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APPRAISING PAKISTAN'S NATIONAL SPACE POLICY 2023 IN THE LIGHT OF INDIA'S GROWING SPACE CAPABILITIES

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ABSTRACT

This paper evaluates Pakistan's Space Policy 2023 against the backdrop of India's expanding space capabilities and strategic ambitions. As India achieves significant milestones in space exploration and defence, such as the Chandrayaan-3 mission and the operationalisation of the Defence Space Agency, the regional security and strategic balance face new dynamics. The study argues that Pakistan's nascent space programme, despite its potential, lags behind in addressing the dual-use nature of space technologies and their implications for national security and development. Using the Policy Cycle Model, this study analyses the key components of Pakistan's Space Policy 2023, assessing its strengths and gaps in fostering innovation, enhancing commercial applications, and addressing the security dimensions of outer space. The analysis identifies significant gaps in Pakistan's policy, particularly in leveraging space as a domain for technological innovation, commercial growth, and defence preparedness. This study contributes to understanding the evolving space dynamics in South Asia, highlighting the strategic imperatives for Pakistan to align its space policy with regional developments and global trends. By addressing these issues, the paper adds to the discourse on the intersection of space technology, national security, and regional geopolitics.

Keywords: Pakistan Space Policy 2023, India's Space Capabilities, Regional Strategic Stability, Space Technology and Security, South Asia Geopolitics

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ABBREVIATIONS & ACRONYMS

ASAT	Anti-Satellite
CARTOSAT	Cartography Satellite
COPUOS	Committee on the Peaceful Uses of Outer Space
CPEC	China-Pakistan Economic Corridor
DRDO	Defence Research and Development Organisation
DSA	Defence Space Agency
ELINT	Electronic Intelligence
EMISAT	Electromagnetic Intelligence-gathering Satellite
ESA	European Space Agency
GAGAN	GPS Aided GEO Augmented Navigation
GEO	Geosynchronous Earth Orbit
GSAT	Geosynchronous Satellite
GSLV	Geosynchronous Satellite Launch Vehicle
ICAST	International Conference on Applications of Space Science & Technology
INCOSPAR	Indian National Committee for Space Research
INSAT	Indian National Satellite System
IN-SPACe	Indian National Space Promotion and Authorisation Centre
IRNSS	Indian Regional Navigation Satellite System
IRS	Indian Remote Sensing
ISR	Intelligence, Surveillance and Reconnaissance
ISRO	Indian Space Research Organisation
ISSAR	Indian Space Situational Assessment Report
IST	Institute of Space Technology
LEO	Low Earth Orbit
LVM-3	Launch Vehicle Mark-3
MOM	Mars Orbiter Mission
MoST	Ministry of Science and Technology
NASA	National Aeronautics and Space Administration
NASTP	National aerospace Science and Technology Park
NC3	Nuclear Command, Control and Communications

NCA	National Command Authority
NSP	National Space Policy
PAKSAT	Pakistan Satellite
PAKTES-1A	Pakistan Technology Evaluation Satellite-1A
PC	Planning Commission
PNT	Positioning, Navigation and Timing
PRSS-1	Pakistan Remote Sensing Satellite-1
PSARB	Pakistan Space Activities Regulatory Board
PSDP	Public Sector Development Programmes
PSLV	Polar Satellite Launch Vehicle
RISAT	Radar Imaging Satellite
SAR	Synthetic Aperture Radar
SIGNINT	Signals Intelligence
SITT	SUPARCO Institute of Technical Training
SLV	Satellite Launch Vehicle
SPD	Strategic Plans Division
SSLV	Small Satellite Launch Vehicle
SUPARCO	Space and Upper Atmosphere Research Commission
TERLS	Thumba Equatorial Rocket Launch Station
US	United States

1. INTRODUCTION

In the modern era, space has evolved into a critical domain for geopolitical competition between major states. Space is an immensely significant domain, not only for states to assert their technological superiority over others, but also to enhance their strategic capabilities and for global power projection. Space technology has a tremendous amount of civilian and military applications, including communication, navigation, remote sensing and military deterrence. As space advancements continue at a rapid pace, particularly in terms of space exploration and satellite technology, states are increasingly realising the strategic significance of space. This is reflected by the growing global investment in both the civilian and military applications of space. The increasing significance of space as a vital domain for national security and technological prowess is also being realised in South Asia, where the space race between Pakistan and India are striving to expand their space capabilities.

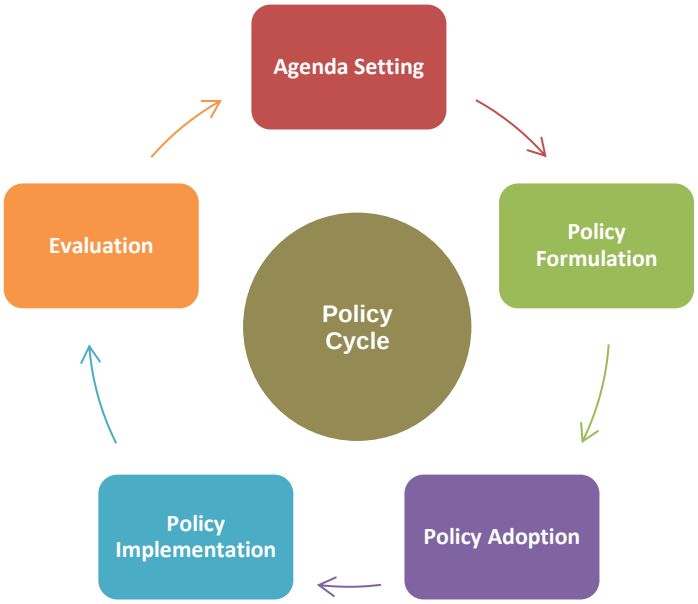
Having a long history of being locked in a zero-sum strategic competition, both Pakistan and India have been embroiled in an incessant rivalry in conventional domains, such as land, sea and air. With the developments in space technologies, outer space has also emerged as a new arena of competition for the arch rivals. During the past two decades, India has emerged as a major player in the global space ecosystem. It has significantly augmented its indigenous space capabilities due to local innovation and technological cooperation with major foreign powers. Pakistan, once the regional pioneer in space exploration, has recently been finding it hard to go against the gravitational pull, in this domain. The significant advancements in India's satellite and missile capabilities have led to a shift in the space power dynamics, and have significant implications for Pakistan's national security and defence posture.

This study aims to appraise Pakistan's National Space Policy (NSP) 2023, in light of India's growing space capabilities. It argues that India's growing space programme poses significant strategic challenges for Pakistan, making it an imperative for the former to reevaluate its space policy in order to reestablish strategic equilibrium. However, the study further argues that this does not mean Pakistan getting into a race to quantitatively match with India, rather it advocates for a strategic response from Pakistan which balances its national security needs with the increasing role of space as a domain of geopolitical competition. The study asserts that, going forward, Pakistan's space policy must address both the defensive and counter-space capabilities of India, while fostering a more inclusive policy that also capitalises on the socioeconomic benefits offered by space technology. The research aims to provide answers to following key questions. Firstly, what is the current state of Pakistan and India's space capabilities? Secondly, what are the strategic implications of India's growing space capabilities for Pakistan? Thirdly, what is the relevance of Pakistan's NSP 2023 in addressing these challenges?

The study utilises a qualitative research methodology, and refers to both primary and secondary sources. The primary data was collected through semi-structured interviews (Annex A & B), which were conducted with experts from the fields of space technology, international relations, and security studies. The secondary data included academic books, journal articles, policy papers, and reports from respective space agencies. This research employed a theoretical framework based on the Policy Cycle

Model (figure 1), developed by Christopher Knill and Andrea Tosun[1]. This framework helps in understanding and analysing the policy cycle, from conception to evaluation.

Figure 1: Policy Cycle by Christopher Knill and Andrea Tosun



The Policy Cycle model allows a thorough and structured examination of how the policy is developed at each of the five stages - Agenda Setting, Policy Formulation, Policy Adoption, Policy Implementation, and Policy Evaluation. Starting from the agenda setting stage, the model identifies the relevant policy problems which require government action. As per model's assumption. These most urgent political and security issues are placed on the government's agenda requiring a policy action/decision. At the second stage, the policymakers propose various options, gather data and consult with experts in order to determine viable solutions. This stage is attributed as policy formulation. The subsequent stage of Policy Adoption leads to either approval or rejection of the proposed policy by the relevant stakeholders. After adoption, the policy moves to the implementation phase, in which the policy is applied through practical actions. In the final stage, called policy evaluation, the effectiveness

[1] Christoph Knill and Jale Tosun, "Policy Making," in Daniele Caramani (ed.), *Comparative Politics*, (Oxford: Oxford University Press, London 2008) 495-519.

of the policy is assessed through feedback and data analysis, which could result in the policy being modified or updated.

2. STRATEGIC SIGNIFICANCE OF SPACE

In 2024, there are over 10,000 satellites orbiting the Earth[2]. Unsurprisingly, the US operates most of these satellites, with over 50 percent. China has made substantial advancements, but still remains significantly behind the US[3]. Although most of the satellites orbiting Earth and for civilian use, the growing dual-use and military nature of space technology has increased its strategic significance, making it more attractive for major states[4].

Space assets are vital for both economic development and effective military operation[5]. In the civilian domain, satellites support critical infrastructure such as communication systems, navigation, weather forecasting, and disaster management. Space technology enables efficient and precise communication, including real-time video transmission, which is crucial for sectors such as telecommunications, broadcasting, and media. The ability to forecast weather patterns is crucial for any state's national security, particularly in monitoring and responding to climate-induced natural disasters. Additionally, the acquisition and mining of space minerals has tremendous potential in the future, with the Moon alone reportedly having trillions of

[2] Eric Mack, "There Are 10,000 Active Satellites In Orbit. Most Belong To Elon Musk," *Forbes*, July 19, 2024, https://www.forbes.com/sites/ericmack/2024/07/19/theres-now-10000-active-satellites-in-orbit-most-belong-to-elon-musk/.
[3] Ashley J. Tellis, "China's Military Space Strategy," *Survival*, 49, no. 3 (2007): 41-72, https://doi.org/10.1080/00396330701564752.
[4] "The Geopolitics of Space," Istituto Affari Internazionali, 2023, https://www.iai.it/sites/default/files/9788893682923.pdf.
[5] Air Marshall Waseem ud din et al., "Development of Pakistan's Space Program," Centre for Aerospace and Security Studies, July 19, 2022, https://casstt.com/development-of-pakistans-space-program/.

dollars' worth of metals and minerals[6]. Space exploration is also incredibly significant, and has already allowed for major scientific and technological advancements[7].

Besides the civilian applications, there are tremendous strategic applications of space for the military sector. Satellites are a powerful tool for intelligence, surveillance, and reconnaissance (ISR)**,** early warning systems**,** and even counter-space capabilities. States with robust space capabilities have advantages in monitoring adversary movements, managing military operations, and ensuring national defence. Space-based ISR systems allow for real-time surveillance of enemy activities, military infrastructure, and missile launches. Satellites play a key role in communication, and the detection of missile launches and other threats. Space-based systems are also vital for ensuring nuclear deterrence[8]. Satellite communication is crucial for nuclear command, control and communications (NC3), as it allows for the relaying of messages within a state's nuclear command chain[9].

The rapid evolution of space-based technologies further complicates the geopolitical landscape. The growing role of private companies in space activities, through agencies like the Indian National Space Promotion and Authorisation Centre (IN-SPACe) and commercial space organisations such as SpaceX, has introduced new actors into the equation. This shift towards privatisation not only affects the economics of space but also challenges traditional norms within space. Nations now

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[6] Gabriel Dominguez, "Geopolitics in space: Why great powers are scrambling for the moon," *The Japan Times,* October 8, 2023, https://www.japantimes.co.jp/news/2023/10/08/world/science-health/global-space-race-moon/.

[7] "Benefits Stemming from Space Exploration," International Space Exploration Coordination Group, September 2013, https://www.nasa.gov/wp-content/uploads/2015/01/benefits-stemming-from-space-exploration-2013-tagged.pdf?emrc=ca90d1.

[8] Nivedita Raju and Tytti Erästö, "The Role of Space Systems in Nuclear Deterrence," Stockholm International Peace Research Institute, September 2023, https://www.sipri.org/sites/default/files/2023-10/the_role_of_space_systems_in_nuclear_deterrence.pdf.

[9] Raju and Erästö, "The Role of Space Systems in Nuclear Deterrence," 2023.

face increasing challenges to grow their space programs and secure their space infrastructure. This is especially pertinent in regions with persistent strategic competition, such as South Asia, where both India and Pakistan are enhancing their space capabilities to support both military and socio-economic needs.

3. INDIA'S SPACE PROGRAMME

India's space programme has witnessed stark changes since its inception in the 1960s with the launch of its first experimental rocket, the Rohini 75. The earlier ambitions behind the development of its space programme were founded in the quest for research for technical autonomy, socio-economic development and national prestige. The programme, throughout its inception phase, focused on progress in weather forecasting, agriculture, and telecommunications.

Dr. Vikram Sarabhai, the leading Indian space scientist established the Indian National Committee for Space Research (INCOSPAR) in 1962 which was later restructured as the Indian Space Research Organisation (ISRO), leading India's space endeavours since then.[10] During this time, India was able to leverage its balanced relations with the United State and the Soviet Union to foster its space research. As a result, India was able to launch its first rocket, the Nike Apache, from the Thumba Equatorial Rocket Launch Station (TERLS) in 1963.

Despite its initial focus on civilian and peaceful applications, the Indian policy makers and strategic elite were quick to realise the strategic significance of space in terms of its military applications. Therefore, the military aspect gradually started gaining prominence in India's space ambitions with an increased focus on the

[10] Fazal Abbas Awan, Umbreen Javaid, and Rabia Munir, 'Pakistan India Space Program and the Satellite System', *Journal of Indian Studies*, January – June 2018, 4, no. 1 (2018): 129–39.

importance of space in national security, missile development and satellite-based monitoring.

The 1970s became an important decade for ISRO after the successful launch of Aryabhatta, India's first satellite, in 1975 underscoring India's potential in space technology. ISRO, during the 1970s and 1980s, remained focused on launching earth observation satellites, including Bhaskara-I in 1979. Meanwhile, it also constructed a robust scientific infrastructure for space exploration. In the 1980s, IRSO had enabled India to utilise space for various civilian applications, mainly, weather forecasting, resource mapping and agricultural development.

The changed world of the 1990s also witnessed the commencement of a new era for India's space programme. Two major factors behind this new dawn were the greater technological independence and growing space collaboration with foreign powers. This was demonstrated by the successful launches of India's first remote sensing satellite, IRS-1B and Polar Satellite Launch Vehicle (PSLV). The success in developing a PSLV was an indication of India's readiness for bigger endeavours in space technology. It provided IRSO confidence to strive for mastery in indigenous satellite launch vehicles, thus reducing the cost as well as external dependence.[11] This development proved crucial for the growth of India's space programme in the coming years.[12]

The development of space capabilities was further accelerated throughout the 2000s. In 2008, ISRO achieved another significant milestone by successfully launching its first lunar mission, Chandrayaan-1. In the subsequent years, India was

[11] Mohammad Ali Zafar, 'Devising National Space Policy in Pakistan', *ÆTHER: A JOURNAL OF STRATEGIC AIRPOWER & SPACEPOWER* 1, no. 4 (Winter 2022): 49–62.
[12] Lecture by NASTP Official at CASS Lahore

standing among the handful of nations to orbit Mars with the Mars Orbiter Mission (Mangalyaan). These milestones not only displayed the evolution of India’s space programme, but also established it as a major space-faring nation.

In recent years, India's space programme has increasingly been utilised for military purposes. In 2019, India's emerging military space abilities were showcased with the well-known Mission Shakti test, underscoring its Anti-Satellite (ASAT) capabilities. This was a strong reply to the security challenges in the region, particularly those concerning the emerging space and missile technologies of China and Pakistan. India's space policy is presently famous for a dual-use approach that combines military and civil domains, highlighting the conservation of strategic sovereignty and space-based deterrence.

In 2020, with the establishment of IN-SPACe, India's space programme evolved to commercialisation of space activities encouraging private sector participation in space exploration and technology development. It helped in making India’s space ambitions economically sustainable by encouraging the participation of the private sector. It was later mirrored in India's National Space Policy 2023, which encourages international cooperation, participation of the private sector, and utilisation of space for national security and socioeconomic growth. As a result of the aforementioned evolutionary journey, India’s space programme is one of the fastest growing programmes in the world.

3.1. Recent Missions

India’s recent space achievements and future plans include several missions such as Chandrayaan-3, Aditya-L1, Mangalyaan, and Gaganyaan. According to the ISRO’s 2023 Indian Space Situational Assessment Report (ISSAR), there were three

active Indian deep space missions by the end of 2023; the Chandrayaan-2 Orbiter, Aditya-L1, and the propulsion module of Chandrayaan-3[13]. These missions were the result of long-term focus on space activities by the Indian government[14]. Undertaking these missions has resulted in spin-off technological breakthroughs[15]. For instance, India's deep space communication capabilities are believed to have benefited because of these missions. It also collaborated with the National Aeronautics and Space Administration (NASA) in these missions, which allowed it to gain the relevant insight and expertise.

3.1.1. Chandrayaan-3

India launched the Chandrayaan-3 Moon mission in July 2023[16], and in August, its lander, Vikram, achieved the historic milestone of successfully soft-landing on the Moon's South Pole[17]—the first mission to do so. This underexplored region holds immense potential for scientific discoveries[18]. The mission's rover, Pragyan, deployed on the Moon's surface, along with the Vikram lander, and carried multiple scientific payloads to study the Moon's physical characteristics, near-surface atmosphere, and subsurface tectonic activity[19]. A key objective was to search for water-based ice, a

[13] "Indian Space Situational Assessment Report (ISSAR) for 2023," Indian Space Research Organisation, April 29, 2024, https://www.isro.gov.in/Indian_Space_Situational_Assessment_Report_ISSAR2023.html.
[14] Gabriel Elefteriu, "The role of space power in geopolitical competition," Council on Geostrategy, January 30, 2024, https://www.geostrategy.org.uk/research/the-role-of-space-power-in-geopolitical-competition/.
[15] Rajeswari Pillai Rajagopalan, "India's Space Priorities Are Shifting Toward National Security," Carnegie Endowment for International Peace, September 1, 2022, https://carnegieendowment.org/posts/2022/09/indias-space-priorities-are-shifting-toward-national-security?lang=en.
[16] "Chandrayaan-3 Details," Indian Space Research Organisation, July 15, 2024, https://www.isro.gov.in/Chandrayaan3_Details.html.
[17] "Chandrayaan-3 Details," 2024.
[18] Dr. Dimitrios Stroikos, "Why does India want to be a space power? Chandrayaan-3 and the politics of India's space programme," The London School of Economics and Political Science, September 26, 2023, https://www.lse.ac.uk/research/research-for-the-world/politics/india-space-programme.
[19] "Chandrayaan-3 Details," 2024.

resource critical for sustaining human life on the Moon and supplying propellant for future missions to Mars and beyond[20].

The mission was a major scientific and political achievement for India, especially following the Chandrayaan-2 mission's failure. It was also lauded for its cost-effectiveness, with a budget of $75 million—approximately one-eighth of similar missions by other states. India has plans to launch additional Chandrayaan missions in the coming years and decades.

3.1.2. Aditya L-1

In September 2023, India launched Aditya-L1, its first solar observatory[21]. By January 2024, the spacecraft reached its destination at a Lagrange Point (L1), approximately 1.5 million kilometres from Earth. The mission's objective was to enable continuous observation of the Sun, monitoring solar activity such as solar winds and flares, and their impact on Earth and near-space weather in real-time[22].

Aditya-L1 carries 7 payloads designed to study the Sun's photosphere, chromosphere, and corona using electromagnetic, particle, and magnetic field detectors[23]. This data could help predict solar phenomena days in advance, allowing satellites to be safeguarded against potential damage. The spacecraft is expected to operate for 5 years, collecting valuable insights into solar activity.

3.1.3. Mangalyaan

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[20] Georgina Rannard, “Ancient ocean of magma found on Moon south pole,” *BBC*, August 21, 2024, https://www.bbc.com/news/articles/cx2n0jgldn5o.
[21] “Aditya-L1,” Indian Space Research Organisation, accessed November 12, 2024, https://www.isro.gov.in/Aditya_L1.html.
[22] Geeta Pandey, “Aditya-L1: India's Sun mission reaches final destination,” *BBC*, January 6, 2024, https://www.bbc.com/news/world-asia-india-67871797.
[23] “Aditya-L1,” accessed November 5, 2024.

The Mangalyaan-1 mission, also known as the Mars Orbiter Mission (MOM), was launched by India in November 2013[24]. It successfully orbited Mars from September 2014 until October 2022, when communication with the orbiter was lost. The mission served primarily as a technology demonstrator, aiming to develop the capabilities required for designing, planning, managing, and operating interplanetary missions. Its secondary objective was to study Mars' surface features, morphology, mineralogy, and atmosphere.

The mission marked a significant achievement in advancing India's capacity for inner solar system exploration[25]. Building on this success, the Mangalyaan-2 mission, or Mars Lander Mission, is planned for 2026. This mission aims to deploy a rover and helicopter on Mars. If accomplished, it would represent a significant milestone in India's long-term space ambitions and towards its future plans for deep space exploration.

3.1.4. Gaganyaan

India's Gaganyaan mission aspires to be its first human spaceflight, aiming to demonstrate the nation's capability for manned space missions. The mission plans to send a crew of three astronauts into orbit for a 3-day mission, culminating in a safe return with a water landing in the Indian Ocean[26]. Four Indian Air Force pilots have

[24] "Mars Orbiter Mission," National Aeronautics and Space Administration, accessed November 13, 2024, https://science.asa.gov/mission/mom/.
[25] Dhruv C Katoch, "India's Space Programme: Developments And Strategic Concerns," India Foundation, January 4, 2024, https://indiafoundation.in/articles-and-commentaries/indias-space-programme-developments-and-strategic-concerns/.
[26] Pranathi DVLS, "From Mangalyaan-2 to Shukrayaan-1, here's what Isro is planning in 2024," *Business Standard*, February 20, 2024, https://www.business-standard.com/industry/news/from-mangalyaan-2-to-shukrayaan-1-here-s-what-isro-is-planning-in-2024-124022000403_1.html.

been shortlisted for this inaugural mission, now scheduled for 2026 after an initial target of 2025.

ISRO has made significant progress toward mission readiness. The programme targets 76 percent readiness for India's Human Spaceflight Program, with at least four successful flight tests of a human-rated launch vehicle and crew escape system, alongside advancements in crew training[27]. If successful, Gaganyaan will mark a transformative milestone for India's space ambitions.

3.2. India's Growing Space Capabilities

India has significantly advanced its space programme in recent years, establishing itself as a major spacefaring nation with a growing array of space assets. As of 2023, India operates 55 active space assets, including 18 communication satellites, nine navigation satellites, five scientific satellites, three meteorological satellites, and 20 earth observation satellites[28]. Of these, 22 satellites are in Low Earth Orbit (LEO) and 29 in Geo-synchronous Earth Orbit (GEO)[29]. Notably, 25 of India's operational satellites are used by its military for various purposes, including Positioning, Navigation and Timing (PNT), Communication, ISR, and Electronic Intelligence (ELINT)/Signals Intelligence (SIGNINT)[30].

India's expanding space capabilities will have strategic implications for Pakistan, particularly in the context of security. The growing integration of space assets into

[27] Douglas Gorman, "India's Budget Sets Aggressive Space Goals," *Payload,* July 24, 2024, https://payloadspace.com/indias-budget-sets-aggressive-space-goals/.
[28] "Economic Survey, 2023-24 Highlights," Government of India, July 2024, https://www.indiabudget.gov.in/economicsurvey/doc/Infographics percent20English.pdf.
[29] "Indian Space Situational Assessment Report (ISSAR) for 2023," Indian Space Research Organisation, April 29, 2024, https://www.isro.gov.in/Indian_Space_Situational_Assessment_Report_ISSAR2023.html.
[30] "The Military Balance 2023," International Institute for Strategic Studies, February 2023.

military operations and the increasing focus on dual-use technologies underscore the importance of space in national security and defence.

3.2.1. Communication Satellites

India's communication capabilities are centred on the Indian National Satellite System (INSAT), which is the largest communication network in the Asia-Pacific region[31]. Key satellites in this system, such as INSAT-2C, INSAT-2D, INSAT-2E, INSAT-3A, and INSAT-4, serve both civilian and military needs. These satellites are crucial for telecommunications, television broadcasting, and meteorological services. Additionally, the Indian military operates two dedicated communication satellites, GSAT-7 and GSAT-7A[32], which facilitate encrypted communication for the Indian Navy and Air Force respectively, enhancing the country's command and control systems and supporting network-centric warfare strategies[33]. These satellites provide secure communication even in remote and challenging operational environments[34]. The GSAT 7-A facilitates secure communication for the Indian Air Force's operations, including coordination between aircraft, ground stations, and command centres[35]. This is particularly important in crisis situations, as the satellites allow for the transmission of sensitive information and tactical data[36].

3.2.2. Remote Sensing Satellites

[31] Shamaila Amir and Nazia Abdul Rehman, "Space Technology and Its Military Application: Options for Pakistan," *Journal of Advanced Military Studies* 15, no.1 (2024): 136-152, https://muse.jhu.edu/pub/419/article/931893/pdf.
[32] "The Military Balance 2023," 2023.
[33] Katoch, "India's Space Programme," 2024.
[34] Lecture by NASTP Official at CASS Lahore
[35] ibid
[36] ibid

India's Indian Remote Sensing (IRS) satellite system is one of the largest constellations of Earth observation satellites in the world[37]. The IRS programme, which began to monitor the Indian Ocean region, is critical for both civilian and military applications. The satellites are used for land-use mapping, groundwater exploration, and monitoring forests and flood-prone areas. In the military domain, India utilises 15 IRS satellites, including 9 high-resolution CARTOSAT satellites and 6 Radar Imaging Satellites (RISAT), for all-weather surveillance and strategic monitoring[38]. These satellites can overcome the limitations of optical satellites, that cannot operate through cloud cover[39]. These assets provide vital intelligence, particularly in relation to Pakistan and regional security concerns. They provide India with a day, night, and all weather, near real time ISR coverage[40].

3.2.3. Reconnaissance Satellites

India operates a variety of reconnaissance satellites that enhance its ISR capabilities. These include the CARTOSAT and RISAT satellites, which provide high-resolution imaging and radar data for land and maritime surveillance[41]. The EMISAT satellite is specifically used for ELINT and SIGNINT[42]. The CARTOSAT satellites, which have the ability to manoeuvre their orbits, are particularly useful for monitoring developments in Pakistan and China, reinforcing India's surveillance and reconnaissance capabilities.

3.2.4. Navigation Satellites

[37] Amir and Rehman, "Space Technology and Its Military Application," 136-152.
[38] "The Military Balance 2023," 2023.
[39] Lecture by NASTP Official at CASS Lahore
[40] ibid
[41] "The Military Balance 2023," 2023.
[42] ibid

India has developed the Indian Regional Navigation Satellite System (IRNSS), also known as NavIC, which consists of 10 satellites providing precise PNT services across India and its surrounding regions[43]. This system is used for both civilian and military applications, including navigation for ground, aerial, and marine operations[44]. The Indian military uses seven of these satellites for operational purposes, including troop movement and targeting[45]. In addition to NavIC, India's GPS Aided GEO Augmented Navigation (GAGAN) system enhances the accuracy of its navigation satellites, supporting smart weapon operations and other precision-guided military activities[46]. GAGAN uses a combination of geostationary satellites and ground stations, to improve the accuracy of traditional GPS systems from an error margin of 10-30 metres to just 1-2 metres[47].

3.2.5. Satellite Launch Vehicles

In order to launch satellites into space, states require satellite launch vehicles (SLVs). India has made significant progress with its SLV programme, with a diverse range of launch options including the PSLV, the Geosynchronous Satellite Launch Vehicle (GSLV), the LVM-3, and more recently the Small Satellite Launch Vehicle (SSLV). The PSLV, played a crucial role in launching key Indian space missions, such as Chandrayaan-1 and Mangalyaan. India has also used its PSLV technology to provide commercial satellite launch services to other countries, generating substantial revenue[48]. If there is any potential disruption to an Indian satellite, from a direct attack

[43] Balak Singh Verma, "Introducing NavIC 2.0: Leveraging India's strategic space advantage," Observer Research Foundation, April 1, 2024, https://www.orfonline.org/expert-speak/introducing-navic-2-0-leveraging-india-s-strategic-space-advantage.
[44] Katoch, "India's Space Programme," 2024.
[45] "The Military Balance 2023," 2023.
[46] Air Marshall Waseem ud din et al., "Development of Pakistan's Space Program," 2022.
[47] Lecture by NASTP Official at CASS Lahore
[48] ibid

or otherwise, the SSLV could offer a flexible route to deploy its space assets. These SLVs have largely reduced India’s reliance on foreign powers, such as Russia, for its satellite launches.

4. EVOLUTION OF PAKISTAN’S SPACE PROGRAMME

Pakistan’s space exploration journey began in 1961, with the establishment of the Space and Upper Atmosphere Research Commission (SUPARCO). The newly found space agency of the country was mandated to promote technological advancements and scientific research in air and space sciences. Within a year, Pakistan launched the Nike-Cajun sounding rocket in collaboration with NASA, marking its entry into space research. Subsequently, Pakistan launched its first indigenous sounding rocket, the Rahbar-I, in 1964. The successful launch of Rahbar-I at the height of 130 kilometres was considered a major success by a developing country. At this point, Pakistan stood ahead of several states in the domain of space science and research.

In the 1970s, Pakistan reevaluated its space capabilities owing to the new regional landscape defined by the fall of Dhaka and India's successful launch of its satellite Aryabhatta in 1975. These developments prompted the policy makers to look at developments in space technology from the security lens leading to the development of Pakistan's PAKSAT series. During the decade, the possible uses of satellite technology in communications, defence, and national development started taking place in the strategic and socioeconomic development planning discourses. However, with the increasing military threats from India, Pakistan’s space programme began to take a more militaristic stance, a trend that would be further highlighted in the 1980s.

4.1. Military Integration and Technological Developments

Significant developments in Pakistan's space strategy occurred in the 1980s, mostly due to geopolitical circumstances and security threats in the region. In 1981, SUPARCO was restructured to include military and civilian space projects. Pakistan's strategic focus widened to encompass military applications with the creation of ballistic missile technologies that could be used for space exploration and missile defence. This dual-use strategy demonstrated Pakistan's goal to exploit space-based technologies to bolster its national defence.[49] However, the administrative control of the Strategic Plans Division (SPD) over SUPARCO changed the outlook of the space programme which now appeared to be more military centric, despite the fact that military use of space is always a dividend of civilian space technologies.

4.2. Impact of Sanctions and China Collaboration

In the 1990s, Pakistan's space programme suffered a significant setback when the United States imposed economic sanctions in response to Pakistan's nuclear tests. Due to the restrictions on access to Western space technology, Pakistan was forced to look for other sources. Pakistan looked to China for assistance, a partnership essential to developing its space capabilities. Pakistan's first digital communication satellite, Badr-1, was launched in 2001 with Chinese help. This partnership also included missile technology, as the Shaheen missile system became operational during this era.[50]

[49] Zafar, ‘Devising National Space Policy in Pakistan’.
[50] Awan, Javaid, and Munir, ‘Pakistan India Space Program and the Satellite System’.

4.3. Reorganisation and Focus on National Security

In 1999, Pakistan's space programme experienced another reorganisation under the direction of the National Command Authority (NCA), which had direct control over SUPARCO and other strategic organisations. This restructuring made the space programme more militarised by stressing the usage of space technology for defence and national security purposes. Pakistan's space ambitions during this time became aligned with its missile development imperatives, reconnaissance, and surveillance capabilities, mainly in response to India's growing missile and space capabilities. In 2011, Pakistan launched communication satellite PAKSAT-1R with Chinese assistance enabling momentous TV broadcast, cellular connectivity, and internet service throughout South Asia, the Middle East, and Central Asia. PAKSAT-1R is also considered an important asset of PAF, and Pakistan is currently using it as its primary communication satellite.[51]

4.4. Space Vision and the National Space Policy

In 2011, Pakistan unveiled its Space Vision 2040. It envisioned the development of its national space programme for socio-economic conduits with a particular focus on disaster relief, agriculture and water resource management. The Space Vision 2040 also called for developing military-related space capabilities. The Space Vision was later refined in the NSP 2023 which marked a major step in Pakistan’s space programme’s development. While recognising the increasing significance of space as a domain for socioeconomic development and national security, the NSP emphasised on the importance of public-private collaboration in the space domain. It identified resource monitoring, disaster management, and tackling

[51] Lecture by NASTP Official at CASS Lahore

climate change adaptation and mitigation as likely avenues for the private sector's participation in the space programme. The formulation of a policy highlights Pakistan's readiness for embracing space technologies in national development instead of limiting their fruits only for military endeavours.

4.5. Recent Space Missions and Developments

Three major pillars of a Space Programme include space launch capabilities, satellites and ground infrastructure including physical and institutional set-ups backed by policy framework. Over the years, Pakistan's space programme has been progressing in all these domains though at a sluggish rate. Among these, a major focus has been on satellite development. In 2018, Pakistan launched its first remote sensing satellite, the PRSS-1 from China.[52] The applications of PRSS-1 include Earth observation and optical imagery. Additionally, the satellite can be used for environmental monitoring, disaster relief efforts, agricultural monitoring, land mapping and more. According to SUPARCO, the satellite also supports infrastructure projects under the China-Pakistan Economic Corridor (CPEC)[53].

In terms of miniaturised satellite technology, Pakistan has made progress. It launched PAKTES-1, which is a small remote sensing satellite, in 2018[54]. More recently, in 2024, Pakistan achieved a significant milestone with the launch of iCube-Qamar, a miniaturised satellite which was deployed as a part of China's Chang'e-6 lunar mission[55]. iCube-Qamar was developed and launched through a collaboration

[52] "Pakistan Remote Sensing Satellite (PRSS-1)," SUPARCO, accessed November 14, 2024, https://suparco.gov.pk/major-programmes/projects/prss-1/.
[53] "Pakistan Remote Sensing Satellite (PRSS-1)," accessed November 14, 2024.
[54] "Pakistan Technology Evaluation Satellite (PakTES-1A)," SUPARCO, accessed November 14, 2024,https://suparco.gov.pk/major-programmes/projects/pakistan-technology-evaluation-satellite-paktes-1a/.
[55] "ICUBE-Q: Pakistan's Lunar CubeSat onboard Chinese Chang'E 6 Mission," Institute of Space Technology, accessed November 14, 2024, https://www.ist.edu.pk/icube-q.

between the Institute of Space Technology (IST), SUPARCO, and China's Shanghai Jiao Tong University. According to IST, the satellite has already successfully demonstrated lunar orbit insertion, deep space communication, thermal control, and imaging technologies. Pakistan also recently launched the Paksat-MM1 satellite, which will enhance Pakistan's positioning accuracy to support military and civilian applications[56].

5. ANALYSIS THROUGH POLICY CYCLE FRAMEWORK

An analysis of Pakistan's NSP 2023 using the Policy Cycle framework (figure 2), helps in understanding the policy process more effectively. The increasing dependency on space-based applications for surveillance, navigation, and communication highlighted the need for an integrated policy framework. Additionally, regional factors particularly India's space capabilities underscored the need for Pakistan to improve its space programme.

In the policy-making stage, the NSP 2023 analysis demonstrates a calculated approach to determining the apprehensions that have been emphasised. The policy aims to include developing space-based resources to advance communication and surveillance capabilities, like the six LEO satellites and five GEO satellites. It further suggests the establishment of the Pakistan Space Activities Regulatory Board (PSARB) to regulate unauthorised satellite launches and help in registration. Furthermore, the policy focuses on promoting academia-industry linkages for space exploration. It aims to foster an academic environment that supports relationships between scholars and industry and encourages public outreach through partnerships with commercial organisations. A major weakness in the Policy appeared to be its lack

[56] Lecture by NASTP Official at CASS Lahore

of wholesome approach during the formulation process. As revealed during the course of this study, Pakistan Air Force, a major stakeholder was not consulted in the formulation stage or even before the agendas setting stage. This lack of wholesome approach during agenda setting and policy formulation resulted in a policy which is not collectively owned by all stakeholder and also reflected in the impediments faced in the implementation phase.

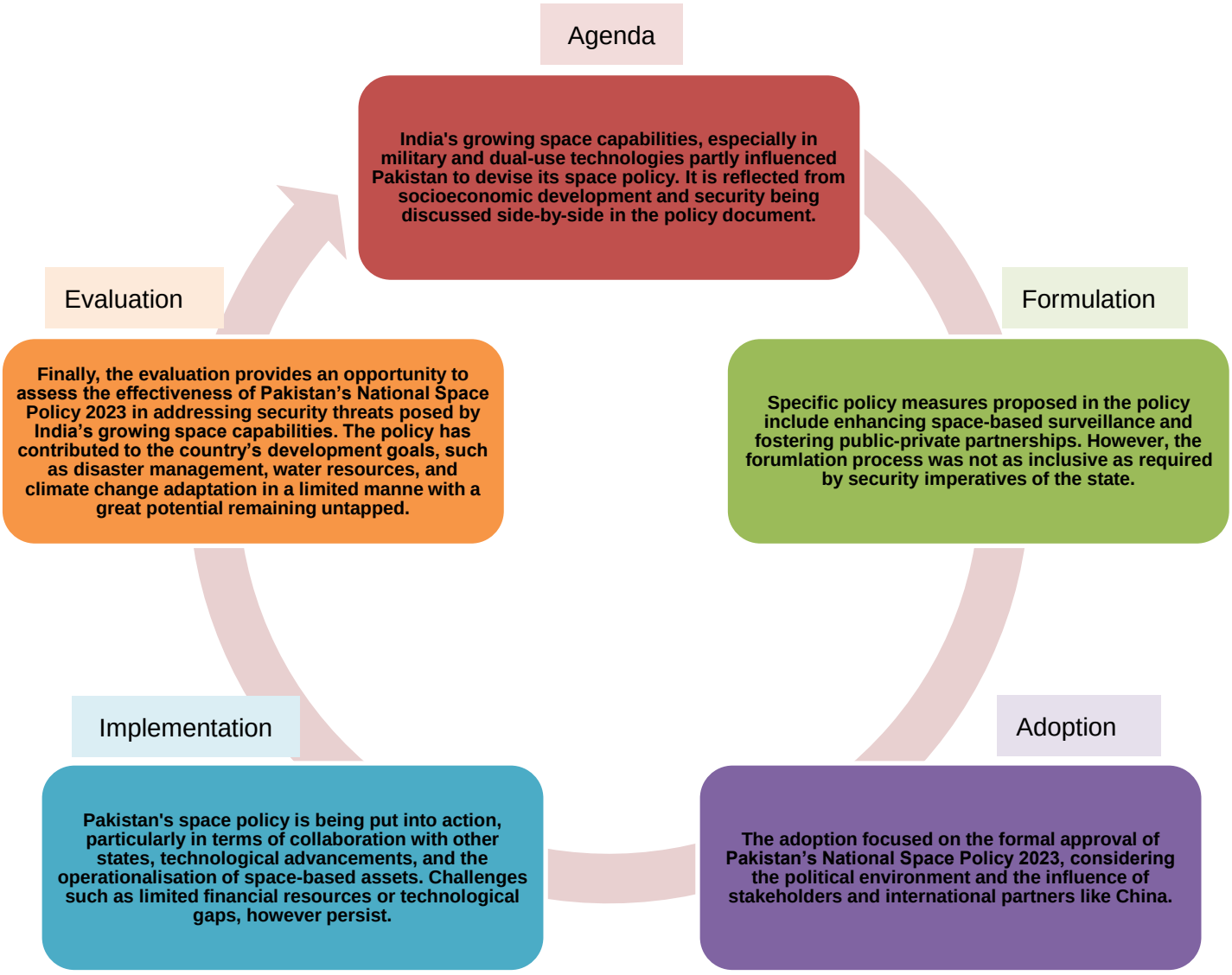

Figure 2: National Space Policy 2023 Analysis through Policy Cycle Model

As discussed, the policy has not been developed through a wholesome consultative approach thus making a thorough implementation difficult. One of the major issues in Pakistan's space programme development is the lack of balance between military and civilian uses of the technology and a clear demarcation between the two. By not involving the PAF in the consultative process, it further loses this balance.

Meanwhile, the implementation of the policy is already underway with regards to policy guidelines relating to enhanced communication infrastructure and surveillance. These measures include commencing the launch of GEO and LEO satellites. Additionally, to implement another policy measure, the Government of Pakistan, under the Pakistan Space Activities Rules – 2024[57] has constituted the PSARB[58] which has been mandated to authorise and regulate all matters and activities related to Outer Space and Upper Atmosphere in Pakistan. As per the website of PSARB, it is currently working to develop a regulatory framework for the country's space sector. This is a major step towards streamlining the participation of the private sector in the space programmes, as identified in the policy[59]. As per the PSARB rules, it is mandatory for private companies, interested in space endeavours to register with PSARB after getting themselves registered with the Securities and Exchange Commission of Pakistan (SECP). To provide an ease in the process and improve service delivery, the PSARB has initiated an online portal for registration. The registration is currently open for satellite operators providing Radiocommunication Service (Telecommunication).

The NSP 2023 mandated SUPARCO as National Space Agency of Pakistan to carry out the implementation, monitoring, review and revision of the policy. SUPARCO

[57] The Gazette of Pakistan, "The Pakistan Space Activities Rules-2024," National Command Authority, The Government of Pakistan, February 02, 2024
[58] Pakistan Space Activities Regulatory Board https://psarb.gov.pk/
[59] Interview 1

is also responsible for identifying gaps and opportunities arising in the space sector. An analysis of SUPARCO's initiatives reveals that it has been actively involved in projects and initiatives which are in line with the policy guidelines of the NSP 2023. SUPARCO has listed several projects including the use of space for the purposes of socioeconomic development on its website. It also highlights five major categories of Space Technology applications. However, no specific programmes are mentioned against these. Moreover, which of these programmes have been designed after the initiation of NSP is also unclear from the available data. However, while following the policy directives regarding space education, the SUPARCO Institute of Technical Training (SITT) has initiated multiple training which mainly cover satellite remote sensing and GIS applications, climate change monitoring, agriculture and forestry mapping, flood hazard assessment, machine learning in remote sensing, and synthetic aperture radar (SAR) technologies. Another major initiative by SUPARCO was the National Space Symposium and the International Conference on Applications of Space Science and Technology (ICAST). Additionally, in terms of international cooperation, several initiatives have been mentioned by SUPARCO but specific details are not given about any of the programmes and initiatives.

Additionally, all Federal and Provincial ministries, divisions and departments, according to the policy, are required to extend full support in achieving the policy objectives. It is pertinent to note that the policy still remains under the patronage of SUPARCO which works under the SPD resulting in the status quo. Ministry of Science and Technology (MoST) remains out of the ambit. It is evident from an analysis of 68 Public Sector Development Programmes (PSDP) under the MoST which reveals that not a single scheme under PSDP 2023-24 and 2024-25 is related to space technologies. Additionally, to assess the policy implementation regarding the use of

space technology for socioeconomic development and disaster management, the National Economic Transformation Plan, titled '*Uraan Pakistan*', launched by the ministry of Planning, Development and Special Initiatives was also reviewed[60]. It is pertinent to note that such an ambitious plan calling for four economic rejuvenations only broadly talks about technology and innovation without explicit mention of space technology whereas textiles, IT, agriculture, telecom, AI and other such areas have been mentioned repeatedly in the document. It also shows that there is a lack of understanding about the significance of the space and the NSP's implementation. Additionally, since the launch of the NSP 2023, the Planning Commission (PC) has not initiated a single project relating to space technology.[61]. With regards to policy implementation at provincial level too, no significant initiative by any government has been noticed. This lack of support from other ministries and federating units shows a lack of inter-agency coordination for the NSP 2023.

In policy monitoring, the National Space Agency, SUPARCO is also responsible for monitoring and evaluation of the policy. However, no data could be accessed in this regard to assess the ongoing evaluation process of the NSP 2023 by SUPARCO. Moreover, feedback systems are important to policy cycles because they permit alterations and improvements to the policy implementation. This study reveals the lack of an extensive evaluation process for the NSP after over a year of its implementation. No specific programme or initiative could be traced from the open sources to analyse the evaluation process of the policy. Moreover, the stakeholders also did not reveal any such process currently underway.

[60] Ministry of Planning, Development and Special Initiatives, "Uran Pakistan," https://pc.gov.pk/uploads/uraanpakistan_book.pdf
[61] Development Projects - Space: Ministry of Planning, Development and Special Initiatives, https://www.pc.gov.pk/web/projects

6. CHALLENGES FOR PAKISTAN'S SPACE POLICY

Pakistan NSP has come at a crucial time; the strategic importance of space is increasing exponentially, India is expanding its space assets and infrastructure, and the growing role of private organisations in space has significantly altered the space domain. In light of the growing disparity between India and Pakistan's space capabilities, it is important to analyse Pakistan's space policy, and highlight both the positive aspects as well as any shortcomings.

6.1. Technological and Financial Constraints

Perhaps the foremost challenge for Pakistan's space policy is its limited technological capabilities and financial constraints, particularly in comparison to India's space programme. India has established itself as a major spacefaring nation, with a robust space programme. In comparison, Pakistan's space programme is significantly smaller, and it remains reliant on collaborations with China for satellite launches and development of space technology. Pakistan's economic constraints further widen its technological gap with India.

Pakistan's NSP does place importance on providing financial support to SUPARCO, through Public Sector Development Programs[62], as well as other mechanisms. However, it does so without adequately detailing where this financing will come from. The NSP mentions the role of public private partnerships and joint ventures, but again remains vague about the exact specifications[63]. Given India's increasing investment in the space sector, Pakistan's space budget and infrastructure

[62] "National Space Policy, Pakistan," SUPARCO, January 2, 2024, https://suparco.gov.pk/wp-content/uploads/2024/01/National-Space-Policy.pdf.
[63] "National Space Policy, Pakistan," 2024.

remain limited. As India continues to enhance its SLVs, space exploration capabilities, and satellite programme, Pakistan must overcome its technological and financial constraints in order to maintain relevance in an increasingly competitive space arena.

6.2. National Security and Strategic Concerns

India's growing space capabilities also directly impact Pakistan's national security concerns. India has developed significant capabilities in space-based ISR, navigation and communication, which support its military operations. The Indian military's use of its space assets, combined with its ASAT capabilities, is certainly a concern for Pakistan's national security[64].

Pakistan's space policy maintains a balance between utilising the space sector for both socioeconomic and national security purposes. The NSP states that "Pakistan will ensure that space technology and services are used to strengthen national security"[65]. The NSP does not go into detail on how the Pakistani military will utilise the country's space assets. However, this should not be taken as a shortcoming of the NSP, as there are strategic benefits to maintaining ambiguity regarding the military applications of space. Ultimately, Pakistan needs to respond to India's growing space-based military assets. The disparity with India's space programme places Pakistan at a strategic disadvantage, which could adversely affect its ability to effectively monitor regional developments and respond to threats[66].

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[64] Dr. J. Wesley Hutto, "Space Entanglements: The India–Pakistan Rivalry and a US–China Security Dilemma," *Journal Of Indo-Pacific Affairs:* (Winter 2020), https://www.airuniversity.af.edu/JIPA/Display/Article/2425757/space-entanglements-the-indiapakistan-rivalry-and-a-uschina-security-dilemma/.

[65] "National Space Policy, Pakistan," 2024.

[66] Mian Zahid Hussain and Raja Qaiser Ahmed, "Space Programs of India and Pakistan: Military and Strategic Installations in Outer Space and Precarious Regional Strategic Stability," *Space Policy* 47 (2019): 63-75, https://doi.org/10.1016/j.spacepol.2018.06.003.

6.3. Geopolitical and Diplomatic Implications

India's growing space capabilities also have significant geopolitical and diplomatic implications for Pakistan. India's growing space programme strengthens its position as a regional and global space power, ultimately giving it a greater role in global governance, particularly in the space domain. Pakistan, although has a strong collaboration with China, does not have the geopolitical and diplomatic leverage that India has within the global space ecosystem.

Pakistan's space policy recognises the importance of international collaboration for the space sector. It states that Pakistan will "pursue all avenues of bilateral and multilateral collaboration with space agencies, intergovernmental, international and regional organisations that provide avenues for space research, technology development and its applications"[67]. This is an important point, as a major reason for the advancement of India's space programme has been its collaboration with NASA and other international space agencies. India's international collaborations in space have also strengthened its global standing and access to advanced space technologies. Pakistan needs to focus on fostering partnerships with countries like China, and also on expanding its space-related collaboration with other countries and space organisations.

6.4. Strategic Autonomy and Space-based Deterrence

A major aspect of India's space programme is the aspect of indigenous development of both satellites and SLVs, as well as the growing role of private space organisations. These factors give India strategic autonomy in regards to its space

[67] "National Space Policy, Pakistan," 2024.

programme creating challenges for Pakistan's strategic autonomy and its ability to develop a space-based deterrence strategy. Due to Pakistan's lack of indigenous SLVs, if it decides to launch a military-class satellite, it would need to reply on the US or China, who would have their own requirements and considerations[68]. An important factor in this regard is that India's development of space capabilities is though indigenous but it has been supplemented through solid international support which Pakistan has failed to harness. It is also reflected in the fact that India's space policy explicitly mentions the promotion of international relations in its vision.

Pakistan's NSP does mention the importance of indigenisation through the development of local research and production facilities. It calls for an enhanced technological base to reduce dependency on other nations[69]. This is a crucial point, as building a robust technological base in the space domain will have tremendous benefits for both the civilian and military sectors. The NSP also states Pakistan's objective to achieve self-reliance by promoting commercial activities, public private partnerships to reduce dependence on national exchequer[70]. Ultimately, Pakistan must go towards achieving strategic autonomy in space and building an effective space-based deterrence. Developing SLVs, satellites and other space-based capabilities is critical for Pakistan in order to maintain strategic autonomy.

6.5. Socioeconomic Development and Space Technology Utilisation

The growing space gap between India and Pakistan has implications for socioeconomic development as well. Both Pakistan and India's space policies highlight the role of space technology in contributing towards sustainable development

[68] Lecture by NASTP Official at CASS Lahore
[69] "National Space Policy, Pakistan," 2024.
[70] ibid

and socioeconomic growth. Pakistan's NSP has a significant focus on socioeconomic development. It specifically provides guidelines for agriculture, forestry, environment, urban planning, land management and disaster monitoring and mitigation. The NSP tasks SUPARCO for the facilitation in utilisation of space applications in various sectors of the economy.[71].

Though the NSP-2023 recognises the potential of space technology for development purposes, the limited scale and development of Pakistan's space assets, coupled with its economic constraints, pose a significant challenge in leveraging the space sector for socioeconomic development. This identifies the needs for priority allocations for research and innovation in this sector.

7. POLICY CONSIDERATIONS

This study suggests following policy options for Pakistan's NSP-2023, given the disparities in its space capabilities with those of India.

7.1. Develop Indigenous Launch Vehicles and Satellite Technology

Currently, Pakistan has been sending its satellite using 'Ride Share' with China. However, as discussed, this affects the autonomy and additionally, the military endeavours cannot be undertaken with full liberty. Thus, the development of indigenous SLVs will make it easier for the private and military sectors to pursue space endeavours with full potential[72]. Moreover, the autonomous SLVs will provide more freedom for dual-use and military specific space applications. The subsequent points will provide further details in this regard.

[71] ibid
[72] Interview 2

7.2. Establish a National Space Innovation Hub

Given the vast need for improvement in the innovation and research ecosystem of the country, it is high time to promote initiatives like the National Aerospace Science and Technology Park (NASTP) which can offer an institutional framework and infrastructural support to carry out such programmes either under its umbrella or taking lead for it. The NASTP model can also serve as a guide for public-private partnership in the research domain particularly relating to software as well as space infrastructure and space launch research and development. A space innovation hub should aim at enhancing capabilities in satellite design, launch vehicle development, space exploration, and other key areas. This innovation hub could serve as the foundation off which Pakistan builds its space programme. Initially, Pakistan should focus more on the commercial applications of space technologies[73]. An agency should also be created, similar to India's IN-SPACe, that empowers Pakistan's private industry. Effective public-private partnership is crucial for any state to build a robust space programme. Similarly, the financial challenges that Pakistan's space programme faces can only be overcome once Pakistan's overall economy stabilises and grows[74]. Pakistan's current economic trajectory is promising, and if it continues on the current path Pakistan could very well return to its original position as a regional space power.

7.3. Develop Counter-Space Technologies

Given India's growing space-based military assets and its successful demonstration of ASAT capabilities, Pakistan must start a plan for developing counter-space technologies in both offensive and defensive domains to maintain strategic

[73] Interview 1
[74] Interview 2

parity. Hedging strategy in this regard can prove to be a more beneficial one in the longer run. A particular focus should be on strategies and measures for increased space situational awareness and defensive countermeasures to protect Pakistan's limited space assets from threats such as jamming, spoofing, and direct attacks.

7.4. Integrate Space into National Defence Doctrine

As the realisation of the significance of space is taking root, there is a need to integrate NSP with the national defence strategies and doctrines of the armed forces. Such an integration must ensure full utilisation of space technology for defence and military operations. Furthermore, with the induction of next generation aircraft into the PAF's arsenals, the need for integration of space technologies with the doctrine of PAF will be further intensified pertaining to network centric warfare, space-based IRS, missile guide and precision strikes capabilities and improved communication networks. An immediate measure in this regard could be the establishment of a dedicated space command, akin to India's Defence Space Agency.

7.5. Space Technologies for Socioeconomic Development

The NSP-2023 lays special emphasis on the use of space technology in socioeconomic development, particularly disaster management, climate monitoring, and agricultural development. However, policy application impediments remain stark, as discussed, mainly due to factors pertaining to the lack of inter-agency collaboration and the absence of advanced remote sensing satellites for precision agriculture programmes. By overcoming these issues, disaster preparedness and food security can be enhanced. Moreover, capacity-building initiatives for common users like farmers, as well as government officials are also required to realise this policy aim.

Additionally, it is also imperative that a robust monitoring and evaluation framework must be established to ensure the effectiveness of space-based interventions.

7.6. Space Policy Integration

As revealed in the analysis, space largely remains absent from the futuristic plans as well as ongoing development programmes, indicating that the conduits of NSP-2023 have not reached to other ministries. Thus, there is a need to launch a robust drive to bring all ministries and departments under the umbrella of NSP-2023 implementation. Similarly, the relevance of space policy should also be communicated to provincial governments so that space technologies should be reflected in their development programmes and initiatives.

7.7. Forge Strategic Partnerships Beyond China

Pakistan's existing space programme is largely a product of its collaboration with China. However, there is a need to enhance strategic autonomy in the space domain. Firstly, by developing indigenous capabilities and secondly by exploring further avenues of international cooperation. Keeping in view the flux in geopolitical dynamics, it is essential that Pakistan should expand diplomatic and strategic partnerships with other space-faring nations and international organisations. In this regard, major players the US, members of the European Space Agency (ESA), and Russia, as well as middle powers like Canada and South Korea can present alternative avenues. Leveraging cooperation in space education and R&D with these entities, Pakistan can access new technologies in satellite development while bypassing the sanctions which mainly affect space launch capabilities. Moreover, cooperation with these states can easily be steered in socio-economic development domain. Joint trainings, satellite data sharing and enhanced participation in global space governance present other avenues

of international cooperation. Collaborations of this nature would also provide opportunities for Pakistan to amplify its role in global discourses on shared space resources. Meanwhile, the multilateral initiatives like United Nations Committee on the Peaceful Uses of Outer Space (COPUOS) and other regional space forums would also allow Pakistan to advocate for equitable space access, and contribute to space law and policy development. A subsequent review of the space policy should also include the promotion of foreign policy objectives through space cooperation.

7.8. Develop a Robust Space Education Ecosystem

Aligning the education system with the knowledge and research on space would be a major investment for the country's future. A starting point in this regard can be the launch of a study initiative to assess how the current curriculum at schools, colleges and university levels teaches about space and how it can be improved to bring it at par with the emerging requirements. This will help in the curriculum expansion of space science and boost the overall educational ecosystem. Similarly, domestic and foreign scholarships for students pursuing education in space and engineering related programmes should be sponsored by the public and private centres. International development partners should also be encouraged to provide funding for such endeavours. Moreover, the change of the national curriculum and examination system is also imperative for sustainable development of the space programme. The current education system focuses on memorisation of information rather than application of scientific knowledge resulting in intellectual stagnation.

Moreover, Space Museums and Space Theme Parks should be established in major cities of all provinces to inculcate an interest in space-related activities. A starting point for this can be the NASTP platform which is already working in major

cities. Besides, in order to enhance public awareness and increase masses' interest in space, plans for social media content creation and dissemination should be formulated.

7.9. Policy Review, Evaluation and Revision

The first National Space Policy of Pakistan is a big step forward but it suffered from shortcomings in several stages of its cycle. As the policy will complete its two years soon, there is a need to start a comprehensive review process. The review process should include all stakeholders including the PAF and other entities which were left out of the consultation process. The review process should also take on board other ministries and their contribution to meeting the policy guidelines should also be gauged with a report presented to the Prime Minister of Pakistan. In order to ensure the long-term success of Pakistan's space programme, an effective monitoring mechanism is necessary.

8. CONCLUSION

Pakistan's journey towards space exploration has suffered major hiccups, however, currently the nation is in recovery stage. However, several challenges need to be overcome for national security and socioeconomic development through space technology. Particularly, India's rapidly expanding space capabilities necessitate a rapid and effective overhaul of the space programme. Recently, Pakistan has achieved some significant strides in the development of satellites, space-based communication, remote sensing, and Earth observation. However, its space assets are still very limited compared to India's vast and sophisticated space infrastructure. Though Pakistan need not to punch above its weight by fully replicating Indian

endeavours and by blindly following its suits, yet a robust space programme akin to national security and economic imperatives should be the top most priority.

The National Space Policy 2023 and Space Vision 2040, present clear pathways for space applications for socioeconomic development and national security. Yet, the analysis of policy through the policy cycle model revealed some significant shortcoming at every stage of the policy cycle. Moreover, technical, financial, and geopolitical impediments further limit Pakistan’s space capabilities.

To bridge the gap with India and to further improve its strategic and developmental use of space, Pakistan needs to invest in indigenous space technology, enhance its military space capabilities, establish international collaborations, and integrate space technology into national development agendas.

The space policies of both India and Pakistan are unique due to their particular security concerns, regional dynamics, and national priorities. In comparison, India has led itself into a strong global space power with a dual-use space programme, whereas Pakistan's space policy is still considerably led by national security issues but with an increased focus on the application of space in disaster management, monitoring climate change, and other socio-economic development contexts. Despite the disparity in space capabilities, Pakistan has provided a basis for a more effective space programme with the potential for future growth and development.

Pakistan's space strategy in the future must emphasize increased technological self-reliance, expanding satellite capabilities, and integration of space technology into national security, economic, and environmental strategies. By doing so, Pakistan will not only ensure its position in the regional space race but also make sure that space

technology plays a transformative role in addressing the country's development challenges and national security priorities.

Given the increasing space race in South Asia, Pakistan needs to be effective in exploiting this space to build its geopolitical advantage, national security, and sustained socio-economic well-being. So, the sustainable future of a Pakistan space programme will depend much on sustained investments, innovation, and strategic collaborative efforts at domestic and international levels to respond more effectively to unfolding space dynamics.

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ANNEXURES

Annex-A: Questionnaires for Semi Structured Interviews

1. How do Pakistan’s space ambitions align with its broader strategic objectives?

2. In your view, could India’s growing space capabilities have a significant impact on Pakistan’s defence and intelligence operations?

3. Do you believe that Pakistan’s space programme can keep pace with India's growing space capabilities, or should we consider alternative goals?

4. How important is it for Pakistan to develop its space capabilities independently, given the rapid advancements in India’s space sector?

Annex-B: Details of Interviews

Sr	Name	Date	Medium
1	Dr Adil Sultan	15-Oct-24	Zoom
2	Dr Ali Sarosh	15-Oct-24	Zoom