human exploration, to return to the Moon as early as 2015 but not later than 2020 etc. Accordingly, a robotic orbiter mission, Lunar Reconnaissance Orbiter (LRO) is designed to map the surface of the Moon and characterize future landing sites in terms of terrain roughness, usable resources, and radiation environment with the ultimate goal of facilitating the return of humans to the Moon. LRO is planned to be launched in 2008.

While the second phase of lunar exploration has been steadily expanding, space - faring nations from Asia Pacific region such as India, Japan and China announced their science oriented lunar exploration missions, namely Chandrayaan-1, SELENE and Change-1 respectively, which are briefly outlined in the following paragraphs.

5.1. Missions from Asia Pacific Region:

5.1.1. India's First Moon Mission - Chandrayaan -1:

The Chandrayaan-1 mission is aimed at high-resolution remote sensing of the moon in visible, near infrared (NIR), low energy X-rays and high-energy X-ray regions[6]. The specific objectives of the mission are defined as:

- To prepare a three-dimensional atlas (with a high spatial and altitude resolution of 5-10m) of both near and far side of the moon.
- Chemical and mineralogical mapping of the entire lunar surface for distribution of elements such as Magnesium, Aluminum, Silicon, Calcium, Iron and Titanium with a spatial resolution of about 25 km and high atomic number elements such as Radon, Uranium & Thorium with a spatial resolution of about 20 km.
- Identification of different geological units through simultaneous photo geological and chemical mapping which would test the early evolutionary history of the moon and help in determining the nature and stratigraphy of the lunar crust.

To fulfill these objectives, Chandrayaan-1 is equipped with a host of scientific instruments - five from Indian laboratories, three from ESA, two from NASA and one from Bulgarian Academy of Sciences and thus reflects a true sense of international cooperation in lunar exploration. Indian instruments include a Terrain Mapping stereo Camera (TMC), Hyper Spectral Imaging camera (HYSI), Lunar Laser Ranging Instrument (LLRI), High Energy X-ray spectrometer and a Moon Impact Probe (MIP).

Apart from the above indigenous payloads, six other Announcement of Opportunity (AO) payloads namely - i) Chandrayaan-1 X-ray Spectrometer (C1XS) through ESA (a collaboration between Rutherford Appleton Laboratory, UK and ISRO), ii) Near Infra Red spectrometer (SIR-2) from Max Plank Institute, Lindau, Germany through ESA, iii) Sub KeV Atom Reflecting Analyser (SARA) through ESA, from Swedish Institute of Space Physics, Sweden and Space Physics Laboratory, ISRO, iv) Radiation Dose Monitor Experiment (RADOM) from Bulgarian Academy of Sciences, v) Miniature Synthetic Aperture Radar (MiniSAR) from Applied Physics Laboratory, Johns Hopkins University and Naval Air Warfare Centre, USA through NASA and vi) Moon Mineralogy Mapper (M3) from Brown University and Jet Propulsion Laboratory, USA through NASA, are also included to complement the science objectives of Chandrayaan-1. Chandrayaan-1 is planned to be launched in the first quarter of 2008.

5.1.2. Japan's SELENE:

SELENE (SELenological and ENgineering Explorer), also named as Kayuga, is Japan's second lunar orbiting satellite, being executed by its space agency, Japan Aerospace Exploration Agency (JAXA), scheduled for launch in September, 2007. The

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[5] *NASA Moon website – http://nssdc.gsfc.nas.gov/planetary/lunar; accessed on September 20, 2007*

[6] *For more details pl visit the Chandrayaan web page at: http://www.isro.org/chandrayaan/htmls.htm; accessed on August 15, 2007*

major objectives of the SELENE mission are to obtain scientific data of the lunar origin and evolution and to develop the technology for the future lunar exploration. SELENE consists of a main orbiting satellite at about 100km altitude carries instruments for scientific experimentations and two small satellites namely Relay Satellite and VRAD Satellite in polar orbit.

5.1.3. China's Change-1:

Change-1, the first of a series of Chinese missions to the Moon is scheduled for launch in late 2007. This spacecraft is planned to orbit the Moon for an year to test the technology for future missions and to study the lunar environment and surface regolith. The payload will include a stereo camera system to map the lunar surface, an altimeter to measure the distance between the spacecraft and the surface, a gamma/X-ray spectrometer to study the overall composition and radioactive components of the Moon, a microwave radiometer to map the thickness of the lunar regolith, and a system of space environment monitors to collect data on the solar wind and near-lunar region[7].

Thus the road map of lunar exploration by various stakeholders, envisions a great deal of scientific investigation of lunar surface and resources exploration, through sophisticated missions including resumption of human landing missions. But how does the legal frame work support these objectives? It has to be noted that, while the Outer Space Treaty (1967) encompassing the overall principles and regulations of the outer space activities was in place, a specific legal regime for lunar resources, called the Moon Treaty was adopted by United Nations in 1979. It is attempted to study whether it is supportive or prohibitive to the scientific experimentation vis-à-vis resources exploration cum exploitation.

6. The Moon Treaty

Before entering into the main topic of contention, the authors prefer to present a brief background on the long process of formation of the moon treaty and to highlight its provisions.

As the first phase of lunar explorations was progressing more on a competition mode, the manned Apollo flights to Moon raised a ray of hope towards economic benefits of lunar exploration. The credible results derived through these human flights and associated experiments proved that the soil and sub soil of Moon contained a large variety and quantity of minerals which are lacking on Earth. Thus the presence of natural resources and its significance created controversies in the matter of an agreement with regard to activities on Moon. The first proposal for an agreement submitted by Argentina in 1970 *(UN Doc. A/AC.105/C.2/L.71 corr.1 of July 3, 1970)*[8] introduced the concept of 'Common Heritage of Mankind (CHM)' with respect to the natural resources of moon. The concept of 'Common Heritage of Mankind', was nothing new to other countries especially the major stake holders, as it was for the first time introduced in the Law of Sea[9] with respect to economic exploitation of ocean resources in order to safeguard the interests of all countries, especially the less-developed countries and was adopted by UN General Assembly on December 17, 1970[10]. Subsequently the proposal submitted by the then USSR in 1971[11] included certain restrictions that it should be applicable to Moon only and also it excluded the term 'Common Heritage of Mankind ', which the working paper from USA[12] confirmed the application of CHM principle to the natural resources of moon.

The draft Moon Treaty of UN[13] included the relevant articles emphasizing that the 'exploration and use of moon and other celestial bodies ... shall be the province of all mankind' and 'the natural resources of the moon and other celestial bodies shall be the common heritage of all mankind'. At this juncture, the working paper submitted by India on April 11, 1972[14] gave a major fillip to

[7] *NASA Moon website – http://nssdc.gsfc.nas.gov/planetary/lunar; accessed on September 20, 2007*

[8] *Bess CM Reijnen, 'The United Nations Space Treaties Analysed', Editions Frontiers, 1992- pp3-15*

[9] *Ibid- Introduced by the Ambassador Arvind Pardo, Head of the Mission to the United Nations - pp 5*

[10] *Ibid- Declaration of Principles Governing the Seabed and the Ocean Floor and the Sub-Soil Thereof, beyond the National Jurisdiction (GA Resoln. 2749 (XXV)*

[11] *Ibid- UN Doc. A/AC.105/C.I/L568 Dt. November 5, 1971*

[12] *Supra note at 8 - UN Doc. A/AC.105/C.2 (XI) Dt. April, 14, 1972*

[13] *Ibid- UN Doc. A/Ac/105/101, Dt. May 11, 1972)*

[14] *Ibid*

the draft Moon Treaty. While it confirmed the application of CHM principle, it further elaborated on establishing an international regime to govern the orderly development and rational management of the resources of the moon and other celestial bodies and to ensure the equitable sharing by all the states in the benefits derived therefrom, taking into consideration of the interests and needs of developing countries; further it stressed that the exploitation of natural resources shall not be done except in accordance with such international regime. The then USSR was not convinced with the application of CHM principle, whereas the USA was not comfortable with the provision on a moratorium on exploitation till the establishment of an international regime. The debate continued with further working papers from Argentina and Austria in 1976 and 1978 respectively, which again reiterated the application of CHM principle and the establishment of and international regime to govern the exploitation of natural resources. The Austrian paper further called for the provision of the information on Moon missions to UN[15]. Subsequent hectic discussions held by the Legal Sub-Committee of UNCOPUOS culminated into the final draft text for consideration of UN General Assembly. The Moon Treaty was adopted by the UN General Assembly on December 5, 1979 vide resolution 34/68, which was opened for signature on December 18, 1979 and entered into force on July 11, 1984.

It is interesting to note that while the debate towards concluding an agreement on the activities on moon by states was seriously pursued, the interest in the moon was practically waning. USA after its sixth manned mission landing in 1972, paused its lunar exploration and the then USSR after its sample return probe Luna 24 in 1976. The apprehensions raised by the stake holders on exploitation of lunar resources, had a definite impact on their lunar programme, which virtually came to a halt.

Yet another interesting fact is that the Moon treaty which was debated by major space - faring nations and subsequently adopted unanimously in UN General Assembly has received a very poor response from the states, unlike other space treaties, with only 13 ratifications[16] and four signatures[17] till date. The last ratification was done by Lebanon in 2006. Except India and France, who have signed the treaty though not ratified, major space - faring nations kept away, even after having participated keenly in the formulation process. Further, it took about five years to come into force, upon the ratification of the fifth state[18]. Before getting into the nitty-gritty on what went wrong, it is preferred by the authors to give glimpse of the major provisions of the moon treaty.

6.1. Major provisions of Moon Treaty:

The Moon Treaty in the overall sense reiterates the general principles and obligations pronounced in the Outer Space Treaty, with respect to freedom of exploration on a non-discriminatory basis, non-appropriation, use for peaceful purposes, non-military activities, providing information on lunar activities to UN, compliance to environmental considerations, exercise of jurisdiction and control over personnel and equipment and other facilities, international responsibility for national activities etc. Nevertheless, which are the specific provisions that project the Moon Treaty as distinct and / or controversial? Does it not support the exploration on scientific objectives? Does it permit or prevent exploitation of lunar resources? To address these questions, analysis of Articles 6, 8 and 9 with respect to freedom of scientific investigation and exploration and Article 11 with respect to CHM principle and resources management and Article 18 with respect to review of Treaty are critically analysed.

6.2. Article 6 - *Scientific Investigation*:

While the freedom of scientific investigation on the moon without any discrimination on the basis of equality and in accordance with the international law has been emphasized as done in Outer Space Treaty, it further addresses the collection and removal of samples from moon.

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[15] *Ibid - UN Doc. A/AC.105/218 Dt April 13, 1978 and Annex1.*

[16] *Australia, Austria, Belgium, Chile, Kazakhstan, Lebanon, Mexico, Morocco, The Netherlands, Pakistan, Peru, Philippines, Uruguay.*

[17] *France, Guatemala, India and Romania.*

[18] *Paragraph 3 of Article 19 - Agreement governing the activities of states on the Moon and other celestial bodies.*

- *Permits the State parties to collect on and remove from the moon, samples of its mineral and other substances.*
- *Permits the State parties to have custody of such samples and use them scientific purposes.*
- *Provides for sharing of such samples with other State parties and international scientific community.*
- *Permits for use of minerals and other substances of the moon in quantities appropriate for the support of their missions.*
- *Provides for exchange of scientific and other personnel on expeditions to or to installations on moon to great extent possible and practicable.*

It permits collection, custody, sharing and use of resources. Almost equivalent to the property rights on Earth, except for appropriating, alienating and selling rights. While it supports the scientific investigations, it must not be ignored that appropriate checks and balances are built in against any possible misuses. It should be construed that the lunar samples collected could be used or kept under custody or shared with others for scientific purposes only and not otherwise. Further, it imposes a limitation on the use of minerals and substances of the moon by a State party. Though the term *'appropriate quantity'* is very much subjective, in scientific context it could be definitive.

6.3. Articles 8 & 9 – *Exploration and Use*:

The exploratory cum exploitation activities of resources on the moon obviously necessitate the landing of space objects and/ or personnel and/ or establishment of stations by State parties. But it calls for certain regulations among the potential players.

Article 8 provides for -

- *freedom on activities to explore and use of moon anywhere, on or below its surface.*
- *Landing of space objects and launching them from the Moon*
- *Placing of personnel, space vehicles, equipment, facilities, stations anywhere on or below the surface of the Moon.*
- *Freedom of movement for personnel and other objects on or below the surface of the moon*
- *Non-interference with the activities of other State parties.*

Article 9 permits establishment of manned or unmanned stations on the Moon with appropriate information to Secretary General of United Nations and in a manner conducive to the activities of other State parties.

Thus the It is hardly to be emphasized that these provisions unequivocally support the scientific investigations on moon and its resources either in-situ or on Earth. It is a fact that these provisions were included in the Treaty, based on the practical realities displayed by the then space powers. Any space system scientist could not have asked for more to support his / her scientific objectives. It is quite unfortunate that the freedom offered to explore has been downplayed on the pretext of exploitation of natural resources.

6.4. Article 11 – *Common Heritage of mankind, Natural resources management*:

As discussed in the previous sections, the scientific investigations of lunar resources gave sufficient scope for exploitation of the same, obviously for commercial purposes. The most contentious issues such as Common Heritage of Mankind, establishment of international regime for management of resources, equitable sharing of benefits which pre-empted the accession of major space powers to Moon Treaty were included in Article 11.

Article 11 –

- *declares that the Moon and its natural resources are the Common Heritage of Mankind*
- *prohibits national appropriation by any claim of sovereignty or by means of use or occupation*
- *prohibits the right of ownership by any State or any international organization; further clarifies that right of use and exploration on Moon does not entail a right of ownership.*
- *guarantees the right for exploration and use of the Moon without discrimination of any kind, on the basis of equality and in accordance with international law*
- *obligates the State parties to establish an international regime, including appropriate procedures, to govern the exploitation of the natural resources of the Moon as such exploitation is about to become feasible and implement in accordance with article 18 (review provision).*
- *obligates the State parties to Inform Secretary General of UN, the public and the scientific community of any discovery*

of resources to facilitate the establishment of international regime.

- *declares the main purposes of the international regime as –*
  - *for the orderly and safe development of the natural resources of the Moon*
  - *for the rational management of those resources*
  - *for the expansion of opportunities in the use of those resources*
  - *for an equitable sharing by all States Parties in the benefits whereby the interests and needs of the developing countries, as well as the efforts of those countries, which have contributed, to the exploration, shall be given special consideration.*
- *expects the activities to be compatible with the purposes specified above and Article 6 paragraph2)*

It must be noted that, except for the few provisions such as, CHM principle (paragraph 1), the establishment of an international regime (paragraph 5) and the rules for rational management of natural resources and the principles of benefit sharing (paragraph 7), the rest are almost common as found in OST, the popular space treaty, ratified by many states, including the major space powers. What are the contentions with regard to these provisions?

The CHM principle is an extrapolation of the term 'province of all mankind' as pronounced in Article 1 of OST and Article 4 Paragraph 1 of Moon Treaty. The CHM concept takes it root from the developments in the Law of the Sea, as discussed under Section 6 of this paper. It assigns the rights over things which can not be appropriated by any one but used by all, *to the humanity*[19]. Thus it goes much further from *res communis*, by offering the rights (and duties) to organize and rule the common thing or territory to the entire global community. When it comes to the question of *organizing*, the paragraphs 5 and 7 of this Article 11show the way. Paragraph 5 calls the establishment of an *international regime* to govern the exploitation of the natural resources of the Moon at a time when the exploitation is about to become feasible. Thus it categorically permits the exploitation of natural resources but with a rider- *such exploitation is about to become feasible.* Till then, does it not allow exploitation? Article 6 paragraph 2 provides the solution, which is dealt in Section 6.2 of this paper.

Paragraph 7 elaborates on the rules of the game for rational management of resources by the so called *international regime.* It advocates for equitable (*not equal*) sharing of benefits derived from those resources, with a special mention for the interests and needs of the developing countries. It further recognizes some special considerations for the direct or indirect contributions of the States in such resources exploitations. Thus it strikes a sensible balance between the rights of all stake holders. The investments of States and / or its private entities towards the exploration and successful exploitation of the resources are ensured. At this juncture, it is needless to emphasize that an answer to the apprehensions on whether the Moon Treaty is *supportive or prohibitive,* has emerged.

6.5. Article 18 – *Review of Treaty*:

Generally, in an agreement or a treaty, a provision for review would be included, when the principles on which it is developed are expected to change in due course due to various factors such as its relevance to practical applications, technological changes, geo-political changes etc. Article 18 of Moon Treaty lists out the terms for review, as -

- Ten years after the entry into force, to include in the provisional agenda of the UN General Assembly (UNGA), in the light of the past application
- At any time after this Agreement has been in force for Five years
  - At the request of one third of the State parties and
  - With the concurrence of the majority of the State parties
    - To convene a review conference, which shall consider the implementation of the provisions of Article 11 Paragraph 5, on the basis of paragraph 1 of the same Article
    - Taking into account of the technological developments.

[19] *Outer space Res Communis, Common heritage, common province of mankind? Armel Kerrest, Notes for a lecture in the Nice 2001 ECSL Summer Course*

The first method of including in the provisional agenda in the UNGA is practically possible only at the initiative of the Legal Sub-Committee of UNCOPUOS, which relies upon the consensus based resolution passing method. The second part is nothing but a method for initiation towards the establishment of an international regime to govern the exploitation of natural resources on the basis of CHM principle at appropriate time. It may be noted that unlike the similar provisions enunciated in Registration Convention (Article -10) and Liability convention (Article -26), the scope for review has been more stressed towards the management of natural resources and linked to the technological developments.

7. The need for re-engineering the treaty:

Having analysed the contentious legal provisions, it is attempted to examine the need for a review of the Agreement. It has to be noted that the authors of the treaty nursed the lingering doubts about its long term applicability due to rapidly changing technological scenario. A provision is therefore made in the treaty itself for its review with a kind of emphasis not seen in the earlier space treaties.

Coming to the present context, there exist renewed global interests in the exploration and exploitation of resources. The fascinating programmes pursued by the Asia Pacific nations and the USA's zeal for Return to the Moon as envisaged under Vision for Space Exploration and the initiatives taken up by some of the European countries on lunar missions would certainly have an impact on the geopolitical perception of the Moon and exploitation of its resources and thus might lead to a logical furtherance of Moon Treaty.

Further, the means and costs of access to space and the technologies for exploration and exploitations have been improving rapidly. The lunar exploration road map as envisioned by major players, depicts a scenario of establishing human habitats, mining of Helium-3 and other important materials, establishment of lunar bases for power generation, production of rocket fuel, base for launching spacecrafts etc. And to some extent these are extended to Mars too. Interestingly, the Moon Treaty is applicable to the activities on other celestial bodies too.

It is envisioned that the lunar economy could be partitioned into three strongly coupled sectors. One sector produces for local consumption. The second sector produces for shipment to Earth or Earth/lunar orbit, and the third sector supports the development of Mars. There could be overlap of these sectors. Possible commercial activities would include in-situ resource utilization as well as processes that benefit from low gravity, hard vacuum, temperature extremes, and isolation from Earth "noise" [20].

It is also worth to note the ongoing plans announced by certain private entities to sell pieces of land on lunar surfaces through advertisements[21]. Though these acts arising out of ignorance or any intentions do not cause any legal concerns, as such efforts could be nullified by the application of Article II of OST and Article 11 -Paragraph 2 of Moon Treaty. Nonetheless, they would add up strength to the argument of need for a review of the Moon Treaty. We are at the threshold of the time - *exploitation is about to become feasible,* as indicated in paragraph 5 of Article 11, to establish an international regime to govern the resources exploitation.

Can we call such a review based on the technological advancements, as *re-engineering?*

Having established the need for re-engineering the Moon Treaty, the technical viability of it has to be looked into, in the context of the conditions of the built-in provision (Article 18) and the consensus based resolution adoption method followed by the Legal Sub committee of UN COPUOS. As mentioned in the earlier sections, the Moon Treaty has earned only 13 ratifications and four signatures as compared to OST which enjoys a tally of 98 ratifications and 26 signatures. As per Article 18, proposal for a review conference could be mooted just by a handful of five states (one third of the State parties) which could be consented by them with an additional two States. What would be the legal sanctity and technical merits of the resolutions and passed by this small group of States, which do not have major stake in space

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20 *Haym Benaroya, 'Prospects of Commercial Activities at a Lunar Base', Solar System Development Journal (2001) 1(2), 1-22, ISSN: 1533-7405 http://www.resonance-pub.com*

21 *Prof. Ram Jakhu , 'Legal issues relating to the Global Public Interest in Outer Space'- prepared for Advanced Cooperative Security Program at the Centre for International Security Studies, Universitry of Maryland, October 2005*

exploration, in the global context? Can it be made to reach to the provisional agenda of UNGA through UNCOPOUS?

The basic requirement is to strengthen the Moon Treaty through acceptance and adherence by more number of states especially all the space - faring nations. In this context, it is again recalled that except for few provisions, which were perceived to be contentious, the overall framework of Moon Treaty is a derivative of OST. Hence, it would be appropriate on the part of the non-state parties to accede to Moon Treaty and contribute to re-engineer the same for wider acceptance and compliance.

While attempting to re-engineer the treaty, the lessons learnt from past experiences on outer space activities, for example, the space debris mitigation, utilization of geostationary orbit etc., have to be necessarily taken into account. Though, ideally all states are assured of sovereign equality under the Charter of United Nations and thus enjoy equal rights and obligations in sharing benefits out of international areas, in reality, it is a resentful fact that some states are most blessed than many others in most of the possibilities to gain such benefits, due to their economic and technological status.

In the case of space debris, the overwhelming activities performed in outer space by the pioneers of space activities and subsequent competent players, *unmindful of others rights*, have sufficiently contaminated the outer space and has brought the global community to a situation, which posed a grave threat to the operation of space systems at low earth orbits including the flight of satellite launch vehicles, ISS and human flight operations. Interestingly, the initiatives taken up by major space - faring nations out of dire necessity culminated in formulation of draft guidelines on debris mitigation, which has been subsequently debated and adopted by UNCOPUOS. Ironically, the new entrants who have just been developing and advancing in space technology and thereby deploying space systems for peaceful purposes are also put at same pedestal and thus expected to follow the common rules of the game; they have to comply with the complex mitigation measures at par with the advanced space - faring nations on the basis of *equality* in obligations. The component of technology to mitigate debris, its availability - rather denial through export control measures and the cost of its implementation onto the space systems, really pose a difficult situation to the new entrants especially the developing countries and thus thwart their access to space. This situation certainly does not take cognizance with the basic principles of the Outer Space Treaty.

Similarly, the utilization of the most sought after geo-stationary orbit for operating communication satellites, which was exploited by the technologically mighty states and thereby depriving of the rights of developing and less developed states over this *natural resource*, is yet another example. After a prolonged debate in UN, the ITU Convention, 1982 has brought some solace by recognizing a formal *equality* among states, in utilizing the geostationary orbit in terms of access to frequencies and slots[22].

The review process should take cognizance of the varied needs of all stakeholders, especially the newcomers from developing countries. Any mistake committed would affect the future generation of the entire humanity, and thus would not spare even the developed ones. *Let us make no mistakes.*

8. Concluding Remarks:

The Moon Treaty has enabled a number of peaceful exploratory missions in the past and thus served the cause of science very well. The renewed pursuit of lunar exploration at present indicate the interests for resources exploitation beyond scientific objectives. Further interests towards human habitat and establishing lunar bases etc., are in the anvil, with the enabling technologies round the corner. Moon Treaty shows the way for commercial exploitation of natural resources in an orderly and equitable manner, through a review at appropriate time. Though such a time is ripe, obviously, such an attempt would lack the consensus of the majority of the states. The need of the hour is to strengthen the Moon Treaty with the accession of more number of states including all space - faring ones. A serious attempt to re-engineer the Moon Treaty towards the objectives of commercial exploitation would pave the way for reaping the real benefits of space technology by the humanity.

'Let us Re-Engineer the Moon Treaty - Together, Quickly'

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[22] *Supra Note at 8*

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