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STUDY ON SELF RELIANT INDIA IN THE FIELD OF SCIENCE AND TECHNOLOGY

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Abstract : A distinctive science and technology (S&T) strategy has shaped the post-colonial and post-independence development of India, a developing nation with a colonial heritage. India, a country of about 1.40 billion people, has not depended on food imports since the 1960s. The advancement of agricultural science and technology has been aided by the Green and White Revolutions. In fields including information technology, biotechnology, pharmaceuticals, and space research, India enjoys a comparative edge because to its innovation system, which includes higher education. India, however, behind East Asian nations in terms of economic competitiveness in technology-based businesses and export promotion. With over 550 million workers, or over 95% of the total labor force, 90% of whom are eighth-class dropouts, India's informal economy presents a significant issue.There is a discrepancy between science policy theory and reality in India, where gross domestic product-based investment on research and development has decreased from 0.8% in the 1990s to 0.7% in 2020. The objective of this study is to critically examine the assertions and counterarguments that influenced India's success, rather than to extol the virtues of science and policymaking.

Keywords : Science ; Technology ; Self-Reliant India ; Economic growth ; Public Impact

INTRODUCTION & BRIEF LITERATURE

Background Of The Study :

In light of India's 75th anniversary, it is necessary to consider the crucial role that science and social interactions play. Organizing and coordinating scientific and technology organizations to meet social, political, and socioeconomic concerns was a major task for India, a sizable nation with a colonial heritage. Being the sole developing nation with a colonial history to form a national science community prior to gaining independence, India inherited a highly functional administrative apparatus and institutional framework within the fields of science and technology. Above all, India was extremely fortunate to have a cadre of distinguished scientists by the 1940s and 1950s, including Sir C. V. Raman, Homi Jehangir Bhabha, Dr. Shanti Swarup Bhatnagar, Professor M.N. Saha, Sir J. C. Ghosh, Ashutosh Mukherjee, Dr. Janaki Ammal, Dr. Kamala Sohonie, and Professor Asima Chatterjee, among several others.

Jawaharlal Nehru, a visionary, played a significant role in India's development of science, technology, and higher education. As David Arnold (2013, p. 361) observes, 'Nehru was one of the principal architects of modern India and, through his enduring commitment to science, a leading figure in the formation of India's science policy and practice'. Nehruvian S&T policy in India's formative years left a distinct imprint in the post-colonial and post-independent India.

Science And Technology Organisation For Independent India :

The 1930s and 1940s in Indian history are significant due to three key events: First is the declaration of Purna Swaraj, that is, complete self-rule by the Indian National Congress on January 26, 1930, and the hoisting of the Indian flag by Nehru on December 31, 1929.As political developments intensified.Second as a group of Indian intellectuals initiated plans for industrialization and development of India through the formation of the National Planning Committee (NPC), India's precursor to the Planning Commission (NITI Aayog) from 1937-1938.

The third important reason for which the period of the 1930s and 1940s are significant due to visit of Archibald Vivian Hill's (A. V. Hill's). He won the Nobel Prize in 1922 and was Professor at the Royal Society. He was invited by the government in 1943, where he advised India on scientific and industrial research organization during the post-war reconstruction plan. A. V. Hill's 1944 report on Scientific Research in India, supported by Nehru's regime and prominent scientists like S. S. Bhatnagar and J. C. Ghosh, served as a blueprint for S&T organization and institutional growth post-Independence, with significant implications for India.

Under the leadership of Nehru as the prime minister, almost all S&T agencies came under one umbrella ministry. Hill himself argued for centralisation and this suited Bhatnagar, Bhabha and other elite scientists close to Nehru. Centralisation and concentration of power were to become the hallmark of the scientific establishment in post-independent India (Kumar 2001, p. 257).Leading Indian scientists, such as Sir M. Visvesvaraya and Professor M. N. Saha, were critical of Gandhi's Sarvodaya perspectives but also supported Nehruvian socialist thought and industrialization.

The study delves into the significant contributions of Indian Trimurti (S. S. Bhatnagar, Homi Bhabha, and M. N. Saha) in the 1950s science organization. Their views and perspectives on science influenced Indian science policy, beyond the institutions they nurtured. As Raina and Jain (1997) remind us, this was also the era of 'big science' institutions led by some well-known elite Indian scientists.

S. S. Bhatnagar And Origins Of CSIR : In the late 1930s, Bhatnagar gained professional recognition and was appointed as head of the Board of Scientific and Industrial Research (BSIR) under Arcot Ramaswamy Mudaliar in 1939. This led to the establishment of the Council of Scientific and Industrial Research (CSIR) in 1942 as an autonomous body under the Societies Registration Act, 1860. Bhatnagar, with a close relationship with Nehru, planned and established a chain of national laboratories after Independence. By 1943, five national laboratories were planned with budgetary provisions. Bhatnagar became known as an 'empire-builder', building a chain of 11 national laboratories from 1947 to 1954 and 22 more to follow. However, A. V. Hill warned Bhatnagar that this rapid expansion could dry up the source of scientific talent or training for the next generation of scientists.

Homi Bhabha And Origins Of TIFR : In 1943, Homi Bhabha became a full professor at IISc and was a prominent figure in nuclear research. He was committed to building a frontier science base in India. In 1944, he requested financial support from Sir Sorab Saklatvala, chairman of the Sir Dorab Tata Trust, to establish a School of Physics and institute. The Dorab Tata Trust responded positively, establishing the Tata Institute of Fundamental Research (TIFR) with Bhabha as director and D. D. Kosambi and R. P. Thatte as founding research faculty. In building the institution at TIFR, Homi Bhabha was very particular in attracting meritorious and brilliant scientists and build research groups around them, giving them full autonomy and support for research and advancement of knowledge.

M. N. Saha And The Saha Institute Of Nuclear Physics (SINP) : In 1940, he introduced nuclear physics to the University of Calcutta as a Palit professor. With Nehru's support, he received a fund from the Sir Dorabji Tata Trust to build a cyclotron at the Palit Laboratory in 1941. By 1946, the Atomic Energy Committee (AEC) was established, and significant research was conducted on building the nuclear research group at the Palit Laboratory under Saha in Calcutta.Homi Bhabha's support from Tata's and proximity to Nehru led to Bombay becoming the main research center in nuclear energy research. Saha contested these decisions but his ideas were marginalized. Despite professional contacts with AEC and CSIR, Saha decided to build the Saha Institute of Nuclear Physics (SINP) from the Cyclotron Group at the Palit Laboratory. Unlike Homi Bhabha's TIFR and AEC, Saha struggled for money, mobilizing only ₹740,000 by 1947. The foundation stone was laid in April 1948 by Shyama Prasad Mukherjee(Asutosh Mukherjee's son).

OBJECTIVE :

1. To research the problems and difficulties facing India's self-sufficient science and technology sector.
2. To determine how Self-Reliant India may solve its scientific and technological hurdles.

SIGNIFICANCE OF THE STUDY :

This analysis has some relevance to the problems and difficulties facing Self-Reliant India, in line with such concerns and challenges. These are the purpose of this study is to elucidate India's Self-Reliant India initiatives. It makes a major contribution to the nation's development and strength.

METHODOLOGY :

For the present study the method of content analysis was adopted with critical approaches.

SOURCES OF DATA:

I used e-newspapers, magazines, journals, and different news sources for this present analysis where they were reviewed and analyzed.

DISCUSSION:

The Concept Of Unbound Optimism And Its Impact On Public Response:
The 1950s, The 1960s & The 1970s :

Nehru and Gandhi aspired to use science and technology (S&T) to build India, eliminate poverty, and create jobs. Their approaches, nevertheless, were very different. Nehru's conception of contemporary science and technology for development in the 1940s, 1950s, and 1960s was predicated on the fusion of Western industrial capitalism and Soviet socialistic planning. This was taken into account when India's mixed economy was first planned economically.Elite Indian scientists such as Homi Bhabha, S. S. Bhatnagar, P. C. Mahalanobis, J. C. Ghosh, and D. S. Kothari were among those with whom Nehru aimed to have a close collaboration. In 1947, he started the alliance with scientists after noticing that there was a rising awareness in India that scientists and politicians ought to collaborate closely.

Nehru was a "messiah" for the advancement of science in India because of his contemporary, secular persona and unwavering support for research. His vision of research and progress was instantly recognizable to the scientific community and the elite, who saw in him a champion of their interests. Nehru's encounters with scientists and decision-makers demonstrated his boundless optimism about the potential of contemporary science and technology for progress. He said that the only thing that can address issues like hunger, poverty, ignorance, superstition, waste, and a wealthy nation home to starving people is science. He thought that breaking India's poverty cycle would be possible with the use of the new power sources made possible by science.

The growth of education, skills, and human capital was central to Nehru's vision of progress via Science and Technology (S&T). He founded the Ministry of Scientific Research and Natural Resources in 1947 with the goal of directing and advancing S&T initiatives across the country. It was in this period that the Indian Institutes of Technologies (IITs) were founded. The Scientific Policy Resolution (SPR) placed a strong emphasis on the necessity of technical and scientific education as well as the efficient use of people and material resources throughout industrialization. India's labor resources are only going to be useful in the contemporary world if they are educated and trained.

During the "policy for sciences" era, India concentrated on building the nation's scientific and technology (S&T) infrastructure, which included growing the university sector's human resources. The top five technological institutes in India were planned, and firms involved in engineering, consulting, design, and development were included in the attempts to increase techno-industrial capability. Significant mission-driven scientific organizations were founded and quickly grew, including the Indian Space Research Organization, Defense, Research and Development Organization (DRDO), Indian Council of Medical Research (ICMR), Indian Agriculture Research Institute, Department of Atomic Energy (DAE), and CSIR. The first formal Scientific Policy Resolution, which authorized the funding and growth of the S&T institutional framework, was enacted by the Indian Parliament in 1958 thanks in large part to the efforts of Homi Bhabha and Nehru.

The rise of science organizations like DAE, CSIR, ICMR, ICAR, DRDO, and ISRO, which have aided in the development of the nation and validated policy expectations, is highlighted from India's science-for-policy viewpoint. India joined the nuclear and space clubs during the early 1980s after ISRO launched its first two satellites, Aryabhatta in 1975 and Rohini in 1980. In 1974, the nation also detonated Smiling Buddha, its first nuclear explosion.To advance electronics and computing technologies at the national level, India established the Department of Electronics and the Electronics Commission in the early 1970s and 1971, respectively. The Department of Electronics subsequently received a National Centre for Software Development and Computing Techniques (NCSDCT) transfer.With the Green Revolution in food grain production and the 'White Revolution' in milk cooperatives, India's agricultural sector saw success.

The 1980s :

The 1980s in India faced challenges in Science and Technology (S&T) due to the Bhopal Gas tragedy and the rise of new technologies. The 1983 Technology Policy Statement emphasized the need for technology assessment studies and strengthening indigenous bases. The establishment of the Centre for Development Telematics (C-DOT) and the National Centre for Software Development and Computing Techniques (NCSDCT) contributed to India's growth in new technologies. The Department of Biotechnology (DBT) and the Centre for Cellular & Molecular Biology were established to address social problems. The country's response to these challenges was marked by indigenous high technological contributions and the establishment of the Centre for DNA Fingerprinting and Diagnostics laboratory in Hyderabad.

The 1990s, The 2000s and The 2010s :

Thomas Friedman initially believed the world was flat, but liberal economic reforms of Manmohan Singh in 1991 sparked hope in South India. The New Industrial Policy focused on exports, private sector involvement, freer market operations, and global niches. Despite criticisms, these reforms brought the industry-market-based S&T policy culture into the center of economic and commerce policy. R. A. Mashelkar, head of the Indian Space Research Institute, set a target to generate 30% of its budget from outside sources and 50% and 100% of its operational budget from non-governmental sources through industry partnerships and technology sales. Although Indian economic liberalization did not transform the economy like East Asian miracles or China, some sectors with innovation-led growth and technological capabilities deserve more space.

Sectors And Technology Developments:

The 1990s saw a continuous increase in Research and Development (R&D) and innovation capacity as a result of the strengthening of biotechnology labs and research groups within CSIR, ICMR, and ICAR. Private pharmaceutical companies began investing in biotechnology as a result of the vaccination and biopharmaceutical research conducted in DBT labs..

In the 1990s, the Information and Communication Technology (ICT) software industry arose, and today there are more than 50 software technology parks in operation in India. The nation is now a center of innovation, R&D, and sales for high-tech manufacturers and ICT goods worldwide. Transnational companies like IBM, Intel, Microsoft, and General Electric are drawn to India as a knowledge-based destination and have invested in research and development there.

By introducing locally produced new car, SUV, and truck models, India's two largest automakers, Tata Motors and Mahindra, have made a substantial contribution to the nation's S&T policy.

Space And Frontier Research :

With the CSIR's national aerospace laboratories working on defense-related strategic projects like the Light Combat Aircraft Tejas, India's aerospace sector has had a major effect on worldwide S&T. India has advanced its technological ability to launch commercial satellites, and the government now supports space missions to the Moon and Mars. Early in the 1990s, work was done on the Polar Satellite Launch Vehicle (PSLV), which was used to launch remote sensing satellites into Sun-synchronous orbit. It had successfully launched more than 50 satellites for both international and Indian clients by 2012. Another important advancement that made cryogenic technology possible for geosynchronous satellite launches was ISRO's Geosynchronous Satellite Launch Vehicle (GSLV). Using the GSLV platform, ten successful satellite launches took place between 2000 and 2010. Space technologies are becoming

more indigenous as a result of India's technical breakthroughs. India has also entered into collaborations with the European Union and the USA, showcasing its strength in S&T advancements.

Post 2014:

According to a report in Indian and foreign print media, the incoming Indian administration is anticipated to match its science, technology, and innovation (STI) agenda with socio-economic growth. The research emphasizes how the social tone of S&T policy culture has changed, with an emphasis on exalting ancient India and a stronger voice than past governments on innovation and development.

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By 2015–2024: In the policy debate, the government's dedication to science and technology for development was clearly audible in 2015. The government established many national flagship programs and missions by 2016–2017; these involve technological resources and inputs, including human and financial talents, as well as S&T and R&D. The government has also released a number of significant policy pronouncements during the past seven years, such as the most recent Science, Technology, and Innovation Policy 2021 draft, which is available for public comment. With approximately 1,210 million mobile phones and 560 million internet connections, 1,230 million Indians have digital identities in the form of Aadhar cards, demonstrating the significant success of the Digital India initiative, which was established during the previous government. This curriculum has included a few advances in the field of finance. India successfully combined its scientific and technological resources to produce two COVID-19 vaccines in record time, as well as two vaccines that were developed domestically.

IMPLICATIONS OF THE STUDY :

If the government focuses on and takes the required actions to enhance the following important areas. They are specifically the student community, Innovation, collaboration, education, governance, and entrepreneurship and start-ups.

Innovation, Collaboration & Education : In order to become self-sufficient, the nation must promote innovation, R&D, and industrial advancement to maintain India's leadership position. These can be accomplished by forming collaborations between eminent Indian academic and research institutions and their international equivalents, or by establishing global innovation hubs in India. The NASA-ISRO relationship and cooperative attempts to produce a Covid-19 vaccine are already seeds of this kind of collaboration, but these links ought to be strengthened across disciplines and organizations. The efficacy of cooperation is key to the accomplishment of "self-reliance," which India attains through its bilateral partnerships, particularly with the United States and Europe.

Governance: As India looks to continue enhancing its "ease of doing business" atmosphere, governance and policy concerns will also require attention. It is impossible to ignore the long-overdue imperative of heavily investing in science and technology in government processes and bureaucracy. It's imperative to build world-class infrastructure, which costs a lot of money. Establishing a robust structure for contracting and funding initiatives of this nature is crucial.

A small idea can become a big innovative solution which can change the future and help in the science & technology growth of a nation in the following ways.

1. **Job Orientation** : New technologies such as robotics, artificial intelligence, and the Internet of things have been introduced by start-ups. These days, the majority of the largest technological corporations outsource their work to startups, which helps to boost their cash flows.
2. **Wealth Creation** : Since entrepreneurs are using their own money to invest, they are drawing investors. When start-ups expand and the money is distributed across society, wealth is generated domestically, the people of the country gain.
3. **Higher level of life** : New businesses can use technological advancements and innovations to raise people's standards of living. Additionally, a lot of start-ups operate in rural locations with the goal of enhancing the local community.

CONCLUSION :

The way that S&T affects people's lives, India, a country of roughly 1.4 billion people, has not needed food from other nations since the 1960s. Despite criticism, the Green and White Revolutions, as well as our agricultural science community, have greatly advanced agricultural research and technology. By any measure, this is an impressive accomplishment.India has a competitive edge in "human capital" in fields like information technology, biotechnology, pharmaceuticals, space research, and many other economic sectors thanks to her public research and innovation system, which also includes higher education. India's mission-driven space and atomic energy research agencies have garnered international recognition, especially in the area of satellite launches, which has elevated India to the status of one of the world's leading nations. The Indian government has taken action to recover the country from the negative impacts of COVID-19 and the economic downturn brought on by lockdown. And with the help of the initiatives the Indian government has unveiled, we expect that India will eventually become self-sufficient.

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