Space Militarization: Threats to Security of Pakistan and Strategic Stability of South Asia

Author

Noor Ul Huda Atif

Regn Number

NUST203000MCIPS79516F

Supervisor

Associate Dean Dr. Tughral yamin

CENTRE FOR INTERNATIONAL PEACE AND STABILITY

NUST INSTITUTE OF PEACE AND CONFLICT STUDIES

NATIONAL UNIVERSITY OF SCIENCES AND TECHNOLOGY

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Author

Noor Ul Huda Atif

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Thesis Supervisor:

Associate Dean Dr. Tughral Yamin

Thesis Supervisor's Signature: _____

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NUST INSTITUTE OF PEACE AND CONFLICT STUDIES

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ISLAMABAD

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I certify that this research work titled "*Space Militarization: Threats to Security of Pakistan and Strategic Stability of South Asia"* is my own work. The work has not been presented elsewhere for assessment. The material that has been used from other sources it has been properly acknowledged / referred.

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Abstract

Outer space is the defining future of international politics, with space faring becoming a global common. This thesis provides an assessment of the national and regional security threats due to the imbalance of space capabilities between two nuclear states on South Asia, India and Pakistan. It begins with an overview of Pakistan's space program and its decline resulting in the emergence of security threat from the potential enemy. It also iterates the importance of Pakistan's space program to enhance the capabilities of armed forces. This thesis is supported by concepts security and technology under *game theory*. Both of them will support the main concepts of technical and security threat. The strategic stability of South Asia due to space race will be supported by the idea of *security trilemma*. This research will induce the methods of qualitative and quantitative research, with interviews and literature review as tool for data collection. The objective of this research is to address the questions of imbalance of civil-military capabilities between India and Pakistan in outer space. To analyze the impact of space militarization by India on national and regional security and to explore the prospects of a long-term strategy for growth of Pakistan's Space Program (PSP). This thesis will explore the aspects of military use of space assets and the way it can contribute towards improvement in military capabilities of Pakistan in outer space. This research presents a policy incorporating capacity building measures to ensure security and a suggestive space strategy for civil-military utilization of space assets.

Key Words: *Space Militarization, Outer Space, Strategic Stability, National Security, Space Program, India, Pakistan and South Asia*

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List of Acronyms

ASATs:	Anti- Satellites
C^4ISR:	Command, Control, Computer and Communication, Information, Surveillance and Reconnaissance
CPEC:	China-Pakistan Economic Corridor
DRDO:	Defence and Research Development Organization
ESA:	European Space Agency
GoP	Government of Pakistan
IOK:	Indian Occupied Kashmir
ISC:	Indian Space Committee
ISRO	Indian Space Research Organization
ITU:	International Telecommunication Union
JPL:	Jet Propulsion Laboratory
OBORI:	One Belt One Road Initiative
PAEC:	Pakistan Atomic Energy Commission
PAF:	Pakistan Air Force
PakTES-1A:	Pakistan Technology Evaluation Satellite-1A
PLA:	People's Liberation Army
PRSS-1	Pakistan Remote Sensing Satellite -1
PSP:	Pakistan's Space Program
SDI	Strategic Defence Initiative
SPD:	Strategic Planning Division
SUPARCO:	Space and Upper Atmosphere Research Commission
UK:	United Kingdom
UN:	United Nations
UNODA:	United Nations Office of Disarmament Affairs
US:	United States
USSR:	Union of Soviet Socialist Republic

Chapter 1 : Introduction

This research study will examine the importance of a space program in the 21st century. It will explore the relation of Pakistan's rudimentary space program in South Asia and its implications to its security and the strategic stability of South Asia. The state of strategic stability in South Asia is fragile owing to the uneven conventional and unconventional military capabilities of the two historic rivals. This study will elaborate on the space capabilities of both Pakistan and India. It will touch upon China's role in the conflict that impacts the geopolitics of South Asia. The nature of relations that China has with India and Pakistan are completely different, and this hold significance in outer space as well.

It may be of interest to note that Pakistan was among those states in Asia that started its space program early. It symbolized the progress that Pakistan was making in the field of technology. Pakistan's space agency, Space and Upper Atmosphere Research Commission, (SUPARCO), first of its kind in South Asia, but it could not keep pace with time. SUPARCO launched its first rocket Rehbar-I in 1962 and after a prolonged gap of twenty-nine years launched its first satellite, Badr-1, in July 1990[1]. Initially, Pakistan led the space race in South Asia, as India launched its space program eight years later. However, from the time of initiating the space research to-date, Pakistan has only been able to launch six satellites altogether. This is an alarming situation because modern systems of communication and surveillance are now completely dependent on space technology. Whereas, the biggest rival India is light years ahead, leading the space race in South Asia. Despite starting late, it has managed to launch a number of satellites for civilian as well as military purposes. The number of satellites that India uses for

[1] "History". 2019. Suparco.Gov.Pk. http://www.suparco.gov.pk/pages/history.asp.

surveillance and military purpose has arisen to sixteen in 2019[2]. This progress provides evidence that India is engaging in the militarization of outer space.

The Government of Pakistan (GoP) over the years has sadly neglected the dimension of Outer Space. The space program of Pakistan needs satellites both for civil and military purpose, if it wants to keep abreast of the modern trends of technology and if it wants its armed forces to be well-equipped to counter the moves of the enemies and rivals in outer space. Pakistan urgently needs to get back in the space race to address its national security concerns. By ignoring its space program Pakistan has actually compromised on its security and reduced strategic stability of the region. At the moment, Pakistan lacks the implementation technology and research that can help the growth of space program. Little research and development has been done towards this end.

Satellites serve as the eyes and ears in outer space, increasing the significance of global entity. They serve the purpose of surveillance, remote sensing, information gathering, communications and collection of real time data to the civil and military users. Pakistan needs to focus on research that may help it attain the practicality of functional satellites to counter the technology being used by Indian Space Research Organization (ISRO), such as Cartostat-2E satellite serves for military applications along with its civilian purposes, which equips the Indian military with most advance technology to keep an eye on Pakistan[3].

1.1. Background

Space race is a growing concern in the international politics today. Since the end of Second World War, curious humanity has been exploring and exploiting outer space. The

[2] Surendra Singh, "Military uses 13 satellites to keep eyes on foes," *Times of India*, Jun 26, 2017. Retrieved from: https://timesofindia.indiatimes.com/india/military-using-13-satellites-to-keep-eye-on-foes/articleshow/59314610.cms, Retrieved on: Mar 11, 2019.
[3] Ibid

European and Asian states have joined this race because they did not want to be left behind. The United Nations (UN) emphasizes the significance of peaceful uses of the outer space. The UN Office of Disarmament Affairs (UNODA) aims for outer space to be used for peaceful activities and discourages its utilization for military purposes. This agenda was adopted months before the launch of the first artificial satellite in outer space[4]. The world powers like Russia and United States have long ignored the efforts of UN to pursue peaceful use of outer space and have placed military space assets capable of monitoring, warning and countering the military attacks from enemies and counter the Anti- Satellites (ASAT)[5]. The world powers have set the precedence for other space faring nascent states that have since developed the satellite systems for military utility. The ASAT weapon developed by China to counter the American space development is one example[6]. The super powers have actually opened up outer space for military activity.

The military capable satellites provide the ground forces services such as communication and information gathering, surveillance of enemy movements - to predict their advances in a war like situation. This includes military and civilian use for vehicle tracking and weather reporting[7]. This must not be confused with space weaponization in which the satellites and celestial bodies possess weapons capabilities like the ASAT satellites[8]. The launch of Sputnik in 1957 by Soviet Union was the beginning of space militarization that prompted US to reply in the same manner[9]. It launched Vanguard in December 1957, which was a failure. However, US successfully

[4] Outer Space – UNODA. (2018). Retrieved from https://www.un.org/disarmament/topics/outerspace/
[5] Mathew Mowthorpe, *The Militarization and Weaponization of Space* (Maryland: Lexington Books,2004), 109
[6] Eric Hagt, "Mutually Assured Vulnerabilities in Space," *China Security* (2006):6
[7] Alvin M. Saperstein, ""Weaponization" vs."Militarization" of Space". *APS Physics & Society Newsletter* (2002).
[8] Michael Krepon & Samuel Black. "*Space Security or Anti-satellite Weapons?"* Henry L. Stimson Center (2009).
[9] Mathew Mowthorpe, *The Militarization and Weaponization of Space* (Maryland: Lexington Books,2004), 14.

launched a satellite, the Explorer, in January 1958[10]. The achievement of this scientific progress encouraged other European and Asian to pursue this development as well.

The European States have pursued space ventures individually as well as collectively. The outer space has been used to strengthen cooperation, which can be explained using the case of European states and their cooperation[11]. European states entered the space age individually. UK, Italy and France were first to initiate their space programs and launched artificial satellites in 1962, 1964, 1965 respectively. The European satellites have also been involved in military operations[12]. However, they have since developed the European Space Agency (ESA) for collective utility of space domain. During NATO operations and Gulf war, it made use of European satellites along with the American satellites for gathering information, communication purposes and were involved in executing these operations as well. They made use of civilian category satellites for assistance in military operations. It is a well-established fact that all spacefaring states have indulged in military utilization of outer space.

South Asia is vulnerable because of historical rivals India and Pakistan, who are also nuclear powers[13]. The region is highly influenced by superpower competition during the Cold War and after that as well. The United States and Soviet Union triggered an arms race in the South Asian region, particularly between Pakistan and India during the Cold War[14].US armed Pakistan to contain the Soviet Union Cold War before and during the Afghan war. It successfully helped Pakistan through arms trade supporting the growth of conventional and unconventional

[10] Frank McDonald & John E. Naugle. Discovering Earth's Radiation Belts: Remembering Explorer 1 and 3. *Eos, Transactions American Geophysical Union*, (2003) *89*(39), 361-363. doi: 10.1029/2008eo390001
[11] Bonnet, R., & Manno, V. (1994). *International Cooperation in Space: The example of the European Space Agency* (6th ed., pp. 62, 63). Harvard University Press.
[12] Mathew Mowthorpe, *The Militarization and Weaponization of Space* (Maryland: Lexington Books,2004), 202-203
[13] . Scott D. Sagan, "The Evolution of Pakistani and Indian and Indian Nuclear Doctrine," in *Inside Nuclear South Asia*, ed. Scott D. Sagan. (California: Stanford University Press, 2009).
[14] Paul, T. V. "Influence through arms transfers: Lessons from the US-Pakistani relationship." *Asian Survey* 32, no. 12 (1992): 1078-1092.

weapons. On the other hand India was eager to have cooperative military relations with United States; however, it was denied any such opportunity. India sought the intended relations with USSR during the Cold War era[15]. By the end of Afghan war in 1979, Russian influence in India and South Asia had outgrown American influence. It was due to the military cooperation of India and Russia that the former was able to develop its nuclear program. It is quite evident that the two world powers, US and USSR, have exploited India-Pakistan rivalry. They have sold them arms and enhanced their conventional and unconventional military capabilities. Pakistan and India are nuclear capable yet there exists an imbalance in their faculties. Pakistan is in a vulnerable position for many reasons and one of them is because it lags behind in utilizing its abilities for advancement of the space program. Pakistan is willing to change its current position and make a mark in the space race by exploring the options available to it. One viable option that it seeks is collaborative measures with China.

China has made technical progress in a very short span of time. It launched its first artificial satellite in 1970. China now has one of the most progressive space programs, which advocates the peaceful uses of space. In 2016 and 2017, at UN General Assembly meetings while discussing the issue of outer space, China maintained the stance of peaceful use and promotion of outer space[16]. Despite the efforts of promoting the peaceful use of outer space, the U.S. perceive China's space program of having military potential because of the reason that the Chinese People's Liberation Army (PLA) initiated the space program[17]. China has had its impact on South Asia, particularly India and Pakistan, in various dimensions, one of which is the

[15] Jerome M. Clooney, "Indo-Russian military and nuclear cooperation: implications for U.S. security interests," *INSS Occasional Paper 3* (USAF Institute for National Security Studies, 2000), 6.
[16] Statement by Ms. Pan Kun of the Chinese Delegation at the 71st Session of the UN General Assembly on Agenda Item 48: International Cooperation in the Peaceful Uses of Outer Space. (2018). Retrieved from: http://www.china-un.org/eng/hyyfy/t1405942.htm
[17] Wu, X. (2015). China and space security: How to bridge the gap between its stated and perceived intentions. *Space Policy*, *33*, 20-28

military and security dynamics. The relations that China holds with Pakistan is cooperative while that with India is based on competition. Pakistan and china have recently collaborated in this domain with the launch of Pakistan Remote Sensing Satellite-1 (PRSS-1) and Pakistan Technology Evaluation Satellite- 1A (PakTES- 1A) [18]. It is clear evidence of Pakistan and China's space cooperation in the security dimension, which will prove fruitful to counter Indian capabilities in space.

Indian government and research institutions are engaged in enhancing their civil-military collaborations on the space front. On 27 March 2019, India conducted ASAT test launch that bear witness to the collaboration of DRDO with ISRO to increase the military capabilities of Indian space program[19]. The reason for the much-hyped military use of space assets is said to the ASAT development. China tested its ASAT system in 2007and since then India is also engaged in military utilization of its celestial bodies. It emerged as the fourth space power to test and ASAT. This act poses a threat to Pakistan and endangers the fragile strategic stability of South Asia.

The fragile strategic stability has rendered South Asia susceptive to security threats. The presence of two nuclear powers in the region has made peace a forlorn phenomenon. Pakistan and India have been involved in building their stockpiles ever since the independence[20]. The two seem to have reached political and diplomatic standoff, but continue to engage in conventional and unconventional arms race[21]. Both the countries maintain asymmetric stockpile, which

[18] Naveed Siddiqui, "Pakistan launches remote sensing satellite in China," *Dawn*, July,9 2018, Retrieved from: www.dawn.com/news/1418966
[19] Mannu Pabby, "India tests first anti-ssatellite missile system codename Mission Shakti", *The Economic Times*, March 28, 2019, Retrieved from: https://economictimes.indiatimes.com/news/politics-and-nation/pm-modis-big-announcement-india-successfully-tests-anti-satellite-weapon/articleshow/68592702.cms
[20] Carranza, Mario E., *South Asian Security and International Nuclear Order creating a robust Indo-Pakistani nuclear arms control regime* (Farnham: Ashgate Publishing Ltd., 2009), 63-65.
[21] Sokolski, D. Henry, *The next arms race* (Createspace Independent Publisher, 2015), 70-71.

threatens the fragile strategic stability of the region[22]. This was observed in the recent events that unfolded after the attack on the convoy of military forces in Pulwama, Indian Occupied Kashmir (IOK). In the aftermath of the attack, there have been military escalations on both sides of border initiated by the Indian Air Force, as they released payload at Balakot, an area in the Khyber Pakhtun Kha (KPK) province[23]. The world states perceived a possible nuclear war in the region as both countries refused to step down from their defensive-offensive positions[24]. The situation worsened as India threatened Pakistan to attack with six missiles. Pakistan has always maintained a defensive position and at this time of high threat, it was ready to reply with three times in response to one missile of India fired at Pakistan[25].

A wide range of literature covers the fragility of Strategic stability in South Asia owing to the presence of nuclear states. However, a little of that covers the aspect of space race in South Asia and military utilization of space assets by India and its impacts on the security of Pakistan and stability of this region. This study will explore the dynamics of space militarization in South Asia and its impact, which will provide avenues for countering the military space capabilities of potential enemy and strengthen the regional stability. It will in turn help in improvement of security aspects of the country.

[22] Lavoy, R. Peter, *Asymmetric Warfare in South Asia: The Causes and Consequences of the Kargil Conflict* (Cambridge: Cambridge University Press, 2009), 163-167.

[23] "Indian aircraft violates LOC, scramble back after PAF's timely response: ISPR", *Dawn News*, Accessed April 4,2019, https://www.dawn.com/news/1466038

[24] "Aircraft carrier & nuclear submarines deployed post Pulwama", Economic Times, accessed April 4, 2019, //economictimes.indiatimes.com/articleshow/68452772.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst

[25] "After Balakot, Pakistan Threatened to Respond to India's Six Missiles 'Three Times Over': Report", News 18, accessed April 4, 2019, https://www.news18.com/news/world/pakistan-threatened-to-respond-to-indias-six-missiles-three-times-over-report-2071289.html

1.2. Research questions

1. How does space race in South Asia threaten security of Pakistan?
2. Is the collaboration with China on space program feasible for Pakistan in the longer run?
3. How do asymmetric space capabilities of India and Pakistan impact strategic stability of South Asia?

1.3. Methodology

This paper will explain the process militarization in South Asia, particularly, the developments of India and China and its impact on the regional stability. It will find out the threats that are posed towards Pakistan's security due to these developments. This approach will create a better understanding of security situations resulting due to military utilization of space assets. As this study is conducted based on ideas and concepts of theories, it will have a deductive approach towards the research. This paper will make use of both qualitative and quantitative research methods.

For the qualitative research method, the research tool used in this study is interviews. These interviews are directed towards the professional associated with various academic and non-academic institutions. This population will include

a) The academic scholars and professors from the universities who are associated with the research and development in field of space sciences and defence and strategic studies

b) The professionals- scientists and engineers associated with the government institutions – specifically from SUPARCO

c) The military personnel that are associated with the aerospace technology

It is important to interview above-mentioned population to comprehend the technology lag and its impact on the security of Pakistan and the strategic stability of south Asia. It will also enable the researcher to collect diverse and extensive information on the prospects of indigenous activity and cooperation for development and progress of space program. The proposed sample size is 10. This study will make use of heterogeneous purposive sampling. Heterogeneous sampling will allow the researcher to select a diverse range of interviewees, which will be helpful in obtaining a rich and diversified view on the strategic importance of space technology for Pakistan and South Asia. There are a small number of academic Research and Development departments working on space sciences and strategic security in Pakistan. Hence, the purposive sampling best suits this research study.

The sample will be collected from institutions and universities across Pakistan. The interview will consist of 15-20 questions. The researcher focuses on the departments of Space Sciences and departments of security and strategic studies located in universities in Islamabad, Lahore and Karachi. The interviews will also be conducted form the renowned scientists and engineers working at SUPARCO. The research inculcates military personnel from Pakistan Air Force and Strategic Planning Division (SPD) working on the Space technology in association with SUPARCO. To get better responses from the interviewees, the questions will be unstructured to as to get better responses of the interviewees. The interviews will be conducted after contacting the interviewees through emails. The validity of responses will be ensured by recording them.

Some of the data will be collected through quantitative method so that it supports the qualitative data. This quantitative data will include the information regarding the space assets of

India and China. It will be gathered from the new articles, government gazettes and websites for authentic and reliable characteristics functions of these assets.

1.4. Theoretical Framework

The research is based on the overview of the concepts that analyze the security threats and technology lapse under *game theory*. It will analyze the security cooperation and finally the military dimensions of state relation in the light of security trilemma. The Economist John Von Neumannn and Oskar Morgenstern initially proposed game theory. They are the pioneers of the game theory, which first appeared in the book *Theory of Game and Economic Behaviour*[26]. Game theory particularly refers to logic and strategic thinking, as the name suggests[27]. However, in the field of international politics and international relations, Thomas Schelling introduced game theory[28]. This research will be based upon the concepts of threat-driven analysis and technology-driven assessment that found its roots in combinational game theory.

The security cooperation and military dimension of the state relation between Pakistan, China and India will be explained through the concept of *security trilemma* in this research[29]. The concept of security trilemma is derived from the main idea of security dilemma.[30]. The security matrix that exists between these states is a triangular interaction[31]. This research will elaborate on the space faring of these states and explore the nature of their relations, which is

[26] Harold W. Kuhn and Albert W. Tucker," John Von Neumann's Work in the theory of Games and Mathematical economics", *American Mathematical Society Bulletin* 64 (1958): 1-3.
[27] Jennifer Serling-Folker, " Game Theory," in Making Sense of International Relations Theory, ed. Jennifer Sterling-Folker, 2nd ed. (Colorado: Lynne Reinner Pblisher, Inc., 2015), 110-111.
[28] Andre du Pisani, "A critical evaluation of conflict resolution techniques from problem solving workshops to theory" (PhD Diss., University of Cape Town, 1988). 52, 63-66.
[29] Robert Einhorn and W.P.S. Sidhu, "The Strategic Chain: :Linking Pakistan, India, China and United States," *The Bookings Arms Control and Non-Proliferation Series,* no.14 (2017): 1-59
[30] Ahmed khan and Zulfiqar Khan, "Space security trilemma in South Asia," *Astrophysics* (Routledge: 2019), 2-3.
[31]Ibid.

affecting the strategic stability of the region. This research will focus on the triangular matrix of relations among these states along the themes of Pakistan- India and Pakistan China.

1.5. Structure

The research thesis is structured into three chapters excluding introduction and conclusion. The first chapter of this research thesis is an introductory chapter that briefly describes the background of the militarization of outer space, militarization of space in South Asia and its influence on the strategic stability of South Asia as India indulges in space race. It highlights the Indian ambitions of becoming a space power and the threats it poses towards the security of Pakistan. This chapter briefly describes the theoretical framework, which forms a basis for this research, the methodology and research questions, which this study attempts to find answers.

The second chapter provides an overview on the militarization of outer space that is transforming it into a battlefield. The chapter is divided into two sections. First section reviews the dimensions of militarization as a national security aspect and its role in modern warfare associated with outer space. The second section discusses the security risks with the theoretical framework provided by zero-sum game and security trilemma. it analyzes the regional instability of South Asia amidst arms race in space.

The third chapter explores features of space programs of Pakistan and India. This program is divided into three sections. First section explores Pakistan's space program historically in the light of its slow-paced R&D. The second section analyzes the space vision of this program. The third section will be exploring Indian space program. This section specifically discusses the military ambitions of the Indian space program.

Lastly, the fourth chapter discusses the regional and national security based on the analysis of India's military approach towards the space technology. This chapter is divided into two main sections. The first section of this chapter will focus on the internal and external threats to Pakistan that emerge due to space militarization in South Asia. The second section will focus on the regional security of South Asia and threats destabilizing the region.

Finally, the last chapter will provide the conclusion to thesis. The chapter is divided into three sections. First section will present recommendations based on the data collected through interviews. Second section will discuss the limitations of the thesis and the third section will focus on the avenues for future work based on this research.

Chapter 2: Threat Assessment of Arms Race in Space

2.1. Introduction

Space is the new frontier, which the states are exploring and exploiting for military purposes. World powers have not exhausted their attempts to dominate land, water and air on the planet earth. The exploitation of all three domains on earth has led to catastrophic consequences that world faced in the form of World War I and World War II. Since then national security has been a major concern for states and they have equipped themselves in all possible ways to strategize a strong national security policy that mainly focused on military security. The nation states have exploited all physical domains in this aspect, including cyberspace and outer space, which is now becoming the new ground for competition. It has the potential to evolve into a military battlefield in future.

Space has always captured and inspired human imagination. In the early days of the Cold War, the powerful states initiated a race, where they strived to put sophisticated and more advance satellites in space[32]. The beginning of space race between the Cold War powers prompted scholars, analysts and intellectuals to analyze the growing security concerns due to militarization of outer space threatening the peace of this domain. However, the states have been engaging in the military utility of satellites, which further led to the development of anti- satellite systems (ASATs). Such activities motivated other states to take the similar path of space militarization.

[32] Leonard Schwartz,. 1963. "When Is International Space Cooperation International". Bulletin Of Atomic Scientists, 19(6), 12-15.

This chapter seeks to determine the components that threaten the global security due to excessive militarization of outer space. It opens with introduction of a new frontier, outer space and pragmatic security concerns that 21st century warfare holds. The first section discusses the concept of militarization in multiple dimensions describing the significance of militarization in national security, in outer space and as knowledge and information engaged into warfare. Firstly, the aim is to develop an understanding of militarization as a core component of national security component in current scenario of space race. Secondly, the understanding of risks that process of militarization in outer space pose with the advance modern warfare. It seeks to determine that although, militarization is essential for national security of a modern state, using outer space assets and information system for the military purpose pose threats to an inevitable arms race.

It is important to understand that South Asia's fragile strategic stability is codependent on growing asymmetric nature of warfare and growing imbalance of conventional forces, offence-defense military relation between two volatile nuclear states of India and Pakistan. India's space ambitions have turned towards militarization, which poses a security threat not only towards Pakistan, because of a vulnerable space program, but the stability of the region as well. The conceptual parameters of militarization strengthen the basis of thesis. The second section of the chapter explores the theoretical parameters of game theory, focusing on the zero-sum game as linked with security trilemma. The dynamics of the south Asian military security revolve around three states of Pakistan, China and India, where one states actions reflect upon other state causing a ripple effect. Security trilemma provides a better understanding of this phenomenon. Furthermore, game theory is employed to theoretically explore the options that the states of Pakistan and India have under the given circumstances. Thus, this chapter provides theoretical

framework for analyzing two situations, first the threat caused by India's space militarization and second the course of Pakistan-China coalition to counter Indian ambitions.

2.2. Security and the new Frontier in 21st century

In 21st century, the modern equipment and advance technology employed by the world powers to maintain hegemony around the world pose threat to global security. The display of their military prowess now covers outer space as well. Outer space has been established as the new frontier in modern times. The region that was once considered a novelty and luxury is now the need of hour. However, the exploration of outer space has yielded global security concerns due to excessive militarization. The term militarization of outer space refers to the capability of states to put satellites in to the outer space for assistance in communication and intelligence, reconnaissance and weather reporting[33]. Militarization of outer space is often confused with the term weaponization, which can be described as the deployment of weapons based offensive command and control systems in outer space or on ground[34]. Weaponization of outer space is linked to placement of ASATs[35]. The militarization of outer space is leading to the preparation of Space force and simulation exercises for space warfare, which threatens the global security. US president Donald Trump is creating a space force while the Indian tri-services Defense Space Agency is organizing the space warfare simulation exercises[36]. These ambitions of the space powers threaten to increase the arms race in outer space.

[33] A. M. Saperstein. "Weaponization" vs."Militarization" of Space. *APS Physics & Society Newsletter*
[34] 15 Duke L. & Tech. Rev. 362 (2002)
[35]Krepon, M., & Black, S. (2009). Space Security or Anti-satellite Weapons?. *Henry L. Stimson Center*
[36] Manoj Sharma,"India holds first ever simulated space warfare exercise in July to counter China's influence: report," *Business Today*, June 8, 2019, https://www.businesstoday.in/current/policy/india-to-hold-first-ever-simulated-space-warfare-exercise-in-july-to-counter-china-influence/story/354412.html, accessed June 15 2019; Helene Cooper, "Trump signs order to begin creation of space force," *The New York Times*, February 19, 2019, https://www.nytimes.com/2019/02/19/us/politics/trump-space-force.html

The offensive capabilities acquired by a few states challenge the global status-quo of space faring nations compelling them to enhance their national security capabilities. The world is operating in anarchy and chaos with the security threat elevating every day. Cold war gave rise to nuclear age and space race, both of which have raised the vulnerability of global security[37]. Since the end of Cold War, nations have emphasized on the importance of national security policy, which developed as a result incidents occurring after the World War II[38]. In the post-Cold war era, national security was described variously by political thinkers such as Hans Morgenthau describes national security interest as an act of a nation where it thrives to increase its power in the international political arena[39]. Walter Lippmann was of the view that national security means that a nation must be capable of securing its assets at all costs[40]. Morton Kaplan is of the view that national security as a system that is bound to secure the interests and values of a national subsystem[41]. The contemporary definition of national security can be concluded from the views presented by the aforementioned scholars that national security interest is the capability of a nation to secure its internal assets from the external threats[42]. Space faring has become a matter of national security interest in the 21st century[43]. Militarization of outer space also began in the Cold war era but has become a global security threat in the 21st century.

[37] Fraser Macdonald. Space and the Atom: On the Popular Geopolitics of Cold War Rocketry. Geopolitics (2008) 13:4, 611-634.
[38] Barry Buzan, "Rethinking Security after Cold War," Cooperation and Conflict 32(1997): 5, DOI: 10.1177/0010836797032001001, accessed June 15 2019.
[39] Bock, P. G., and Morton Berkowitz. "The emerging field of national security." World Politics 19, no. 1 (1966): 122-136; Speer, James P. "Hans Morgenthau and the world state." World Politics 20, no. 2 (1968): 207-227.
[40] Bock, P. G., and Morton Berkowitz. "The emerging field of national security." World Politics 19, no. 1 (1966):132-133.
[41] Ibid, 134.
[42] Ibid ; Melvyn P. Leffler, "National security." The Journal of American History 77, no. 1 (1990): 143-152.
[43] Defense of Japan, 2014 Annual White Paper, https://www.mod.go.jp/e/publ/w_paper/2014.html, accessed June 8 2019.

2.3. Militarization as an essential element of National Security

The term militarization commonly refers to as the increased role of military in the domestic and international activities[44]. Scholars in various ways have explained this notion. Miles Wolpin describes militarization as a process, which feeds on the state resources for military forces and their activities[45]. According to Francis Beer, militarization is linked to the legitimizing war, military alliances and trade with the allies. He is of the opinion that military dominance in international and domestic affairs seeks legal justification[46]. Augusto Varas defines the term militarization as an accentuation of the military affairs and increased military power as a response to the national security[47]. Barton Bernstein sees militarization as phenomenon that has the potential of disintegrating a society by division of social setting into hierarchical order, which entails class, gender and race[48]. The Stockholm International Peace Research Institute (SIPRI) has also defined militarization in broader terms, stating that it highlights the potential of military growth of a state.[49] This growth is evident in domestic and international affairs include the political, social and economic spheres. In a broader view, incorporating the essential components of militarization are the political, social and economic dimensions that make up the core values

[44] Andrew L. Ross "Dimensions of militarization in the third world." Armed Forces & Society 13, no. 4 (1987): 561-578; Marek Thee, "Militarism and militarization in contemporary international relations." Bulletin of Peace Proposals 8, no. 4 (1977): 296-309.
[45] Andrew L. Ross "Dimensions of militarization in the third world." Armed Forces & Society 13, no. 4 (1987): 561-578.;Miles D. Wolpin, "Comparative perspectives on militarization, repression and social welfare." Journal of Peace Research 20, no. 2 (1983): 129-155.
[46] Andrew L. Ross "Dimensions of militarization in the third world." Armed Forces & Society 13, no. 4 (1987): 561-578.; Francis A. Beer, "Militarization. Peace Against War." (1981).
[47] Andrew L. Ross "Dimensions of militarization in the third world." Armed Forces & Society 13, no. 4 (1987): 561-578.;
[48] Andrew L. Ross "Dimensions of militarization in the third world." Armed Forces & Society 13, no. 4 (1987): 561-578.; Catherine Lutz. "Making war at home in the United States: Militarization and the current crisis." American Anthropologist104, no. 3 (2002): 723-735.; Barton J. Bernstein, 1999 Reconsidering "Invasion Most Costly": Popular-History Scholarship, Publishing Standards, and the Claim of High U.S.Casualty Estimates to Help Legitimize the Atomic Bombings. Peace and Change 24(2):220-248.
[49] Stockholm International Peace Research Institute (SIPRI), "Militarization and Arms Control in Latin America," World Armament and Disarmament SIPRI Yearbook 1982 (London: Taylor and Francis, 1982), 393.

of domestic affairs of a state. These core values are defined as the basis of national security policy of a state.

Parameters of militarization in modern times have been expanded. The militarization paradigm now also includes knowledge and information, and science and technology. The modern warfare is more sophisticated with its lethality and power to cover long range[50]. This hi-tech sophisticated military weaponry relies heavily on three main characteristics: the ability of the weapons to cover long-range targets, the firepower and lastly, the information gathering and communication systems[51]. Modern warfare has made complete use of science and technology as evident form its revolution over the years. The modern information technology, which is contemporarily known as C^4ISR (command, control, communication, computers, intelligence, surveillance and reconnaissance) is the basis of modern warfare revolution[52]. C^4ISR is considered the future of military technology[53]. In its operating environment, C^4ISR is capable of providing with battlefield awareness, assistance in decision-making, analyzing the situation and consists of attacking capabilities[54]. The employment of modern technology in the warfare has militarized the knowledge base as known to mankind. The emerging modern frontiers such as cyber space and outer space have provided states with more space to militarize, as they become the modern battlefields[55]. C^4ISR capabilities have been employed in the rocket systems and later missile systems. However, in the recent times, space-based communication and reconnaissance is also dependent upon the C4ISR by the space powers. The knowledge-based militarization has seeped into the peaceful new frontier of outer space leading to its militarization.

[50] Stephen D. Biddle, *Military power : Explaining Victory and Defeat in Modern Battle* (New Jersey: Princeton University Press, 2004), 60-62
[51] Ibid. 63
[52] Ibid 65-68
[53] Richard e. Hayes, "C4ISR Framework of the Future." *Phalanx Online* 34, no. 1 (2001).
[54] Ibid 2-4.
[55] Ibid 3 ;

2.3.1. Security Risks due to militarization of outer space

The military utility of the outer space began in the early 1980's. The US president Ronald Reagan announced a defense program, on 23 March 1983, during the Cold War that would protect the country from a potential nuclear threat[56]. This program was known as the Strategic Defence Initiative (SDI). SDI was announced to counter the nuclear threat that emerged from the successful test of Inter-Continental Ballistic Missiles (ICBMs) conducted by Soviet Union[57]. Ronald Regan, the then president of United States perceived the idea of space-based ballistic missiles. Hence, he initiated the development of advance technology inceptors under SDI, which projected the development of a defense system. It was perceived that this defence system would consist of laser battle stations based in space and on earth[58]. There were three phases of the SDI. Phase-I would have allowed the United States to deter a nuclear attack from the Soviet Union and the follow up strikes that might have been hurled towards it[59]. This phase of SDI would enable the US to counter limited attacks and any accidental launch[60]. The Second phase of the SDI was the follow up phase in which the development of energy system and discriminatory sensors was included. The discriminatory sensors would be able to discriminate between friendly and hostile assets. The final phase of the initiative would focus on the development of directed energy weapons and the technologies that would be capable to support these systems[61]. The initial phase is said to have been focused on the development and deployment of space-based weapons. In September 1987, the Defense Acquisition Board (DAB) reviewed the elements from

[56] "Strategic Defense Initiative,1983," US Department of State, , https://2001-2009.state.gov/r/pa/ho/time/rd/104253.htm (accessed June 21, 2019).
[57] Ibid
[58] Adam Augustyn et al. *Encyclopedia Britannica,* s.v. "Strategic Defence Initiative." Chicago: Encyclopedia Britannica, 2009. https://www.britannica.com/topic/Strategic-Defense-Initiative. Accessed on June 21 2019
[59] Ibid
[60] Ibid
[61] Mathew Mowthorpe, *The Militarization and Weaponization of Space* (Maryland: Lexington Books,2004), 14

the phase-I of SDI[62]. The Board made recommendations regarding the concepts and technologies including the space-faring weapons, such as space-based tracking and surveillance systems and space-based interceptors[63]. However, the US called-off the SDI project after Soviet Union disintegrated ending the Cold War.

2.3.1.1. ASAT capabilities

There has been continuous militarization and weaponization of the outer space with multiple weapons such as killer satellites and the ASAT. An ASAT missile is capable of destroying of jamming the enemy satellite in outer space[64]. Till recently, only three countries were capable of attacking their adversary through the satellites and these included United States, Russia and the People's Republic of China. Now India also joined the ASAT club. It tested an ASAT on 27 March 2019[65]. This was not India's first ASAT test. On 10 February 2019, there was a failed ASAT test. During the ASAT capability demonstration, the said country usually destroys its own satellite. This phenomenon can be understood through Mission Shakti launched by India[66]. India launched an inceptor missile, which was a three-stage missile with two solid fuel rocket boosters, which targeted a Microsat-R military communication satellite that it launched in January 2019[67]. This test was conducted in the Low Earth Orbit (LEO) where the International Space Station is also located. The United States space agency, NASA has shown

[62] "Strategic Defense Initiative | Description, History, & Facts". 2019. *Encyclopedia Britannica*. https://www.britannica.com/topic/Strategic-Defense-Initiative.
[63] Ibid, p 18
[64] "What Is ASAT And How Can It Be Used In War?- Business News". 2019. *Businesstoday.In*. https://www.businesstoday.in/current/economy-politics/what-is-an-asat-pm-narendra-modi-space-missile/story/331585.html.
[65] Howell, Elizabeth. 2019. "India Follows Anti-Satellite Missile Test With 29-Satellite Launch". *Space.Com*. https://www.space.com/india-launches-29-satellites-after-asat-test.html.
[66] Express Web desk, "What is Mission Shakti-ASAT," *The Indian Express*, March 27,2019, accessed June 22,2019, https://indianexpress.com/article/what-is/mission-shakti-asat-missile-5645166/
[67] Abhishek Bhalla, "Decoded: Why Mission Shakti holds Significance for India," *India Today*, March 28,2019, accessed April 11,2019, https://www.indiatoday.in/mail-today/story/decoded-why-mission-shakti-holds-significance-for-india-1488233-2019-03-28

concern over the debris created as a result of this ASAT test as they are a threat to the ISS[68]. However, India remains ignorant of the international laws on outer space and the security of astronauts in the ISS as it celebrates its new position as a Space-super power.

S. No	Country	Test Date	Missile/ Interceptor	Launch site/vehicle	Target Satellite	Mission/ Program
1.	United States	19 Oct 1959	Bold Orion	B-47 Aircraft	Explorer -VI	Program 505
2.	Soviet Union	1 Nov 1963	Galosh ABM Interceptor	Polyot Rocket	Kosmos Satellite	Istrebital Sputnikov
3.	People's Republic of China	11 Jan 2007	SC-19 (Missile named by US)	Xichang Satellite Launch Center	FY-1C polar satellite	Funded by 863 program
4.	India	27 March 2019	Ballistic Missile Defence Interceptor	APJ Abdul Kalam's island launch center	Microsat-R Satellite	Mission Shakti

Table 1: ASAT tests conducted by space powers

United States and Russia have developed highly sophisticated technology for strengthening the offensive and defensive measures in outer space. Contemporarily both of them are attempting to increase their military capabilities in the outer space. The President of United States Mr. Donald Trump on 19 February 2019 signed on the directive order for the pentagon, which stated that it must establish a separate military force for the outer space[69]. The Space Policy Directive 4 (SPD) states that the United States will now confer a sixth military establish exclusively for fighting in the outer space[70]. On the other hand, Russia is regularly testing the limits of its ASAT capabilities. It recently developed the Nudol system, which is an ASAT

[68] BBC, "Mission Shakti: Space debris warning after India destroys satellite," *BBC*, March 28,2019, accessed April 11,2019, https://www.bbc.com/news/world-asia-india-47729568
[69] Mike Wall, "Trump Signs Directive to Create Military Space Force," *Space.com*, February 21, 2019, accessed June 21, 2019, https://www.space.com/president-trump-space-force-directive.html
[70] Ibid

weapon system[71]. On March 2019, Russia tested PL-19, which the US military intelligence claims to have been tested seven times since 2018[72]. The PL-19 missile is capable of targeting the communication and imagery satellites in the Low Earth Orbit[73]. Although, ASATs have not yet been employed in any conflict or war; however, they can have disastrous impact. The implication of ASAT use in a war can be more dangerous than a nuclear attack since a large portion of world communication is space-based in the 21st century. The world powers are not willing to prevent the arms race in outer space; rather they are pursuing the military utilization of it. This trend is slowly propagating to other parts of the world, where developing states are also testing the similar military capabilities.

India has joined the race to militarize outer space. In doing so it not only poses a challenge to the security of Pakistan but it is also becoming a threat to the strategic stability of the region. Currently, India has 13 satellites in orbit. These are under direct use of its armed forces and meant to keep its enemy under constant observation[74]. The enemy includes inter alia Pakistan and China. While Chinese space program is very advanced, Pakistan has lagged behind. Although the Space and Upper Atmosphere Research Commission (SUPARCO) of Pakistan; was established in early 1960's, it has not kept pace with times[75]. In almost six decades since its establishment, the space agency has not been able to live up to its initial promise. It has not caught up with the technological advancements around the globe and has fallen behind its regional competitors. It has managed to launch few indigenous satellites, which mostly cater to

[71] Ankit Panda, "Russia Conducts New Test of 'Nudol' Anti-Satellite System," The Diplomat, April 2, 2019, accessed June 21 2019, https://thediplomat.com/2018/04/russia-conducts-new-test-of-nudol-anti-satellite-system/
[72] Amanda Macias and Michael Sheetz, "Russia Conducted another successful test of an anti-satellite missile, according to a classified US report ," CNBC, January 18, 2019, accessed June 21, 2019, https://www.cnbc.com/2019/01/18/russia-succeeds-in-mobile-anti-satellite-missile-test-us-intelligence-report.html
[73] Ibid
[74] Surendra Singh, "Military uses 13 satellites to keep eyes on foes," Times of India, Jun 26, 2017. Retrieved from: https://timesofindia.indiatimes.com/india/military-using-13-satellites-to-keep-eye-on-foes/articleshow/59314610.cms, Retrieved on: Mar 11, 2019.
[75] "History". 2019. Suparco.Gov.Pk. http://www.suparco.gov.pk/pages/history.asp

the requirement of communication and weather reporting but has got to cover a lot of ground. There is revival of sorts in Pakistan's space activities. SUPARCO recently launched the PRSS-1, a satellite with remote sensing capabilities that has been endorsed by the military for its aid and support[76]. Pakistan is currently dependent on commercial satellites on foreign countries, mainly China for various activities including communications, environment and agriculture.

To summarize the militarization process of outer space in South Asia, there is active competition between China and India. Pakistan is a poor third in this triangle. Pakistan had a head start in space program, however, over the time; because of official neglect this program has lost steam. Hopefully the late surge in launching of satellites will give it the boost and impetus it needs. The relation between these states needs to be understood within the structure of a theoretical framework, which will be discussed in the next section.

2.4. Assessing the Security Threat under theoretical framework

Theoretical framework provides a structure for the research, where the presence of a theory and concepts support the research study. It is an integral part of the research. In this study, the situation presented can be best studied within the boundaries of Game theory, focusing on zero-sum game. The Game theory is a mind game of John von Neumann and Oscar Morgenstern[77]. In 1944, Neumann and Morgenstern presented the idea in their book "Theory of Games and Economic Behaviour" in 1944[78]. The main idea behind the theory was to present an understanding of typical problems via strategically played games[79]. Although, game theory was

[76] Sputnik, "Pakistan pours millions into Civilian-Military satellites, Space Program," *SputnikNews*, May 5,2018 , https://sputniknews.com/science/201805051064163828-pakistan-millions-space-satellite-program/ , accessed June 23, 2019.
[77] John V. Neumann and Oscar Morgenstern, *Theory of Games and Economic Behaviour* (New Jersey: Princeton University Press, 1944), 1-2.
[78] Ibid 42
[79] Ibid 43

initially proposed to understand the economics and statistical data, however, many political scientists have employed it to understand the cooperation and competition between states in international arena. These scientists includes Thomas Schelling, who introduced the game theory into international politics in his book "The strategy of conflict", William H. Ricker, tried to explain the zero-sum game in his book "The Political Theory of Coalitions" and Martin Shubik who, being an economist keenly indulged in explaining social behaviours using the game theory. Others include Karl W. Deutsch and Arnold Rapport. Rapoport used game models of 'Chicken out' and 'Prisoner's Dilemma' to explain the international cooperation[80]. In this study research presents two players – Pakistan and India- has been considered. Both are investing heavily into their military capabilities for different reasons, Pakistan for its survival and India for power projection. The application of game theory in this context will try to explain the behavior of the two antagonist states.

This study focuses on the zero-sum game theory. Neumann and Morgenstern defined zero-sum game theory as a game where the one of all outcomes is zero, in the case one player behaves rationally. They argue that of the two players, one player wins at the cost of other players' loss. William Riker advocates the zero-sum game in his book "The Political Theory of Coalitions"[81]. He argues that the states at the stake are prone to forming coalitions and cooperative relations that will help them survive in conflicting situations and later win the conflict[82]. However, he differs in his opinion of theoretic and practical utility of the zero-sum game. Riker is of the opinion that in actual, the states are unaware of the loyalties that other

[80] Simpson, Erika, "The Contributions of Anatol Rapoport to Game Theory" (2016). Political Science Publications. 135
[81] Kellie Maske and Garey Durden. "The contributions and impact of Professor William H. Riker." *Public Choice* 117, no. 1-2 (2003): 191-220.
[82] Ibid 192

coalition states hold in the international community[83]. Lucía Martínez furthers this argument by stating that the choice of coalition formation is intuitive. He argues that the state has to assume the information of its adversary's next move in order to influence it[84]. The state when anticipates this information is supposed to come out up with an outcome that is better than the supposed outcome than the outcome that might be perceived without this information. Gregory Koblentz in his study "Second nuclear age" suggests that in order of states to upgrade their military technology and warfare, they ought to conduct assessments based on worst-case scenario possibilities[85]. This process of anticipating the future ambitions of adversary, as presented in this study, can be best described with 'zero-sum'. He further suggests that zero-sum compliments the concept of security trilemma that describes the South Asian military relation aptly.

The regional complexity of South Asia exists due to multiple factors, among which the nuclear capabilities of Pakistan and India is prominent. In this region three states- China, Pakistan and India- exists co-dependently. This process of militarization is reliant on each other. Indian militarization is due to fast track militarization process adopted by China. However, Indian ambitions are divided into two parts- international and regional. On international level it competes with China and on regional level the target of Indian military ambitions is always Pakistan. It in turns causes Pakistan to take defensive stance, hence creating a "chain reaction" as highlighted by Robert Einhorn and W.P.S. Sidhu[86]. They claim that this chain reaction is an extension of the "security dilemma" which in this case can be termed as "security trilemma". Linton Brook and Mira Rapp-Hooper defined security trilemma as a condition where if one state

[83] Ibid 195
[84] Lucía.Martínez Ordóñez, 2017. "Military Operational Planning and Strategic Moves." Contributions to Economics, no. 2003: 25–36. https://doi.org/10.1007/978-3-319-56108-0.
[85] Ibid 26
[86] Zulfqar, Khan and Ahmad Khan. "Space Security Trilemma in South Asia." *Astropolitics* 17, no. 1 (2019): 4-22.; Robert Einhorn and W. P. S. Sidhu (eds.), "The Strategic Chain: Linking Pakistan, India, China and the United States," The Bookings Arms Control and Non-Proliferation Series, no. 14 (March 2017): 1–59.

take an action against another state to secure itself, the third state feels insure by the actions of first state and acts to abruptly strengthen its defenses[87]. Gregory Koblentz has also endorsed the notion of security trilemma in his report second nuclear age, yet he has included non-nuclear technology as a trigger of this phenomenon[88]. Various scholars and intellectuals attempting to explain the South Asian complex nature of military interaction justifies the notion of security threat existing in the region, which has now reached to outer space.

The South Asian trio- China, Pakistan and India are interdependent on the domain of regional and individual security. Two of them- China and India- have acquired ASAT capabilities in the recent times and claim to be the space powers, jeopardizing the strategic stability of the region. The technology-based threat to the regional peace can be understood in terms of "security trilemma". Linton Brook and Mira Rapp-Hooper, while explaining nuclear power and strategic stability being the common factor among the three states initially introduced the term *Security Trilemma*[89]. They are of the view that existence of a relation based on offensive-defensive uncertainty creates a triangle[90]. South Asia has been termed as a sensitive region due to existence of archrivals with nuclear capabilities. These states have always put the regional security at risk in past and the advancement of technology is diluting the strategic stability. Brook and Hooper argued that security trilemma exists in the South Asia due to the continuous interaction of China, Pakistan and India in a specific nuclear manner however, Gregory Koblentz presents that non-nuclear technologies in the 21st century have emerged as a

[87] Gregory D. Koblentz, *Strategic stability in the second nuclear age*. No. 71. Council on Foreign Relations, 2014.; Linton Brooks and Mira Rapp-Hooper. "Extended deterrence, assurance, and reassurance in the Pacific during the second nuclear age." *Strategic Asia 2013–14: Asia in the Second Nuclear Age* (2013): 292-293.
[88] Gregory D. Koblentz, *Strategic stability in the second nuclear age*. No. 71. Council on Foreign Relations, 2014.; Linton Brooks and Mira Rapp-Hooper. "Extended deterrence, assurance, and reassurance in the Pacific during the second nuclear age." *Strategic Asia 2013–14: Asia in the Second Nuclear Age* (2013): 292-293.
[89] Linton Brooks and Mira Rapp-Hooper. "Extended deterrence, assurance, and reassurance in the Pacific during the second nuclear age." *Strategic Asia 2013–14: Asia in the Second Nuclear Age* (2013): 292-293.
[90] Ibid 293

tool to challenge the strategic stability. He terms ASAT acquisition by India and China as "complex multilateral development"[91]. The South Asian security trilemma has evolved into the concept of space security trilemma.

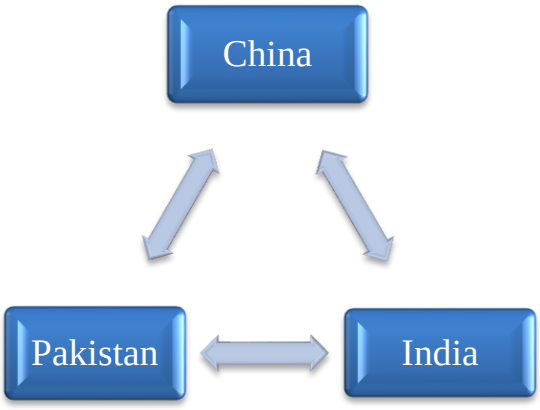

Figure 1: Security Trilemma in South Asia

Outer space is the new frontier that India is using to display its military prowess in the name of countering China. India's military build-up has always compelled Pakistan to strengthen its defenses, which leads to strategic vulnerability. In outer space as well, India has gained military edge by conducting ASAT tests. India announced its ASAT program in 2010 after China conducted its ASAT test in 2007[92]. Gregory Koblentz argues that non-nuclear technology generates security trilemma in South Asia and acquisition of ASAT capability is one of them[93]. Historically Indian nuclear ambitions and capabilities have been directed offensively towards Pakistan, which generates a national security concern for the latter as India moves to strengthen its non-nuclear technology and warfare. This creates security trilemma in outer space involving the three states. Ahmed Khan and Zulfiqar Khan argue that space in South Asia has been under security trilemma with a three-way relation[94]. They are of the view that there exists a chain

[91] Gregory D. Koblentz, *Strategic stability in the second nuclear age*. No. 71. Council on Foreign Relations, 2014.
[92]Victoria Samson, " India's missile defense/anti-satellite nexus," *The Space Review*, May 10, 2019, accessed June 25, 2019, http://www.thespacereview.com/article/1621/1
[93] Gregory D. Koblentz, *Strategic stability in the second nuclear age*. No. 71. Council on Foreign Relations, 2014.
[94] Zulfqar, Khan and Ahmad Khan. "Space Security Trilemma in South Asia." *Astropolitics* 17, no. 1 (2019): 4-22.

reaction, which starts with United States, China arms race in outer space. This generates a competitive environment between India and China, which in turn generates same relation between India and Pakistan.

2.5. Conclusion

This chapter has presented the evolution of outer space from a frontier to a battlefield as a threat to global security. It begins with introducing the new frontier – the outer space- and seeks to determine the prospects that threaten to transform it into a battlefield. It explored militarization in various domains as an element of national security secondly, the risks it poses towards security of outer space and lastly, it explores the horizon of into information and technology due to Space Situation Awareness (SSA). The main elements involved in the process are modern warfare, technical advancement and the national security policy of a state. All these components lead towards militarization of outer space in 21st century. International community believes that the process to militarize outer space began with the launch of first celestial body. However, the alarming situations arise with the launch of (ASAT) systems by new aspirant of space power like India. India's military capabilities and political hatred directed towards Pakistan and its nascent space ambition can disturb strategic stability of South Asia which is already very volatile and fragile. Gregory Koblentz states that military planners are always curious to know about the motives of their adversaries[95]. This characteristic of anticipating the modern technical progress follows the pattern of zero-sum game, which can be linked to security trilemma between in the South Asian states. The succeeding chapter will explore the features of space programs of Pakistan and India, and their future ambitions.

[95] Gregory D. Koblentz, *Strategic stability in the second nuclear age*. No. 71. Council on Foreign Relations, 2014.

Chapter 3: Features of the Space Program of Pakistan and India

3.1. Introduction

Outer space is gaining strategic significance with time. To obtain maximum benefit out of this entity it is important to devise strategies and policies that will strengthen institution. Exploring the outer space requires space assets supported by ground facilities. The space program of a state provides the roadmap to the institution to move forward. Many states in the world have formulated space programs to help explore the outer space and develop the technology required to carry out these programs. Among South Asian states, Pakistan was the first country to formulate it space program however, its amateur nature has contributed to the relative slow-paced progress. India initiated its space program following the footsteps of Pakistan. The space programs of both states have distinctive attributes that account to the progress of respective institutions.

This chapter comprises of three sections, which will highlight the features of space programs of Pakistan and India in various dimensions. It will discuss the technical and security aspect of Pakistan's space program and highlight the military capabilities in outer space acquired by India. The first section will discuss the space program of Pakistan. The foreground is set on the phases of the space program that cover different eras in research and development of Space and Upper Atmosphere Research Commission (SUPARCO). It then moves to analyse the current standings of SUPARCO and Pakistan's space program. Finally, the section closes with the discussion on the prospects of Pakistan Space Vision. The space vision is said to boost up the outer space endeavours of Pakistan. The space vision focuses on the development and launch of

satellites that will occupy the outer space. The second section of this chapter will cover the features of Indian Space Program. It will start by discussing the Indian space ambition and then move on towards the Indian military ambitions in the outer space. India holds an actively extensive space program that holds the capability of launching multiple satellites at once. This section will focus on the role of Defence and Research Development Organization (DRDO) in the development of satellites. DRDO and ISRO collaboratively launched the ASAT that is also known as 'Mission Shakti'. This section will analyse the impacts of these military ambitions on security of Pakistan and the region. Lastly, the section will discuss the future of Indian Space program and the direction that it will take for its progress, as India prepares to launch a moon mission and an international space station. This chapter will provide analysis of the quantitative data of Pakistan and India's space programs.

3.2. Space Program of Pakistan

Pakistan has a relatively small space program as compared to other states in the region. Despite having a head start in the space program, compared to other India, the agency and other R&D departments associated with it have not been to provide with satisfactory results. This section attempts at explaining the space program of Pakistan in multiple dimensions starting from the historical background of the program and its current standing in the international arena. It will explore the areas where Pakistan's space program (PSP) lags behind regionally and then proceed to highlight the space vision of PSP.

The world-renowned physicist and a noble laureate, Dr. Abdus Salam, was the pioneer of Pakistan's space program[96]. He conceived the idea of an institution that can cater to the strategic

[96]Miqdad Mehdi and Jinyuan Su. 2019. "Pakistan Space Programme and International Cooperation: History and Prospects." Space Policy 47 (July): 175–80. https://doi.org/10.1016/j.spacepol.2018.12.002.

and modern scientific needs of the state. Under the brilliance of his faculties, Pakistan became the third country in Asia to launch an ambitious space program[97]. He understood the strategic and scientific importance of this domain and initiated the program under the umbrella of Pakistan Atomic Energy Commission (PAEC) in 1961[98]. Under the auspices of this parent organization, Space and Upper Atmosphere Committee that was established that was later recognized as an autonomous body in 1964[99]. However, Space and Upper Atmosphere Commission (SUPARCO) became the successor institute of this commission that dealt with the research and development in the field of outer space. Owing to the strategic significance of outer space, the status of this commission was once again changed from the autonomous body and it was placed under the direct authority of Strategic Planning Division (SPD). Since, Pakistan has lagged in the indigenous capabilities of space technology; United States that assisted in initiating the space program. US supported in the launch of sounding rockets such as Rehbar- I and Rehbar-II in 1962[100]. In 1961, when Pakistan perceived the idea of exploring the outer space, the US president John F. Kennedy announced his ambition of landing on the moon[101]. This mission required knowledge and information of the upper atmosphere exceeding stratosphere and Indian Ocean provided the suitable environment to collect this data[102]. Pakistan seized this opportunity and offered to join NASA with their data collection[103]. Hence, Pakistan became the part of a historic

[97] Ibid 4
[98] Kingwell, Jeff. 2014. Asian Space Race: Rhetoric or Reality? Space Policy. Vol. 30. https://doi.org/10.1016/j.spacepol.2014.05.001.
[99] Ibid 50
[100] Salim Mehmud, 1989. "Pakistan's Space Programme," 217–26; Mehdi Mehdi, and Jinyuan Su. 2019. "Pakistan Space Programme and International Cooperation: History and Prospects." Space Policy 47 (July): 175–80. https://doi.org/10.1016/j.spacepol.2018.12.002.
[101] Salim, Mehmud. 1989. "Pakistan ' s Space Programme," 217–26
[102] Miqdad Mehdi and Jinyuan Su. 2019. "Pakistan Space Programme and International Cooperation: History and Prospects." Space Policy 47 (July): 175–80. https://doi.org/10.1016/j.spacepol.2018.12.002
[103] Ibid 3

event for humanity, the landing of man on moon. Since then, Pakistan's scientists have mastered the missile technology and have launched multiple missiles for defense purpose.

3.2.1. Phases of space program

Establishing a strong and effective space program for Pakistan is a necessity, which cannot be ignored. The regional and international outer space hegemony has become in which the country stands nowhere. Pakistan's space program is said to be a multi-stage program that in still in the development phase[104]. The first phase of the research and development in the field of outer space in Pakistan comprised four main areas[105]. It focused on the development and construction of a state of the art research facility that will assist the scientists and engineers to utilize their faculties in the best possible manner at SUPARCO[106]. It was engaged in the production and launch of sounding rocket, and flight-testing ranges[107]. However, SUPARCO's main focus was on the development of Badr satellite program that consisted of two satellites[108]. This phase ended with the launch of Badr-I satellite on 16 July 1990[109]. The second phase of the space program began with the R&D of second satellite of Badr program, named Badr-B[110]. However, it was mostly considered a hiatus, where research and development in the field of outer space was decreased for very long time[111]. The third phase is the on-going phase that is associated with the future of space program and space organization. The institution is working in

[104] Ahmed Bilal (Revisiting Pakistan's Space Program), interviews by Noor Ul Huda Atif and Dr. Tughral Yamin , National University of Science and Technology, Islamabad, 27, March 2019.
[105] Ibid
[106] "National Space Programme." n.d.
[107] Ahmed Bilal (Revisiting Pakistan's Space Program), interviews by Noor Ul Huda Atif and Dr. Tughral Yamin , National University of Science and Technology, Islamabad, 27, March 2019.; "National Space Programme." n.d.
[108] Ibid
[109] "National Space Programme." n.d.
[110] Ibid
[111] Ahmed Bilal (Revisiting Pakistan's Space Program), interviews by Noor Ul Huda Atif and Dr. Tughral Yamin , National University of Science and Technology, Islamabad, 27, March 2019; Ahsan, Ali, and Ahmad Khan. 2019. "Pakistan's Journey into Space." Astropolitics 17 (1): 38–50. https://doi.org/10.1080/14777622.2019.1578933.

collaboration with China under the program[112]. The third phase of space program will launch Pakistan as an emerging space faring state in the world.

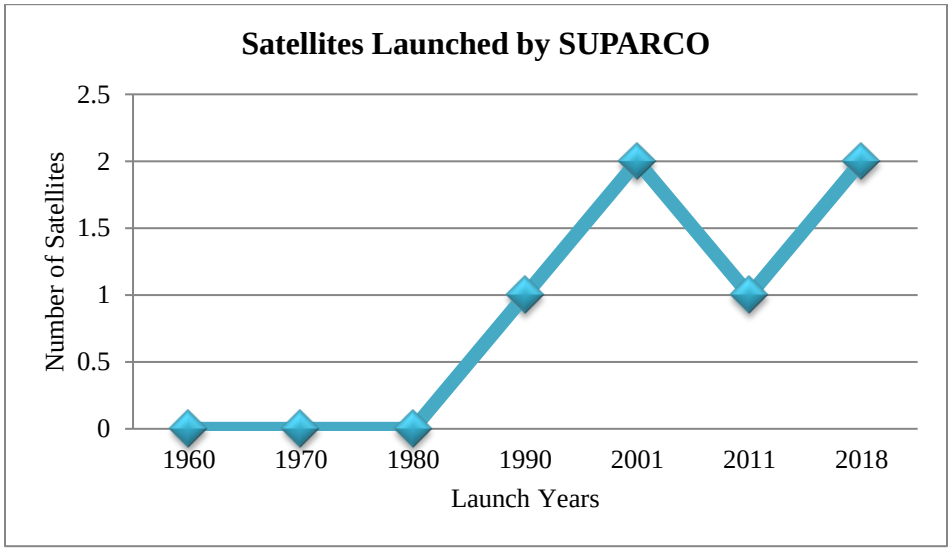

Figure 2: Progress of SUPARCO

3.2.2. Satellites by Pakistan

Pakistan has managed to launch six satellites; however, the gap between the first launch of rockets and launch of satellites is very alarming[113]. Pakistan launched the first satellite *Badr-1* in 1990, after a daunting gap of thirty years[114]. The indigenously made satellite was launched from the Chinese Long March-2E launcher[115]. It was an artificial satellite launched for experimental purpose, with a lifetime of fifteen years[116]. The second satellite again took a decade to launch. *Badr-B/Badr-2* launched 2001, was a Russian Zenith-2 Rocket with only two years of

[112] Ahmed Bilal (Revisiting Pakistan's Space Program), interviews by Noor Ul Huda Atif and Dr. Tughral Yamin , National University of Science and Technology, Islamabad, 27, March 2019; Ahsan, Ali, and Ahmad Khan. 2019. "Pakistan's Journey into Space." Astropolitics 17 (1): 38–50. https://doi.org/10.1080/14777622.2019.1578933.
[113] Ahsan, Ali, and Ahmad Khan. 2019. "Pakistan's Journey into Space." Astropolitics 17 (1): 38–50. https://doi.org/10.1080/14777622.2019.1578933.
[114] Ibid 40
[115] Miqdad Mehdi, and Jinyuan Su. 2019. "Pakistan Space Programme and International Cooperation: History and Prospects." Space Policy 47 (July): 175–80. https://doi.org/10.1016/j.spacepol.2018.12.002.
[116] Ibid 174

shelf life[117]. It was more sophisticated than the Badr-1 and had a CCD camera, which took pictures of the Earth[118]. The system allowed ground stations to change the direction of satellite in space. In the same year, the *PAKSAT-1* was launched[119]. The Turkish satellite, which was earlier used by Indonesia as well, was a communication satellites leased to Pakistan[120]. This satellite was launched to retain the slot provided to Pakistan by the International Telecommunication Union (ITU)[121]. It took yet another decade for Pakistan to launch PAKSAT-1R, which was launched in 2011, into the geostationary orbit[122]. Pakistan used Chinese launcher CZ-3B to launch PAKSAT-1R, which replaced PAKSAT-1 that was launched earlier[123]. However, it took another eight years for Pakistan to launch more satellites. In July 2018, Pakistan launched PRSS-1 and PAkTES-1A[124]. Apart from these satellites, Pakistan also owns an iCube satellite that was a project of Institute of Space Technology (IST)[125]. IST is an educational institution affiliated with the SUAPRCO. These satellites are very less in terms of quantity and quality as compared to the other states in the region that started many years after Pakistan's space program**.**

[117] Miqdad Mehdi, and Jinyuan Su. 2019. "Pakistan Space Programme and International Cooperation: History and Prospects." Space Policy 47 (July): 175–80. https://doi.org/10.1016/j.spacepol.2018.12.002
[118] Ahmed Bilal (Revisiting Pakistan's Space Program), interviews by Noor Ul Huda Atif and Dr. Tughral Yamin , National University of Science and Technology, Islamabad, 27, March 2019; "National Space Programme." n.d.; [118] Miqdad Mehdi, and Jinyuan Su. 2019. "Pakistan Space Programme and International Cooperation: History and Prospects." Space Policy 47 (July): 175–80. https://doi.org/10.1016/j.spacepol.2018.12.002
[119] [119] Miqdad Mehdi, and Jinyuan Su. 2019. "Pakistan Space Programme and International Cooperation: History and Prospects." Space Policy 47 (July): 175–80. https://doi.org/10.1016/j.spacepol.2018.12.002
[120] Ibid
[121] Ibid
[122] Ibid
[123] Ibid
[124] ICUBE, https://www.ist.edu.pk/about/breakthrough-research-projects/icube, accessed on: 14 July 2019;
[125] Ibid

S.No	Satellite	Launch Date	Function carried out by Satellite
1	Badr-1	16 July 1990	Experimental and Educational Purpose
2	Badr-B	10 December 2001	Experimental Purpose
3	PakSat-1	December 2001	Communication satellite used for tele-medicine and tele-education
4	PakSat-1R	11 August 2011	Geosynchronous and Communication satellite that replaced the PakSat-1 satellite
5	PRSS-1	9 July 2018	Dual purpose remote sensing satellite used for earth observation and optical satellite
6	PakTES-1A	9 July 2018	Technology Evaluation Satellite- remote sensing

Table 2: Pakistan's satellites launched in outer space

3.3. Pakistan's Space Vision

Pakistan envisions space faring owing to its importance in the 21st century. The outer space has gained significance in the modern world due to technical advancement of the command, control, and communication. It broadens the horizon of capabilities for any state in the world with the dual-purpose utility, including civilian and military use. Pakistan is all set to rise as an ambitious space faring state. The space vision entails the third phase of space program that will be According to which, Pakistan launched two satellites through the Chinese Jiuquan satellite launch centre[126]. PRSS-1 is Pakistan's' first Remote Sensing Satellite that will mainly serve the purpose of monitoring of CPEC projects[127]. PAkTES-1A is an indigenously developed satellite by the SUPARCO[128].

[126] Emerging Issues, 2012. "Regulation of Space Activities," no. September.
[127] Ibid
[128] Miqdad Mehdi, and Jinyuan Su. 2019. "Pakistan Space Programme and International Cooperation : History and Prospects." Space Policy 47 (July 2018): 175–80. https://doi.org/10.1016/j.spacepol.2018.12.002.; Ahsan, Ali, and Ahmad Khan. 2019. "Pakistan's Journey into Space." Astropolitics 17 (1): 38–50. https://doi.org/10.1080/14777622.2019.1578933.; Zahid, Shakeel. "An Insight into Pakistan Space Program." In *14th International Conference on Space Operations*, p. 2343. 2016.

Space vision was initially named the Pakistan' Space Program (PSP) -2040, approved by the then Prime Minister Yosuf Raza Gilani[129]. However, it was later renamed to *Space Vision*[130]. The main aim of the space vision is that the people of Pakistan must benefit from the space technology[131]. This can be done by utilizing outer space for socio-economic and defence purposes[132]. Currently, Pakistan uses space technology agriculture, communication, meteorology, and aeronautics[133]. The 'space vision' functions by an operational framework of Pakistan's Space of Program -2040[134]. Under this framework, Pakistan has set its ambitions of developing and launch of certain quantity of satellites. This framework will provide the institution with the roadmap for development of five Geo-stationary satellites and six Low Earth Orbit (LEO) satellites.[135] The details of the space vision have been kept confidential as Pakistan treats its space program as a national security issue with its growing utility in endangering the country's security[136]. This space vision will prove to be a guide for Pakistan to regain its outer space autonomy and counter the threats it faces from the adversaries.

[129] Murad Shah, Regulation of Space Activities Emerging Issues & Regulatory Challenges for Pakistan's Space Program, 2012. http://suparco.gov.pk/ downloadables/nsc17.pdf. (Accessed 7 July 2018).
[130] SPD Official 1 (Militarization of Outer Space: threats to security of Pakistan and strategic stability of South Asia), interviewed by Noor Ul Huda Atif, SPD Head Quarter, Rawalpindi, 31 May 2019.
[131] Murad Shah, Regulation of Space Activities Emerging Issues & Regulatory Challenges for Pakistan's Space Program, 2012. http://suparco.gov.pk/ downloadables/nsc17.pdf. (Accessed 7 July 2019).; SPD Official 2 (Militarization of Outer Space: threats to security of Pakistan and strategic stability of South Asia), interviewed by Noor Ul Huda Atif, Centre for International Peace and Stability, National University of Science and Technology, Islamabad, 27, March 2019.
[132] Murad Shah, Regulation of Space Activities Emerging Issues & Regulatory Challenges for Pakistan's Space Program, 2012. http://suparco.gov.pk/ downloadables/nsc17.pdf. (Accessed 7 July 2019)
[133] "Development Programmes." n.d. Accessed June 27, 2019. http://www.suparco.gov.pk/pages/rsss.asp?rssslinksid=1.; "National Space Programme." n.d.; Ahsan, Ali, and Ahmad Khan. 2019. "Pakistan's Journey into Space." Astropolitics 17 (1): 38–50. https://doi.org/10.1080/14777622.2019.1578933.
[134] Murad Shah, Regulation of Space Activities Emerging Issues & Regulatory Challenges for Pakistan's Space Program, 2012. http://suparco.gov.pk/ downloadables/nsc17.pdf. (Accessed 7 July 2019)
[135] Ibid
[136] SPD Official 1 (Militarization of Outer Space: threats to security of Pakistan and strategic stability of South Asia), interviewed by Noor Ul Huda Atif, SPD Head Quarter, Rawalpindi, 31 May 2019.

3.4. Indian Space Program

Pakistan and India are historic rivals that have been competing, since independence, with each other in all aspects. India followed Pakistan into the outer space and launched its space program in 1969.[137] The Indian National Committee for Space Research (INCOSPAR) was established by Vikram Sarabhai, which later developed into the Indian Space Research Organization (ISRO)[138]. ISRO has been working very efficiently and effectively since its establishment. The first satellite that India launched was Aryabhata on 19 April 1975[139]. Since then, India has launched 57 satellites in the outer space, among which 16 satellites are in use of the armed forces[140]. India has also maintained a sub-branch of the ISRO named as the Integrated Space Cell, which is responsible for the security if space assets[141]. On 1 April 2019, India launched a reconnaissance satellite Emisat, which is a mutual product of ISRO and DRDO[142]. *Emisat* is an electronic intelligence satellite that will assist the military in locating hostile radars. Apart from these satellite programs, India also plans to send a mission to Mars[143]. This is an alarming situation for Pakistan as it lacks the ability to counter the technology and protect the handful of satellites that it owns, since India is increasing its space-based military capabilities.

3.4.1 India's military ambitions in space

India has been moving abruptly with its ambitions of militarizing the outer space. It has successfully employed satellites to facilitate the ground forces and is now preparing for outer

[137] Kingwell, Jeff. 2014. Asian Space Race: Rhetoric or Reality? Space Policy. Vol. 30. https://doi.org/10.1016/j.spacepol.2014.05.001.
[138] Misty, Dinshaw. 2017. "India ' s Emerging Space Program India ' s Emerging Space Program" 71 (2): 151–74.
[139] Ibid
[140] SPD Official 1 (Militarization of Outer Space: threats to security of Pakistan and strategic stability of South Asia), interviewed by Noor Ul Huda Atif, SPD Head Quarter, Rawalpindi, 31 May 2019.
[141] Sobia. Paracha, "Military dimensions of the Indian space program." *Astropolitics* 11, no. 3 (2013):156-186.
[142]Emisat, "ISRO", Retrieved from: https://www.isro.gov.in/Spacecraft/emisat, accessed on: 1 July 2019
[143]Ibid

space warfare. In 2019, India successfully acquired the ASAT capability, launched Moon mission, Chandaryan-II, to the southern side and is preparing for simulation exercises of space war. India is actively involved in militarization of outer space, which is having an impact three different levels[144]. In order to understand the impact of India's military space ambitions on international scale. The question arises that how it affects the international community, secondly to analyse its impact regionally on South Asian states with space capabilities and finally, its effect on Pakistan as an adversary.

3.4.1.1. Indian Military satellites

India has launched numerous satellites in the Low Earth Orbit and Geosynchronous orbit since it initiated its space program. While these satellites provided it with the experience of sophisticating the space technology and improving space sciences in country, it also employed technology to benefit the military forces. Apart from socio-economic benefits, it has enhanced the prospects to defence as well. India is currently engaging 16 satellites for the use by its forces[145]. ISRO is producing these satellites in collaboration with Defence Research and Development Organization (DRDO). The Technology Experimental Satellite (TES) was launched in 22 Oct 2001[146]. The main function of this satellite was that it demonstrated and validated technologies such as attitude and orbit control system, high-torque reaction wheels, new reaction control system[147]. RISAT-2 and RISAT- 1 are also in the use of Indian military, launched on 20 April 2009 and 26 April 2012 is capable of radar imaging reconnaissance

[144] SPD Official 1 (Militarization of Outer Space: threats to security of Pakistan and strategic stability of South Asia), interviewed by Noor Ul Huda Atif, SPD Head Quarter, Rawalpindi, 31 May 2019.
[145] Ibid
[146] Mian Zahid and Raja Qaiser. 2019. "Space Programs of India and Pakistan : Military and Strategic Installations in Outer Space and Precarious Regional Strategic Stability." Space Policy 47: 63–75. https://doi.org/10.1016/j.spacepol.2018.06.003.
[147] Ibid 65

satellite used for border defence security[148]. The other satellites used by the Indian military belong to the GSAT series[149]. GSAT-7 launched on 30 August 2013 is in use of Indian Navy to enhance their blue water capabilities and communicate with ships[150]. The GSAT-9 launched on 5 May 2017 provides navigational services to the security forces and ATC[151]. The GSAT-7A was launched on 19 Dec 2018. It is an advanced military communications satellite meant exclusively for Indian Air Force[152]. India is heavily armed with the modern warfare equipment that provides it capabilities on all the fronts. It is capable of competing with China and Pakistan.

India has dedicated a complete series of satellites to China and Pakistan. It uses these satellites for intelligence and reconnaissance purpose. It is known as the Cartosat satellite series. The Cartosat series are also exclusively in use of Indian Military to conduct operations against Pakistan and to monitor the developments of China-Pakistan economic corridor (CPEC)[153]. The series has been termed as Eye-in-the-Sky. CARTOSAT-1, launched on 5 May 2005 is an Observational satellite. CARTOSAT-2 that was launched on 10 Jan 2007 is capable of advanced remote sensing satellite carrying a panchromatic camera that provide scene-specific spot image[154]. The CARTOSAT-2A that India Launched on 28 April 2008 is an Indian military satellite which carries panchromatic (PAN) camera capable of capturing black and white pictures

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[148] Ibid 65

[149] Mian Zahid and Raja Qaiser. 2019. "Space Programs of India and Pakistan : Military and Strategic Installations in Outer Space and Precarious Regional Strategic Stability." Space Policy 47: 63–75. https://doi.org/10.1016/j.spacepol.2018.06.003.; [149] V. Siddhartha, Military dimensions in the future of the Indian presence in space, J Unit Serv Inst India 130 (Apr/June 2000) 540, 243-58.

[150] Ibid

[151] '27 Indian Satellites are currently operation, says government in Lok Sabha', http://www.dnaindia.com/india/report-27-indian- satellites-are-currently-operations-says-government-in-lok-sabha-2063999. Accessed April 12, 2017

[152] V. Siddhartha, Military dimensions in the future of the Indian presence in space, J Unit Serv Inst India 130 (Apr/June 2000) 540, 243-58.

[153] Ibid 60

[154] Mian Zahid, and Raja Qaiser. 2019. "Space Programs of India and Pakistan : Military and Strategic Installations in Outer Space and Precarious Regional Strategic Stability." Space Policy 47: 63–75; Sobia. Paracha, "Military dimensions of the Indian space program." *Astropolitics* 11, no. 3 (2013):156-186.; Ahmed, Raja Qaiser, and Misbah Arif. 2017. "Space Militarization in South Asia: India's Quest for Space Weapons and Implications for Pakistan." Asian Survey 57 (5): 813–32. https://doi.org/10.1525/as.2017.57.5.813.

in the visible region of electromagnetic spectrum[155]. The CARTOSAT-2B launched on 12 July 2010 consists of panchromatic camera mounted on the satellite can be panned to 26 degrees to take photographs[156]. The CARTOSAT-2C launched on 22 July 2016 was an Indian military satellite that it 'claims' using it for the planning of the so called 'surgical strike' across LOC in 2016[157]. CARTOSAT-2D 15 Feb 2017 defence surveillance for military purposes similarly, the CARTOSAT-2E that India launched on 23 June 2017 has similar specifications and utilization to Cartostat-2D[158]. Indian military ambitions have always been focused towards China and Pakistan and it has begun to employ space technology for this purpose as well.

[155] Raja Qaiser Ahmed, and Misbah Arif. 2017. "Space Militarization in South Asia: India's Quest for Space Weapons and Implications for Pakistan." Asian Survey 57 (5): 813–32. https://doi.org/10.1525/as.2017.57.5.813.
[156] Ibid 30
[157] Mian Zahid,, and Raja Qaiser. 2019. "Space Programs of India and Pakistan : Military and Strategic Installations in Outer Space and Precarious Regional Strategic Stability." Space Policy 47: 63–75
[158] Ibid 65

S. No	Satellite	Launch Date	Utility
1	Technology Experimental Satellite (TES)	22 /10/01	Demonstrate and validate technologies such as attitude and orbit control system, high-torque reaction wheels, new reaction control system
2	CARTOSAT-1	5/5/05	Observational satellite
3	CARTOSAT-2	10/1/07	Advanced remote sensing satellite carrying a panchromatic camera capable of providing scene-specific spot image
4	CARTOSAT-2A	28/4/08	An Indian military satellite which carries panchromatic (PAN) camera capable of capturing black and white pictures in the visible region of electromagnetic spectrum
5	RISAT-2	20/4/09	Radar imaging reconnaissance satellite for border defense security
6	CARTOSAT-2B	12/7/10	Cartosat 2B's panchromatic camera can be panned to 26 degrees to take photographs
7	RISAT- 1	26/4/12	Radar Imaging Satellite (used for both civilian and military purposes)
8	GSAT-7	30/8/13	In use of Indian Navy to enhance their blue water capabilities and communicate to the ships
9	CARTOSAT-2C	22/7/16	Claimed to have been used by Indian Military to conduct the so called 'surgical strike' across LOC on 21 November 2017
10	CARTOSAT-2D	15/2/17	Defense surveillance, in use of Indian Military
11	GSAT-9	5/5/17	Provides navigational services to the security forces and air traffic control
12	CARTOSAT-2E	23/6/17	Similar specifications and utilization to Cartostat-2D
13	GSAT-7A	19/12/18	Advanced military communications satellite meant exclusively for Indian Air Force

Table 3: Indian Military Capable Satellites

3.4.1.2. Acquiring ASAT capability

Outer space weapons might not have been realized as of yet, but the concept of destroying satellites has been actualized. The powerful states that claim to have the ultimate power and hegemony in the world have acquired such tool and weapons that are said to trigger

an arms race in outer space[159]. Recently, India has also joined the domain of space power, as it tested its Anti-satellite (ASAT) capability in March 2019[160]. Among United States, Russia, and China, India is the fourth state to achieve the status of a 'space power' by testing ASAT[161]. India has always centred its acquisition of military stockpile towards out-growing Chinese military ambitions[162]. However, their military aggression is always directed towards Pakistan. After China tested its ASAT capability, India maintained a contradicting approach towards militarization of outer space[163]. On one hand, the political leadership and civil bureaucracy maintained the stance of peaceful utility of outer space while the military hierarchy stressed upon the importance of a counter measure. Within three years, their ambitions on militarization of outer space became evidently visible. In 2010, the integrated Defence Staff of HQ stated in a policy document, "India will develop anti-satellite weapons 'for electronic and physical destruction of satellites in both LEO and GEO-synchronous orbits'[164]. On another occasion, the chief of DRDO and the scientific advisor to the defence minister, V.K. Sarawat commented, "India has begun the development of ASAT capability"[165]. In February 2011, at the press conference after the test of Agni-III, Sarawat referred to the test as India's anti-satellite capability. He validates the simulation of anti-satellite technology on ground at the same occasion[166]. Similarly, the president of India, APJ Abdul Kalam has also boosted about the anti-

[159] Rajeswari Pillai Rajagopalan, India's changing policy on space militarization: impact of China's ASAT test, India Rev. 10 (No. 4) (2011) 354-378. http://www.isro.gov.in/launchers/lvm3, accessed on 17 June 2019

[160] "Mission shakti and a sat missile test: all you need to know", *Times of India,* 27 March 2019, accessed 14 July 2019.

[161] Ibid

[162] Rajagopalan, Rajeswari Pillai. 2011. "India's Changing Policy on Space Militarization: The Impact of China's ASAT Test." India Review 10 (4): 354–78. https://doi.org/10.1080/14736489.2011.624018.;

[163] Rajeswari Pillai Rajagopalan, India's changing policy on space militarization: impact of China's ASAT test, India Rev. 10 (No. 4) (2011) 354-378. http://www.isro.gov.in/launchers/lvm3

[164] Ibid 354

[165] Ibid 356

[166] Ibid 356

satellite technology of India on the Golden Jubilee celebration of DRDO stating that it has the capability of intercepting and destroying any spatial object within the radius of 200km[167]. Nine years later, after projecting its ambitions to the world, India realized its ambitions of militarizing the outer space. It conducted a successful ASAT test on 27, March 2019[168]. India claims to be creating deterrence with China in the outer space as it prepares for Space warfare simulation exercise in July 2019.

The development of ASAT capability by India will have international and regional impacts on multiple fronts. It claims to be competing with China to counter it in outer space but this progress can have devastating effect on Pakistan in future. Pakistan should be able to foresee the threats that this aggressive advancement can have on the country and develop a multi-fold program[169]. It is capable of countering these threats just need a proper direction. Pakistan has proven itself repeatedly at multiple occasions[170]. Military utility and militarization of outer space is inevitable[171]. A space program must be capable of incorporating dual-purpose utility of space assets and ground facilities as military and commercial purposes are beneficial for each other[172]. India has attained a dual-use capability of space assets as for them it is a matter of prestige rather

[167] Rajeswari Pillai Rajagopalan, India's changing policy on space militarization: impact of China's ASAT test, India Rev. 10 (No. 4) (2011) 354-378. http://www.isro.gov.in/launchers/lvm3

[168] Ibid 358

[169] Dr. Rizwan Riaz (Militarization of Outer space: threats to security of Pakistan and Strategic Stability of South Asia), interviewed by Noor Ul Huda Atif, Research Centre for Modeling and Simulation, National University of Science and Technology, Islamabad, 19, June 2019.

[170] Ibid

[171] Dr. Rizwan Riaz (Militarization of Outer space: threats to security of Pakistan and Strategic Stability of South Asia), interviewed by Noor Ul Huda Atif, Research Centre for Modeling and Simulation, National University of Science and Technology, Islamabad, 19, June 2019.

[172] Dr. Rizwan Riaz (Militarization of Outer space: threats to security of Pakistan and Strategic Stability of South Asia), interviewed by Noor Ul Huda Atif, Research Centre for Modeling and Simulation, National University of Science and Technology, Islamabad, 19, June 2019.

than the national security[173]. This ASAT test has made India capable of challenging China but it will have tertiary impact on Pakistan.

3.4.1.3 Space Warfare Simulation Exercise

War-gaming has always been a part of military trainings around the world. The ground forces perform training exercises to enhance their capabilities to strategically plan and analyse the situations in case of war[174]. Until now the war-gaming exercises were performed for ground-based forces, however, India plans to take it to the next level[175]. Recently, the western powers, including United Sates and France, have hinted towards forming space force to enhance the authority of Air force to control and secure the outer space[176]. Evidently, the world powers are moving to equip themselves for a future galactic battle in outer space. India is also keeping pace with the changing dynamics of warfare and planning its policies accordingly and the *IndSpaceEx* is the manifestation of its new space policy[177]. The new space policy of India intimates its adversaries regarding the militarization of outer space. Times of India reported that IndSpaceEx would enhance India's space warfare capabilities and counter space capabilities[178]. The attendees of this exercise include the top officials of military and scientific community as it is perceived as a tablet-op war-game[179]. Modi government has raised a new organization to conduct first of its

[173] SPD Official 1 (Militarization of Outer Space: threats to security of Pakistan and strategic stability of South Asia), interviewed by Noor Ul Huda Atif, SPD Head Quarter, Rawalpindi, 31 May 2019.
[174] War gaming, Rand Cooperation, https://www.rand.org/topics/wargaming.html, accessed on: 16 July 2019
[175] Ibid
[176] "France details military 'command of space' plans to protect satellites," DW News, 25, July 2019, https://www.dw.com/en/france-details-military-command-of-space-plans-to-protect-satellites/a-49747318, accessed on: 25 July 2019; Helene Cooper, "Trump signs order to begin creation of space force," *The New York Times*, February 19, 2019, https://www.nytimes.com/2019/02/19/us/politics/trump-space-force.html, accessed June 15 2019.
[177] Rajat Pandit, "India to hold first simulated space warfare exercise next month," *Times of India*, 8 June 2019, https://timesofindia.indiatimes.com/india/india-to-hold-first-simulated-space-warfare-exercise-next-month/articleshow/69697289.cms, accessed 16 July 2019.
[178] Ibid
[179] Ibid

nature exercise, namely Defence Space Agency (DSA)[180]. The military and civilian bureaucracy has come together to accomplish the task of preparing the ground forces for space warfare.

The significance of the IndSpaceEx has been made apparently visible by the growing importance of outer space. If the world powers raise space forces and divisions to safeguard outer space then they will need such simulation exercises in future to prepare strategically. In such case, India will prove to be an important strategic ally. The DRDO Chief G. Satheesh Reddy is of the view that outer space has become the final frontier of warfare and put the national interests at stake[181]. He claims that through this exercise India will be capable of analysing the rudimentary space and counter space strategies[182]. He further emphasized on the future military ambitions of India that point towards the militarization in interest of national security[183]. Indian willingness to secure its national interest whilst militarizing the outer space is evident as it is determined to develop counter capabilities in space warfare with kinetic and non-kinetic weapons and expertise. The DRDO Chief pointed out some of the capabilities that India plan to acquire including the Directed Energy Weapons (DEWS), Lasers, Electromagnetic Pulse (EMP) weapons, and Co-orbital killers[184]. He further adds that India is ambitious to secure its satellites from electronic and physical threats[185]. The Indian space policy is much too ambitious

[180] Rajeswari Pillai Rajagopalan, "A First: India to Launch First Simulated Space Warfare Exercise," *The Diplomat*, June 12, 2019, accessed on: 8 June 2019, /https://thediplomat.com/2019/06/a-first-india-to-launch-first-simulated-space-warfare-exercise/.
[181] Rajeswari Pillai Rajagopalan, "A First: India to Launch First Simulated Space Warfare Exercise," *The Diplomat*, June 12, 2019, /https://thediplomat.com/2019/06/a-first-india-to-launch-first-simulated-space-warfare-exercise/. accessed on: 8 June 2019
[182] Rajat Pandit, "India to hold first simulated space warfare exercise next month," *Times of India*, 8 June 2019, , https://timesofindia.indiatimes.com/india/india-to-hold-first-simulated-space-warfare-exercise-next-month/articleshow/69697289.cms, accessed 16 July 2019
[183] Ibid
[184] Rajat Pandit, "India to hold first simulated space warfare exercise next month," *Times of India*, 8 June 2019, , https://timesofindia.indiatimes.com/india/india-to-hold-first-simulated-space-warfare-exercise-next-month/articleshow/69697289.cms, accessed 16 July 2019
[185] Ibid

to halt at the militarization of space. India is determined to follow into the footsteps of world powers to increase its hegemon by exploring and exploiting the outer space.

3.5. Conclusion

This chapter has explored and explained the features of space programs and institutes of India and Pakistan. It explored the three main frames, past, present and future of these organizations and their accomplishments. This was significant for thesis to understand the militarization of outer space and its impact in South Asia. This chapter aimed at determining the imbalance that exists between the space technology and approach in space policy of India and Pakistan. India followed into the footsteps of Pakistan in initiating an outer space policy; however, it has managed to surpass Pakistan. The empirical data evidently shows the imbalance between the progresses of both states. While exploring this imbalance an interesting manifestation was made vis-à-vis space policy that India forgo the policy of peaceful utility of outer space decades ago and focused at acquiring ASAT capability. Secondly, in Pakistan the huge requirement of the National Satellite Development Program, the Human Resource is entailed from the fields of: aeronautics, communications, engineering, mechanical manufacturing, remote sensing, and environment sciences. Pakistan has formulated a space vision that aims at enhancing the progress of Pakistan's space progress and salvages the status quo it once enjoyed in outer space. This chapter has determined imbalance in outer space capabilities that render national and regional security vulnerable. The next chapter will attempt to impart rational strategy guidelines in order to address this national security dilemma.

Chapter 4: National and Regional Security in Outer Space

4.1. Introduction

Outer space in recent times has increasingly gained popularity among the developing states pertaining to its multidimensional significance in academics, science and technology and security aspect. The global importance of the domain has become evident as defining the future. In short, world's approach towards outer space has changed altogether. The exploration has shifted to the paradigm of exploitation of outer space and its resources. This exploitation has rendered the global security vulnerable, with states like India and Pakistan becoming space faring states. The hostile nature of the two states not only jeopardizes the mutual relations but also negatively impact the regional peace and stability. If the similar scenario continues in future, the situation in outer space can lead to severe consequences. The fast-track advancement in space technology has already created an imbalance in the capabilities of both countries, as discussed in detail previously. Owing to the assessment of the threats within these circumstances, the security of outer space in future must be sought after. The regional security dynamics of South Asia has more potential of facing direct threats as the hostile nuclear states of India and Pakistan are more capable of resorting to unconventional technological methods. India's ambitions to militarize and weaponize outer space threaten the national security of Pakistan.

This chapter is based on the analysis of the data collected through interviews and characterizes it into three different themes; academic, technology and security. During this analysis, the available resources were overviewed, to formulate a strong policy of space program for Pakistan. It analyzed the trajectory that Pakistan must choose to strengthen the academic

basis and counter the imbalance of space technology with India, in order to address the national and regional security threats due to an arms race in outer space. Regionally, the outer space dynamics revolves around the competition between China and India. However, this competition has adverse effects on Pakistan's national security as discussed previously. Considering the arms race in outer space as a national and regional security threat, the chapter moves on to discuss the prospects of securing both fronts. The imbalance of outer space capabilities in this age can be challenging for a state like Pakistan. Pakistan has to not only secure its own territory but also maintain the regional peace. The first section of this chapter will discuss and analyze the prospects of a successful space policy on immediate basis if outer space is projected as a national security emergency. Secondly, it will discuss and analyze the prospects of Pakistan's collaboration in outer space program and explore other options. The last aspect of this chapter is to find a solution to the regional threat caused by the militarization of outer space. This chapter discusses and analyzes the obtained data in an attempt to finda road map for Pakistan incorporating the academic and technical aspects of space militarization at the lower educational level, inspiring young students to be more pro-active towards the cause of national security. The threats posed towards Pakistan's security can be classifies as internal and external threats that will addressed in this chapter.

4.2. Outer space as a national security emergency

The world leaders, scholars and intellectuals regard Pakistan's location geo-strategically significant. They all acknowledge the eagerness and inclination of the Pakistani nation to achieve maximum in as little time as possible. They have been discussing Pakistan's geostrategic location and its acquisition of strategic assets for a very long time. In every era and every government setup, the pros and cons of Pakistan's political and military engagements has been

discussed and analyzed at great length. The scientific community and military leadership of the country have always taken pride in becoming a nuclear power with very little resources. The hostile nature of relationship required Pakistan to ensure safety and the security of its people and territory from its adversary by initiating a nuclear program. It was a national security concern that prompted Prime Minister Zulfiqar Ali Bhutto to declare that his countrymen would even eat grass if that was required of them to make the nuclear bomb[186]. Attaining nuclear capability was a national security emergency and it took Pakistan nearly thirty years after Bhutto's 'eating grass' statement. No stone was left unturned to achieve this strategic aim.

Today as the means of waging a war are shifting from kinetic to non-kinetic and unconventional methods, arms race in outer space is also emerging as a new security challenge. The significance of this domain in South Asia has increased in the last few years. South Asian states are using outer space like other states in any other region for militarization. Militarization is a phenomenon linked with the control of arms race in the outer space. The region is heavily militarized by India. It is quickly emerging as a space power and it should be taken into account that India's space ambitions will always be directed towards Pakistan. As mentioned in the previous chapter the threat emanating from Indian space program should not be ignored and it should be treated as a national security emergency. Unfortunately, the weakness of Pakistan's space program lies in the inability to devise a strategy. It should be remembered that a strategy is worth nothing in the absence of a supportive policy.

4.2.1. National Space Policy

This thesis sets out to explore the major challenges to the national and regional security due to militarization of outer space and the imbalance of civil-military space capabilities between

[186] Farah Gul Baqai, "Zulfikar Ali Bhutto's Role in Nuclear Programme of Pakistan (1971-1977)." *Pakistan Journal of History and Culture* 37, no. 2 (2016): 3.

India and Pakistan. There can be no two opinions that Pakistan needs a dynamic space program. As pointed out by many respondents from academia and Pakistan Air Force, Pakistan lacks a formal Space Policy that can be presented as a roadmap to the concerned institutions to move forward. Policies are made as a set of guidelines for an organization to help achieve its goals. The reason Pakistan's space program has lagged behind is because it has lacked a formal policy . The absence of a state policy has resulted in a slow-paced progress and a lack of synergy between state institutions and military and civilian working separately in silos. It was only recently that the Minister of Science and Technology, Chaudhry Fawad Hussein, announced that Pakistan would be sending its first man into space by 2022 and this task has been given to the air force[187]. Perhaps India's failed effort to land its first space craft on moon will give further impetus to this ambition[188]. A space policy would provide the set of rules to our rocket scientists and planners

Countering the threats of space militarization is like a complex mathematical problem. The competition in outer space should not be zero-sum game Pakistan must play the right cards in order to win the game. The country has the potential to utilize its faculties in achieving the maximum benefit yet it lacks a proper strategic approach to solve the problem at hand. A well-planned policy should incorporate short-term and long-term goals; capacity building, enhancing the capacity and implementation of technology. It is a known fact that political and economic stability are foundational steps for a massive program to operate efficiently. However, the basic capacity building measures require realistic approach towards academic expertise in technical

[187] "Will Send our first person to space in 2022, says Fawad Chaudhry," *Dawn News*, 25 July, 2019, https://www.dawn.com/news/1496140/will-send-our-first-person-to-space-in-2022-says-fawad-chaudhry accessed on 2 August 2019.

[188] Jeffrey Gettleman, Kenneth Chang, Kai Schultz and Hari Kumar, "India Loses Contact With Chandrayaan-2 Moon Lander During Its Descent," *The Newyork Times*, 6 Sept, 2019, https://www.nytimes.com/2019/09/06/science/india-moon-landing-chandrayaan-2.html, accessed on 11 Sept, 2019.

and social R&D. These factors will strengthen Pakistan's Space Program (PSP) and promote the peaceful utility of the program as envisioned[189].

4.2.1.1. Capacity Building Measures

Capacity building requires immense economic stability in order to support the operations of a space program. A stable and strong space program consists of three basic segments i.e. a space segment comprising of space assets and satellites, the ground segments that provide with the command and control centers facilitating the C4 capabilities, thirdly the launching facilities encompassing launching sites and vehicles to carry the satellites in the outer space. For Pakistan to acquire all these facilities and technologies indigenously will take longer than the leadership ambitiously envisions. The space policy will set the course for long term and short term goals through capacity building measures. According to this research it should focus on the strengthening of academic basis for experts in space technology and space engineering along with the strategists and policy-makers focusing on the subject of outer space. The academic foundations will facilitate the program with more technical experts and engineers exclusively working on satellites, its production and maintenance. At present, Pakistan needs to immediately claim its slots in lower earth orbits. One possibility of achieving this target is by launching smaller student satellites, which are engineered in the educational institutions. Pakistan has up till now launched only one student satellite, the iCube in 2011, which is ten times less in quantity than its adversary. India, on the other hand has managed to launch ten satellites in last one decade alone. Pakistan is technically and academically very far behind to counter its adversary's military ambitions.

[189] Salim, Mehmud. 1989. "Pakistan ' s Space Programme," 217–26

4.2.1.2. Strong Academic Foundation

Education has the foremost significance in the growth of any research and development institution. The higher studies in Pakistan offer studies in a number of disciplines that collectively contribute towards the space technology and development of satellites. However, only a few dedicated higher education institutions offer academic expertise in space sciences and technology.

The educational institutions in the Pakistan need to focus on this particular field of study, space sciences and engineering, in order to produce more unidirectional research oriented scientists and engineers. In Pakistan, only three universities, Karachi University, Punjab university and Institute of Space Technology, Islamabad offers the subject of Space Sciences, yet only two of them, PU and Karachi University, offer specializations that too in non-engineering courses. The social research related to space militarization and strategic significance of outer space is only taught at the department of Aerospace Sciences and Strategic Studies in Air University, Islamabad of Pakistan under the umbrella of strategic studies. These departments are educating hundreds of students, with almost 500 students graduating with expertise in the space sciences and technology from the Institute of Space and Planetary Astronomy, Karachi University who are employed in different government and private organizations. The respondents to the research related interviews indicated that these educational intuitions have industry linkages that yield better-equipped scientists and engineers who have firsthand experience of the latest technology that is employed worldwide. These students are not only working as interns and fellows at the government institutions such as SUPARCO but in international organizations like UAS-global, which is Pakistan's first and only authorized UAV

provider for civil and military purposes. These private organizations provide experience and exposure to the students in aviation but not in satellite technology and outer space dynamics.

S. No.	Field of Study	Institute
1	BS Space Sciences	Institute of Space Technology, Islamabad
2	BS Space Sciences	Punjab University, Lahore
3	M.Sc. Space Sciences	Punjab University, Lahore
4	MPhil. Space Sciences	Punjab University, Lahore
5	P.G.D Space Sciences	Punjab University, Lahore
6	B.Sc. (Hons.) Space Sciences	Karachi University, Karachi
7	MSc. Space Sciences	Karachi University, Karachi
8	MS Space Sciences	Karachi University, Karachi
9	PhD Space Sciences	Karachi University, Karachi

Table 4: Subject of Space Sciences offered in Pakistan

4.2.2. Pakistan's Outer Space Strategy

The space program has gained strategic significance over the years given the military ambitions of India, as discussed in the previous chapter. The growing strategic significance of the outer space has prompted Pakistan to resurrect its space program and make an investment in space technology. It makes sense that space education should begin at the grass root level. The vision of Pakistan's space program should provide an institutional framework for the future. The space vision represents the state's ambitions of approaching the outer space, however, it does not provide with the operational outline. A strategically significant problem must be approached with a strategy. The state must devise a plan to counter the adversary's ambitions of threatening the country's sovereignty.

The PSP should address the military threat from outer space. The development of defensive strategies should include securing space assets, ground facilities and monitoring the

space activities of adversary. The outer space strategy must be built around the national awareness of space militarization at national and educational level, incorporating the students to participate in different activities enlightening them on strategic importance of outer space. It should be prioritized at the top. Hereafter, the national strategy should be focused on Pakistan' defensive strategies that instill the counter measures in the safeguard of space assets that are of tactical importance. The adversary is capable of monitoring your activities even in the darkest of nights hence; Pakistan's priority of safeguarding your strategic assets must be treated as an urgent matter. India has developed the geo-stationary satellites that are used for monitoring and are capable of providing inter and intra communication continually.

4.2.2.2. Development of dual-use satellites

Space vision of Pakistan has provided with a framework of developing geo-stationary satellites that will be beneficial in the socio-economic domain[190]. As military utilization of the outer space and its assets in inevitable in the modern age, Pakistan should invest in the development of dual-purpose satellites. The international technology has been in use of Pakistan military for ages including the space until Pakistan launched its own remote sensing satellite. Space technology offers the dimensions that can serve both civilian and military used for imagery and communication and indigenous development can address the security threat in short term. Pakistan's space program urges to promote the peaceful utilization of outer space in the longer run however; Pakistan must have strong defensive space policy and technology to counter the threat that looms in the region.

[190] Murad Shah, Regulation of Space Activities Emerging Issues & Regulatory Challenges for Pakistan's Space Program, 2012. http://suparco.gov.pk/ downloadables/nsc17.pdf. (Accessed 7 July 2019)

The aim of Pakistan's space program is to promote the space technology for peaceful civilian purposes. All of its faculties till now have been employed for the civilian benefits incorporating; communication, weather information and agricultural utility. However, regionally, the activities in outer space have taken a drastic shift towards military utilization, which is inevitable in the space age. In the light of current events that have unfolded in recently; India's ASAT test and space simulation exercises, it has become a necessity for Pakistan to devise a space strategy that addresses both civilian and military requirements. It will not only strengthen the country's defense but will also contribute to the state's economy. However, the country faces a shortage of technical expertise. Evidently, Pakistan launched its first Remote Sensing satellite (RSS) in 2018 despite SUPARCO initiating a dedicated division for RSS Research in 1973[191]. It distinctly manifests the slow-paced progress of PSP that took almost forty years to develop its technical research into a final product.

4.3. Countering External Threats in Outer Space

The space ambitions of some advanced countries are frightening and that of India is certainly dangerous for the security of Pakistan. Strategically and militarily, India currently leads the race of militarizing outer space in South Asia. India owns the Cartosat and GSAT satellite series that has been exclusively dedicated for the use of the armed forces . These sixteen satellites are mainly used in providing intelligence, surveillance and reconnaissance (ISR) services to Indian military against Pakistan. The external threats of space militarization to Pakistan are evident from the progress of its adversary in the region. However, these external threats have emerged over the years mainly due to the inability to access the global space

[191] Salim Mehmud, 1989. "Pakistan's Space Programme," *Space Policy*, 217–26.

technology. The lead in space technology still remains with the pioneering states of Russia, Unites States and China. The nascent space faring states usually form collaborations with these advanced countries or make agreements of technology transfer. Pakistan was able avail these two available options in the initial stages, however, due to its instable political and economic conditions it could not sustain its space developments. The powerful and technologically advanced are not willing to share their information and technology besides the commercially available information is exorbitantly expensive .

4.3.2. Transfer of Technology

Initially Pakistan's space scientists experimented with the technology of sounding rockets. This was the first phase of Pakistan's space program, where the country was able to launch the Rehbar rocket series in 1962. The quick and early research of satellites improved the understanding of the outer space enabling Pakistan to launch its first Badr satellite series. However, the first communication satellite that Pakistan launched was leased from Turkey. PakSat-1 was previously in use of Indonesia and Pakistan needed it to retain the slot in outer space. Hence, it launched the Turkish made communication satellite in 2001. Pakistan's reliance on other countries for satellite communication and monitoring puts national security at risk. The dependence on others for information is not beneficial in terms of state security.

In the international community states have their own ulterior motives, which can change depending on their national interests. Since Pakistan suffers from instable political and economic conditions, the countries possessing space technology are generally reluctant to provide complete transfer of technology. At the same time dependence on other states for information and communication is not an ideal arrangement. The expenditure on space program is usually termed as the black hole because it can gobble up huge amounts without any visible outcome e.g. the

abortive Indian plans to land the first space craft on moon had cost their exchequer roughly 900 crores Indian rupees[192]. For a new entrant into outer space , like Pakistan assigning huge budgets is difficult to say the least It has also has to be kept in mind that international giants of space technology often transfer the technology on their own terms and conditions that can prove to be a threat to the acquiring states' national security.

4.3.3. Foreign Collaborations

Pakistan has a long term strategic partnership with China, which extends into the space domain. As China –Pakistan Economic Corridor (CPEC) becomes the significant regional game changer incorporating the economic and infrastructure development; the collaborations of strategic nature have also been noted in the field of space collaboration. Most recently it helped Pakistan launch two satellites[193]. Academics, intellectuals and scholars in Pakistan are divided in the opinion of China being Pakistan's only viable option in exploring the outer space capabilities. Lately, china has become Pakistan's only viable option for collaboration; however, more venues can be explored in this regard. The states that have significantly progressed in the outer space technology regionally and globally can enhance the horizon of cooperation. The progressive space programs of states such as that of Japan and France can offer promising future in R&D of space program for Pakistan. The improvement of strategic relations between Pakistan and Russia can also be a rational option for Pakistan to explore. This stance will improve Pakistan's space program, strengthen the national security and play a vital role in ensuring the regional security of South Asia.

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[192] Jeffrey Gettleman, Kenneth Chang, Kai Schultz and Hari Kumar, "India Loses Contact With Chandrayaan-2 Moon Lander During Its Descent," *The Newyork Times,* 6 Sept, 2019, https://www.nytimes.com/2019/09/06/science/india-moon-landing-chandrayaan-2.html, accessed on 11 Sept, 2019.

[193] [193] Emerging Issues, 2012. "Regulation of Space Activities," no. September.

Space militarization has historically assisted states in gaining the regional and global hegemony broadening the strategic significance of the field. The development and research that is required to compete in the domain of outer space must be realized by the nascent space faring states considering its aforementioned importance. India has successfully exploited this opportunity by shifting the strategic balance in its favour. It holds close collaborations with United States and Israel for technical assistance and upgraded assets. Pakistan must also broaden its sphere of collaborations with Asian and European states such as China, Japan and France. India managed to access the global technology of outer space segments through collaborations with former USSR and Israel. During the Cold War era up until the late 2010's the India-USSR-Israel nexus has been the largest civil-military nexus of Asia that has favored India in multiple domains. It was during this period that India tested its first Polar Satellite Launch Vehicle (PSLV) in 1980's.

4.4. Regional security of South Asia due to space race

Regional security is currently at stake in Asia due to the two technically most advance states of China and India are competing for an arms race in outer space. After successfully militarizing the outer space, both these states are quickly moving towards weaponization in outer space. There are no doubts about India's growing space program and its impact on Pakistan's security as discussed in the previous chapters.

Since the Kargil war of 1999, India has realized the importance of space technology and openly admitted to employing it for military purposes. India devised its short term strategies for militarily enabling the satellites incorporating the Cartosat and GSAT satellite series that are currently in use of Indian armed forces. The preview of the capabilities of these satellites was displayed during the small conflicts that have repeatedly emerged in the past few years. In 2016,

after the Uri attack India falsely claimed to have conducted a surgical strike against the terrorists' outfits operating from Pakistan, at the midnight, where the on ground location was identified by the help of Cartosat- 2E satellite. Secondly, in 2019, in the post-Pulwama standoff the Indian government once again tried to manipulate the international community, spreading disinformation with deceptive satellites images of attack in district Balakot of KP Province, , which was later countered by Reuter's satellite images, as have been earlier mentioned in first chapter.

It is emerging as a new regional challenge in outer space with close partnerships of United States and Israel. The biggest US manufacturing company of aerospace Jet Propulsion Laboratory (JPL) is provided strategic support to India for its flourishing space program. India has become the international attraction as it made a world record of launching 104 satellites with a single rocket at once. The satellites that are launched in the outer space have the capabilities of monitoring the region closely. The technology support and information gained is shared with India on daily basis. Such activates and capabilities strengthen the industry and space program of India, which is not alone in militarizing the outer space and jeopardizing the security of South Asia. The academics from security studies advocate the idea that Pakistan and India must follow into the footsteps of Russia and United States. Both the countries have collaborated in the outer space despite the hostile relations since the Second World War. The US astronauts are being sent to the international space station via Russian rockets.

4.5. Conclusion

This chapter has analyzed the prospects of countering national and regional security threats emerging due to the militarization of outer space by India. It has presented with the viable options of sustaining internal and external threats caused by the military ambitions of India space

program. Pakistan's space program lacks a dedicated strategy, which can help in achieving the idealistic goals of Pakistan Space vision, however, a strategy must be supported by a national policy which is also absent. The unavailability of a national policy on the strategically significant issue has resulted in an incoherent approach that does not integrate various national institutions. This chapter has suggested an outline for the national space policy that incorporates long term and short goals for PSP. These long term and short term goals deal with the planning of capability building measures. It starts with the basics of academic teachings to elevate the technical experts and engineers who can contribute to the uplifting of Pakistan's space program. Secondly, this chapter deals with the regional security threats that have emerged due to the imbalance of military capabilities of India and Pakistan in outer space. It elaborated on the stances from the recent events where India used its satellite technology for disinformation leading to the conflicting situations between both countries that jeopardized the peace of the region.

Chapter 5: Conclusion

Outer space has been extensively studied in the light of international laws, existing treaties, socio-economic policies and strategic significance of the space faring states. The international law and international relations have analyzed and assessed, in depth, the impacts of space militarization and weaponization to control the arms race in space; however, it does not yield much fruitful result. This thesis has taken a relatively new dimension to explore the gap in the literature – covering outer space and South Asia. South Asia has been extensively studied through the lens of regional instability owing to the unconventional arms race between India and Pakistan. This research assesses the threats that have emerged in the outer space and aims to do so by analyzing the Indian approach towards militarization of outer space. This study is premised on the game theory, where it analyzes the existence of zero-sum game between the two countries, addressing the security trilemma that emerged due to presence of a super power, China, in the region. This thesis is focused on the hostile relations shared by India and Pakistan, which adversely impact the regional stability and national security of the country as India is determined to use outer space for military purposes.

This thesis started off with analyzing the outer space in 21st century as a new frontier that is being transformed into a battlefield due to militarization in multiple domains. Militarization is an essential element of national security; however, militarization of outer space is regarded as a global threat in the international community[194]. The research provides a thorough background of the space militarization initiated by the United States and USSR, from Strategic Defense Initiative (SDI) to testing the Anti-Satellites (ASATs) weapons. China and India has also joined

[194] "Raising Alarm over Possible Space Wars, First Committee Delegates Explore Ways to Build New Order for Preventing Celestial Conflict, Confrontation", https://www.un.org/press/en/2018/gadis3609.doc.htm

this arms race in outer space by testing ASATs in 2007 and 2019, respectively, placing them in the category of space powers. This venture of these states threatens the strategic stability of the region and national security of Pakistan. This research analyzes these threats focusing on three main objectives; to address the imbalance of civil-military space capabilities between India and Pakistan, to analyze the impacts of space militarization by India on national and regional security and finally to explore the prospects of a long-term strategy for growth of Pakistan's Space Program (PSP).

Firstly, this study sets out to analyze the imbalance of civil-military space capabilities between India and Pakistan. The research analyzes the relations between India and Pakistan in context of outer space, exploring the space programs of both countries and their future ambitions. The relations between both these states have been studied under various dimensions; historic, economic, political and military relations leading up to the unconventional arms race. However, the context of outer space in the relations of India and Pakistan still remained an unchartered territory in the academics. The study of outer space and arms race in South Asia has not yet been considered as a threat to the regional peace process and it retains a daunting gap in the international academia, giving India a blind spot to advance with its motives of militarizing and weaponizing the outer space.

Secondly, the thesis attempted to analyze the impact of India's military ambitions in outer space and the imbalance between India and Pakistan's space capabilities on the regional and national security of Pakistan in the light of game theory. This research studied the combination of zero-sum game theory with the concept of security trilemma to understand the dynamics of relations among South Asian space faring states. Security trilemma is an extension of the security dilemma theory, which has guided the relations between two nuclear states of South Asia in

outer space. Moreover, the concept of security trilemma facilitates the role of China in this outer space conflict.

Finally, it has explored Pakistan's space ambitions and the national security threats that it faces by the military ambitions of South Asian states in the region. The study aimed to explain the causes of internal and external threats to Pakistan and explored the prospects of a long-term strategy for Pakistan's space program in the paradigm of strengthened academics, technical expertise and feasibility of international collaborations for Pakistan's space program. The study intended to provide with recommendations that will strengthen the space program and enable it to compete regionally and globally, securing the territory and strategic assets of the country. The analysis of the current situation has provided with a complete picture of threats that Pakistan faces and presented elements required dealing with them.

5.1. Recommendations

This research has identified the loop holes in basics of space program that have caused national security threats. The space program of Pakistan is of the military domain, with institution of SUPARCO being supervised by the Strategic Planning Division (SPD) and chaired by high official of Pakistan army. The space program is believed to counter the security threats that emerge on the surface, while the foundation of this program is left weak generating a gap between R&D and the implementation phase. To achieve the goals envisioned by the Space Vision of PSP, it is necessary to limit the gap and that can be made possible by strengthening the foundation of space program of Pakistan. For this purpose, this research suggests necessary steps to be undertaken.

The educational foundation for the space program in Pakistan is particularly weak with very little to no capacity building for the stated purpose. The space program needs to be addressed at its

foundational level, which are the academics. More institutions have to take up the responsibility of generating awareness by engaging students' interest in space sciences and engineering technology. The interest of the students in the space program is expected to arise when they develop and engineer the technology at pre-graduate level. The more advanced stage of the same will be to form synergies of different engineering universities across Pakistan, with the industrial institution chairing these synergies for their application development of satellite. Smaller student satellites can then be sent off to occupy the slots in space for Pakistan that are allotted by the International Telecommunication Union (ITU). This step will produce more experienced scientists and engineers for the National Space Organization. Such models are already being applied by the advance space powers, which can also form collaborations with educational institutions of nascent space faring states.

Another step that can be undertaken by the government institutions and universities for young graduates of space sciences programs is to promote and sponsor the entrepreneurial startups of space launch and satellite R&D. This will not only contribute towards the growth of private industry but the R&D can also be applicable to the national space program. It will promote the national space program of Pakistan for peaceful civilian purposes, while the national space program can focus on the development of dual purpose- civil and military- satellites. The development and engineering of dual purpose satellite is the need of hour for nascent states such as that of Pakistan. This thesis analyzed the current regional situation; inferring that the development of military phase of the space program at a fast pace to secure its national interests is necessary for the country.

The scientists and engineers need professional trainings to keep up with the latest technology that is being researched upon. As the advanced space faring states, United States, Russia and China,

are leading in the space technology, Pakistan must form collaborations for its professionals to get trainings from these states. Pakistan should also analyze its national interests in the outer space and make policies that favour these interests.

5.2. Limitations

The nature of this study prompted the researcher to approach the topic with mixed method - qualitative and quantitative- research. Exploring a topic of the strategic significance was a limitation for data collection in itself. The research made use of semi-structured interviews, approaching the heads of space science departments, strategic studies heads and officials from SPD and Pakistan Air Force (PAF). 10 -15 samples were identified for the purpose of data collection on the said areas and while the interviews were conducted adequately, the results, however apt, are limited by the nature of study. Due to the strategic nature of the research, the interviewees were reluctant to answer many of the questions. Some of the interviewees, initially identified in the sample, refused to answer the questions owing to the strategic nature of the subject stating that the information they contain is to remain confidential.

5.3. Future Work

The conclusions of this research identify the venues that can be explored in future. The research sets a foundation for national policy and strategy of Pakistan's space program. It opens the avenue for the study of legal prospects of South Asian space race, the technical advancements and R&D for dual-purpose – civilian and military- satellites. The game theory provides a relatively new framework to the study of relations between India and Pakistan, while this research has made use of zero-sum game, chicken-out theory still remains a viable venue for exploring the relations in outer space.

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APPENDIX I

Questions for heads of Space Sciences Department

1. What is the intake of your department per year for this program?
2. Do you see the young generation being fascinated by the outer space? / at what rate the young generation is interested in space sciences and technology?
3. How do you account for so few departments of space sciences in Pakistan?
4. What are the opportunities for space scientists in Pakistan given the slow-paced space program?
5. How is your department contributing towards the demands of Pakistan's space program?
6. Is there any institutional collaboration with government organizations?
7. Do you think the curriculum of space sciences is in accordance with the need of modern space faring?
8. What threats do you see for Pakistan due to an amateur space program?
9. How can academics play their part in resolving these threats?
10. What are the technical improvements that Pakistan needs for space faring right now?
11. Where do you see Pakistan's space program in next five years?
12. Will Pakistan be able send a manned space mission indigenously?
13. For how long will we have to rely on other countries for our space ambitions?
14. Is there any educational collaboration between Pakistan and China for space sciences and technology?
15. What are our options for enhancing academic basis for a strong space program?

APPENDIX II

Questions for Heads of Security Studies Department and Military personnel

1. How do you perceive militarization of outer space in South Asia?
2. Should asymmetric space programs of Pakistan and India be considered national security concern?
3. What threats do you see for Pakistan due to an amateur space program?
4. How do you perceive India's military oriented space ambitions? Should Pakistan be threatened by it?
5. How can academics play part in resolving these threats?
6. What are out options for enhancing academic basis for a strong space program?
7. Is Pakistan technologically capable of countering Indian space program?
8. Does currently employed technology benefits Pakistan military.
9. Do you believe that industry linkage with educational institutions can provide better equipped space scientists and engineers?
10. Is Pak-China collaboration our only option for space faring and will it help us in preparing for space faring indigenously?

APPENDIX III

List of Interviewees

1. Former Chairman SUPARCO (31 August 2010- 31 August 2015), Major General Ahmed Bilal
2. Principal, Research Centre for Modulation and Simulation (RCMS), NUST, Air Vice Marshal Dr. Rizwan Riaz
3. Head of Space Education and Research Program, College for Aeronautical Engineering (CAE), NUST, Dr. Ali Sarosh
4. Officer from Strategic Planning Division, Ms. Misbah Arif
5. Officer from Strategic Planning Division, Dr. Ahmed Khan
6. Chairman Strategic Studies Department, National Defence University, Islamabad, Dr. Zulfiqar Khan
7. Chairman Aerospace Science and Strategic Studies, Air University, Islamabad, Dr. Ghulam Mujadid
8. Chairman Institute of Space and Planetary Astronomy, Karachi University, Dr. Javed Iqbal
9. Professor, DHA Suffa University, Karachi, Dr. Ahmed Saeed Minhas
10. Assistant Professor, Department of International Relations, Quaid e Azam University, Islamabad, Dr. Raja Qaiser Ahmed