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Theme: "Necessity for Science Diplomacy"

Science - The Cake on Diplomacy's Menu

Dr Jenice Jean Goveas
DST-STI Postdoctoral Policy Fellow
DST-Centre for Policy Research, IISc, Bangalore
Hosted at the Office of the Principal Scientific Adviser to the Government of India

We have often heard the light-hearted definition of a diplomat as "one who can ask you to go to hell in such a way that you'll actually look forward to the journey." This, however, does not take into account 'Science diplomacy,' which could be used to prevent the conversion of our planet into hell. When nations are at trade wars, and deglobalisation is the new trend, inclusive Science, Technology, and Innovation (STI) diplomacy is the need of the hour. It forges ties and fosters genuine collaborative efforts to tackle common enemies like '*Global Warming*' and '*COVID-19*'. Political and ideological conflicts can deter countries from engaging in meaningful interactions. But Science always comes to the rescue. History is proof of the fact that even after exhaustion of all political options, science extended its hand of friendship. Yes! I am referring to 1975's historic handshake in space between the Russian Cosmonaut and American Astronaut aboard the Apollo-Soyuz test project, even at the peak of the cold war.

Time and again, Science has proved that it is above the trivial Homosapiens' conflicts. Take the example of the *European Organization for Nuclear Research* (CERN) particle physics laboratory where German and Israeli scientists worked together for the first time after the Nazi regime; *Synchrotron-light for Experimental Science and Applications in the Middle East* (SESAME) laboratory in Jordan, where the need for development and harnessing each other's scientific knowledge brought together Israel, Iran and other Middle Eastern countries which otherwise were at loggerheads. It is well known how science was one of the major reasons for the fall of the Berlin wall. Science has the uniting power to establish meaningful partnerships across borders, thus enabling faster discovery and a safer world. The *Atacama Large Millimeter Array* (ALMA) Radio Telescope and *Square Kilometre Array* (SKA) observatory projects, the International Space Station, and various other scientific projects prove that Science can be the cake on the diplomacy's menu and can be savoured as science diplomacy.

Science Diplomacy: A three-layered Cake

The need for Science diplomacy can be visualised as a three-layered cake encompassing vital aspects. Firstly, evidence-based mapping of national priorities before deliberating on international platforms such as, India's 'not-for-profit' public-private partnership (PPP) venture - *Global Innovation and Technology Alliance* (GITA) - works in this direction and implements several bilateral programmes and funds on strategic and emerging sectors key to Industrial Revolution 4.0. The '*Make in India*' initiative benefits highly from diplomatic engagement through technology transfers, particularly in the defence sector.

The second layer comprises cross-border interests, including disaster management, biodiversity protection, connectivity and trade. The Delhi Declaration for the transboundary protection of the Asian Rhino between India, Bhutan, Indonesia, Malaysia and Nepal was one such effort. Launching the GSAT-9 'South Asia satellite', India reaffirmed the *Indian Space Research Organisation's* (ISRO) scientific prowess and geopolitically strengthened its 'Strong Neighbourhood' policy.

Thirdly, addressing global needs and challenges. The *Intergovernmental Panel on Climate Change* (IPCC) and the *Sustainable Development Goals* (SDGs) supported by the UN's Technology Facilitation Mechanismare classic examples of massive collaborative scientific, environmental, and diplomatic efforts towards achieving common goals by pooling needs and resources. The emerging digital technologies and escalated cyber terrorism threats highlight the need to strengthen diplomatic contacts and work closely to solve problems together. India has meaningfully engaged with its counterparts worldwide, including international collaboration for mega-science projects and telemedicine services in Sub-Saharan Africa. She has played an impressive role as the pharmacy of the world, and particularly during these difficult times, India can become a beacon of accessible drugs, traditional medicines and low-cost medtech devices like 'Prana-Vayu'- the indigenously developed ventilator by IIT Roorkee. India used 'Bhabhatron II' as a Science Diplomacy tool by gifting the tele-cobalt radiotherapy unit to Myanmar, Vietnam, Malawi, Kyrgyzstan, Kenya and Madagascar for treatment of cancer.

The Three Flavours of Science Diplomacy

The Royal Society, London and the American Association for the Advancement of Science (AAAS) present Science diplomacy in three flavours-

- 'Science for Diplomacy' where scientific co-operation is leveraged as soft power for fostering international relations.
- 'Diplomacy for Science' where diplomatic efforts aim to facilitate international scientific and technical co-operation.
- 'Science in Diplomacy' where scientific know-how and evidence enables informed foreign policymaking.

Transnational scientific collaborations are achievable by diplomatic efforts to fight common enemies like natural calamities, epidemics, climate change, etc. Having experienced the disastrous impact of climate-related floods and droughts, India should take the lead to prevent a generation of climate refugees. More institutes on the lines of the *International Crops Research Institute for Semi-arid Tropics* (ICRISAT), should work towards climate-resilient technologies. The *Indian Technical and Economic Cooperation* (ITEC) Programme has been impressive in Science Diplomacy through global capacity building. When former Afghan president Hamid Karzai, Myanmar's State Counsellor Aung San Suu Kyi and other Indian educated international leaders speak endearingly about their experiences as students in India it also highlights the need for using education as a tool for diplomacy.

Ingredients of Indian Science Diplomacy

The International Cooperation Division of the Department of Science and Technology (DST) plays a major role in India's international S&T engagements with over 80 bilateral STI agreements and several multilateral and regional engagements. India's Ministry of External Affairs has highlighted the need for STI diplomacy by setting up the New and Emerging Strategic Technologies (NEST) division. Likewise, the Office of the Principal Scientific Adviser to the Government of India, the Ministry of Electronics & Information Technology (MeitY), the Department of Biotechnology (DBT), and the Department of Scientific and Industrial Research (DSIR) also initiate international STI co-operation activities, mega-science projects, funds, etc. Besides, the Newton-Bhabha, WellcomeTrust, and other organisations exhibit track II backchannel diplomacy engaging non-governmental, informal contacts to achieve common grounds without official negotiations' hurdles.

India needs to be more proactively involved in Science Diplomacy and leverage the active STI engagements like the India-US-Israel initiative on digital leadership and innovation, the Brazil, Russia, India, China and South Africa (BRICS) STI Framework Programme, the India-European Union (EU) Innovation Partnership, Association of Southeast Asian Nations (ASEAN)-India Innovation Platform and so on.

Space missions have particularly demonstrated Science diplomacy. Out of the 104 satellites launched by India's PSLV C-37, 101 were international customer satellites from the USA, South Africa, Netherlands, Switzerland, Israel, Kazakhstan and UAE. Science Diplomacy is particularly essential for Ungoverned Spaces lying beyond any central government's reach, including outer space. The International maritime law was codified by the *United Nations Convention on the Law of the Sea* (UNCLOS). The Antarctic Treaty 1959, *United Nations Office for Outer Space Affairs'* (UNISPACE) stay as the icing on the cake of Science diplomacy to maintain global peace and make the planet more beautiful for the next generation.

If All is Well, then Why isn't Science Diplomacy a Cakewalk?

Why did Greta Thunberg remark, "How dare you fool us with your fairy tales?" She attempted to awaken an entire generation to realise the need to frame the motto of 'sustainability' and put it into action. This clearly indicates that the *United Nations'* efforts have not been articulated into tangible results and how global goals have failed to entail outcome-oriented and realistic strategies, monitoring, and evaluation mechanisms. If results have to be witnessed for global welfare, regional, subregional and local science and environment advisors should take on the role of science diplomats and become the key linking intermediaries between international agencies and the external affairs ministries.

The lack of diversity and inclusivity in leadership structures is yet another cause of concern. Most vulnerable countries lack the capacity and resources to build an effective STI ecosystem and hence have not yet pushed for Science diplomacy on a large scale. It is high time that political leaders worldwide understand the urgency of promoting inclusive Science diplomacy to sort global problems. The failure of the *United Nations Framework Convention on Climate Change* (UNFCCC) COP25 reveals that political diplomacy can fail even when our very existence is threatened. A clear STI diplomacy roadmap is essential for an emerging economy like India to tackle global challenges while protecting national interests. With the *International Solar Alliance* (ISA), *Bonn Challenge* and other agreements, India is emerging as a champion campaigner for global causes and must continue its efforts in this direction. Just like the *India International Science Festival* (IISF) 2020, Science diplomacy too celebrates the joys of science, technology, engineering, and mathematics (STEM) that can provide solutions to improve our lives. STI needs to trickle deep into India's foreign policy agenda to augment domestic capabilities, boost self-reliance, revitalize the economy, and celebrate a truly '*Aatmanirbhar Bharat*'. I believe Science diplomats can do much better by learning the art of compromise in the words of Ludwig Erhard, "Dividing the cake in such a way that everyone believes he has the biggest piece."

Dr Swati Gupta
Scientist B
Epidemiology and Communicable Disease Division, Indian Council of Medical Research, New Delhi, India

We are living in the most unprecedented times. The tragedy of COVID-19 has a profound effect on the lives of billions of people globally. Millions have lost their lives, the financial and mental stability of people has been disrupted, ultimately affecting the global economy. Since the SARS-CoV-2 virus from Wuhan city of

China has crossed the international borders and created havoc in the entire world, science diplomacy for laying down the policies and advisories has got special attention. The battle against this new virus with initially no information of its origin, etiology, transmission, diagnosis and treatment, the international support and exchange of available information and technology through science diplomacy formed the foundation to deal with this pandemic.

"Diplomacy" refers to the management of international relationships whereas "Science Diplomacy" is the amalgamation of both science and diplomacy in which diplomacy benefits the exchange of scientific knowledge and information and supports the expansion of science and technology (S&T) internationally and S&T aids in maintaining diplomatic relationships and influences the exchange of other non-scientific facets like cultural exchange, tourism, trading, etc. Science diplomacy is a mode to develop international relationships wherein appropriate information to the diplomats is conveyed regarding the emerging scientific evidence and newer tools available for tackling various challenging scientific and non-scientific issues. This helps them to best leverage the in-house strengths of the country and accordingly helps them in building international ties. Through science diplomacy, it has become possible to globally share the discoveries and interventions which through timely collaborations make the best use of resources of one country and foster the development of other countries. Besides, this helps in avoiding the exhaustion of time and limited resources in developing similar technologies. Moreover, science diplomacy also gives the opportunity to underdeveloped and developing countries to advocate and share their inventions for global acceptance thus, favouring the development of international ties and economic progress.

The COVID-19 pandemic has presented an excellent example of the use of science diplomacy for global benefit. Diagnosis of COVID-19 could have been a nightmare if the inter-country exchange of required reagents and information could not be made available. World Health Organization (WHO) alerted the world with the COVID-19 pandemic and declared it as a public health emergency of international concern (PHEIC).[1] Furthermore, updates by WHO on cases, death rate and recovery rate of COVID-19 helped various countries in developing preparedness plan.[2] Centres for Disease Control and Prevention launched the advisories on its website which facilitated other countries to use the available information.[3] It is through science diplomacy, the availability of data related to COVID-19 has been made mandatory to publish on a public forum by reputed international journals even before its submission to the journal for publication. Implementation of such policies made all the information available to the countries and bolstered their combat strategies.

During COVID-19 pandemic, we realized the need and urgency for a vaccine more than ever, but not every country is self-sufficient (monetary and non-monetary) to fulfil its vaccination needs. Through the history of vaccine development, we have learned that vaccine development could take years to decades. Along with this, any prospective vaccine candidate requires millions of dollars in clinical trials and a huge amount of time and efforts in getting desired approvals. Therefore, through science diplomacy, the relevant data on vaccine research/clinical trials can be shared and understood to get the desired approvals for the import of vaccine from other countries. One such example is the Japanese Encephalitis (JE) vaccine, i.e. "SA 14-14-2" which was first developed in China. After WHO approval, many countries, including India, the Republic of Korea, Sri Lanka, and Thailand are importing this vaccine as this is a safe and cheap vaccine among other JE vaccine candidates.[4] Presently, India is working towards the launch of its indigenous COVID-19 vaccine (Covaxin by Bharat Biotech limited, India).[5] For the global availability of COVID-19 vaccine, countries through science diplomacy can share data on vaccine safety, immunogenicity and efficacy which facilitate decision on vaccine uptake by other countries. Scientific diplomacy is not limited to vaccination and medicine development. During the Nipah virus outbreak (caused by fruit bats) in 2018 in Kerala, India[6], it is through the involvement of S&T in diplomacy the further spread of the virus to other countries was prevented.

Science diplomacy is also essential to address global goals and challenges. The achievement of the Global Goals or Sustainable Development Goals (SDGs) by the countries is supported by the United Nations

Development Programme (UNDP) where S&T plays a major role.[7] With the S&T inputs, formulation and adoption of suitable policies and generation of required resources are facilitated towards achieving the global goals. Furthermore, S&T helps in developing strategies and policies for boosting innovation. This helps in the sustenance and retention of skilled manpower which ultimately helps the country to avoid brain drain and thus enable them to achieve development goals. The "startup India" policy is one such policy of India, which has boosted innovations and new startups by giving opportunities to young entrepreneurs, increased access to funds and reduced the building cost.[8] Through this and many other new policies, India has emerged as a leading outsourcing destination and attracted foreign investors, which has generated jobs, avoided brain drain, increased access to education and other resources, decreased poverty and thus augmented national growth. At the same time, capacity building and skill sharing is another aspect to develop international bonds and release inter-country tensions. An Indian brain is appreciated across the world as our education system has taught us to be resourceful and quick-witted. Indian IT professionals compensate for the shortfall of staff in the USA and therefore, the Indian IT industry is an important stakeholder in strengthening the India-USA ties.[9]

Various cultures and civilizations are influenced by science. The scientific reasons behind the cultural exchange and its impact on human health through music, dance, paintings and cuisines evoke interest and reverence for the traditional cultural practices of countries and thus enhance international collaborations. This in turn also promotes tourism and the economy. The effect of music and painting on the brain, the science behind the use of various spices in Indian cuisine, the effect of dance or yoga on health gives a boost to cultural exchange, easy acceptance and appreciation by the masses thus upsurge the economy. Similarly, medical tourism is another growing sector in India because of cost-effectiveness, low waiting time for major surgeries, high-quality facilities and competent English speaking medical professionals.[10] The supportive government policies and privatization in the medical sector accelerated the influx of foreigners for the treatment and surgeries which generated extra revenue and also strengthened the health care system of the country.

Behind countries' new policies, there could be a hidden motive that can bring a huge global impact. Such as, increased industrialization and relaxation in environmental laws can increase carbon emission, pollution, global temperature change, increased precipitation, floods and erosion in coastal regions and drought which affects the global climate. On the other hand, countries' policies to increase investment in STEM help embarking towards innovation, development and self-reliance. In agriculture, through science diplomacy, the Food and Agriculture Organization of the United Nations FAO/UNDP supported agricultural education, research, technology transfer and capacity building through which India's food crop production rose manifolds. Similarly, FAO/UNDP supported India's dairy-cooperative movement by providing technical assistance for on-farm production through animal feeding, breeding, veterinary services, efficient milk production and preservation.[11] All these evolutionary practices generated job avenues, revenues, resources, reduced hunger index, poverty and fostered economy.

Wars have taught us that power needs to come with responsibility. To address global issues, science diplomacy can help countries strengthen their position and global reputation. Tensions at India's Line of Actual Control (LAC) and to resolve the demand of Indian Force, through science diplomacy, India purchased 36 new generation fighter planes "Rafale" from France in September 2016.[12] On the contrary, increased investment in S&T led to an exaggerated proliferation of nuclear weapons.[13] Increased nuclear power of one country like North Korea affects global insecurities. Therefore, to maintain global peace countries need to abide by international norms. Bioterrorism is another way to affect global peace and the economy. It is through science diplomacy, early warnings and threats can be communicated to diplomats and subsequently, timely formulation and implementation of policies can save a country and the world. Therefore, the lack of strong science diplomacy could be one of the reasons behind the COVID-19 pandemic.

Economic stability, global support and strong investment in S&T and innovation are indispensable to become a self-reliant country. India with the great reputation of its political leaders has adroitly used science diplomacy in strengthening international ties and economical expansion. India has a great potential to become self-reliant and with its increased inclination towards the development of S&T, it will soon come out as a developed nation.

References

1. World Health Organization (2020) COVID-19 Emergency Committee highlights need for response efforts over long term. https://www.who.int/news/item/01-08-2020-covid-19-emergency-committee-highlights-need-for-response-efforts-over-long-term#:~:text=Dr%20Tedros%20accepted%20the%20advice,and%20no%20deaths%20outside%20China.
2. World Health Organization (2020) https://covid19.who.int/?gclid=Cj0KCQiAifz-BRDjARIsAEElyGLrL8ABzlelG0Bi-ZzRE9- Lwku9nIwUTqwve0zGHkx8AHuAV8zlMgAsaAvRIEALw_wcB
3. Centers for Disease Control and Prevention (2020) https://www.cdc.gov/coronavirus/2019-ncov/index.html
4. https://www.who.int/ith/vaccines/japanese_encephalitis/en/
5. Bharat Biotech Limited (2020) https://www.bharatbiotech.com/covaxin.html#:~:text=COVAXINTM%20%2D%20India's%20First%20indigenous%20COVID%2D19%20Vaccine&text=After%20successful%20completion%20of%20the,over%2025%20centres%20across%20India.
6. https://www.who.int/southeastasia/outbreaks-and-emergencies/health-emergency-information-risk-assessment/surveillance-and-risk-assessment/nipah-virus-outbreak-in-kerala
7. United Nations Development Programme. https://www.undp.org/content/undp/en/home/sustainable-development-goals.html
8. https://www.startupindia.gov.in/
9. Times Now News (2018, January 18) United States: In THIS city, more than 40% techies are Indians. https://www.timesnownews.com/international/article/indians-us-silicon-valley-seattle-40-per-cent-indian-immigrants-microsoft-amazon-boeing-it-professionals-h-1b-visas/189987
10. Gupta AS (2016) Medical tourism in India: winners and losers. *Indian Journal of Medical Ethics*, 5(4): 4. https://doi.org/10.20529/IJME.2008.002
11. India and FAO Achievements and Success Stories (2011) http://www.fao.org/3/a-at007e.pdf
12. Aljazeera News (2020, July 27) Rafale: First French fighter jets head to India after purchase. https://www.aljazeera.com/news/2020/7/27/rafale-first-french-fighter-jets-head-to-india-after-purchase
13. NTI Building a Safer World. https://www.nti.org/learn/countries/north-korea/

Dr Jyoti Gupta

Associate Professor

Silver Oak College of Engineering and Technology, Ahmedabad

The words 'Science' and 'Diplomacy' sound like an oxymoron at first glance. One seems to belong to people with inventive brains, high scientific aptitude, shabby hair-do and untidy dressing while the other picturizes appertain to people with formal dressing, high political aptitude, tactful and superbly skilled in sorting out sensitive issues. But the present world scenario demands plenty of scientific collaborations across the globe due to the advent of new kind of problems like new diseases, electronic waste, air pollution, waste

management, and the list goes on which need expeditious attention and faster resolution. This invites the participation of diplomats of many countries. This essay discusses the exigency and importance of science diplomacy from many aspects, especially (i) impact on finding the sustainable solution(s) at a faster pace and (ii) influence on the society.

The world is changing rapidly in all respects, positively, with new inventions, better connectivity through innovative means of transportation and communication, medical advancements, better infrastructure, increased food production, new industries and much more; and on the other hand, downwards, with manifold increase in accidental deaths, crimes, newer diseases with virulent viruses, excessive air pollution are few to count. Many countries are spending a huge amount on research and development activities for finding solutions. Newinventions and innovations are taking place. Smaller problems are being solved with creative ideas. For example, in Las Vegas, when throwing the litter into the trash in a public park was gamified with the help of a robot, people loved to throw theirs as well as others waste into the bin.

Such problems are comparatively small and can be handled at a certain pace. But when it comes to bigger problems like the one which the world is facing for the last one year that is COVID-19 pandemic, which has completely thrashed human lives, has hit the world's economy and millions have succumbed to it, and still, its rampage sees no slowing down. Such problems have to be addressed at the utmost priority with maximum efforts. In this particular instance, the first challenge was to identify the behaviour of this new virus, its population dynamics, then develop a test to identify whom it has infected. This all was to be done within the shortest possible time. The next step was to develop remedies and then a vaccine as the behaviour was found to be highly contagious and very inconsistent in different individuals. This all was practically impossible for any one nation to do all by itself as this research and development work demanded a lot many brains to work together, infrastructure and large finances, and above all – giving 'no time'.

At this point, the entire world came together and science diplomacy came in the role. World health organization (WHO) took the initiative for a multinational collaboration. WHO, Coalition for Epidemic Preparedness Innovation (CEPI), Global Alliance for Vaccines and Immunization (GAVI) along with many countries joined hands and ventured forth. And the result is apparent; the task of developing a vaccine right from scratch, which needs more than 10 years seems to be achieved within a time frame of fewer than 10 months! It could be made possible only because all the nations came together applying their might and keeping selfish motives aside and working towards human welfare. This is a true example proving the importance and the need for science diplomacy. This is just one problem. There are many problems that are being addressed by nations individually and even after years of hard work and expenses, nothing striking is found. For instance, the problem of air pollution in Delhi. The government is trying all possible ways, employing many interventions like odd-even and more, but there is no permanent change in the situation. So, if there could be some collaboration(s) with the nations who are facing or kicked against a similar problem, the issue might have been sorted out much earlier.

Apart from finding solutions to big problems, another subtle and beautiful thing that arises through science diplomacy is 'world unity'. It creates an opportunity for the people of diverse culture and different thinking to work together and mingle up. It also provides a window to understand each other better and grow together. This makes people feel that they are not different. They just do things differently. That leads towards the feel of fraternity which is the most revered philosophy of Indian Culture known as "वसुधैव कुटुम्बकम" which means the entire world is one family.

In today's time, when we look around, we see differences everywhere. Most people are living a self-centred life working to fulfil their needs and their personal achievements. Science diplomacy can help people team up and make them realize that they are growing faster along with the growth of their teammates as well as of the nation. This will foster and nurture the brotherhood among the populations of different nations, cultures and religions. Then the true beauty of the world will outshine and will make the universe glow.

In conclusion, people differ in opinions, beliefs, culture, ideas and creativity. Besides, people are differentiated based on their religion, caste, skin colour and socio-economic status, though these things have nothing to do with the brilliance and creativity in them. That is something toxic for a healthy society. Scientific collaborations create situations where people work together leaving all prejudices aside. Such collaborations utilize these differences of ideas and backgrounds in a constructive manner for producing the most wonderful and unexpected outcomes which leave the world dazzled. The concept of science diplomacy has existed for ages and organizations like WHO, UNESCO, G7 and many others exist as its necessity has been realized by the world decades ago. But the real problem is that it has not been utilized with its full potential. Science diplomacy is the greatest need of the world not only for fighting crucial challenges, or for inventing new things, but also for establishing peace and harmony across the globe. This may lead the world towards a day when nobody will laugh at others but will hold hands for laughing together.

Radhika Deshpande
PhD Scholar
German Aerospace Centre (DLR), Cologne, Germany

"*We owe a lot to the Indians, who taught us how to count, without which no worthwhile scientific discoveries could have been made*."- Albert Einstein

The idea of science diplomacy has existed for many centuries in India. From a historical perspective, the inheritance of science diplomacy dates back to the era of ancient India when Aryabhatta added Zero to the Mathematics.[1] This is an exemplary example of science diplomacy when India gifted Zero to the world in the form of knowledge. Following him, Pingala discovered the system of binary numbers which is the foundation of all computer programs today.[2] Some of the more predominant examples include ancient India's knowledge in Metallurgy which embraces the science and technology behind producing Wootz steel[3,4] and Zinc extraction from the ores. Although today, India adds to science by imparting the primal knowledge in ayurveda, yoga, meditation and performing arts, the country's worldview is bent by both the ancient history and the invasion of India by the colonists. Therefore, the country is exploring the primitive understanding of diplomacy from 'Arthashastra' and linking it to improve the foreign policies of economics, market & trade and social welfare.

The current global challenges that we are facing today whether it's climate change or the COVID-19 pandemic, call for global solutions. Intertwining at the frontiers of science and technology by policymaking and diplomacy can bring the major structural changes in an international environment to find global solutions. The COVID-19 pandemic situation has discovered that no country has all the technological tools to fight and contain the virus. And so, the practice of science diplomacy pushes the scientific and technological boundaries for the advancement in the quality of science and technology through bilateral or multilateral collaborations. Typically in the developing countries where the economy is crucial and the buyer-vendor relationship between countries for technology trading becomes unaffordable and a cost-effective middle ground is needed to be found and so, engaging in scientific collaborations is relatively easy. Technology brings strength to any country in terms of health systems, military allies and so on, but it is traded for money. Vendors are generally countries that quote a price for selling their technology since every country owns their technology considering that it makes them influence globally. But science is the foundation of technology and is not possessed by any one country.

Indian Space Research Organization (ISRO) has previously been benefitted from international collaborations so be it the launching of the first successful GSLV or our first astronaut Rakesh Sharma

who went to space on a Soviet module. Since India is a developing country, innovative policies are built in a cost-effective manner. This is fascinating for the western countries who can pour an immense amount of money into the research. ISRO's UNNATI training program in 2018[5] for building simple, compact and inexpensive nano-satellites attracted the attention of 45 different countries. This was India's efforts into spreading knowledge of their cost-effective innovative strategies with the countries who are interested in learning and signing bilateral or multilateral collaborations. Scientific collaborations are a soft way of building international relations and living in harmony with other countries. Indeed, science diplomacy has the ability to empower people with knowledge and gain access to cutting-edge science and technology for national development and security. Experts from various scientific fields come together to tackle and provide solutions to various problems. The demographic dividend of India claims a large youth power, but the nation doesn't have the infrastructure or funds to provide access to cutting-edge science, therefore students can go to foreign countries on exchange programs, get themselves acquainted with the new knowledge on science who then become the ambassadors when they return to India. They can share their knowledge and fast forward the procedure of building technology in India itself, thereby making India self-reliant.

Today, science collaborations on mega-science projects expose one to new technologies. Let's take an example of a recent breakthrough in science on capturing the first picture of a black hole in cooperation with the event horizon telescope.[6] This was a global collaboration of scientists from 60 scientific institutions across 20 countries who worked together to test Albert Einstein's theory of general relativity. In pursuit of this goal, they created a virtual Earth-sized telescope by linking together the radio telescopes on various locations on Earth. It eventually created an essentially new instrument that offers scientists to study the farthest matters in the universe. This event is a success of years of international collaboration on the scientific level.

On another topic, there is a great debate among climate scientists about the ongoing 'Global warming' crisis. It is a global threat of climate change due to discernible human influence which should be mitigated. According to a study at NASA's Goddard Institute for Space Studies, over the past 10 decades, the temperature of the planet Earth has increased by 0.4-0.8°C.[7] The emission of carbon dioxide and other greenhouse gases by the conventional use of limited resources such as fossil fuels has been one of the primary reasons for global warming. This is a matter of concern otherwise what does the future hold? The Paris agreement[8] on climate change is crucial for the world to become a better place to live. Under this agreement, each country must report the statistics on their set emission target of the carbon dioxide and other greenhouse gases, the increase in the renewable energy market share aiding to mitigate global warming. Although the USA leaving the Paris agreement has its consequences.

Indeed, science diplomacy is a great way to empower people with knowledge on current scientific discoveries and hence, each country can become self-sustainable reflecting into peaceful relationships with the other countries.

References

1. Kautilya, Sanskrit Original: कौटल्य अर्थशास्त्र, Arthashastra, at the Wayback Machine Book 3, 9 Feb 2017.
2. Bag AK (1966) Binomial Theorem in Ancient India. Indian J. Hist. Sci., 1(1): 68–74.
3. Bronson B (1986) The making and selling of wootz, a crucible steel of India. Archeomaterials, 1: 13–51.
4. Srinivasan S (1994) Wootz Crucible Steel: A Newly Discovered Production Site in South India. Papers from the Institute of Archaeology, 5: 49–59.
5. Department of Space, Indian Space Research Organization (2019, 18 January) https://www.isro.gov.in/update/18-jan-2019/unnati-%20unispace-nanosatellite-assembly-training-%20isro#:~:text=India%20announced%20a%20capacity%20building,anniversary%20of%20the%20f%20irst%20United

6. Event Horizon Telescope (2020) https://eventhorizontelescope.org/

7. NASA Global Climate Change (2020) https://climate.nasa.gov/

8. United Nations Climate Change (2020) The Paris Agreement. https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement

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Dr Perumalsamy Navaraj
Former Principal
Annai Fathima College of Arts and Science, Tirumangalam, Madurai

About a decade back, Science diplomacy has been coined to strengthen the international collaborations in science and technology between the countries for designing an innovative tool to protect the well-being of the human and the environment at the global level. India, the superpower in science and technology also needs strong science diplomacy with all developed and developing countries to achieve this.

In the era of the emergence of pandemic explosions, climate change casualties of carbon emissions, loss of biodiversity due to the natural as well as the manual operated hazards, spoilage of environment through pollutions including the dumping of cyber wastes and medical wastes and threatening of life through bioterrorism, this diplomacy has to be handled in the best possible way.

India already has demonstrated the impact of this diplomacy through its leadership in the International Solar Alliance (ISA), involving 79 countries that have good sunshine as signatories and 121 countries as the prospective partners. The vision and mission of this Alliance are to build a platform for generating cooperation among solar shine - rich countries. This platform is to achieve the common goals of hiking solar energy usage through an affordable, equitable, sustainable and safe manner in addressing the energy demands of member countries. A similar successful collaboration with Italy in 1983 for the ICGEB covering genetic engineering and biotechnology is to be recollected in favour of this diplomacy.

Another successful case study of this diplomacy is the building up of climate and disaster-resilient infrastructure, CDRI to combat the unexpected changes in the climate. This is piloted by India in consultation with 35 countries. No single nation alone has the capability and resources to address the challenges that the environment and human faces, threatening their existence.

It is a welcome step that the Government of India is now signing a pact with all Heads of the countries on the Science and Technology Innovation framework. Moreover, it is legally bound, protecting intellectual property, sharing benefits and preventing the taxation for the research tools.

The present-day researches need a huge amount for the infrastructure, chemicals, manpower and other related expenses. To overcome this, India has to sign a pact with the developed countries to lessen the financial burden. Hence, the outcome will be a good remedy to the common man at a low cost.

The denial of technology will cost much for the developing country. India itself has been projected as a victim of a denial of nuclear technology. This could be solved only with the well-built science diplomacy between us and other countries.

In order to be at the forefront of the frontier scientific research, India should have a diplomatic relation with science and technologically developed countries. This is vouched for India's participation in international projects like Thirty-metre telescope, square kilometre array, LIGO, CERN and ITER. It is also to be reminded

that India has missed the projects like the Human Genome Project and International Space Station. This unexpected missing may be due to the defective approach in our earlier science diplomacy.

India needs to get involved in top-level space exploration projects, deep-sea researches and other pressing probing areas for the well-being of the common man like robotic designs in all spheres including precision medicines, generating artificial organs through well-defined science diplomacy. Through the best diplomatic approach in science, India's S&T cooperation with EU, ASEAN, BRICS, IBSA, SAARC, BIMSTEC, ASEM, EAS has emerged. The newly planned Carnegie Group Meetings and its spin-offs like GSO-GRI, Science and Technology in Society Forum will be a boon to the global citizens in the near future. Also, the themes for collaboration for Mission Innovation and International AIDS Vaccine Initiative draw good attention all over the globe. The Government of India is also recognising Indo-French Centre for Promotion of Advanced Research, Indo-US Science and Technology Forum and Indo German Science and Technology Centre to boost up the research between the respective countries. These approaches will yield a good result and for which science diplomacy plays a vital role.

It is observed that India's collaborative engagements are aiming to achieve the gainful consequences and spin-offs for enlarging India's pursuit of influence over the global arena as well as incorporating the Science, Technology and Innovation (STI) to develop international diplomacy and foreign relations through projecting the research and development competencies of the country at the global platform.

In general, India has to generate a well-knit collaboration with the advanced countries as well as to support the developing countries to achieve the sustainable development goals set by the UN. Also, India wants to export innovative technologies to stamping its scientific leadership among developed and developing countries. For these, science diplomacy is an inevitable one. All countries have planned to restore SDG by 2030 and for which the south-south collaboration in science and technology is highly expected. Each country will get benefitted from the best brains of the collaborative countries.

The Technology Facilitated Mechanism set up the UN member states advocating the developing countries to generate technology to achieve the SDG through their goodwill collaborations. New inventions like bicycle ambulance to help the rural people have to be promoted, propagated and promptly supported. The 115th ranked India has to jump through the proper science diplomacy to reach the top ranks for achieving the SDGs.

India is taking a pivotal role in providing capacity-building assistance to the developing countries in science and technology innovation programmes through the Indian technical and economic cooperation programme by the Indian Missions. Through the science diplomatic decisions, the brain drain of the super brains from country favouring the best ecosystem could be prevented. Further, the collaboration will provide the necessary encouragements to the best talents of our country.

As per the GDP share, India's R&D expenditure in science is lesser than BRIC nations. Interestingly, UNESCO favoured 2% of GDP for GERD, but our share is only 0.7%. Also, the private participation in Science and Technology Research is 40%, which is lower when compared to the 60% participation in other countries. Hence, this science diplomacy helps to accelerate the anticipated shares as and when more international collaborators are entering our territory. Besides, R&D activities in the institutions will get geared up due to the best science diplomacy.

At present three major organisations DAE, DOS, and DRDO get a lion share from the budget. The other departments are to be geared up and for which international collaboration is highly needed through a well-defined diplomatic understanding.

The leading multinationals like GE and Microsoft have their research centres in India and many more giants like Google, Amazon may open up the mighty research centres through a well-accepted collaborative approach of the country through this diplomatic route. The mode of collaboration may be recruiting the

best brains from the developing countries to the labs of the developed countries and/or setting up the high tech infrastructure lab in the developing countries. Either way, it will be a positive outbreak for the progress of the country. In the normal bilateral S&T agreements, sharing the cost, collaborative implementation and its activities, as well as periodic review meetings, will be observed.

As per the source of information, out of 80 agreements, 44 are very much active in the Department of Science and Technology in the Govt. of India. The remaining has to be activated. Interestingly, DAE and DOS have agreements with many countries and it should be strengthened. It is the need of the hour that better coordination will alone bring a fruitful result. We have to broaden the network of Science diplomacy as it is very small now. It is highly needed to train our diplomats to handle cooperation activities. Compare to the wider network of science diplomacy of the USA and Japan, we need to widen our network sharply.

We have to have a project like SESAME, a research facility located in Amman, Jordan. The accelerator produces beams of X-rays of widely varying energies which are useful for scientific experiments. Also, we have to start a project like the EU's Horizon Europe that attracts skilled brains for designing the best project. For all these, science diplomacy is the sole remedy. India has overrun the challenges posed by science diplomacy in certain projects like Nuclear Technology. Now India is using indigenous and imported reactors as well as Thorium-based fuel. Like in the field of climate change, the rapid progress in solar photovoltaic technology and energy storage technology has brought down the cost of solar energy considerably and this should be propagated through the best diplomatic way. The emergence of new problems in information technology demands stern action at the international level. These global challenges will have to be met only through science diplomacy.

Also, the objections rose against genome editing, stem cell therapy, gene-modified foods have to be sorted out through the best science diplomacy. The protection of biodiversity is also a major concern for all countries. Hence, science diplomacy is highly needed in India.