IRSTI 06.71.57
UDC 33.334.01
JEL L83

https://doi.org/10.46914/1562-2959-2025-1-3-282-293

KOZHANAZAR A.SH.,*[1]
PhD student.
*e-mail: arnakozha@gmail.com
ORCID ID: 0000-0002-7582-8596
TLEUBAYEVA A.T.,[1]
PhD., associate professor.
e-mail: aitolkyn.t@mail.ru, tleubayeva_at@enu.kz
ORCID ID: 0000-0002-5749-4289
DINCER M.Z.,[2]
PhD, professor.
e-mail: mzdincer@gmail.com
ORCID ID: 0000-0002-4928-8303
KAZYKESHOVA A.T.,[3]
PhD.
e-mail: AKazykeshova@ektu.kz, akasykeshova@mail.ru
ORCID ID: 0000-0002-3143-3680
[1]L.N. Gumilyov Eurasian National University,
Astana, Kazakhstan
[2]Istanbul University,
Istanbul, Turkey
[3]D. Serikbayev East Kazakhstan
Technical University,
Ust-Kamenogorsk, Kazakhstan

COMPATIBILITY OF SPACE TOURISM FROM THE BAIKONUR COSMODROME WITH THE CONCEPT OF SUSTAINABLE DEVELOPMENT

Abstract

Space tourism is becoming a new milestone in space exploration on the horizon of technological development for humanity as a whole, opening commercial prospects and scientific opportunities. However, its development must align with the concept of sustainable development, minimizing environmental and social risks. Baikonur has been one of the main hubs of space tourism in the world since the launch of the first space tourist into orbit. Baikonur plays an important role in launching orbital and suborbital flights, including prospective tourist ones, both in terms of infrastructure and geographical location. This article assesses the compatibility of space tourism development centered on Baikonur with the goals of sustainable development and Kazakhstan's national "Green Economy" strategy. The article discusses current environmental conditions, regional infrastructure, investment structure, and ongoing sustainability efforts in the Kyzylorda region, as well as their integration into the broader framework of the UN 2030 Agenda and national strategic documents such as "Kazakhstan–2050."

Keywords: tourism, sustainable development, space tourism, enviromental indicators, Baikonur cosmodrome, environmental aspects, cost-benefit analysis.

Introduction

Governments, institutions, and citizens equate sustainable development with a number of problems that are interlinked. They consist of population growth, commencement of the development of developing nations, sustainable and long-term steady provision of minerals and energy, and Prevention of environmental problems.

Sustainable development is an ongoing process to ensure a balance of economic, social and environmental factors in an effort to meet the needs of today and tomorrow's generations. We realize

that economic growth, social justice, and Environmental Protection are interdependent aspects which have to be addressed through integrated strategies to bring about long-term sustainability.

There are many definitions of the word "sustainable development," since it is constantly evolving based on the business sector to which it will be used [1].

According to S. Specter of the Department of Tourism, University of Otago, published in 2017, he views sustainable development in a completely different way in a paper on tourism and sustainable development beyond the biosphere. According to him, sustainable development in literature is approached as a state. That either the activity, business, and process are sustainable, or they are not. But our world is making a shift towards a sustainability state from an overconsumption ideology. It does require some energy and, more importantly, time to be sustainable. Being stable does not exactly occur overnight. The issue of these time scales is usually not addressed in sustainable development definitions [2].

Sustainable development is "development that meets the needs of the present without compromising the ability of future generations to meet their own needs"[3].

These two areas are interlinked, space tourism will make space accessible at affordable costs, and this will bring genuine sustainable development, and space tourism companies should take cognizance of these interlinks and shape their positions accordingly [4].

Space tourism is a blend of the space business and the tourism business, which is most culled in the area of environmental protection under the name of sustainable development. Space tours can't be called harmful to nature, it is greatly required now to examine the role of space tourism in promoting sustainable development, to discover possibilities for the restriction of the devastation of space tourism to the environment. This article covers the main issues of sustainability and whether space tourism is or is not sustainable. The outstanding issues of reducing the damage of space tourism to the environment, use of outer space for tourism by international states are analyzed.

The concept of sustainable development should be the foremost direction for the space tourism industry. By opening up to sustainable practices, interaction with local societies, and promoting sustainable economic and institutional behavior, space tourism can become a positive influence on sustainability. Zhang and Wilson believe that we must try our best to transform the brown economy into a green sustainable economy in the context of renewable and net zero emission-based models of energy consumption [5].

Ecological sustainable development is one of the main issues in the field of space tourism today. Besides space tourism, there are certain grave environmental issues associated with space flights for the sole purpose of scientific or other purposes. The most relevant in the near future and the most receiving attention in literature are orbital debris, which consist of launch vehicles and special-purpose orbital hardware that has been retired. It is feared that if such debris build up in the future, their impact with the Earth's atmosphere would have a colossal impact [6]. The first problem with existing launch vehicles is that rocket launches release a large amount of greenhouse gases into the atmosphere, which is one source of climate change. Secondly, noise from launches disturbs nearby nature and makes ecosystems get devastated. In order to curtail these effects, sustainable practices such as clean fuel use and noise reduction of launch systems must be embraced by space tourism companies. It is difficult to state their exact impact on the environment today due to the lack of regular suborbital and Orbital manned space flights. Suborbital and orbital space tourist flights penetrate several layers of the atmosphere and can have a decaying impact on the Earth's atmosphere, especially in the upper layers of the atmosphere [7]. A direct suborbital flight using technology similar to the Bristol Spaceplanes Ascender produces 6,267 kg of CO2 per flight. Meanwhile, Virgin Galactic has already announced that its Cosmodrome will be run on renewable energy and could even be a clean energy generator in the future.

Whereas space technology, private space companies and market demand have developed significantly in the past two decades, the regulatory environment covering the operation of space tourism has lagged significantly behind. The current space tourism activities are mainly regulated under four space treaties: the Space Treaty, the rescue treaty, the convention on liability and the convention on registration.

Looking at the reality that there are virtually no participant states in the lunar treaty and that most of the major space powers have not ratified the lunar Treaty, the majority of space lawyers have strongly

contended that it cannot be seen as an international legal norm to govern space tourism activities. Space agreements were concluded in the period of the Cold War, when both space-faring states, the United States and the USSR (now Russia), were competing in the space race, seizing speculation and each other's ambition. So, they have already set just the minimum regulatory framework. For this reason, space agreements are formulated in a very general and vague way, which generates a lot of ambiguities in interpretation. While space conditions are developed in light of only national space agency space exploration and are not ideally equipped to respond to the modern legal challenges of space missions of private enterprises, including space tourism [9].

The treaty assured states sovereignty over the airspace above their land. Today, the relevance and importance of this treaty needs to be renewed less than 100 years later [10]. After all, the commercial exploitation of the near space of the Earth's orbit for tourism travel of tourists has entered the agenda. Today, environmental sustainable development ranks among the major issues in the context of space tourism. Besides space tourism, there are also environmental concerns of gravity in space flights for sheer scientific or other purposes.

Indeed, the commercial use of the near space of the Earth's orbit for traveling of tourists has come to the agenda. At today's level of globalization, the next step is necessarily the development of space tourism. Because if we look at the airspace map of individual countries, we will see that the planes are jammed. The harmful emissions of these aircraft into the air are also not small. We need Flight de ices that work on the basis of upgraded fuel and are much faster than aircraft.

The data given on the experience of the previous utilization of the Baikonur cosmodrome is limited by the government and is offered to guests in the context of an acceptable past, with a tendency to glamorize Soviet era space program successes, at the expense of other parties, specifically individuals from the environment community [11]. Space tourism and sustainable development issues are interlinked and today there are incredible contradictions in this field. The influence of the space launch environment, including the accumulation of orbital debris, greenhouse gases released into the atmosphere, and environmental impacts on launch sites, are key determinants that act as a constraint in the growth of sustainable space tourism. Clean fuels have to be utilized, the magnitude of noise in launching rockets lessened, and green technology such as space waste management implemented in order to address these concerns.

Materials and methods

The purpose of this article is to find out how the space tourism affects environmental pollution. The research methodology is the methodology of Cabinet research.

Within this paper, the most constraining factors for space tourism in order to realize an innovative breakthrough within the model of the concept of sustainable development are uncovered. This paper aims to resolve the following key issues: firstly, to establish what the impact of space tourism on environmental pollution is in the interest of sustainable development.

The presented indicators provide only a conceptual basis for the analysis and require further filling with empirical calculations and field research. Some of the data (for example, the level of income leakage or the carbon intensity of tourist flows) can only be estimated based on statistics and on-site monitoring. In future research, it is advisable to focus on collecting primary data, as well as on modeling scenarios that will more accurately measure the long-term compatibility of cosmotourism with the principles of sustainable development.

Results and discussion

The growing public interest in sustainable development issues will guarantee that space vehicles and spaceports will have to be designed with sustainable development principles in mind, and issues such as fuel and material choice, and design for final disposal, will take on greater importance. The sustainable development problems are not quite so straightforward as often supposed, as may be realized from the issue of fuel. Hydrogen is being touted as an environmentally low-pollution fuel, green and clean, but this is a patent oversimplification, for hydrogen is not an energy source but only an energy carrier. Hydrogen is typically produced from fossil fuels by using fossil fuel-derived energy,

and it certainly does have a huge “carbon footprint” unless it is produced using renewable energy sources. Overall system analysis shows that hydrogen produced from fossil fuels without carbon capture and storage has the same carbon footprint as when gasoline is burned [14].

Space tourism and sustainable development are not generally related, yet they are related at five levels: the operational level and the cultural level, economic level, resource level, survival level (figure 1).

As one is able to see from figure 1, sustainable development is a complex and multidimensional concept which requires an integral and holistic approach. “Sustainable development” is a development that meets the needs of the current generation without compromising the ability of the future generation to meet their own needs” [11]. It requires economic, social and environmental aspects to harmonize so that a sustainable development occurs and it benefits the current as well as the future generation. Researchers such as sering and Muller (2008) have identified three dimensions of sustainability, namely society, the environment, and finance, where mutual relationship of the three pillars is a complicated phenomenon [12]. The rapid progress in the development of technology for meeting the needs of human beings is raising concern for the environment. It says that the world is encountering environmental problems in terms of air pollution, emissions of CO2, global warming and ozone layer depletion. UN reports warn that the world pattern of development is not stable and prompt action is needed in order to improve the plight of humanity. Researchers are therefore providing the needed green technologies and innovations to support sustainable development in all industries [13].

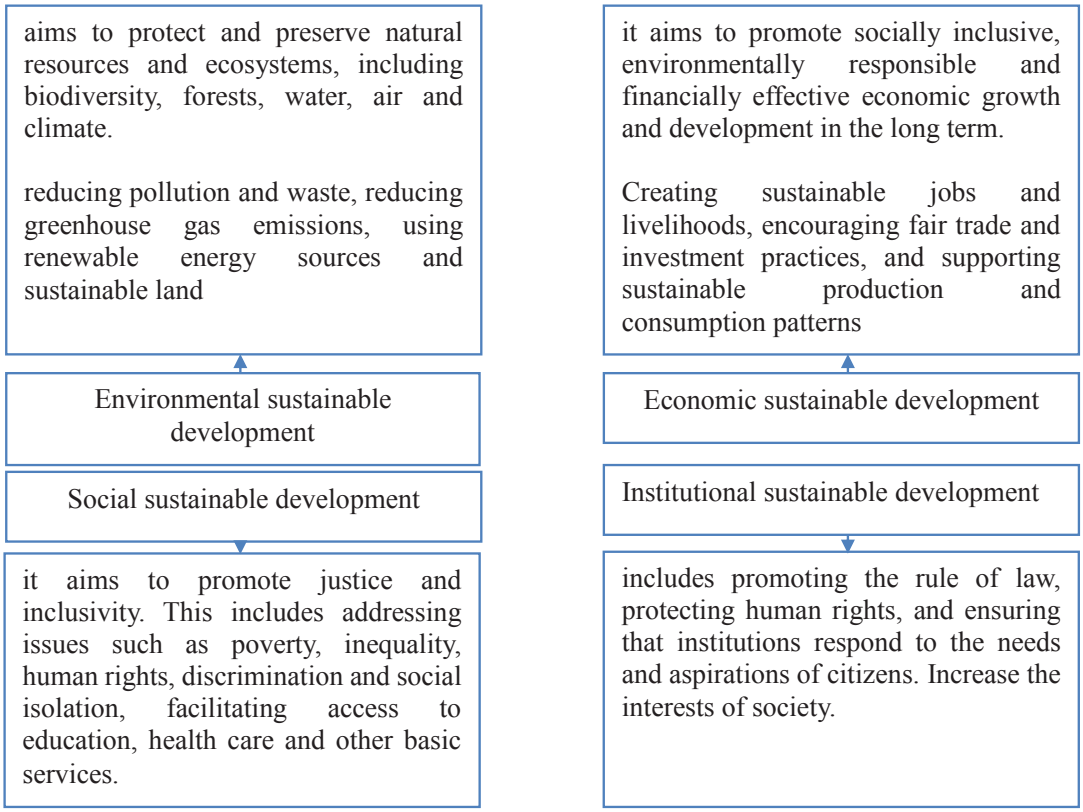

Figure 1 – The main aspects of sustainable development

Note: Compiled from source [4].

Baikonur is located at 450 degrees north latitude and 630 degrees east longitude. The land area is located in a semi-desert zone, the relief of the territory is a flat cumulative plain. [10]. The information presented by the government about the Soviet heritage’s past experience is controlled by the government and is for tourists within the framework of an acceptable past that has a tendency to commemorate the success of the Soviet space program, without regard to other stakeholders’ views, particularly for those representing the environmental community [11]. Spaceports need to be environmentally friendly.

Kazakhstan has committed to the realization of the UN Sustainable Development Goals (SDGs), integrating them into its national strategies such as the "Concept for Transition to a Green Economy" (2013) and the "Kazakhstan 2050 Strategy." In line with these strategies, a number of sustainable investment projects have been launched in the Kyzylorda region, including the Baikonur Solar power plant (50 MW) that reduces CO_2 emissions by approximately 75,000 tons per year. Moreover, a recycling plant for waste with a capacity of 65,000 tons/year has been opened in order to decrease the environmental heritage of past industrial activity [18].

These developments are the start of green investment and environmental rehabilitation in the Baikonur region (table 1). However, continuing heavy rocket launches, legacy pollution, and infrastructure limitations pose challenges to balancing space tourism expansion with sustainability principles.

Table 1– SWOT-analysis

Strengths	Weaknesses
- Uniqueness: the only active spaceport destination in the world accessible to tourists.	- High prices for tours, limiting the number of tourists.
- The global Baikonur brand associated with the history of cosmonautics.	- Poor tourist infrastructure in the region (hotels, transport).
- Potential for scientific and educational tourism.	- Dependence on Russian lease and management. - The possibility of integration with the cultural and ecotourism of the region.
- The possibility of integration with the cultural and ecotourism of the region.	- Low recognition of Kazakhstan as a space travel destination.
Opportunities	Threats
- Growing interest in space tourism and STEM education.	- Environmental risks (fuel waste, pollution).
- Development of public-private partnerships (PPP).	- Political instability and inter-State contradictions.
- Attracting foreign investors.	- Competition with other space centers (USA, UAE, France).
- The opportunity to create a «magnet destination» in Central Asia.	- Safety risks for tourists and staff.
Note: Compiled from sources [17, 18].	

Table 2 – Cost-Benefit Analysis of Baikonur Based Space Tourism in the Context of Sustainable Development

Benefits	Costs
Economic diversification of the Kyzylorda region.	Environmental damage from launches (fuel, noise, waste).
Tourist flow growth - multiplier effect for hotels, transport, catering.	High security and infrastructure costs
New jobs (guides, service, infrastructure).	Dependence on Russia's political decisions.
Improving the international image of Kazakhstan.	Risks of uneven income distribution (center vs. region).
Potential for scientific and educational projects and branding.	The threat of «over-tourism» in the absence of regulation.
Note: Compiled from source [12–18].	

The cost-benefit assessment system applied to space tourism at Baikonur allows for a systematic assessment of both its potential benefits and the associated risks (table 2). As for the costs, there are three critical issues. Firstly, the environmental risks are particularly high, given the environmental vulnerability of Kazakhstan's steppe regions and pollution caused by rocket fuel residues. Secondly, safety issues remain relevant for both the local population and tourists due to the technical complexity

of the launch. Third, heavy dependence on Russia's administrative and infrastructural control over the Baikonur cosmodrome creates institutional vulnerability and limits Kazakhstan's autonomous ability to extract long-term benefits.

Conversely, the benefits point to significant opportunities for regional and national development. Diversifying the regional economy beyond extractive industries can help reduce income instability related to the use of natural resources. The growth of tourist flows will stimulate the hotel sector, transport and local services, thereby creating jobs and increasing the region's income. In addition, the positioning of Baikonur as a world space heritage site and a tourist destination could strengthen Kazakhstan's international brand, contributing to "soft power" and recognition at the national level.

Taken together, cost-benefit analysis highlights the importance of balancing economic aspirations with sustainable development considerations. Maximizing benefits requires effective governance, environmental safeguards, and policies that ensure a fair distribution of tourism revenue at the local level while reducing structural dependency.

The selected indicators (table 3) represent a multidimensional framework for assessing the compliance of space tourism based on Baikonur with sustainable development goals. Each indicator reflects a specific aspect of sustainability. Economic indicators such as the tourism income dependency ratio, employment ratio, and PPP ratio highlight the contribution of space tourism to regional growth, job creation, and investment diversification. Distribution and equity indicators, including the leakage rate, the local business participation index, and the community benefit ratio, highlight the extent to which benefits are maintained at the local level and benefits are distributed fairly within the community.

Table 3 – Economic indicators of sustainable development of Baikonur Space Tourism

The indicator	Significance for Baikonur
Tourism Revenue Dependency Ratio (The share of tourism in the regional GRP)	Evaluates the degree of dependence of the region on cosmotourism. It is important to prevent the «resource curse of tourism».
Employment Multiplier	It shows how tourism contributes to job creation in related industries (hotels, transport, services).
Leakage Rate	It is critical for Baikonur: a significant part of the income may go to Russia or beyond Kyzylorda
Local Business Participation Index	The higher it is, the greater the benefits for the local economy.
Community Benefit Ratio	Demonstrates the social justice of the distribution of tourist income.
Environmental Cost Share	It shows the readiness of the economy to take into account the costs of remediation and control of fuel emissions
Carbon Intensity of Tourism	Connects income with the ecological footprint. It is important for the justification of «green» investments.
Return on Sustainable Investment	It allows you to show the benefits of eco- and socially oriented initiatives (museums, STEM centers).
Note: Compiled from sources [12–18].	

At the same time, environmental indicators such as the share of environmental protection costs and the carbon intensity of tourism revenues emphasize the need to take environmental considerations into account when developing tourism, especially given Baikonur's unique environmental vulnerability. Finally, the principle of return on sustainable investment (ROSI) links economic profitability with the promotion of environmentally friendly and socially oriented initiatives, providing a link between short-term benefits and long-term sustainability.

Together, these indicators form an integrated assessment system that not only identifies opportunities for regional development, but also identifies potential risks. Their application demonstrates that sustainable space tourism on Baikonur requires a combination of economic aspirations with environmental responsibility and social inclusion. For decades, activities at the Baikonur Cosmodrome have had a significant negative impact on the boundaries of the Republic of

Kazakhstan, the territory of falling fragments and parts of launch vehicles, and the population of these regions. This, in turn, violates the “rights of residents to live in a favorable environment”, that is, it violates the right of each person to use a clean environment, an ecologically clean territory, water, food [15] this, in turn, demonstrates the “rights of residents to live in a favorable environment”, that is, it violates the right of each person to use a clean environment, an ecologically clean territory, water, food. In total, the remains of a number of crashed missiles will be discarded in 47 regions of the Republic of Kazakhstan. On May 14, 1996, the Soyuz launch vehicle crashed. On May 20, 1997, the Zenit launch vehicle crashed, and on July 5, 1999, the Proton launch vehicle crashed. In 1999, the Proton launch vehicle crashed again. Baikonur will be beneficial to us only if we can find a way to deal with the consequences [16].

The most hazardous danger of crash missiles is heptyl.

Heptyl is a highly boiling point rocket fuel component, which is widely used in rocketry. It is extremely poisonous to human health and nature. That the devastating power of the heptyl is not worse than that of chemical weapons, Russian scientists themselves do not argue. It is absorbed by water, air, soil and even a metal surface and spread by the wind into the atmosphere. Even a small amount of heptyl that has penetrated the human body has a very dangerous effect through water, air and soil. The process of its poisoning of the body is not felt and lasts for decades. The human body contaminated with heptyl can be infected even after years. According to the statistics of scientific investigation, the life expectancy of the population of the rocket launch site is only 55 years. If in the Republic the mortality rate of infants is 18 children per 1000 children, then in Ulytau district alone the mortality rate of infants is 40 children per 1000 children. That is why the World Health Organization calls it a very dangerous chemical compound [16]. Rocket waste destroyed Pavlodar, East Kazakhstan and Karaganda regions of Kazakhstan. Proton launch vehicle’s first of six tank blocks failed and fell to the earth, releasing 1.5 to 3.5 tons of heptyl waste on the earth.

Even from a single launch rocket, on average 2 tons of heptyl are dumped on the ground, for 44 years this is 520,000 tons of heptyl. Actual problems of aviation and Cosmonautics N8, Volume 2, 2012 issue. 74% of ulytau district, 39% of Shet District, 37% of Zhanaarka District, 37% of Aktogay district are recognized to be polluted with heptyl fuel [17]. In order to compensate for the rocket damages launched from the Baikonur Cosmodrome, first of all, it is necessary to introduce a system of space insurance in the Republic of Kazakhstan. To this day, the problem of toxic heptyl is not settled. Kyzylorda and Karaganda therefore need special labs to study the consequences of such emergencies.

Heptyl disinfection, which easily and quickly spreads through the air and soil, needs to be given utmost attention. Immediately after the accident, the respective samples need to be taken and deactivation procedures initiated.

Table 4 – Number of launches from the Baikonur Cosmodrome

Years	Total	«Soyuz» manned vehicle	«Progress» Unmanned vehicle	Other Unmanned vehicle
2015	18	4	5	9
2016	11	4	3	4
2017	13	4	3	6
2018	11	4	3	4
2019	13	3	3	7
2020	11	2	2	7
2021	15	3	4	8
2022	7	2	3	2
2023	9	2	4	3
2024	8	2	4	2
Note: Compiled from source [16].				

From the table 4, if we consider the number of rocket launches from Baikonur during 2015–2024, we can observe a decrease in the total number of rocket launches from the Baikonur Cosmodrome. The number of launches of Proton rocket carriers fell drastically: in 2015-8, and in 2023-just 2. This is due to the fact that "Proton" is gradually being retired due to environmental and technological factors. Even under normal conditions, there is a hazard to public health in the sphere of rocket and space activities, beginning from the launch point of ballistic missiles and missile carriers along the whole trajectory of flight. On the surface, 2 phases away from the site of going up to 800 km and 3 phases away up to 2500 km, "spots" of 1500-5000 km2 are formed, that are scattered with pieces of rockets and ballistic missiles [16]. Natural objects are severely damaged as structural parts of rocket part separations and residues of unburnt fuel parts. The affected area for a single contamination can be as big as several hectares, depending on the hydrometeorological and geographical conditions of the site of exposure to a highly large amount of PH, and furthermore, liquid propellants are used.

"Zenit" – very seldom applied (during the entire time it was launched 2 times, in 2015 for the first time). "Zenit" is practically not used (due to political and economic factors connected with its production in Ukraine [14].

As follows from data presented by the Ministry of digital development, innovation and aerospace industry of the Republic of Kazakhstan, aerospace committee, the number of Proton rocket carrier launches decreased from -8 launches in 2015 to just 2 in 2023. For environmental and technological reasons, steps are being taken on the phasing out of "Proton".

If we take types of missiles, the most reliable carrier of missiles is Soyuz, the number of launches ranges from 5 to 12 a year. The greatest part of the load falls on Soyuz missiles.

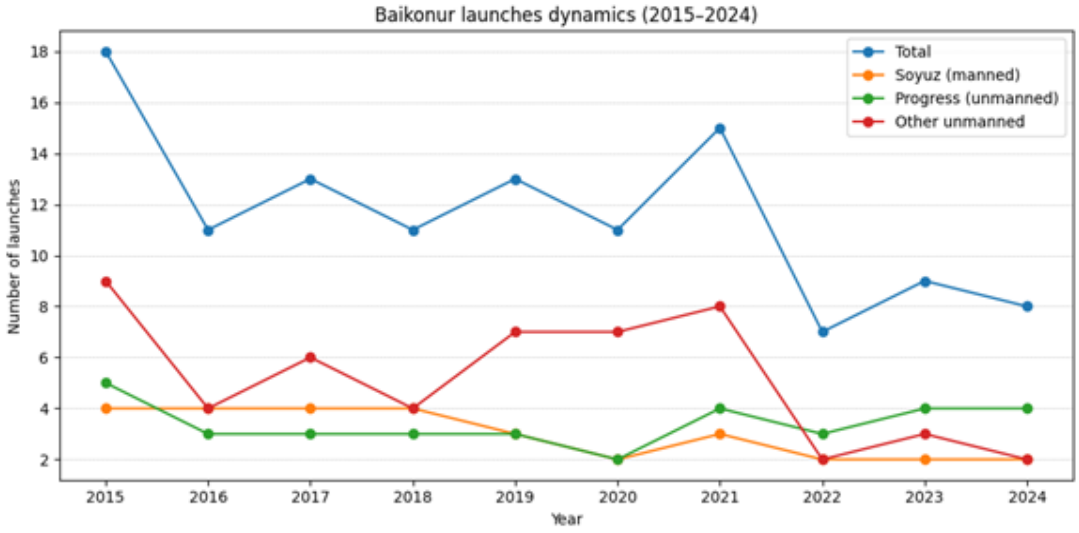

Figure 2 – Dynamics Of Rocket Launches From Baikonur (2015–2024)

Note: Compiled from source [16].

In 2024, 8 launches were carried out from the Baikonur Cosmodrome (figure 2) and 9 launches are planned for 2025. Accordingly, on the days when rocket launches are planned, the flow of tourists to Baikonur and Toretam stations will increase.

According to the indicator of the region of arrival of tourists, Baikonur is most often visited by tourists from St. Petersburg and Moscow, other regions of the Russian Federation. There are tourists from the CIS countries, Ukraine, Belarus, Kyrgyzstan. The British, French and Japanese often come from far abroad. Tourists from the CIS and abroad prefer to travel to Baikonur by air through the city of Astana-Kyzylorda. Kyzylorda is located 240 km from the Baikonur Cosmodrome, and the quality of the highway connecting the two cities is at a high level. We witnessed this on April 8, 2025 during a trip to Baikonur.

Conclusion

The findings indicate that the inclusion of Baikonur in the sustainable development of Kazakhstan is not complete. While the solar power plant and recycling facility are tangible moves towards decarbonization and circular economy standards, these projects are currently separate from space tourism proposals. Moreover, the space tourism sector is not addressed by an holistic policy framework design that would align it with Kazakhstan's general green development targets. This policy detachment carries the danger of greenwashing or tokenistic sustainability if not arrested through proactive governance interventions.

Although the economic benefits in Kazakhstan are a consequence of Baikonur Cosmodrome's activities, their negative impact on the environment is quite significant. Secondly, environmental harm caused to most lands in Kazakhstan, such as heptyl toxic fuel contamination, is an enormous threat to public health and the environment. To solve these problems, environmental control needs to be increased, rocket waste neutralized, and new technologies meant to reduce the harmful impact on the environment to be put into practice.

Generally, the market of space tourism will prosper in the long term only through following the rules of sustainable development. With this aim, governments, space business companies, ecological organizations and society in general must collaborate. In addition, with emerging technologies, increased international cooperation and an improved legislative environment, space tourism can be rendered environmentally and socially sustainable.

Space tourism can promote sustainable development, however, despite such issues. Space solar power, for example, can provide the earth with clean, renewable energy, and Space manufacturing can reduce the need for mining, which requires extraction of precious resources from the earth. Space tourism has the potential to generate income for local communities and make ecologically sensitive areas conservation-friendly.

To ensure compatibility between space tourism and sustainable development based at Baikonur, the following is proposed:

Develop a standalone "Sustainable Space Tourism Strategy" aligned with SDGs and national green economy targets; Boost green infrastructure investment (e.g., green transport, clean energy) in the Baikonur region; Establish rigorous environmental monitoring and legacy pollution abatement programs; Step up cross-border cooperation with Russia on ecological restoration and joint management of the Baikonur region.

REFERENCES

1 Mollenkamp D., Brown J., Li T. What is sustainability? How Sustainabilities work, benefits and example. 2025. URL: https://www.investopedia.com/terms/s/sustainability.asp (accessed:15.03.2025)

2 Spektor S., Higham J.E. Space tourism in the Anthropocene // Annals of research in the field of tourism. 2019, no. 4(2). pp. 1–8.

3 Fawkes S. Space tourism and sustainable development // Journal of the British Interplanetary Society. 2007, no. 11(60), p. 401.

4 Duval D., Hall M. Sustainable space tourism // New destinations and new challenges. 2015, no. 5, p. 179.

5 Chatziantoniou I., Abakah E., Gabauyer D., Tiwari A. Quantile time-frequency price connectedness between green bond, green equity, sustainable investments and clean energy markets // Journal of Cleaning Production. 2022, no. 361. URL: https://doi.org/10.1016/j.jclepro.2022.132088

6 Ross D. Social Sustainability // Encyclopedia of Corporate Social Responsibility. 2010, pp. 2245–2249. URL: https://link.springer.com/referenceworkentry/10.1007/978-3-642-28036-8_58

7 Padhy A.K., Padhy A.K. Legal mysteries of space tourism // Acta Astronautica. 2021, no. 184, p. 269. URL: https://doi.org/10.1016/j.actaastro.2021.04.024

8 United Nations. Sustainability. 2020. URL: https://www.un.org/en/academic-impact/sustainability (accessed:10.03.2025)

9 Koshim A., Sergeeva A.M, Saparov K., Wendt J.A. Development of scientific tourism at Baikonur cosmodrome Kazakhstan // Geojournal and Geosites. 2019, no. 24(1), pp. 266–278. URL: https://doi.org/10.30892/gtg.24121-358

10 Tiberghien G. Investigating space heritage interpretation for tourism developmentand heritage preservation at Baikonur Cosmodrome, Kazakhstan // Tourism Planning and Development. 2024, no. 21(6). URL: https://doi.org/10.1080/21568316.2024.2319145

11 Seuring S., Muller M. From a literature review to a conceptual framework for sustainable supply chain management // Journal of Cleaning Production. 2008, no. 16(15), pp. 1699–1710. URL: https://doi.org/10.1016/j.jclepro.2008.04.020

12 Frank E.D., Elgowainy A., Reddi K., Bafana A. Life-Cycle Analysis of Greenhouse Gas Emissions from Hydrogen Delivery: A Cost Guided Analysis. 2021. URL: https://www.sciencedirect.com/science/article/pii/S0360319921014270 (accessed: 10.02.2025)

13 Сагатов А. Право на благоприятную окружающую среду в контексте современной космической деятельности государств // ТУРАБИ. – 2009. – No. 1. -С. 55–58.

14 Matos P., Barreiros D., Vaz-Ferreira L., Korolkov A., Geohistorical changes and space exploration: a study of the Baikonur Cosmodrome // InterAcao. 2024, no. 15(1). URL: 10.5902/2357797585565

15 Токатов Р.А., Оспанова М.Н. Байқоңыр кешенінің қазіргі құқықтық жағдайы // Қарағанды университетінің хабаршысы. – 2017. – Б. 240–246. URL: https://rep.ksu.kz/bitstream/handle/data/3168/tokatov3.pdf?sequence=1&isAllowed=y of. (өтініш берілген күн: 13.03.2025)

16 Байконур. Пусковые услуги, Аэрокосмический комитет Министерства цифрового развития, инноваций и аэрокосмической промышленности Республики Казахстан. 2025. URL: https://www.gov.kz/memleket/entities/kazcosmos/activities/801?lang=ru&parentId=5 (дата обращения: 19.02.2025)

17 Abdrazak P.Kh., Musa K.Sh. The impact of the cosmodrome «Baikonur» on the environment and human health // International Journal of biology and Chemistry. 2015, no. 8(1), pp. 26–29. URL: https://doi.org/10.26577/2218-7979-2015-8-1-26-29

18 Kazakh Invest, Success story Baikonur Solar. https://kyzylorda.invest.gov.kz/ru/about-kazakhstan/success-story/20324/ (accessed: 21.02.2025)

REFERENCES

1 Mollenkamp D., Brown J., Li T. What is sustainability? How Sustainabilities work, benefits and example. 2025. URL: https://www.investopedia.com/terms/s/sustainability.asp (accessed:15.03.2025). (In English).

2 Spektor S., Higham J.E. (2019) Space tourism in the Anthropocene // Annals of research in the field of tourism, no. 4(2). pp. 1–8. (In English).

3 Fawkes S. (2007) Space tourism and sustainable development // Journal of the British Interplanetary Society., no. 11(60), p. 401. (In English).

4 Duval D., Hall M. (2015) Sustainable space tourism // New destinations and new challenges, no. 5, p. 179. (In English).

5 Chatziantoniou I., Abakah E., Gabauyer D., Tiwari A. (2022) Quantile time-frequency price connectedness between green bond, green equity, sustainable investments and clean energy markets // Journal of Cleaning Production, no. 361. URL: https://doi.org/10.1016/j.jclepro.2022.132088. (In English).

6 Ross D. (2010) Social Sustainability // Encyclopedia of Corporate Social Responsibility, pp. 2245–2249. URL: https://link.springer.com/referenceworkentry/10.1007/978-3-642-28036-8_58. (In English).

7 Padhy A.K., Padhy A.K. (2021) Legal mysteries of space tourism // Acta Astronautica, no. 184, p. 269. URL: https://doi.org/10.1016/j.actaastro.2021.04.024. (In English).

8 United Nations. Sustainability. 2020. URL: https://www.un.org/en/academic-impact/sustainability (accessed:10.03.2025). (In English).

9 Koshim A., Sergeeva A.M, Saparov K., Wendt J.A. (2019) Development of scientific tourism at Baikonur cosmodrome Kazakhstan // Geojournal and Geosites, no. 24(1), pp. 266–278. URL: https://doi.org/10.30892/gtg.24121-358. (In English).

10 Tiberghien G. (2024) Investigating space heritage interpretation for tourism developmentand heritage preservation at Baikonur Cosmodrome, Kazakhstan // Tourism Planning and Development, no. 21(6). URL: https://doi.org/10.1080/21568316.2024.2319145. (In English).

11 Seuring S., Muller M. (2008) From a literature review to a conceptual framework for sustainable supply chain management // Journal of Cleaning Production, no. 16(15), pp. 1699–1710. URL: https://doi.org/10.1016/j.jclepro.2008.04.020. (In English).

12 Frank E.D., Elgowainy A., Reddi K., Bafana A. (2021) Life-Cycle Analysis of Greenhouse Gas Emissions from Hydrogen Delivery: A Cost Guided Analysis. URL: https://www.sciencedirect.com/science/article/pii/S0360319921014270 (accessed: 10.02.2025). (In English).

13 Sagatov A. (2009) Pravo na blagoprijatnuju okruzhajushhuju sredu v kontekste sovremennoj kosmicheskoj dejatel'nosti gosudarstv // TURABI. No. 1. P. 55–58. (In Russian).

14 Matos P., Barreiros D., Vaz-Ferreira L., Korolkov A. (2024) Geohistorical changes and space exploration: a study of the Baikonur Cosmodrome // InterAcao, no. 15(1). URL: 10.5902/2357797585565. (In English).

15 Tokatov R.A., Ospanova M.N. (2017) Baiqoñyr keşenınıñ qazırgı qūqyqtyq jağdaiy // Qarağandy universitetınıñ habarşysy. P. 240–246. URL: https://rep.ksu.kz/bitstream/handle/data/3168/tokatov3.pdf?sequence=1&isAllowed=y of. (ötınış berılgen kün: 13.03.2025). (In Kazakh).

16 Bajkonur. Puskovye uslugi, Ajerokosmicheskij komitet Ministerstva cifrovogo razvitija, innovacij i ajerokosmicheskoj promyshlennosti Respubliki Kazahstan. 2025. URL: https://www.gov.kz/memleket/entities/kazcosmos/activities/801?lang=ru&parentId=5 (data obrashhenija: 19.02.2025). (In Russian).

17 Abdrazak P.Kh., Musa K.Sh. (2015) The impact of the cosmodrome «Baikonur» on the environment and human health // International Journal of biology and Chemistry, no. 8(1), pp. 26–29. URL: https://doi.org/10.26577/2218-7979-2015-8-1-26-29. (In English).

18 Kazakh Invest, Success story Baikonur Solar. https://kyzylorda.invest.gov.kz/ru/about-kazakhstan/success-story/20324/ (accessed: 21.02.2025). (In English).

КОЖАНАЗАР А.Ш.,*[1]
докторант.
*e-mail: arnakozha@gmail.com
ORCID ID: 0000-0002-7582-8596
ТЛЕУБАЕВА А.Т.,[1]
PhD, қауымдастырылған профессор.
e-mail: aitolkyn.t@mail.ru, tleubayeva_at@enu.kz
ORCID ID: 0000-0002-5749-4289
ДИНЧЕР М.З.,[2]
PhD, профессор.
e-mail: mzdincer@gmail.com
ORCID ID: 0000-0002-4928-8303
КАЗЫКЕШОВА А.Т.,[3]
PhD.
e-mail: akazykeshova@ektu.kz, akasykeshova@mail.ru
ORCID ID: 0000-0002-3143-3680
[1]Л.Н. Гумилев ат. Еуразия ұлттық университеті,
Астана қ., Қазақстан
[2]Стамбул университеті,
Стамбул қ., Түркия Республикасы
[3]Д. Серікбаев атындағы ШҚТУ,
Өскемен қ., Қазақстан

БАЙҚОҢЫРДАН ОРЫНДАЛАТЫН ҒАРЫШ ТУРИЗМІНІҢ ТҰРАҚТЫ ДАМУ ТҰЖЫРЫМДАМАСЫМЕН ҮЙЛЕСІМДІЛІГІ

Аңдатпа

Ғарыш туризмі коммерциялық перспективалар мен ғылыми мүмкіндіктерді ашатын, жалпы адамзат баласы үшін ғарышты игерудегі, технологиялық даму көкжиегіндегі жаңа белеске айналып келеді. Алайда оның дамуы экологиялық және әлеуметтік тәуекелдерді барынша азайта отырып, тұрақты даму тұжырымдамасына сай келуі керек. Байқоңыр – алғашқы ғарыш туристін ғарышқа шығарған күннен бастап, әлемдегі негізгі ғарыш туризмі айлақтарының бірі. Орбиталық және суборбиталық ұшуларды, оның ішінде перспективалы туристік рейстерді іске қосуда Байқоңырдың инфрақұрылым тұрғысынан да, орналасу орны тұрғысынан да маңызды рөл алады. Бұл мақалада Байқоңырға бағдарланған ғарыш туризмді дамытудың тұрақты даму мақсаттарымен және Қазақстанның ұлттық «Жасыл экономика» стратегиясымен сәйкестігі бағаланады. Мақалада қазіргі экологиялық жағдайлар, аймақтық инфрақұрылым, инвестициялар құрылымы және Қызылорда облысындағы тұрақты даму саласындағы күш-жігердің жалғасуы, оларды БҰҰ-ның 2030 жылға дейінгі күн тәртібінің және «Қазақстан-2050» сияқты ұлттық стратегиялық құжаттардың кеңірек шеңберіне енгізу мәселелері талқыланады.

Тірек сөздер: туризм, тұрақты даму, ғарыш туризмі, экологиялық көрсеткіштер, космодром, экономикалық аспектілер, шығындар мен пайданы талдау.

КОЖАНАЗАР А.Ш.,*[1]
докторант.
*e-mail: arnakozha@gmail.com
ORCID ID: 0000-0002-7582-8596
ТЛЕУБАЕВА А.Т.,[1]
PhD, ассоциированный профессор.
e-mail: aitolkyn.t@mail.ru, tleubayeva_at@enu.kz
ORCID ID: 0000-0002-5749-4289
ДИНЧЕР М.З.,[2]
PhD, профессор.
e-mail: mzdincer@gmail.com
ORCID ID: 0000-0002-4928-8303
КАЗЫКЕШОВА А.Т.,[3]
PhD.
e-mail: AKazykeshova@ektu.kz, akasykeshova@mail.ru
ORCID ID: 0000-0002-3143-3680
[1]Евразийский национальный университет
им. Л.Н. Гумилева,
г. Астана, Казахстан
[2]Стамбульский университет,
г. Стамбул, Турция
[3]Восточно-Казахстанский технический
университет им. Д. Серикбаева,
г. Усть-Каменогорск, Казахстан

СОВМЕСТИМОСТЬ КОСМИЧЕСКОГО ТУРИЗМА С КОСМОДРОМА «БАЙКОНУР» С КОНЦЕПЦИЕЙ УСТОЙЧИВОГО РАЗВИТИЯ

Аннотация

Космический туризм становится новой вехой в освоении космоса на горизонте технологического развития для человечества в целом, открывая коммерческие перспективы и научные возможности. Однако его развитие должно соответствовать концепции устойчивого развития, сводя к минимуму экологические и социальные риски. «Байконур» – одна из основных гаваней космического туризма в мире с момента запуска первого космического туриста в космос. Важную роль в запуске орбитальных и суборбитальных полетов, в том числе перспективных туристических, «Байконур» играет как с точки зрения инфраструктуры, так и с точки зрения местоположения. В данной статье оценивается соответствие развития космического туризма, ориентированного на «Байконур», целям устойчивого развития и национальной стратегии Казахстана «Зеленая экономика». В статье обсуждаются текущие экологические условия, региональная инфраструктура, структура инвестиций и продолжающиеся усилия в области устойчивого развития в Кызылординской области, их включение в более широкие рамки повестки дня ООН до 2030 г. и национальных стратегических документов, таких как «Казахстан–2050».

Ключевые слова: туризм, устойчивое развитие, космический туризм, экологические показатели, космодром, экономические аспекты, анализ затрат и выгод.

Article submission date: 01.07.2025