UDC 341.1/8

THE OBJECTIVE OF THE USE OF NATURAL RESOURCES IN OUTER SPACE

© Gambaro Monica, Yesan Pedro Zavala

University of Bologna, Bologna, Italy; University of Piura, Piura, Peru

e-mail: monica.gambaro@studio.unibo.it; pyesang@hotmail.com

Human development is fueled by natural resources that are provided by planet Earth. As it turns out, 88 billion tons of natural resources were extracted, as of the year 2017[1]. Since this rate is only expected to increase, the current situation is alarming, as more and more resources are needed to sustain mankind in its ever-accelerating growth. It is almost a survival instinct to turn to other planets and celestial bodies for obtaining these supplies.

Resources can be classified using different methods. The first useful distinction is between natural and artificial resources. [2] Artificial resources are invented, developed and manufactured by humans. From simple houses to the most recent form of technological advancement. On the other hand, natural resources are present on Earth without the need of man-powered labor to produce them. They are a substrate already existing in the environment, which encompasses both living beings and non-living materials. This type of resources is at the core of every artifact a man can devise.

A major problem though is that, while artificial resources are mainly renewable and easily so, natural resources are both renewable and non-renewable. If the former is relatively inexhaustible, the same cannot be said for the latter. As a matter of fact, non-renewable natural resources can be replaced naturally by the ecosystem, however their rate of replacement is not compatible with the rate at which they are consumed. As a result, there is only a limited amount of them at our disposal. The primary example is the use of fossil fuels to produce energy. Nowadays, the energy sector is powered by fossil fuels (petroleum, natural gas and coal). The ever-escalating intensity at which these fuels are being depleted has already sparked a debate over its lack of long-term environmental sustainability.

Moreover, the excessive exploitation of natural resources by humans is at the root of environmental alterations that are becoming more and more irreversible. There is indeed a measure of how much disturbance an ecosystem can endure before it reaches its critical point and it is denominated ecological resilience. Nature’s ability to recover from a perturbation, may it be a fire or an insect outbreak, is a documented fact in ecology; yet what matters is the severity and the extent of these disturbances, that can in some cases exceed the resilience capacity. As these disturbances also occur naturally, there are instances in which the human impact affected the environment more than it could have sustained. For instance, overfishing has exploited more than 70% of fish stocks and at the same time endangering numerous marine species, while excessive and irresponsible mining has caused erosion and pollution in many mining sites, thus affecting their biodiversity.

Coming full circle, the next step for humanity is the possibility of acquiring resources from outer space. Even though there are no life forms as the ones on Earth, space bodies still represent a valuable mean for modern industry since essential components for its functioning are in dire need of being replenished. Copper, tin, gold, silver, zinc and even water could be brought back on Earth from space.

Furthermore, space-based solar power (SBSP) is also a potential outcome of space exploitation, as it represents a form of green energy source. Solar and wind energy as they are right now are indeed still costly to implement in large scales because they are not as efficient when energy demand grows, combined also with the fact that electricity storage is still a difficult task to manage completely. SBSP would resolve a great array of problems, as it would eliminate the loss of large quantities of energy because of our atmosphere and it would dispense energy even when it is night on Earth.

On the other hand, when it comes down to fuels, water can be used an "energy carrier"[3], since its components (hydrogen and oxygen) can be broken down by electricity generated by solar panel, thus generating a combustion that can propel rockets forward. However, the real aim in space exploitation seems to be helium 3, an isotope of helium that represents a clear opening for nuclear fusion reactions. Because of its stable structure, helium-3 could fuel nuclear reactions without rendering other materials radioactive. Safety concerns would be swept away, along with production costs.

Economic progress in both developed and developing countries cannot continue without the very basis on which it was built, that is raw materials. Raw materials fall into the category of non-renewable resources, thus originating an escalating competition over their ownership. Scarcity of finite goods is induced by various factors; for instance, population growth can inflate the demand of these limited resources, further decreasing their availability. The direct effect is that their market value multiplies and so do their production costs and market prices. Nobody wins but the ones that have complete jurisdiction over these resources, as one's ownership excludes another one's control.

Asteroid mining is the key to stabilize the supply of raw materials in the long run. Asteroids, other minor near-Earth objects and even comets can be future extraction sites for materials needed both back on Earth but also as construction materials or as rocket fuel *in-situ*. Not surprisingly, these space rocks are indeed untouched gold mines, figuratively and literally. Water, raw materials and the platinum-group metals can be obtained thanks to these asteroids. It is indeed important to underline that rare metals were embedded on Earth's crust by multiple rains of asteroids themselves. However, the likelihood of asteroid mining happening in the near future is low.

First of all, 75% of asteroids (C-types), that contain up to 22% of water[4, 5], are also the farthest away from the Sun. This fact implicates that the costs will outweigh the benefits, even with the current state of technological equipment and extraction techniques. As a result, the focus was moved to the so-called "easily recoverable objects" (ERCs), that are considerably closer to Earth. Being at shorter distance, their change in velocity can be more easily calculated and the travel time is reduced to a more viable option. Additionally, in this closer section of space, another and more profitable type of asteroids is more common: the S-type, which contains little amounts of water but far larger amounts of metals.

Second of all, even though resource exploitation may now seem less of a dream and more of a reality, the price of space access is still at play. Economic feasibility of space mining has been estimated throughout the decades without ever being within our grasp. Admitting that mining missions were successful and great quantities of rare metals were introduced in the world market, their price would fall by an amount so great, it would nullify the benefits of such exploitation. Third of all, to conduct a fully funded mining exploration there need be proof that the reserves are large enough to even justify the mission itself, coupled also with their viability.

While space mining is still up to debate, a discussion about its regulation can already be started, since all legal regulations require time to be codified, signed and then ratified by the various parties. In this case, it would be international law and the parties involved are all the existing and recognized States of the world. It takes years before a treaty is officially implemented and is finally legally binding to the States that decided to ratify it. In some cases, in spite of meetings, talks and negotiations, many treaties never arrive to that final stage.

It is valuable for our research mentioning the Earth-based legislation about the exploitation of natural resources, both because it inspired the existing law regarding outer space and also because it can still represent the foundations on which to base future broader legal arrangements.

The United Nations Convention on the Law of the Sea (UNCLOS) outlines the norms that States must abide to for the use of the oceans. It divided the oceans in different areas which have specific characteristics and purposes. While the convention made clear that the nations had the obligation of collaborating with one another for the protection of the marine environment, it primarily established the complete state ownership of marine resources.

The complete example was set by the Protocol on Environmental Protection to the Antarctic Treaty, which established that the parties were committed in protecting Antarctica as a place of wilderness and its soil would be used solely for research expedition. In any case Antarctica, its flora and its fauna, would be subject to the sovereignty of any State.

The manner to use natural resources in outer space now is an important topic of discussion for the advance of the technology and the needs of that resources as we explained before.

The United Nations adopted in 1962 the Outer Space Treaty is a declaration of legal principles governing the activities of states in the exploration and use of outer space, there, they develop principles for the activities outer space, for the natural resources as:

- Exploration and exploitation outer space are for the Benefit of humanity.
- Freedom and equality following international law, all countries with the same rights are free to explore and exploit outer space.
- Prescribe the claim of sovereignty from countries about Outer space and celestial bodies.
- Respect to the international law and Charter of the United Nations.
- Liability from countries and persons related to countries about their activities outer space.

These principles are the most important declaration in space law. Then 1979 it made the Agreement governing the activities of states on the moon and other celestial bodies. That agreement its related to de moon and celestial bodies in our solar system. In this declaration its open the possibility to use resources from moon and other celestial bodies with ‘peaceful proposes’. But if one country wants to use the resources in the moon or the celestial bodies, for their direct impact on the earth has to benefit all the member's countries parts of the treaty.

There is no strict regulation in international law and national law for outer space yet, less for the use of natural resources, but the principles and objectives to use need to be the same a harmonic growth that let us seen a sustainable development.

The use of the natural resources outer space for states or privates it is just a beginning, in the next years for the advance of these activities, international and national legislation are going to grow. In that line, space law needs to be flexible to regulate a new reality, the outer space reality, with their singular circumstances and development.

One of the most important topics about the regulation of the use of outer space natural resources is related to the objective of this use, as we can see in the treaties, that free use of the resources needs to be harmonic with the international environmental laws, in that sense, the objective of the regulations attends to made resilient ecosystems (like "Permanent sovereignty over natural resources" treaty) be responsible with the environment and the resources. Then with the advance of technologies and new realities, they are going to attend the special characteristic for each of the natural resources.

References

1. We are consuming the future. N.D theworldcount.com. URL: https://www. theworldcounts.com/challenges/planet-earth/state-of-the-planet/overuse-of-resources-on-earth.

2. Types of Resources. N.D toppr.com. URL: https://www.toppr.com/guides/geography/ resources/types-of-resources.

3. DunnilL, W. Charles, Phillips Robert. “Making space rocket fuel from water could drive a power revolution on Earth”. September 27, 2016. URL: https://theconversation.com/making-space-rocket-fuel-from-water-could-drive-a-power-revolution-on-earth-65854.

4. Gradie et al. pp. 316–335 in Asteroids II. Edited by Richard P. Binzel, Tom Gehrels, and Mildred Shapley Matthews, Eds. University of Arizona Press, Tucson, 1989.

5. Shaw Stephen. Asteroid Mining (C, S, M Types) – Know Everything About It. August 21, 2012. URL: https://astronomysource.com/tag/m-type-asteroids.