

Space Economy and Sustainable Development Goals: Technological Spin-offs and Policies for Emerging Economies

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Abstract: *Space economy, worldwide, has been transformed from being a field of scientific discovery to being critical infrastructure to support sustainable development. The present qualitative study analyzes its role in being a driver for development through its various economic, sociological, technological and policy perspectives for developing countries. Based on the institutional perspective provided in UN and OECD documents, the article shows the utility of space services in achieving Sustainable Development Goals (SDGs). The paper claims that lowering of launch costs and international collaborations have created new possibilities for the Global South. The article presents case studies from African and Latin American continents, and from India in terms of shifting to a demand driven approach in order to provide practical guidance to technological self-sufficiency. However, such a potential can be harnessed only through appropriate frameworks which match the economics and priorities of the country concerned. The paper ends with providing policy imperatives for emerging economies based on such an institutional framework.*

Keywords: Space Economy, Sustainable Development Goals, Technological Spin-Offs, Global South, Space Policy, Socioeconomic Development

1. INTRODUCTION

Space exploration had long been considered an activity for select advanced countries—a sphere of science, politics, and prestige. This view of the matter has drastically changed. Space is no longer a far-off horizon; it has turned into the next layer of world infrastructure that silently supports all aspects ranging from world economics and logistics to climate change monitoring and disaster response. In this regard, one should note the appropriate remark by the United Nations Deputy Secretary-General Amina Mohammed who stated that “Space is not the final frontier. It is the foundation of our present” (United Nations News, 2025, para 3). Without satellites above our heads, the world’s food supply systems will collapse in a few weeks; rescuers will lose their lifelines; the idea of sustainable development goals will remain a mere dream (United Nations News, 2025).

There are also significant economic implications. The global space economy stood at \$613 billion in 2024 and will grow beyond \$1.8 trillion by 2035 (World Economic Forum, 2025). While much of this development is about rockets and launchers, it is also about satellite-based services that help keep markets in sync, supply chains transparent, and people connected. An interruption of GPS services provided by the United States would result in a loss of roughly \$1 billion every day, reflecting how orbital disruptions affect agricultural, logistical, and financial activities well away from any launch site (World Economic Forum, 2025).

Among the developments worth mentioning is the fact that even nations which do not boast of major space organizations are now able to reap benefits from the space economy. University-based CubeSats, smaller satellites, and collaborations between government and private sectors have reduced the barrier to entry. The launch of the first satellite in Kenya in collaboration with the United Nations and Japan’s KiboCUBE program started out as a university initiative and paved way for national capabilities in space information and engineering. Brazil’s Amazonia-1 satellite provides regular images of forests that help policy makers and supply chain managers keep track of deforestation efforts (World Economic Forum, 2025).

In this study, there are three main perspectives discussed concerning the impact of space economy on sustainable development, namely, the socio-economic perspective on the use of space technologies in addressing development issues in sectors such as agriculture, health, education, and disaster management; spin-off technologies

in which space innovations create economic impacts in areas outside the space sector; and the policy perspectives that entail the policies needed for ensuring participation by emerging economies in the space economy. The discussion is informed by the framework of the United Nations' Space2030 Agenda and the SDGs, as well as research from the OECD on space sustainability.

2. THE SPACE ECONOMY AND THE SUSTAINABLE DEVELOPMENT GOALS: A SYMBIOTIC RELATIONSHIP

The connection between space operations and sustainable development cannot be accidental and unidirectional. Indeed, as articulated by the United Nations Office for Outer Space Affairs (UNOOSA), the core architecture of the Space2030 Agenda relies on four distinct foundational tracks specifically "space economy, space society, space accessibility, and space diplomacy" to function as programmatic mechanisms for achieving the SDGs. The first overarching goal set out by the Space2030 Agenda is to enhance space-derived economic benefits and reinforce the contribution of the space sector to sustainable development (United Nations, 2024).

Several expert reviews have already shown that space activities positively affect nearly all the 17 SDGs. There are significant impacts in many goals; specifically, there is an impact on SDG 6 (Clean Water and Sanitation), SDG 9 (Industry, Innovation and Infrastructure), SDG 12 (Responsible Consumption and Production), SDG 14 (Life Below Water), and SDG 16 (Peace, Justice and Strong Institutions) (Cernev et al., 2024). UNOOSA identifies six priorities in terms of accelerating the SDGs – food systems, energy transitions, digital connectivity, education and skills, environment, and employment and social protection – all of them requiring space technologies (UNOOSA, 2025).

The COPUOS 2025 side event was the first time the space economy was investigated from an economic perspective, which is an important step toward the realization of a more realistic view of space as a tool of sustainable development and economic development (UNOOSA, 2025). What was stressed in the discussion was that creating a sustainable and inclusive space economy demands a congruence of economic logic and national interests, as well as establishing an ecosystem and making connections between sectors. All countries, irrespective of their size and initial position, can make their own space strategy valuable for their people (UNOOSA, 2025).

3. SOCIOECONOMIC DIMENSIONS: SPACE AS DEVELOPMENT INFRASTRUCTURE

3.1 Agriculture and Food Security

Space technology has made huge changes to farming in developing countries. Space observation provides tools for precision farming, weather forecasts, crop surveillance, and drought prediction these all contribute to the security of food. In the Rift Valley of East Africa, farmers are now able to track their rainfall patterns through simple mobile phones, thanks to space technology that used to be available only in developed countries (World Economic Forum, 2025). In Africa, space technology is being used to track weather patterns and aid drought prediction (UNOOSA, 2024).

The downstream industry, which involves converting satellite information into business services, presents the biggest chance for emerging economies. Instead of constructing expensive facilities to launch satellites, emerging economies can concentrate on applications such as Earth observation, precise agriculture, logistics, weather prediction, disaster response, telecommunications, analysis of data, and artificial intelligence applications. One specialist put it best when he said, "The most valuable launch system of the future will not be a rocket it will be a graduate." (Vietnam Space Week, 2026, para 3). This paradigm shifts in the thinking about development places emphasis on skills as infrastructure.

3.2 Connectivity and Digital Inclusion

Low Earth orbit satellite constellations are now providing high-speed broadband services to regions where fiber-optic technology has not reached before, making it possible to conduct classes and telemedicine sessions through satellites, along with other commercial activities. Satellite constellations such as Starlink and OneWeb have already launched thousands of satellites, and as the costs decrease, governments will be able to start connecting schools and hospitals followed by private individuals.

In India, space technology applications represent 75% of the value in the industry, contributing towards agricultural applications, disaster management, rural connectivity, and climatic applications (India UN, 2025). In India, the space economy valued at approximately USD 8 billion is forecasted to reach up to USD 40 billion by 2040. Driven by over USD 350 million private funding in the last few years, there are over 420 space technology startups functioning in India, which is nearly double of that recorded four years back (Businessworld, 2025).

3.3 Disaster Management and Climate Resilience

Space technology is an essential tool for disaster management and climate resilience. Satellite technology provides early warnings about weather-related emergencies, quick damage assessment after natural disasters, and constant environmental monitoring. The UN Office for Outer Space Affairs helps nations like Tonga, Trinidad and Tobago, and Ghana to make use of satellite technology and develop 3D models of whole cities, which helps to respond to disasters quickly and saves lives (UNOOSA, 2025).

The Brazilian approach shows how a country can adapt its space economy according to its national strengths regardless of financial restrictions. Brazil uses Earth observation technology for environmental monitoring and climate resilience by relying on decades of expertise and international collaboration. Current reforms aim at liberalisation of the industry through regulatory reform, commercialization, internationalization, and entrepreneurship, and help to adapt space development to the global role of Brazil in environmental management (World Economic Forum, 2025).

In addition, the Republic of Singapore can serve as an alternative approach for other countries that have similar economic conditions and wish to join the space industry. As compared to the development of upstream capabilities,

Singapore prioritizes niche areas like secure communication and satellite analysis. This state attracts investments by means of research and development financing, launch services, and foreign trade (World Economic Forum, 2025).

3.4 Health and Telemedicine

Space technology has been a key driver for improving the provision of healthcare services, especially in areas which are difficult to access. Telemedicine, through satellite connections, has been used in order for health professionals in rural clinics to consult specialists and send their medical records. NASA has been able to use its technological innovations to solve problems such as disaster relief, telemedicine, and even water quality (Wood, 2011).

“SpaceShip Vietnam,” the idea presented by NASA flight surgeon Dr Josef Schmid, highlights the fact that the space industry cannot be established purely by aerospace engineers and astronauts. There is always a group of physicians, data experts, lawyers, teachers, entrepreneurs, policy makers, and communicators behind every space mission. This multi-disciplinary approach makes clear that the value of space extends beyond the technical field and involves healthcare, education, laws, and public policies among others (Vietnam Space Week, 2026).

4. TECHNOLOGICAL SPIN-OFFS: FROM SPACE TO SOCIETY

4.1 The Spin-Off Phenomenon

Space technologies that help in promoting activities related to space through hardware, software, project management tools and technical processes can be put to societal uses beyond space. This technology is used to solve broader societal problems using creativity and problem-solving skill sets of the space industry (Wood, 2011). Traditional space agencies such as NASA and ESA have particular offices to ensure that space technology is incorporated into spin-off ventures.

There have been many instances when a firm has licensed out the space technology from any one of the space agencies and built their business on the spin-off. Other organizations including universities, NGOs and government agencies can also act as agents of spin-offs (Wood, 2011). However, the difficult part is how to utilize the spin-offs of space technology to solve developmental challenges faced by the emerging economies.

4.2 Spin-Offs in Developing Countries

Innovations arising from space activities are increasingly being used to address the needs of society in developing countries. Organizations operating in developing countries are focused on using the skills and innovations from the space sector to their local needs. Fieldwork done in countries which have recently been exposed to national space activities shows current efforts and potentials to use the innovations from the space sector to develop national needs (Wood, 2011).

The impacts can be potentially lifesaving, but several issues need to be addressed to use the innovations from the space sector to promote development. It is necessary to consider such ideas as technology transfer, international cooperation, systems thinking and appropriate technology

(Wood, 2011). The OECD organization has underlined that although the results of space R&D are intangible in nature, they are extremely important since they contribute to improved government services, development of technology and economy (OECD, 2023a).

4.3 The Indian Experience

The space programme of India serves as an interesting example of technology transfer and spin-off generation. ISRO has been spending considerable amounts on their space programme and must be obliged to maximize the transfer of technologies developed in different fields to Indian industries to aid in self-reliance in technology, industrial development, and nation building (ISRO, 2023). The financial benefits received directly from the Department of Space because of technology transfer are quite insignificant compared to the other developmental benefits.

ISRO supports the industry to discover applications and spin-offs through exploiting the technologies developed at ISRO through an efficient technology transfer policy. One of the areas of interest here is that of indigenization where the objective is to indigenize the space parts and equipment so as to reduce dependence on foreign sources (ISRO, 2023). Till date, in 2025, NSIL has entered into 100 technology transfer agreements for transferring the technologies developed at ISRO to Indian industries. IN-SPACE, in July 2025, has facilitated the transfer of ten cutting-edge technologies developed at ISRO to six Indian Industries (Chundru, 2025).

India's path in the sphere of space has moved from its history of state-dominated approach to that of a competitive market dominated by private players. India's revenues which started from around 8.4 billion dollars (around 2% of the world market) are now set to grow to around 44 billion dollars by 2033, representing about 8% of the market (Fortune India, 2025). The above change can be attributed to a policy decision from the supply-led to demand-led strategy (Chundru, 2025).

5. POLICY IMPERATIVES FOR THE EMERGING WORLD

5.1 Building Enabling Ecosystems

The COPUOS side event in 2025 stressed that an inclusive space economy will only be sustained if economic considerations are balanced with national priorities and enabling ecosystems created and cross-sectoral relationships made (UNOOSA, 2025). In this new era of space agencies as market facilitators, knowledge of economics is essential to evaluate trade-offs, resource allocation, and socio-economic benefits to ensure a return on investment (UNOOSA, 2025).

For developing countries, involvement starts with data services, downstream applications, research, and human resources, not launches (Vietnam Space Week, 2026). Full realization of this potential involves incorporation of space applications into mainstream industries such as agriculture, energy, and disaster relief. The achievement of which depends on demand-driven use cases, user engagement, and messaging of impact. It is only through this transition from upstream to downstream that sustainable market development can occur (OECD, 2023b).

5.2 International Cooperation and Technology Transfer

International cooperation becomes essential for the sustainable development of outer space, which allows emerging space faring nations to take advantage of an invaluable opportunity to address their development problems. Exchange of research and development results, as well as sharing best practices and technological achievements with developed nations can help emerging countries advance in their development. Development of space applications in line with SDGs, such as Earth observation for environmental monitoring, disaster management and agriculture optimization become an important way forward (OECD, 2023b)

Technology transfers from space-faring nations to developing countries could be encouraged through increasing training programs in applying off-the-shelf technologies (Wood, 2011). African Union Agenda 2063 and the African Space Agency seek to develop international cooperation within the Global South as well as between the Global South and Global North to promote the sustainable utilization of outer space (World Economic Forum, 2025). Establishment of various platforms, including “Space for Earth Labs” in Dubai, aimed at fast-tracking commercialization and application of space technologies in the Global South provides innovative approaches towards closing the gap in outer space development (MBRSC, 2025).

5.3 Regulatory Frameworks and Private Sector Participation

India’s example shows the necessity of a clear regulatory framework regarding private sector involvement. The Indian Space Policy 2023 and the creation of IN-SPACE and NSIL represent a significant step towards fostering the participation of the private sector in developing ground and space-based infrastructure. However, an advanced industry should have more instruments for risk management, liability, and financing. Given that space represents an inherently transnational phenomenon and is associated with international treaties, it becomes necessary to turn the current policy frameworks into predictable and investment-friendly legislation (Chundru, 2025).

Recommendations for improving India’s space industry involve creating incentives such as an exclusive Production Linked Incentive policy in the area of space manufacturing, setting up a state-sponsored venture capital fund worth billions of dollars targeting startups, and creating special Space Economic Zones where launch infrastructure could be constructed and managed privately within a regulatory framework (Businessworld, 2025; Chundru, 2025). These recommendations apply not only to India but to all other countries trying to develop a thriving space industry.

5.4 Ensuring Orbital Sustainability

Over 100 million debris pieces contaminate the orbital environment and pose collision dangers leading to more debris (OECD, 2024). Overcrowding in space with too much debris will trigger irreversible chain reactions making specific orbits unexploitable; mathematically

speaking, this critical point could have been surpassed in certain orbit areas (OECD, 2023b).

In view of the USD 191 billion worth of global economy threatened mainly through satellites policy intervention is necessary to ensure stability in the orbital environment (OECD, 2024). In its efforts to find solutions to the problem, the OECD has tried to examine command and control regulation, incentives, and voluntary initiatives (OECD, 2024). The involvement of emerging economies in such deliberations is key.

6. CONCLUSION

The space economy has shifted from being a realm of scientific interest to an important part of the infrastructure for sustainable development. The socio-economic aspects of the space economy, which include agriculture, connectivity, disaster management, health, and education, prove the importance of space technology for reaching the Sustainable Development Goals. Spin-off technologies from space missions result in advantages on Earth, which go beyond the space industry, leading to industrialization, self-sufficiency in technologies, and national development. Effective policy instruments, which will take into account economic logic and national priorities and create conditions for equal participation in the space economy, are crucial for emerging economies.

Space democratization, made possible by reduced launch prices, miniaturized satellites, and international collaboration, opens unparalleled possibilities for the Global South nations. But to take advantage of these possibilities calls for effort. As the United Nations Deputy Secretary-General rightly put it, “in an era of constrained investment, we must align capital with high-impact solutions. Space is one of them” (United Nations News, 2025). Looking at the Earth from above, one can see neither countries nor borders but just one single planet which we all call our home. This way of seeing things could very well be a guiding principle for the governance structures for space exploration and utilization, which would make it possible to reach the SDGs.

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