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# Science Diplomacy



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# Science Diplomacy

VOL 8(1) JULY–SEPTEMBER 2024

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## Science and Diplomacy: Catalysts for India's Vision of 2047

India's journey towards becoming a developed nation by 2047, the centenary of its independence, is a defining mission of the current government. The vision of **'Viksit Bharat @ 2047'** was notably emphasised by Hon'ble Prime Minister Narendra Modi in his Independence Day speech on 15 August 2024, where he called upon the 140 crore citizens of India to collectively resolve to transform the country into the third-largest economy in the world. The role of Science, Technology, and Innovation (STI) is critical to achieving this ambitious vision, which will serve as the backbone for propelling India into a new era of growth, development, and global leadership.

A key initiative driving this transformation is the establishment of the Anusandhan National Research Foundation (ANRF), a premier body designed to promote research, development, and innovation across India's universities, research institutions, and R&D laboratories. By encouraging collaborations among industry, academia, and government, the ANRF will catalyse the creation of cutting-edge technologies and solutions that are essential for India's rise as a global power by 2047. The recently approved BioE3 (Biotechnology for Economy, Environment, and Employment) Policy is a significant step toward realising the Viksit Bharat vision. By focusing on sectors such as agriculture, healthcare, clean energy, and waste management, BioE3 aligns with the broader national objectives of innovation-driven development.

The importance of science and scientists in this Grand National vision was underscored by Hon'ble Vice-President Jagdeep Dhankhar at the 83<sup>rd</sup> CSIR Foundation Day Celebrations on 26 September 2024. He remarked, "You are the major stakeholders. You may not be that visible on the screen, but you are the driving force of it. You will have to be contributing 24X7." His words echo the sentiment that scientific innovation and ingenuity will be indispensable to India's development journey.

Guided by this vision, this special issue brings together insights from distinguished experts to explore the role of STI and science diplomacy in advancing the objectives of Viksit Bharat @ 2047. It highlights the crucial steps India must take to strengthen its global standing and ensure that STI continues to be a cornerstone of national progress.

Dr Arabinda Mitra, Former Scientific Secretary, Office of Principal Scientific Adviser to the Gol, offers a compelling vision of leveraging science diplomacy in key areas of co-development, co-investment, and co-production. His article advocates for joint research projects in frontier technologies, cross-border open innovation, and technology facilitation in sectors that serve India's national interests, including expanding market access. Science diplomacy, he argues, must be driven by collaboration and shared goals to advance both national and global priorities.

Dr Archana Sharma, Principal Scientist at CERN, discusses how India's leadership in the digital space can be further amplified through open-source collaboration, joint data sharing, and digital innovation. She emphasises the long-term benefits of assisting developing countries as they evolve and highlights the need for increased funding for R&D in science and technology. Her article makes a strong case for public-private partnerships and policy incentives to encourage innovation and the growth of India's R&D ecosystem.

Dr W. Selvamurthy, President, Amity Science, Technology & Innovation Foundation and co-author Sneha Nair, address India's challenges in science diplomacy, including resource limitations, bureaucratic complexities, and geopolitical considerations. They call for a focused effort from policymakers, scientists, and diplomats to streamline processes, enhance coordination, and prioritise international scientific cooperation in India's foreign policy agenda. Overcoming these hurdles, they argue, will require sustained commitment and innovative solutions.

Prof. V. Ramgopal Rao, Vice-Chancellor, Birla Institute of Technology and Science, Pilani and co-author Dr Arindam Kushagra, delve into India's potential to become a global leader in nanoelectronics by 2047. Their article highlights the gaps between research and innovation, particularly the need for stronger academia-industry collaboration. They advocate for an integrated approach where academia and industry work closely to develop new technologies, create jobs, and position India as a key player in semiconductor manufacturing and other high-tech sectors.

Finally, Dr Shailja Vaidya Gupta, Former Senior Adviser at the Office of Principal Scientific Adviser to GoI, explores the role of science diplomacy as a powerful yet underutilised tool in India's global influence. With the government's growing confidence in the country's scientific capabilities, she envisions that India's scientific soft power will play an increasingly significant role in shaping global affairs and advancing India's international stature.

As we present this special issue, we hope it will serve as a valuable resource for policymakers and stakeholders alike. The insights India's scientific community shares in these pages are vital to realising the vision of Viksit Bharat @ 2047. By embracing innovation, strengthening global partnerships, and fostering a culture of research and collaboration, India can indeed fulfil its destiny as a fully developed nation by its centenary year of independence.

**Monika Jaggi**



# Leveraging Science Diplomacy for High Priority and High Opportunity Areas

**Arabinda Mitra**

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International dynamics of the 21<sup>st</sup> century are increasingly driven by a nation's scientific, technological and innovation prowess, which significantly shapes economic and social growth, market dynamics and access, self-reliance, and security quotient. More importantly, it directly influences the stature of a country in the high table of nations.

For India, Science, Technology and Innovation (STI) are now recognised as drivers and pillars of growth across sectors covering agriculture, communication, clean energy, climate resilience, defence, disaster management, education, health, manufacturing, transport, water, etc. As India transitions to being one of the top global economies, the role of S&T will be profound and prolific, touching the lives of its people and polity. The span of S&T policy interventions, both in its breadth and depth, has become increasingly important in addressing national needs and aspirations by being inclusive, and at the same time meeting international obligations as a responsible state actor in the comity of nations.

India's efforts towards integrating STI to achieve a national development agenda have been imbibed in many of its current national missions and programs. Unlike in the past, these missions are based on scientific knowledge convergence by employing smart technology platforms for efficient last-mile delivery and service access.

India today has a thriving and vibrant innovation ecosystem, with the third-largest start-up enterprise globally and perceptible growth of science-led deep-tech start-ups. Emerging areas of cyber-physical systems like AI, ML, analytics, IoT, deep learning, quantum, cybernetics, semiconductor research, 5G/6G communication, defence tech, clean energy, health tech, aerospace and outer space technology, along with new frontiers of bio-engineering & bio-manufacturing has provided enabling platforms for creating new knowledge and developing indigenous products, patents, and services that have market potential domestically but more significantly also at a global level.

The Product Linked Incentive (PLI) schemes of the government, with an outlay of approximately ₹ 1.97 lakh crores, aim to ensure high-end indigenous manufacturing backed by technology-led innovations in solar photovoltaic modules, green hydrogen, semiconductors, advanced battery technology, automobiles, bio-medical devices, pharma, drones, telecom, technical textiles, etc. It will not only help import substitution but also enable India to play a crucial role in the global supply chain management in critical areas such as energy, digital, defence and health security. In many frontier areas of R&D, India currently has a level playing

field with respect to other advanced countries, thus providing an opportunity for us to compete in the world market.

India has already demonstrated the power of digital public infrastructure in promoting welfare objectives, from financial inclusion to vaccine delivery. It has been amply showcased and recognised how S&T-led innovation played a critical role in fighting COVID and meeting the multifaceted challenges posed by the pandemic. The '*Vaccine Maitri*' initiative scripted a new paradigm in health diplomacy, leveraging seamless partnerships and collaborations at sub-national, national and international levels.

Clearly, using S&T as a potent tool for diplomacy is becoming increasingly significant now than ever in our foreign policy enunciation. Addressing the 2022 Global Technology Summit, External Affairs Minister Dr S Jaishankar acknowledged that the rise of India is deeply linked with the rise of Indian technology. He alluded to the central role that technology will play in shaping our future relationships with countries worldwide. In future, India's engagements will be increasingly scripted based on technology sharing and transfer, including supply chain and market access in all critical sectors.

This profound statement was further solidified by the historic June 2023 Indo-US Summit declaration captioned 'Charting Technology Partnership for Future'. This declaration highlighted the cardinal role of scientific and technological collaboration in defining and deepening our strategic partnership with the United States. The Initiative of Critical and Emerging Technology (ICET) announcement was a watershed moment in diplomatic parlance based on the tacit prowess of collaboration in emerging and frontier domains of S&T. It will enable engagement and partnership across the entire spectrum of non-strategic (soft) to strategic (hard) sectors based on mutual strength, capabilities and needs. Technology has become the central focus of India's bilateral engagement not only with the USA but also with countries like Australia, France, Germany, Israel, Japan, Singapore, South Korea, Sweden, the UK and the EU.

This can be truly described as leveraging science diplomacy for high-priority and high-opportunity areas founded on principles of co-development, co-investment and co-production, leading to technology transfer aimed towards ushering in high-tech commerce. It marks a departure from the old regime of technology sanctions and denials. It is also a nuanced acknowledgement of India's scientific, technological and intellectual capabilities.

In future, the key to success will remain in 'building partnerships on a win-win model' based on shared values of co-creation, co-development and co-deployment. India's mantra should be conducting joint research projects in frontier domains, cross-border open innovation, and effective use of technology facilitation mechanisms in high-opportunity and high-priority areas of our national interest and needs, including market access.

Going ahead, India's cross-border engagement in STI should be strategically driven to accrue value-add to our national priorities and needs. Gaining global competitiveness and visibility through collaboration and connecting Indian research with international efforts to address global challenges should be one of the key objectives. New knowledge creation through scientific cooperation to mitigate technology gaps and promote techno-economical gains should be proactively pursued, particularly when engaging with developed countries. This will be a 'give and take' relationship driven by leveraging each other's complementary strengths, infrastructure and resources.

At the geopolitical level, using the soft power of S&T to build trustworthy relationships should be imperative for directed foreign policy. A chosen path should be to engage with developing countries by investing in need-based infrastructure to address local problems and promote human capital development. This engagement is anchored on the principles of 'giving is gaining' with the objective to build people-to-people connect. Our 'Act East' and 'Neighbours First' policies, including South-South cooperation focussing on Africa, should adopt this engagement model proactively. India can play a role model by extending its S&T capabilities to provide technological solutions and build human capacity for deserving and desiring countries with which we seek to develop long-standing relationships.

The third pillar of S&T diplomacy should be to promote technology-led innovation by forming alliances with highly innovative countries. It can be best leveraged through collaborations that enable innovation and techno-entrepreneurship, leading to cost-optimised smart products and processes that penetrate both developed and developing markets. Internationally, we must collectively portray India as an emerging S&T powerhouse, effectively leveraging its technology-led innovation skills and trained workforce to provide solutions to various challenges in an affordable, accessible and available manner.

Technology denial or prohibitive cost of technology, especially under climate change and clean energy negotiations, and prevailing WTO patent regime are some practical challenges that could hinder equitable and inclusive technology facilitation mechanisms. Our S&T community and the diplomatic fraternity should collectively highlight and defend the country's position and interests to ensure a level playing field while addressing pressing global challenges and meeting the Sustainable Development Goals (SDGs) we are committed to as a nation. India can play a leadership role by providing the STI roadmap and tools for achieving the SDGs in developing countries, leading to impactful and visible contributions by our country.

As STI increasingly becomes an intrinsic diplomatic tool in India's foreign policy enunciation, it will require the engagement of non-government actors such as the private sector, academia and research community, the Indian diaspora, and the media. Structured communication is about developing and delivering strategic national aims by understanding and influencing world opinion. Often, the Indian commentary on scientific and technological advancements is tactical, responsive and fragmented. Managing risk and reputation through a cogent media narrative is vital when discussing S&T and diplomacy.

This requires proactive and dynamic engagement of the scientific and technological community with other stakeholders, including the diplomatic fraternity and other knowledge enterprises, including media, to appreciate, design and develop effective international engagement tools through STI to meet both the national needs and global challenges that India will face in a closely connected and shrinking world.

To conclude, international collaborations in STI are a necessity today. No nation alone has the capacity, infrastructure and human resources to address the humungous challenges that the earth as a planet and mankind as a progenitor faces for its existence. It is inevitable, therefore, that STI will increasingly become an intrinsic and chosen diplomatic tool in India's foreign policy during the Amrit Kaal.

# A Paradigm Change for India: Science Technology and Emerging World Order by Viksit Bharat 2047\*

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In an era where boundaries are not just geographical but extend into the realms of innovation and knowledge, the role of science and technology (S&T) in diplomacy has become increasingly crucial. As a nation with a rich history and a promising future, India must harness S&T to not only propel its development but also to foster international collaboration and goodwill. This shift in global priorities underscores modern exports extending beyond physical goods to include information, technology, and expertise, enabling countries like India to contribute significantly to global progress. While Saudi Arabia remains the largest oil exporter, the Brazilian economy thrives on coffee beans export, and Switzerland exported over USD 100 billion worth of gold in 2022 alone; the era when precious goods were the only meaningful exports is over. Today, data, technology, and expertise are as important as physical resources and can be used not just for the betterment of India but humankind as a whole.

India has always been a cradle of ancient wisdom, and in today's context, this wisdom has manifested itself in the form of cutting-edge scientific and technological advancements. From space exploration to information technology, India has made significant strides. It is now time to leverage these achievements for humanity's greater good. S&T diplomacy for India should not be viewed merely as a means to enhance economic growth or gain a competitive edge but as a tool to address global challenges collaboratively. Climate change, healthcare, poverty, food and water security, and sustainable development are challenges that transcend national boundaries. By fostering international cooperation in S&T, India can contribute to finding innovative solutions.

India has a vast pool of talented scientists, engineers and researchers. Our globally renowned institutions of higher learning and research should open doors wider for collaborations and exchanging ideas. Joint research, technology transfer and collaborative initiatives can be the cornerstone of our diplomacy efforts. CERN serves as a relevant and effective example of governance and international cooperation. Scientists and engineers from across the world come together to explore the universe's biggest questions— something that would be impossible for one nation acting alone. But when more than 50 nations pool their resources and intelligence, world-changing discoveries can be made. CERN's 'One-Earth' approach is a shining example of global togetherness. As CERN Director General Fabiola Gianotti once said: "Places like CERN contribute

\* Based on the author's contribution to Raisina Dialogue 2024

to the kind of knowledge that not only enriches humanity but provides the wellspring of ideas that become the technologies of the future.” From a human and diplomatic standpoint, India must continue representing itself globally in such collaborative efforts.

In the fields of artificial intelligence, biotechnology, and renewable energy, India has a significant role to play. By aligning our scientific pursuits with the United Nations Sustainable Development Goals, we can showcase our commitment to a better world and inspire collaboration on a global scale. Digital diplomacy is also essential in today’s interconnected world. Through open-source collaboration, joint data sharing, and digital innovation, India is and can further amplify its influence and shape global norms in the digital space.

In recent years, India has emerged as a global leader in scientific research, technological advancements and innovation. The Indian Space Research Organisation (ISRO) has consistently demonstrated India’s capabilities globally. Missions like the Mars Orbiter and Chandrayaan have not only showcased our technological prowess but have also underscored India’s commitment to peaceful exploration and collaboration in space. In information technology, Indian professionals have played a pivotal role in driving global innovation. Indian tech companies and start-ups are at the forefront of creating cutting-edge solutions, be it artificial intelligence, cybersecurity, or blockchain technology. The 32 million-strong Indian diaspora has significantly contributed to the success of Silicon Valley and tech hubs worldwide. Advancements in information and technology come with responsibility. Leading the world safely and securely requires balancing scientific progress with responsible practices. International collaboration is essential to develop adequate safeguards and rules for a new era of civilisation, particularly with recent advances in artificial intelligence. Inclusivity is vital in global engagement. S&T should not be exclusive to developed countries. With its commitment to inclusive growth, India must actively support capacity building in developing nations, facilitating knowledge and technology transfer to uplift societies globally.

For the sake of diplomatic sustainability, helping countries down the economic ladder can pay off long term as they develop and evolve. Diplomacy is not about making the best deals with the prominent countries alone but positioning India as a powerhouse for generations. Better diplomatic relations can maximise the benefits of India’s vast resources. Our commitment to sustainable and inclusive development is evident in initiatives like the International Solar Alliance (ISA). By bringing together nations to harness solar energy, India is leading the charge in addressing climate change and promoting sustainable practices globally. The next



Figure 1. R&D expenditure as % of GDP for selected countries (2020)  
(Source: DST R&D statistics at a glance, 2022-23)

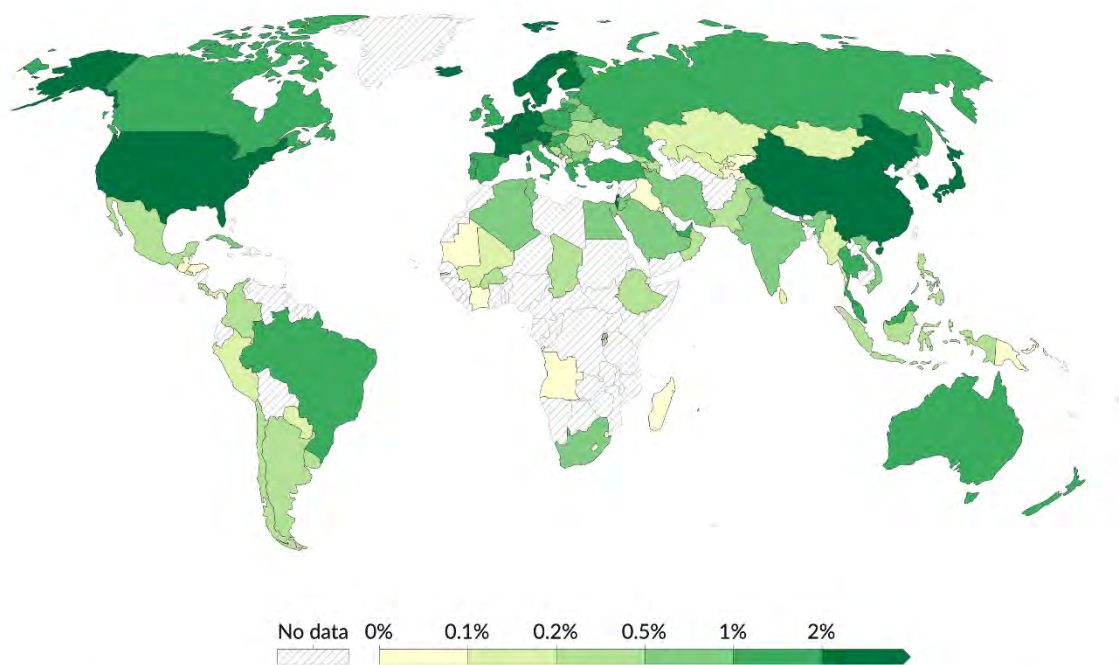
generation of geopolitics is set to be driven by scientific developments, and India’s voice in these historic moments is crucial. S&T diplomacy for India is not just an option but a necessity. It is a pathway to a future where nations collaborate, innovate, and grow together. Harnessing the power of S&T will help India emerge not only as a global leader but also as a force for positive change. There are certain imperatives that we must embark upon.

India’s R&D investment, understandably, given the challenges of our country, has been relatively low, declining from 0.8% of Gross Domestic Product (GDP) in 2009–10 to 0.64% in 2020–21. In comparison, other developing BRICS countries spent more on R&D in 2020-21: Brazil allocated 1.3%, the Russian Federation 1.1%, China 2.4%, and South Africa 0.6%. Most developed countries invest over 2% of their GDP in R&D, while India lags, as shown in Figure 2.

## Research & development spending as a share of GDP, 2021



Includes basic research, applied research, and experimental development.



Data source: UNESCO (via World Bank)

[OurWorldInData.org/research-and-development](https://OurWorldInData.org/research-and-development) | CC BY

Note: Spending includes current and capital expenditures (public and private) on research.

**Figure 2. R&D spending as a share of GDP (2021)**

Increasing the Gross Expenditure on Research and Development (GERD) as a percentage of GDP is crucial for India’s economic growth, innovation, and global competitiveness. Here are some suggestions to strengthen S&T in India:

The Indian government should allocate more funds for R&D in S&T sectors to encourage innovation. The budget allocation should be increased so that the percentage of GDP allocated to R&D matches global standards. Investing in state-of-the-art research facilities and infrastructure is essential for conducting high-quality research. We must upgrade existing research facilities and establish new ones in emerging fields of S&T. Developing and maintaining technological platforms and databases to support R&D activities is necessary.

Provide grants, subsidies, and tax incentives to institutions, universities, and industries involved in R&D with Public-Private Partnerships. Collaboration between the government and the private sector can accelerate

R&D activities by pooling resources and expertise in PPP models. Encourage industries to invest in R&D by offering tax benefits and other incentives. Joint ventures between public and private sectors to share the risks and rewards of R&D projects should be promoted. Establish and fund incubators and accelerators focused on S&T. Tax breaks should be provided along with financial incentives to venture capitalists investing in S&T start-ups.

Increasing funding for universities and institutions to support high-quality research with competitive research grants can be introduced to support innovative projects and encourage interdisciplinary research. Partnerships with international research institutions and organisations to jointly fund and undertake R&D projects and facilitate exchange programs for researchers and scientists must be encouraged. Specialised training programs and workshops should be implemented to enhance researchers' skills and knowledge. In addition, scholarships and fellowships should be offered to attract and retain talented individuals, including the Indian scientific diaspora.

Increasing public awareness and engagement in S&T can foster a culture of innovation and scientific curiosity. Science communication and public engagement programs to raise awareness about the importance of R&D need to be amplified and consolidated. It can be further supported by encouraging citizen science initiatives where the public can participate in scientific research projects. Implementing these suggestions can help India become a global leader in S&T. India's leadership in S&T is about impact and addressing societal challenges. Looking ahead, this leadership must be guided by collaboration, forging international partnerships, sharing knowledge and contributing to global initiatives. This approach will elevate our capabilities and foster a collective global effort to solve pressing challenges.

By continuing this journey with determination and collaboration, we can harness the power of S&T to build a more sustainable, equitable, and prosperous world for all.



# Strengthening Nation through Science: Role of Science Diplomacy in India's Development

**W. Selvamurthy<sup>a,\*</sup>, Sneha Nair<sup>b</sup>**

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## Introduction

Science diplomacy integrates science and diplomacy to foster international cooperation and advance socio-economic progress. It has solidified India's global scientific standing and is pivotal in nation-building efforts, promoting international cooperation, innovation, and sustainable development.<sup>1,2</sup> Science has a significant role in/for diplomacy, and diplomacy also contributes appreciably in strengthening the science base in emerging and critical areas, including the strategic domain.

By leveraging its scientific expertise and diplomatic outreach, India has become a proactive player in the global scientific community, contributing to a more interconnected and prosperous world. This integration of science and diplomacy is crucial for international collaborations, pushing research agendas, and bolstering India's socio-economic progress.<sup>3</sup>

India has used a sophisticated approach to science diplomacy to address global concerns, build alliances, and strengthen its standing in the international arena by utilising its scientific expertise. The Indian Space Research Organisation ([ISRO](#)) exemplifies this through space missions, such as the Mangalyaan and Chandrayaan, which have not only showcased the country's technological capabilities but also fostered international cooperation.<sup>4,5</sup> Collaborative ventures with countries like the United States, Russia, and European nations have enhanced India's space exploration endeavours and strengthened diplomatic ties.<sup>6</sup>

Government institutions like the Department of Science and Technology ([DST](#)) and the Department of Biotechnology ([DBT](#)) have facilitated collaborations in renewable energy, healthcare, and agriculture. Similarly, [CSIR](#), [ICAR](#), and [ICMR](#) have also established strong foreign research collaborations through their bilateral and multilateral S&T schemes.

The present leadership has adopted science as a tactical instrument for diplomacy, resulting in multiple bilateral and international partnerships paving the way for National development. These efforts have placed India on the global scientific pedestal, as reflected in Figure 1.

## Key Examples of Indian Science Diplomacy

India actively engages in various science diplomacy programs to promote international collaboration and

address global challenges. Some illustrative cases of India's science diplomacy include:

- **International Solar Alliance (ISA):** This alliance was co-founded by India and France in 2015 to promote global solar energy deployment, mobilising investments, facilitating technology transfer, and building capacity. It has over 119 member countries.<sup>7</sup> India developed a dedicated SAARC Satellite for civil application.
- **Biotechnology and Healthcare Initiatives:** Through partnerships with organisations like [CEPI](#) and [GAVI](#), India has contributed to global health by participating in vaccine development, disease surveillance, and healthcare capacity-building.
- **Science and Technology Fellowship Programmes:** Launched by various S&T departments of the Government of India, these programmes aim to train Indian scientists, enhancing their capacity to participate in international forums and build collaborations.
- **Participation in Multilateral Forums:** Active involvement in BRICS, G20, and the UN, advocating for inclusive approaches to S&T and contributing to global discussions on sustainable development and climate change. In the G20 Summit held under India's Presidency in 2023, one crucial vertical was Science 20 (S20), focussing on the three major global initiatives, i.e. Clean Energy for a Greener Future, Universal Holistic Health, and Connecting Science to Society.<sup>8</sup>
- **Global Collaborations in S&T:** India's science diplomacy is exemplified through diverse initiatives such as the SAARC's Meteorological Research Centre, Coastal Zone Management Centre, and Agricultural Information Centre, all fostering regional scientific cooperation. The India-based Neutrino Observatory ([INO](#)) collaborates with international partners like [Fermilab](#) (USA), [KEK](#) (Japan) and [CERN](#) (Europe) to advance particle physics.<sup>9</sup> Joint efforts with France's Centre National de la Recherche Scientifique ([CNRS](#)) span nanotechnology, biotechnology and environmental science. The Integrated Long Term Programme (ILTP) with Russia enhances collaboration in space research, biotechnology and advanced materials.<sup>10</sup>



Figure 1. India's Global Position in S&T (Source: Ministry of Science & Technology, Government of India)

Additionally, the Department of Atomic Energy ([DAE](#)) works with the [IAEA](#) and [GCNEP](#), and maintains bilateral agreements to advance India's nuclear energy capabilities.<sup>11</sup>

### Strengthening National Security through Diplomatic Relations

The Defence Research and Development Organisation ([DRDO](#)), India, engages in international collaborations to enhance its R&D capabilities through joint projects, technology transfer agreements, and co-development of defence systems. Notable collaborations include:

- **Israel:** Working with Israel Aerospace Industries ([IAI](#)) on several projects, including the Barak 8 surface-to-air missile system, focusing on missile technology, radar systems, and unmanned aerial vehicles (UAVs).<sup>12,13</sup>
- **Russia:** Maintaining a long-standing defence relationship, highlighted by the BrahMos supersonic cruise missile, which is a joint venture between DRDO and Russia's NPO Mashinostroyenia.<sup>14,15</sup>
- **United States:** Collaborating with American defence agencies and companies, including Lockheed Martin, on the development of the Multi-Role Helicopter (MRH) and participation in joint research initiatives like the Defence Technology and Trade Initiative (DTTI) and Indo-US Joint Technology Group (JTG).<sup>16</sup>
- **France:** Partnering with French defence companies like Dassault Aviation and MBDA on various projects, including missile systems and avionics for fighter jets like the Rafale.<sup>17</sup>
- **United Kingdom:** Engaging in joint research in advanced materials and defence technologies, exemplified by the partnership with Rolls-Royce for developing aircraft engines and related technologies.
- **European Union:** Collaborating with several European defence stations and companies on R&D in electronic warfare, communication systems, and advanced sensors.

### Advancing Nuclear Science and Technology through Diplomacy

The DAE in India engages in extensive international collaborations to advance nuclear science and technology across various domains, including nuclear power, safety, medicine, and fundamental research in physics.<sup>18</sup> Key collaborations include working with the International Atomic Energy Agency ([IAEA](#)) on nuclear safety, security, and safeguards, with India being a significant contributor to IAEA's research and training programs. The India-U.S. Civil Nuclear Agreement, also known as the 123 Agreement, signed in 2008, facilitates cooperation in nuclear energy development and nuclear safety.<sup>19</sup> With Russia, DAE collaborates on the Kudankulam Nuclear Power Plant.<sup>20</sup> The DAE works with Russia's Rosatom on reactor technology, nuclear fuel supply, and safety systems. Partnership with French nuclear energy company EDF and nuclear reactor manufacturer AREVA focuses on technology transfer, safety training, and the planned construction of nuclear reactors at Jaitapur.<sup>21</sup> The European Atomic Energy Community ([Euratom](#)) partners with DAE on nuclear fusion research and other advanced nuclear technologies. India is an associate member of the [ITER](#) project, an international nuclear fusion research and engineering megaproject in France. Similarly, DAE collaborates with the UK, Japan and other countries. These international collaborations enhance DAE's nuclear technology capabilities, ensure the safety and security of its nuclear facilities, and contribute to global nuclear research initiatives.

### Addressing Global Challenges through Science Diplomacy

India's commitment to addressing global challenges through S&T is exemplified by its robust international partnerships, focusing on innovative solutions and sustainable development. Notable initiatives include the Indo-US Science and Technology Forum ([IUSSTF](#)) for clean energy, water, health, and advanced materials, and the India-UK Science and Innovation Council for Newton-Bhabha Fund, [UKIERI](#), and joint research projects in sustainable cities, health, and energy. The Indo-German Science & Technology Centre ([IGSTC](#)) targets advanced manufacturing, biotechnology, and renewable energy, while the India-Israel Industrial R&D and Technological Innovation Fund ([I4F](#)) focuses on water management, agriculture, energy, and healthcare.

Other key collaborations include Indo-Japan Science and Technology Cooperation in AI, robotics, renewable energy, and disaster management technologies; Indo-French Centre for the Promotion of Advanced Research ([IFCPAR/CEFIPRA](#)) for life sciences, IT, environmental science, and industry-academia collaborations; BRICS Science, Technology and Innovation (STI) Framework Program targeting Joint research projects, innovation programs, and capacity-building among BRICS countries, and India-Australia Strategic Research Fund (AISRF) in agriculture, energy, health, and environmental sciences, including marine and climate science.

### **Academic Diplomacy: Harnessing Higher Education for Nation Building**

India's higher education landscape features diverse institutions, from prestigious universities to specialised research centres. Through the lens of science diplomacy, higher education institutions (HEIs) have emerged as pivotal actors in shaping global relations, driving socio-economic development, and advancing national interests. An initiative like a yearly in-person course on science diplomacy focusing on South-South cooperation is being organised under the auspices of the Indian Technical and Economic Cooperation Programme of the Ministry of External Affairs of India since 2017.<sup>22</sup> By nurturing a cadre of science diplomats, India is better equipped to engage in dialogue, negotiate agreements and promote scientific collaboration on the global stage.

Programs like the Indo-US Fulbright Fellowship and Erasmus Mundus promote student mobility and academic cooperation, enriching the educational experience and promoting intercultural dialogue. India's participation in forums such as the BRICS Network University, the Asia-Pacific Economic Cooperation ([APEC](#)) Education Network, and the Association of Indian Universities ([AIU](#)) facilitates academic cooperation, exchange of best practices, and capacity building across borders.

The Pan-African e-Network Project (PAENP) initiative launched by the Government of India exemplifies its commitment to bridging the digital divide between Africa and the rest of the world by providing high-quality education and medical services.<sup>23</sup> The project connects African nations with Indian institutions, facilitating distance education, telemedicine, and e-governance services. Indian Universities such as Amity University, IIT and IGNOU contribute immensely to this project.

### **Conclusions**

The collaborative efforts with countries like the USA, Russia, Israel, France, Japan, Germany, the UK, and Australia have significantly bolstered India's scientific and technological landscape. These partnerships have facilitated the exchange of expertise, technology transfer, joint research, and capacity building, contributing to India's growth as a global leader in S&T. By leveraging international support, India continues to advance its scientific endeavours, addressing national and global challenges. Through initiatives spanning space exploration, healthcare, renewable energy, and beyond, India continues to demonstrate its commitment to harnessing the power of science for the greater good while simultaneously strengthening its bonds with nations across the globe.

However, challenges persist in India's science diplomacy efforts, including resource constraints, bureaucratic hurdles, and geopolitical complexities. Addressing these challenges requires a concerted effort from policymakers, scientists, and diplomats to streamline processes, enhance coordination, and prioritise scientific cooperation in India's foreign policy agenda.

In conclusion, India's strategic embrace of international scientific collaboration underscores its dedication to leveraging global expertise for mutual advancement and addressing shared challenges. By fostering robust partnerships and navigating the intricacies of science diplomacy, India not only elevates its scientific and technological capabilities but also contributes significantly to the development of global scientific community. Overcoming the existing hurdles will require sustained commitment and innovation in policy and practice, ensuring that science remains a cornerstone of India's international relations and a catalyst for sustainable development and global progress.

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# Bridging Innovation Gaps: India's Path to Nanoelectronics Dominance by 2047

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## Introduction

As India ascends to its place as the world's most populous nation<sup>1</sup>, it stands on the cusp of a technological revolution that could transform its economic landscape. By 2047, the centenary of India's independence, the country has the potential to emerge as a global powerhouse in nanoelectronics. However, to realise this vision, India must overcome significant challenges, including bridging the gap between research and innovation, fostering stronger academia-industry collaborations, and building a robust ecosystem for deep-tech startups.

## Harnessing the Demographic Dividend

India's demographic advantage, with a working-age population of around 60% as per the recent economic survey<sup>2</sup>, presents a tremendous opportunity. However, this potential remains largely untapped due to the socio-economic challenges in the country's poorest states. The lack of quality education and skills training in these regions hampers their contribution to the economy. While India has launched multiple science and technology missions, including biotechnology, nanotechnology, cyber-physical systems and AI, the impact of these scientific missions on job creation has been below expectations. It is primarily due to the disconnect between research, which generates new knowledge, and innovation, which transforms this knowledge into new products and services.

India ranks 3<sup>rd</sup> globally in knowledge generation but falls behind in innovation (40<sup>th</sup>) and academia-industry collaborations (66<sup>th</sup>).<sup>3</sup> This disconnect is a significant barrier to technological advancement. To achieve the status of a developed nation by 2047, India must address its lagging technological development in core areas like automated manufacturing, advanced materials, Internet of Things (IoT), and nanoelectronics. These technologies are crucial for driving the country's growth, especially in sectors beyond IT services. However, the key to bridging the gap between research and innovation lies in fostering stronger collaborations between academia and industry. Research thrives in academic institutions, while innovation primarily happens in deep-tech startups and high-tech industries. A more integrated approach is needed, where academia and industry work together to develop new technologies and create jobs. Establishing a supportive ecosystem for deep-tech startups is crucial, as these are the breeding grounds for future industries.<sup>4</sup>

The world is currently experiencing the sixth wave of innovation, focusing on sustainability and automation.<sup>5</sup> Each wave has demanded new skill sets, and this one is no different. To remain competitive, India's academic institutions must continuously evolve their curricula to meet the changing demands of the job market. McKinsey Global Institute highlights the rapid adoption of digital technologies in India, predicting a potential market valuation of USD 435 billion for core digital sectors by 2025.<sup>6</sup> This makes India fertile ground for new technology adoption, particularly in AI and semiconductor manufacturing.

### **Semiconductor Manufacturing: The Way Forward**

Launched in 2021 with a substantial USD 10 billion investment, the India Semiconductor Mission (ISM) is a crucial initiative aimed at establishing India as a prominent global semiconductor manufacturing hub. This mission goes beyond merely boosting the economy; it encompasses national security, technological autonomy, and advancing India's digital future.<sup>7</sup> Encouragingly, early developments signal progress, with major players like Micron, Tata, and CG Power receiving government approvals to set up semiconductor manufacturing facilities in regions like Gujarat and Assam.<sup>8</sup> India is ambitiously targeting a 10% share of the global semiconductor market by 2030, a market expected to be worth USD 1.1 trillion, thus positioning itself as a key international player in this critical industry.<sup>3</sup>

Over the past two decades, India has made significant advancements in manufacturing, particularly in the automotive and pharmaceutical sectors, while cementing its status as a leading global provider of IT services. Projections suggest that the automotive sector could reach USD 300 billion by 2026<sup>9</sup> and the pharmaceutical industry might touch USD 130 billion by 2030.<sup>10</sup> However, these sectors have primarily focused on scaling production rather than pioneering new products. Despite being the third-largest producer of pharmaceuticals globally and a dominant force in IT, India still lags in groundbreaking drug innovations.

The primary barrier to innovation in these sectors is the limited collaboration between academia and industry. India ranks impressively high in research output, standing 3<sup>rd</sup> globally in publications, 6<sup>th</sup> in patent filings, and 9<sup>th</sup> in research quality as measured by citations. In cutting-edge fields like the IoT and sensor technology, Indian academic institutions rank among the top five globally. According to industry forecasts, IoT markets are anticipated to grow to a trillion dollars by 2032. However, despite these academic achievements, the potential for innovation remains largely untapped by both government and industry. Globally, India ranks 66<sup>th</sup> out of 130 countries in academia-industry partnerships, with academic institutions often viewed merely as talent pools rather than sources of innovative ideas or technologies. The lack of strong academia-industry collaborations stifles innovation, preventing the emergence of transformative products similar to Tesla in the automotive sector or disruptive technologies like ChatGPT in the IT industry.<sup>3</sup>

In addition to establishing manufacturing facilities, there must be a concerted effort to foster innovation through collaborations between academia and industry. Taiwan, for instance, boasts a highly integrated semiconductor supply chain, with Taiwan Semiconductor Manufacturing Company Limited (TSMC) leading the way in manufacturing. Taiwanese universities offer a comprehensive range of semiconductor-related courses, ensuring robust education, research, and skill development. They also regularly upgrade their semiconductor infrastructure, encouraging more public-private research partnerships and helping to bridge the talent gap in the semiconductor industry.<sup>11</sup> The United States, through the CHIPS Act, is similarly investing in academia, with the Biden administration allocating over USD 5 billion for research and development in collaboration with academic institutions.<sup>12</sup> To fully harness India's innovation potential, ISM must invest heavily in establishing academia-industry consortia and integrate academic institutions from the outset. India possesses a wealth of talent within its academic institutions, and tapping into this resource requires a unified effort from the government and industry. A strategic and coordinated approach is crucial for directing this talent toward nation-building initiatives rather than merely serving as a training ground for the workforce. Without such alignment, Indian research risks becoming a 'solution looking for a problem' rather than addressing real-world challenges.

A way forward for the country's semiconductor mission, therefore, is to distribute the investment of approximately USD 9 billion in cutting-edge technology areas, as highlighted in the figure below. Additionally, around USD 1 billion is needed for various R&D initiatives involving industry-academia partnerships across different scenarios. To achieve the vision of a developed India by the country's centenary year of independence in 2047, fostering entrepreneurship and creating jobs through collaborative efforts between industry and academic institutions is essential.

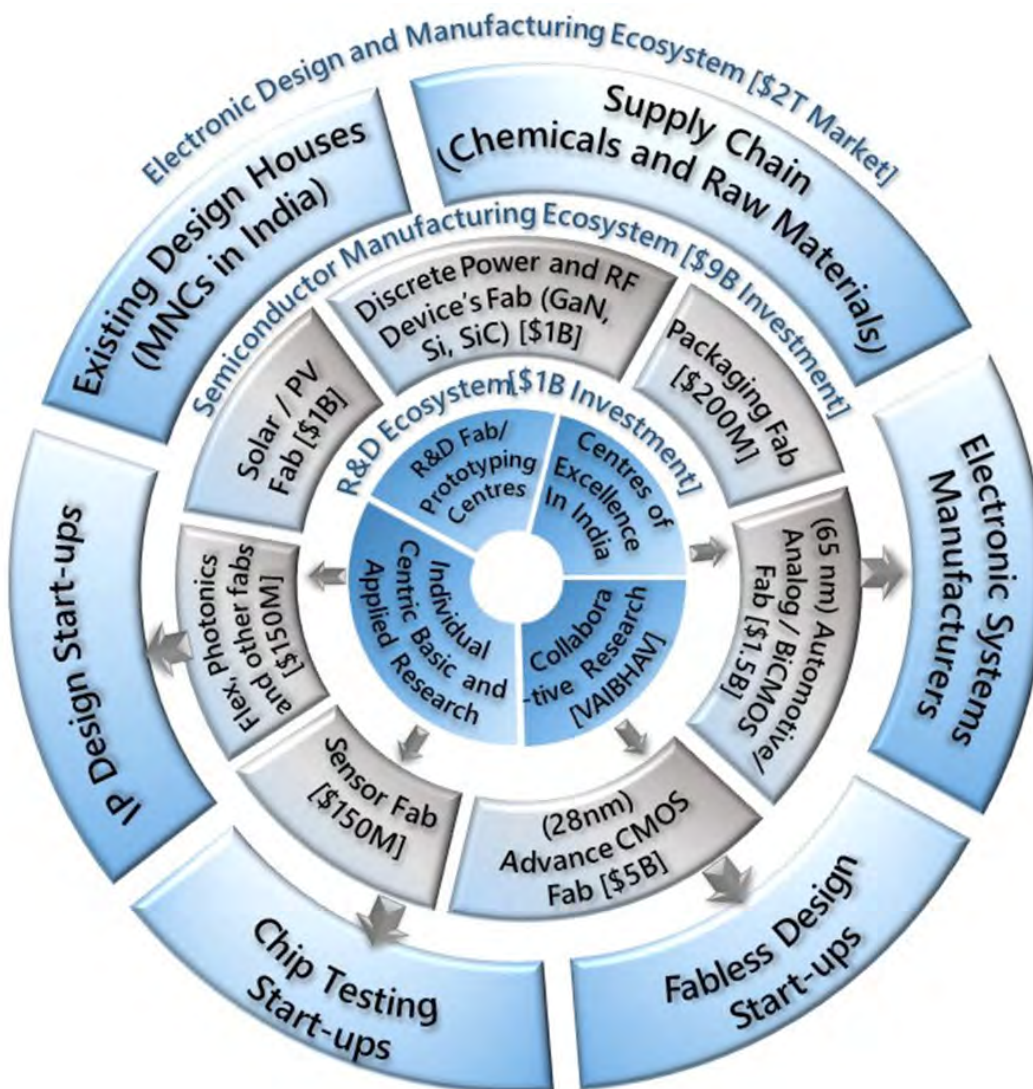


Figure 1. The infographic outlines the holistic approach required to support a USD 2 trillion electronic design and manufacturing ecosystem, highlighting the necessity of a USD 9 billion investment in semiconductor manufacturing and USD 1 billion in collaborative industry-academia R&D (Picture credit: Prof. Mayank Shrivastava, IISc)

### Conclusions

India's journey to becoming a developed nation by 2047 hinges on its ability to harness the potential of nanoelectronics and other emerging technologies. By fostering stronger academia-industry collaborations, building a robust ecosystem for startups, and strategically investing in semiconductor manufacturing, India can position itself as a global leader in technology. The vision of Viksit Bharat is within reach, but a concerted effort from all stakeholders is required to turn this potential into reality.

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# Science, Technology and Education Diplomacy: India's Emerging Influence in Global Affairs

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Historically, nations leading in science, research and development have been the dominating influence on world affairs. The developed world invests heavily in the pursuit of science and the acquisition of knowledge, and it continues to dominate science and technology development, its global use and consequent economic global power.

Post-pandemic, global geopolitics is in flux, and world markets are fluid. The emerging science superpower, China, has suffered a major setback with the erosion of trust, growing acknowledgement of the need for multiple production and supply nodes and the dangers of single large conglomerates holding the world to ransom.

The changing dynamics of global geopolitics have placed India in a fortuitous position to move its scientific machinery centre stage. The resilience and inherent capacity of Indian research institutions and industry was evident during the pandemic, delivering affordable and quality vaccines, diagnostics and healthcare equipment and devices in record time, a model for equitable healthcare for the world.<sup>1</sup>

Sir Peter Gluckman, President of the International Science Council and Founding Chair of the International Network for Governmental Science Advice (INGSA), in his compelling essays on Science Diplomacy, states "One of the most significant manifestations of science's changed relationship with society has been its place within public policy. There is an ever-growing recognition that science has an important role to play in virtually every dimension of policymaking at every level of government, from local to international. These dimensions exist in the social, environmental, and infrastructural areas, as well as in the innovation and economic sectors. Particularly because of the latter, investment by governments in research and development has generally risen, and one consequence of this increased investment has been a much more utilitarian perspective on the role of science from public and politicians alike."<sup>2</sup>

Fortunately for India, there exists much trust and pride amongst the majority population in science and scientists, as evident from the unquestioning support for the many missions of the Indian Space Research Organisation (ISRO) and unhesitant acceptance of vaccines. Science and its potential to influence national and international thought is a card not fully encashed by India. For the developing world or the Global South, India is a fine example of a thriving multicultural democracy with inherent strengths in science and technology and education in STEM, a perfect opportunity for India to flex its soft power in science- using Science Diplomacy to India's advantage.

Science diplomacy can go a long way to developing relationships between two countries. India is emerging as a cogent voice for the Global South, and not without a reason - it has much to contribute to this part of the world:

1. **Affordable quality health care:** The rapid digitisation of healthcare during COVID-19, along with the effective coming together of academia, industry and government to quickly bring to national and international markets low-cost health care products, making it possible for many previously deprived individuals to access quality healthcare services.<sup>1</sup> The Indian “vaccine diplomacy” has successfully positioned India as a global (affordable) vaccine powerhouse.

India has also been acknowledged as the “pharmacy of the world.” The generic medicines the Indian pharma industry supplies to the world at low costs and of high quality are exceptional; India has the largest number of FDA-approved pharma manufacturing units outside of the USA.

India ranks 10<sup>th</sup> in “medical health and wellness tourism” of the 46 global destinations<sup>3</sup>; the affordability and quality of health care, the confidence Indian doctors and nurses elicit/inspire, is an invaluable diplomatic tool for generating goodwill amongst even our sworn “enemies”.

2. **Affordable quality education in STEM:** The Indian education system is admired globally, with multinational corporates/ tech companies dominated by CEOs emerging from the Indian education system. While in India, we strive to make our education system better, it is also essential that India opens access to our educational and research institutions to the Global South. The migration and amalgamation of different cultures and brain circulation will enrich any education system. The people educated in India return to their country as “Indian brand ambassadors” for life. Many political leaders of neighbouring countries have acquired higher education in India.

The establishment of the IIT Madras and IIT Delhi offshore campuses in Zanzibar, Tanzania, and Abu Dhabi, United Arab Emirates, respectively are perfect examples of education and science diplomacy, cementing the bilateral relationship between India and these countries definitively. “Education in STEM Diplomacy” has an unlocked potential, and attention must be paid to the ease of education in India.

Research Institutes could consider establishing “Short-Term Training Courses” in cutting-edge science and technology, inviting participation from low and middle income countries (LMICs); there is a huge demand from these countries for high-value short-term training programs. iBRIC-Translational Health Science and Technology Institute, Faridabad, conducted one such training course in advanced vaccinology with an overwhelming number of applications from LMICs. Ministries of External Affairs and Home Affairs must support higher education and research institutes in this diplomatic endeavour.

3. **Bilateral collaborations in science and technology:** Few enterprises in the world are as thoroughly internationalised as science; with decided and emphatic global impact. Collaborating with the biggest science nations participating in the most ambitious scientific experiments - International Thermonuclear Experimental Reactor (ITER), Large Hadron Collider (LHC), Laser Interferometer Gravitational-Wave Observatory (LIGO), and steering global challenges - climate change, disaster preparedness, positions Indian science well with the competitive global best, underscoring India as an emerging scientific powerhouse.

International links strategically strengthen expertise and quality of research, increasing the chance that useful knowledge will be taken forward, accelerating the growth of new knowledge. India, one of the largest emerging economies, can use science within the diplomatic spheres to advance its interests in both the Global North and South while understanding varied socio-economic aspirations and needs of individual nations.

Science Diplomacy is a powerful albeit underutilised tool, however, with increasing confidence of the government in Indian science, the scientific soft power will slowly and steadily become a major contributing factor to the increasing influence of the Indian voice in global affairs.

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## Capacity Building of Science Diplomats\*

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Science Diplomats are flag-bearers for developing knowledge-based relationships between nations. The inculcation of skill sets such as perception of a broad spectrum of science and technology and its impact on the economy, negotiations, understanding of foreign policy, capitalising on geopolitical tensions, interaction with counterparts, overcoming cultural and language barriers, encompassing global challenges, fusion of technological advancements, tripartite or multilateral cooperation, integration of human resources, facilitating the scientific movement, usage of informal interactions for policy breakthroughs and developing long term relationship need extensive priming.

With these critical skill sets, science diplomats are uniquely positioned to navigate the intersection of science and foreign policy, especially as science diplomacy becomes crucial in addressing global challenges and shaping international relations. Science diplomacy needs informed advice (mainly data- and evidence-driven) to engage with multiple entities in order to facilitate strategic agreements, promote scientific, technological, and innovative trade, and foster a cordial relationship. General diplomatic activities involving STEM topics include, among others, negotiating international agreements (such as climate accords), participating in international science and technology cooperatives, establishing trade deals (including technology transfers), addressing cybersecurity and internet governance, leading international public health initiatives, working on non-proliferation agreements, drafting démarches, promoting STEM education and research collaborations, and engaging in international standard-setting bodies.<sup>1</sup>

Successful science diplomacy depends on negotiators having a solid grasp of the underlying science. This means it requires either a scientist with exceptional diplomatic skills (diplomat scientist) or a skilled diplomat who deeply understands the scientific implications (scientist diplomat/career diplomat).<sup>2</sup> Sometimes, a civil servant, embassy staff, science/policy managers, innovation delegates, liaison officers and policy scientists also mediate science diplomacy.<sup>3</sup> A science diplomat is an umbrella term for science counsellors, science attachés or science ambassadors. A science diplomat facilitates international collaborations, the exchange of scientists, capacity building, technology exchange/licensing, encourages innovations and industrial trade-offs, dissolves cultural barriers, and builds trust and long-term relationships.<sup>4</sup>

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\* Views in the article are of the authors and do not belong to the organisations they represent.

## Capacity Building

Foreign policies, economic demands, technological competitions, relevant policies for technological supremacy and the world's polarity influence the role of science diplomats. In order to delegate their responsibilities, science diplomats need multiple skills such as diplomacy, building trust using the soft power of science, human resource management, etc. Science diplomats often acquire these skills through empirical learning, i.e., experience, which is indeed time-consuming and opportunity-oriented. Therefore, it is pertinent that science diplomats must be trained in advance before deputing them on a foreign mission.

## Current Training Agencies

Globally, some agencies provide short-term training courses in science diplomacy. Such courses are offered by the American Association for the Advancement of Science (AAAS), USA and Jefferson Science Fellowships by the National Academies of Sciences, Engineering, and Medicine, USA and Research and Information System for Developing Countries (RIS), India, as well as a few online platforms.<sup>1,5,6</sup> To strengthen the capacities of science diplomats from developing countries, AAAS and UNESCO-The World Academy of Sciences (TWAS), organise an annual summer course on science diplomacy in Trieste, Italy.<sup>7</sup> Further, the Global Young Academy also conducts workshops and seminars on science diplomacy.<sup>8</sup> The Geneva Science and Diplomacy Anticipator (GESDA) Foundation hosts the Geneva Science Diplomacy Week, an annual event launched in 2022. This week-long program offers a unique learning and networking experience, connecting current and future leaders with international agencies, diplomatic missions, academic institutions, global NGOs, and technology leaders to discuss and shape the future of science and multilateralism.<sup>9</sup> In 1989, establishing the Centre for Science and Technology of the Non-Aligned and Other Developing Countries (NAM S&T Centre) in New Delhi is one of the few steps towards promoting science diplomacy.<sup>10</sup> The Ministry of External Affairs, India, also support courses on Science Diplomacy under its Indian Technical and Economic Cooperation (ITEC) programme at eminent training facilities and higher education institutions.<sup>11</sup>

## Recommendations

Science diplomacy is a key component of the foreign policy of many developed and some developing countries. However, this concept is either non-existent or significantly under-utilised in much of the world.<sup>12</sup> To fully benefit from science diplomacy, these countries must invest in building the capacity of science diplomats and deploying them effectively. Here, a few measures are recommended to ensure the professional growth, personal development and productivity of science diplomats.

Science diplomacy is mostly rendered to career diplomats with limited scientific exposure, whereas some nations have started placing scientists on such assignments. Developing countries like India are still placing ten science diplomats abroad in just six out of the 195 countries in the world, which is reasonably imbalanced and minuscule.<sup>13</sup> India must target at least 10-20 countries consistently high in the global innovation index to ensure diversified cooperation, technology exchange and dissolving the barriers to scientific advancements. The challenge can be easily relieved by widening the scope of the existing science diplomats. From the Indian perspective, it would be helpful to expand the number and have Science Diplomats posted in Brussels (for Belgium and European Union), Toronto or Vancouver (Canada), Sydney or Melbourne (for Australia and Oceania), Paris/ London (France and UK), Addis (Ethiopia and African Union), Tel Aviv (Israel), Beijing/ Seoul (China and Korea), Brasilia (Brazil and Latin American countries).

Career diplomats at most global diplomatic stations serve as science diplomats, bridging science and diplomacy. While scientists and academicians may be assigned to diplomatic roles, they often have a limited understanding of diplomatic processes. Therefore, training scientists through desk experience is crucial to align them with diplomatic assignments over a substantial period. Many countries appoint science attachés for 2-4 years, though extending their term or rotating their postings could better leverage their relationships and expertise. This longer tenure allows for deeper scientific cooperation, fostering goodwill between nations. Their experience can be utilised upon their return to build collaborations with new stakeholders.

Science is broad, but scientists or academics assigned diplomatic roles often specialise in a specific area. However, the role of a science diplomat requires a broad understanding and openness to various scientific disciplines, innovations, and technological advancements. A science diplomat must embrace science holistically, beyond their own expertise, and be able to learn from the host country while sharing relevant developments with their home country. This approach fosters strong relationships and enables new collaborations.

Science cooperation produces return through persistent and long-term engagement, while career diplomats emphasise on current political circumstances and immediate return in cooperation. In order to sustain and thrive in new scientific collaborations, a science diplomat trained in the linguistic, cultural and diplomatic fabric of a foreign nation can be very helpful in bringing together the scientific and diplomatic community of the cooperating nations.

The role of a science diplomat is vital in addressing global challenges like pandemics, requiring rapid cooperation and solutions, as seen during COVID-19. The pandemic reshaped the relationship between governments, policymakers, and the scientific community, highlighting the need for strong communication skills.<sup>14</sup> Diplomacy relies on effective interaction, and science diplomats must stay updated on evolving communication tools. Continuous training is essential to adapt to these changes and master the art of clear, secure, and efficient communication. They must also learn to distinguish valuable and sensitive information from general content, especially in the age of social media, while safeguarding against misinformation.

Cooperation in high-end technologies is extremely challenging, considering their economic impact. A scientific diplomat can play a vital role in fine-tuning and aligning national demands to create win-win outcomes for all stakeholders. Sharp negotiation skills and strong logical reasoning can be game-changers in this process. To be effective, a science diplomat must also understand the economic aspects of such cooperation. To develop these negotiation skills, science diplomats should be exposed to high-level meetings involving multiple nations, such as G20, BRICS, Shanghai Cooperation Organization and Mission Innovation. They can also learn from case studies, simulated models like pilots or specially designed games.<sup>15,16</sup> On these global platforms, a nation's position is driven by well-informed scientific data. Therefore, a science diplomat must be skilled in data visualisation, assessing its relevance, and using it to support decision-making.

Science has long played a key role in fostering collaborations between nations, even in adversarial situations. Examples include SESAME in the Arab world, the International Space Station initiative between the USA and Russia during the Cold War, and health cooperation between the USA and Cuba. Building relationships under such conditions is a daunting task, requiring patience and continuous efforts. Persistent pursuance needs a high level of interpersonal and manoeuvrability skills. Such skills can be honed by closely working with experienced career diplomats.

In tense negotiations, there is also the risk of scientific collaborations being exploited for espionage. A science diplomat must remain vigilant and avoid involvement in any suspicious activities. Negotiations between opposing nations often involve tension, so staying calm, composed and non-reactive is essential in establishing cooperation. Stress management techniques are invaluable for science diplomats in these high-pressure situations.

A country's progress depends on factors like foreign investment, technology exchange, and ease of doing business, but pursuing these goals is challenging, especially in countries with strict regulatory environments. Therefore, science diplomats must thoroughly understand potential obstacles and approach foreign partners strategically. Given the economic impact of technology-related matters, regular training is needed to stay updated on relevant issues.

Translating scientific advancements into marketable products requires huge investment and co-sharing of the patents for broader market access. A science diplomat must have a stronger understanding of national and international patent regimes, as well as the regulatory environment of the host country, to avoid costly legal disputes arising from contentious data sharing and patentisation issues.<sup>17</sup>

Informal interactions, such as conversations over coffee or shared meals, often create a relaxed

atmosphere where real problems can be discussed and potential solutions can be explored. A science diplomat should be mindful of cultural norms to foster closer emotional connections.

During their tenure, science diplomats gain valuable professional experience, making them an asset to any organisation. Their skills and expertise can be utilised as consultants on key assignments, especially in negotiations or science-related foreign affairs.

## Conclusions

The adaptability and skills of a science diplomat require thorough pre-departure training to effectively navigate diplomatic challenges, foster long-term relationships between the nations and ensure fair and equitable promotion of science and economic benefits for all participating countries.

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## Bridging Science Diplomacy and Science Communication: Recommendations for the Latin American and the Caribbean (LAC) Region

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### Introduction

Science, Technology and Innovation (STI) are becoming increasingly prominent in international affairs, significantly influencing geopolitical dynamics and every nation's global standing. Concurrently, international scientific collaboration and science diplomacy are crucial in facilitating the discovery and application of relevant knowledge to address today's global challenges and enhance relations between countries.<sup>1</sup> Science diplomacy can thus be defined as a tool that intersects scientific collaboration, technology, international relations, and public policy, emphasising the role of science in fostering international cooperation and addressing global challenges.<sup>2</sup>

Science communication emerges as an essential tool for advancing foreign policy objectives through science diplomacy<sup>3</sup>, especially during complex and challenging situations. It facilitates informed decision-making and aids in negotiating international agreements and treaties. Disseminating scientific knowledge beyond academia is crucial for addressing global and regional challenges and contributing to evidence-informed policymaking. Transdisciplinary collaboration in this context is needed to produce relevant, legitimate, and salient knowledge to assist decision-making in crucial moments posed by environmental and global problems, such as the COVID-19 pandemic. However, a survey conducted in Latin America in 2020 confirmed that scientific knowledge does not effectively reach decision-makers<sup>4</sup>, highlighting the imperative need to leverage effective science communication in policy and diplomacy.

This article explores the synergies between science communication and science diplomacy, highlighting culturally relevant and effective science communication within the Latin American and the Caribbean (LAC) region. We will focus on this region as a unique context where emergent efforts to build capacities in science diplomacy and science communication are built. Finally, this article provides recommendations for building bridges between scientists, diplomats, policymakers, and the public by offering insights on addressing global and regional challenges through science communication and science diplomacy.

## Science Diplomacy in the LAC Region: Challenges and Opportunities

In LAC countries, science diplomacy reflects the region’s diverse socio-economic, political, and environmental landscapes. These complexities pose challenges in implementing and developing science diplomacy initiatives, often linked to funding constraints, resource limitations, inequality, political and economic instability, and institutional fragmentation.<sup>5</sup> Since the UNESCO Regional Office of Science for Latin America and the Caribbean introduced science diplomacy into its 2015 sustainable development agenda<sup>6</sup>, it has gained prominence among LAC countries and multilateral organisations. Furthermore, the relevance of science diplomacy has notably grown in fields such as environmental sciences, public health, agriculture, and renewable energy, as these sectors require international collaboration to address common challenges and meet mutual needs effectively.<sup>7</sup>

Interest in science diplomacy, public policies, and public engagement is rapidly growing within the LAC region despite ongoing disparities in human, financial, and institutional capacities among countries.<sup>8</sup> In recent years, several key science diplomacy efforts and capacity-building initiatives have been launched (Table 1), signalling a stronger commitment to scientific collaboration, training in science diplomacy, international knowledge exchange, and developing national scientific policies. These initiatives are designed to address region-specific challenges and incorporate science communication as a central component to strengthen the connections between science, policy, and society. This training is essential for enhancing scientific and diplomatic skills and helping the public grasp the importance of STI in improving societal well-being.

The expansion of these initiatives highlights the growing significance of science diplomacy and science communication in the region. It empowers nations to participate actively in global and regional scientific cooperation, negotiations, and evidence-informed policymaking. These capacity-building efforts, although hosted in different countries, are centred on regional training for policymakers and scientists. By promoting open and effective exchange of scientific advancements and engagement in capacity-building training, these initiatives foster transparency, reduce misunderstandings, and strengthen diplomatic relations among LAC countries.

**Table 1. Recent science diplomacy efforts and capacity-building initiatives in the LAC region**

Country	Initiatives
<b>Panama</b>	<ol style="list-style-type: none"> <li><a href="#">National Strategic Plan for Science, Technology, and Innovation Diplomacy</a></li> <li><a href="#">Inter-American Institute for Global Change Research (IAI) Science Diplomacy Center (SDC)</a></li> <li><a href="#">Science Diplomacy Training Program for Policy Makers in the Americas</a></li> <li><a href="#">Building Bridges between Science and Sustainable Public Policies</a></li> </ol>
<b>Colombia</b>	<ol style="list-style-type: none"> <li>National Science Diplomacy Strategy in progress</li> <li><a href="#">Virtual science diplomacy course from Universidad Externado</a></li> <li><a href="#">Introduction to Science Diplomacy virtual course from Corporación Universitaria del Caribe (CECAR)</a></li> <li><a href="#">Virtual science diplomacy and strategic engagement course from Universidad de Antioquia</a></li> </ol>
<b>Brazil</b>	<ol style="list-style-type: none"> <li><a href="#">São Paulo Innovation and Science Diplomacy School (InnSciD SP)</a></li> </ol>
<b>Chile</b>	<ol style="list-style-type: none"> <li><a href="#">Virtual science diplomacy course from Universidad de Chile</a></li> <li><a href="#">Science diplomacy course at the Diplomatic Academy of Chile</a></li> </ol>
<b>Mexico</b>	<ol style="list-style-type: none"> <li><a href="#">Critical Introduction to Science Diplomacy course at Universidad Nacional Autónoma de México</a></li> </ol>

<b>Uruguay</b>	<ol style="list-style-type: none"> <li>1. <a href="#">Science Diplomacy Applied to Neurosciences for the Global South hybrid course</a></li> </ol>
<b>Argentina</b>	<ol style="list-style-type: none"> <li>1. <a href="#">Graduate Program in Science Diplomacy from Universidad Nacional de la Plata</a></li> <li>2. <a href="#">Climate, Environment, and Health for the Americas workshop</a></li> <li>3. <a href="#">Seminar on Science Diplomacy in the Southern Common Market (MERCOSUR)</a></li> </ol>

### Science Communication as a Fundamental Component of Science Diplomacy in the LAC Region

Science communication is conveying scientific information about science, technology, engineering, mathematics, and medicine (STEMM) in a clear, accessible, and compelling manner.<sup>9</sup> Its purpose is to make complex scientific concepts and findings understandable and relevant to non-experts, including the public, policymakers, and stakeholders in various fields. Previous research has identified capacity-building in science communication as essential for effective evidence-informed policymaking and bridging the gap between scientists, the public, policymakers, and diplomats in the LAC region.<sup>4,10</sup> Communicating with a non-scientific audience requires training, which some Latin American researchers have reported lacking.<sup>4</sup> Without a doubt, these communities have a gap in their practices, expectations, and common language.<sup>11</sup> Although there is no simple solution, science communication stands out as the most crucial skill for bridging this gap.<sup>12,13,14</sup>

Global challenges such as the COVID-19 pandemic and environmental change highlighted the critical role of effective science communication in combating misinformation worldwide and in the LAC region.<sup>15,16</sup> These challenges highlight the responsibility of scientists to disseminate their findings in ways that address global and regional issues through international cooperation, thereby contributing to evidence-informed policymaking.<sup>17,18</sup> To effectively communicate science and advance science diplomacy, scientists must develop skills tailored to engage with diplomats, policymakers, and the public.

Understanding regional challenges and cultural contexts is essential for effective science communication to inform policymaking and advance science diplomacy. In this regard, culturally relevant science communication, defined as connecting science to people’s everyday lives, identities, needs, and concerns through their cultural context<sup>19</sup>, emerges as a tool to enhance the relevance and impact of science for policymakers, diplomats, and the public in the LAC region. Developing tailored science communication and diplomacy strategies that are culturally and locally relevant and inclusive of different forms of knowledge and expertise is crucial. Therefore, it is imperative to improve and create new training programs for local scientists, policymakers, diplomats, and communicators that address specific cultural and contextual challenges, thereby building their capacity for effective science communication.

Such approaches will facilitate trust and collaboration among countries to tackle common challenges. They will also inform policymaking and encourage international cooperation by helping diplomats and decision-makers understand complex scientific concepts. Moreover, effective science communication will support efforts to address global issues that demand coordinated, cross-border solutions while promoting cultural exchange and engagement through joint scientific initiatives.<sup>5</sup>

By translating complex scientific ideas into clear and accessible language, science communication helps the public grasp the significance of science diplomacy and international scientific collaborations. It illustrates how global research partnerships address critical issues like climate change and pandemics, demonstrating their tangible benefits. Effective communication builds public trust through transparency about research goals and outcomes and engages the public by highlighting the interconnected nature of global scientific efforts. This clarity and openness are crucial for building support for international cooperation and emphasizing the role of the public in these efforts.

## Recommendations to Build Bridges between the Public, Scientists, Diplomats and Policymakers

Science diplomacy serves as a bridge between nations, leveraging scientific knowledge and expertise to foster cooperation, build public trust, and address shared challenges. Effective science communication is essential, translating complex scientific knowledge into actionable insights that resonate with stakeholders and public opinion and promoting informed decision-making at multiple levels. In today's interconnected world, the synergy between science diplomacy and science communication is vital for strengthening connections among governments, international organisations, civil society, academia, and the private sector, especially when addressing transnational issues like public health, sustainable development, and environmental challenges.

The COVID-19 pandemic underscored the vital role of science diplomacy in coordinating international research, sharing essential data, and developing global health strategies. It also emphasised the need for transparent and effective science communication to combat misinformation, shape public perceptions, and build trust in scientific guidance. To strengthen science communication within the framework of science diplomacy, the following strategies should be prioritised:

- 1. Understand local contexts:** Recognise LAC countries' unique socio-political and cultural contexts. Frame scientific content to align with policymakers' priorities and goals, bridging the gap between science and society and ensuring diverse perspectives are considered in decision-making processes.
- 2. Show relevance and impact:** Use concrete examples and case studies to demonstrate how scientific findings address local issues like economic development, public health, and environmental protection.
- 3. Communicate clearly:** Avoid jargons, use straightforward language, and incorporate local languages and culturally appropriate visual aids for better comprehension.
- 4. Build trust and relationships:** Engage in continuous dialogue with policymakers, diplomats, and the public, respecting their perspectives and values and being open to feedback.
- 5. Tailor messages to local needs:** Align scientific communication to match local priorities, traditions, and political contexts, ensuring it resonates with the public, policymakers, and diplomats. Community-driven initiatives and non-governmental organisations (NGOs) addressing global challenges through science-based solutions can amplify impact and support broader diplomatic objectives.
- 6. Be proactive and responsive:** Anticipate needs and questions, provide timely updates and feedback, and address emerging issues promptly.
- 7. Maintain objectivity:** Present evidence transparently, ensuring the message remains unbiased and credible.

Integrating these approaches allows science diplomacy to effectively harness science communication for navigating the complexities of our globalised world and achieving sustainable solutions to urgent issues. This process begins with capacity-building programs that enhance science communication skills and foster intersectoral interactions. Well-trained public officials and community members are better equipped to comprehend complex issues, initiate meaningful dialogues, and make informed decisions. This fosters trust, ensures policies reflect community needs and promotes an inclusive and informed society. Incorporating these elements can help build a more resilient, sustainable, and equitable future for the LAC region.

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## Power of Science Diplomacy: Key Insights from 2024 AAAS-TWAS Course on Science Diplomacy

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### Introduction

Science diplomacy integrates scientific research with international relations to tackle global challenges. It leverages international scientific collaborations to foster positive diplomatic partnerships, address transboundary issues, and promote peace and sustainable development. Science diplomacy encompasses three primary dimensions: science in diplomacy (using scientific evidence to guide diplomatic negotiations), diplomacy for science (enhancing international scientific cooperation), and science for diplomacy (strengthening diplomatic relationships through scientific collaboration).

In an interconnected world, climate change, pandemics, and resource scarcity require collaborative approaches that transcend national boundaries. Science diplomacy offers a strategic avenue for securing such cooperation, tapping into the collective expertise and resources of the global scientific community. This field enables countries to work together towards common goals by leveraging scientific expertise, accelerating innovation, enhancing research capacity, and developing evidence-based policies contributing to global security and stability.

Science diplomacy fosters dialogue and trust, enabling the resolution of global challenges. It involves scientists working closely with policymakers and diplomats to translate scientific findings into actionable policies and enhance international research cooperation. This collaborative approach serves as a bridge between nations in addressing critical issues such as climate change, public health and technological advances. By integrating scientific insights into policymaking, science diplomacy empowers nations to make informed decisions that benefit the global community and individual countries.

Prioritising science diplomacy is crucial for promoting peace, prosperity, and sustainable development across borders. This collaboration enables countries to pool their knowledge, technology and resources, leading to more effective solutions to transboundary problems. Science diplomacy is vital in fostering collaborative problem-solving and advancing sustainable development.

Promoting the importance of science diplomacy, the 11<sup>th</sup> annual AAAS-TWAS Course on Science Diplomacy took place in Trieste, Italy, from June 18-20, 2024. Co-organised by The World Academy of Sciences (TWAS) and the American Association for the Advancement of Science (AAAS), the course gathered 20 early-career scientists and policymakers from 11 countries to enhance their skills in science diplomacy.



Participants of the 11<sup>th</sup> AAAS-TWAS Course on Science Diplomacy (Photo credit: G. Ortolani/TWAS)

These aspiring science diplomats engaged in role-playing simulations designed to develop their active listening, respect and negotiation abilities. Working in pairs – an early-career scientist and a policymaker usually from the same country – participants tackled complex problems through diplomacy, gaining firsthand experience in how science can guide political decisions. Established in 2011, this collaboration between AAAS and TWAS has trained 388 alums from 89 countries since its first program in 2014, with many graduates now advising policymakers on international issues. The course is supported financially by the Swedish International Development Cooperation Agency (Sida) and AAAS, with additional funding from the Organization for Women in Science for the Developing World (OWSD) this year.

### **Key Takeaways from the Course**

During the course, participants engaged in interactive role-playing simulations designed to develop critical diplomatic skills. They honed their abilities of actively listening and immersing themselves in realistic negotiation scenarios, all aimed at fostering transparency and collaboration in international science policy.

Dr Gihan Kamel's experience with the SESAME (Synchrotron Light for Experimental Science and Applications in the Middle East) project, where she works as an Infrared Beamline Principal Scientist, reveals the profound impact of emotions on the art of science diplomacy. This experience serves as a timely reminder that, in pursuing scientific progress, the emotional undercurrents that drive individuals are often overlooked. Hope is a potent force that can mobilise individuals to strive toward a common goal. It ignites passion, fosters collaboration and builds bridges between nations. When infused with a sense of vision, hope inspires people to work together toward a shared objective, transcending boundaries and cultivating a sense of community. In diplomacy and science, there is often a tendency to focus primarily on the technical aspects of work, thereby neglecting the emotional intelligence essential for building trust and forging meaningful relationships. Emotions are integral to the human experience; they form the fabric that weaves collective pursuits together and inspires individuals to strive for greatness. Gihan's discussion of the SESAME project within the current geopolitical environment exemplifies the importance of emotional intelligence in science diplomacy. Acknowledging and harnessing the power of emotions makes it possible to create positive

change. This approach can inspire individuals, build trust, enhance and expand scientific endeavours, and forge lasting bonds that transcend borders and disciplines.

This training tackled complex transboundary issues like water management conflicts and biodiversity preservation challenges, emphasising the need for scientific input in policymaking and cooperative conflict resolution. Participants sharpened their active listening and negotiation skills through exercises addressing real-world issues, such as disputes over transboundary water resources. A fictional scenario involving a river demonstrated the diplomatic complexities of managing shared resources among multiple countries, highlighting the necessity for neutrality and appreciating different negotiation perspectives.

Negotiating water rights among nations sharing transboundary resources poses scientific and diplomatic challenges. Different legal frameworks can cause conflicts over resource allocation and competing interests, complicating the balance of needs, mainly when one nation's requirements affect another's water security. Enhanced data collection on water availability, usage, and quality is essential for informed decision-making and equitable agreements.



**Minister Plenipotentiary Giuseppe Pastorelli (on video), Deputy Director General for the Promotion of Italy at the Italian Ministry of Foreign Affairs and International Cooperation, sharing insights with the participants (Photo credit: G. Ortolani/TWAS)**

Historical and political tensions can hinder negotiations because long-standing distrust prevents open and productive conversations. Environmental degradation and climate change further complicate discussions by exacerbating water scarcity. Differing national priorities regarding environmental protection versus economic development can lead to disagreements on resource-sharing strategies. Moreover, some countries may need more institutional capacity or resources for effective negotiation, causing imbalances.

Ensuring the long-term sustainability of agreements is a significant challenge, as water resources are finite, and future demands must be anticipated. Establishing robust dispute resolution mechanisms and engaging local communities are crucial for achieving equitable outcomes, although this may require including diverse perspectives and interests in negotiations.

Addressing the challenges of transboundary water resource management necessitates a collaborative approach that integrates diplomacy, scientific expertise, and stakeholder engagement to formulate equitable and sustainable agreements. The simulated scenario provided a unique opportunity to balance technical knowledge with diplomatic insight.



**Participants involved in simulated negotiations building on discussions about active listening and transparent negotiation techniques (Photo credit: G. Ortolani/TWAS)**

As participants aimed for definitive solutions, they learned that diplomacy often requires compromise and consideration of diverse national interests. Their scientific expertise was instrumental in navigating multifaceted challenges, highlighting the importance of clear communication and adaptability in international discussions.

This experience highlighted that scientists can be valuable assets in diplomacy if they effectively translate scientific knowledge into actionable insights for policymakers. Ultimately, it demonstrated the intricate interplay between science and diplomacy, emphasizing the need for interdisciplinary collaboration in addressing global issues.

## **Conclusions**

The AAAS-TWAS course offered practical applications rather than just theoretical knowledge. The diverse group of participants, interactive sessions, and expert-led discussions provided valuable insights and experiences.

This course opened our eyes to a new dimension of impact: the world of science diplomacy. Imagine a scientist sitting at the negotiation table, using their expertise to tackle global challenges alongside diplomats. This is the essence of science diplomacy.

The course presented simulated negotiations around topics such as the transboundary dam project and the conservation of endangered species in a transboundary forest, challenging participants to balance data reliance with the need for compromise and political navigation.

Initially, scientists' instinct was to seek definitive solutions, a natural reflex. However, diplomacy requires understanding, compromise, and navigating political landscapes. This is where authentic learning begins. The scientific background proved valuable in analysing impacts, translating technical data and suggesting mitigation strategies. The key takeaway was the importance of effective communication, bridging the gap between scientific research and policy by translating complex knowledge into actionable insights for policymakers.

This enlightening course highlighted the challenges and opportunities at the intersection of science and diplomacy. It showed how scientists could be powerful assets on the international stage when they effectively communicate their expertise. This skill is essential for addressing today's complex global challenges, from climate change to resource management. Science diplomacy offers a powerful tool for tackling these issues and building a sustainable future for all.

# NEWS //

## ***EU Science Diplomacy Alliance holds the third edition of a Science Diplomacy training for COST***

On 20 June 2024, the EU Science Diplomacy Alliance partnered with the COST Association (European Cooperation in Science and Technology) to organise a science diplomacy training at COST’s headquarters in Brussels. Over 30 researchers from newly funded COST actions participated, marking the third edition of this collaboration. Regardless of their scientific disciplines, participants expressed a strong interest

in how science diplomacy intersects with their work. The training featured insights from experts, including discussions on the EU’s strategic approach to science diplomacy, international cooperation and research security. Interactive group work and an interview with Ágota Dávid, a practising science diplomat, enriched the experience.

## ***Launching of ASEAN-India Fellowship for Higher Education in Agriculture and Allied Sciences***

The ASEAN-India Fellowship for Higher Education in Agriculture and Allied Sciences was launched by the Union Minister of Agriculture and Farmers’ Welfare and Rural Development, Shri Shivraj Singh Chouhan, at the Indian Council of Agricultural Research (ICAR), Pusa, New Delhi, on 14 August 2024. India has maintained a strong partnership with ASEAN member countries since ASEAN’s inception. ASEAN is the cornerstone of India’s ‘Act East Policy’ and the ‘Indo-Pacific Vision’ built upon it. India remains committed

to ASEAN unity, centrality and its Indo-Pacific outlook. The fellowship aims to support postgraduate studies in emerging fields within agriculture and allied sciences. Participating Indian faculty members will be facilitated with introductory visits to ASEAN member countries to aid ASEAN capacity-building, promoting the development of a pool of expert human resources in ASEAN for the growth of agriculture and allied sciences.

# MoUs Signed //

## ***Signing of Donor Agreement between Ministry of Ayush, Government of India and WHO***

On 31 July 2024, the Ministry of Ayush, the Government of India, and the World Health Organization (WHO) signed a Donor Agreement at WHO Headquarters in Geneva. The agreement outlines financial support for the WHO Global Traditional Medicine Centre (GTMC) in Jamnagar, Gujarat. India will contribute US\$ 85 million over ten years (2022-2032) to fund the centre’s operations. The interim office of the WHO-GTMC is already operational, focusing on capacity-building

and training programs, including campus-based, residential, and web-based sessions in collaboration with the WHO Academy and other strategic partners. The GTMC is established as a key knowledge hub for evidence-based Traditional, Complementary, and Integrative Medicine (TCIM) aimed at enhancing global health. This collaboration aligns with the Sustainable Development Goals, benefiting both India and the global health community.

## *FSSAI sign MoU with Brazil's Ministry of Agriculture and Livestock in the Area of Food Safety*

The Food Safety and Standards Authority of India (FSSAI) signed an MoU with the Ministry of Agriculture and Livestock (MAPA) of Brazil on the sidelines of the Global Food Regulators Summit, 2024, at Bharat Mandapam, New Delhi, on 21 September 2024. The MoU aims to improve food safety through joint

projects and technical collaboration. It was signed by Mr Carlos Henrique Baqueta Fávoro, Agriculture and Livestock Minister, Brazil and counter-signed by Shri G. Kamala Vardhana Rao, CEO of FSSAI. Both FSSAI and MAPA are committed to fostering a mutually beneficial and productive partnership.

## New Publications

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Echeverría-King LF, Pantović B, Pinerós-Ayala RE, Figueroa P, Flores-Zamora AF (2024) **Developments and Approaches in Science Diplomacy: Latin America and the Caribbean**. *IGI Global*. <https://doi.org/10.4018/979-8-3693-2746-3>

Gehrke C (2024) **Applications of science communication in science diplomacy: communicating (for) Arctic marine mammal governance**. *Polar Geography*, 1–23. <https://doi.org/10.1080/1088937X.2024.2403673>

Ghavidel S, Danesh F, Gharebaghloo V (2024) **A Study on the Convergence of Scientific Diplomacy and Governance of Data in Science, Technology, and Innovation**. *Sciences and Techniques of Information Management*. doi: 10.22091/stim.2024.10719.2096

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Klimovich-Mickael A, Sacharczuk M, Mickael ME (2024) **Navigating the Nexus of Bioethics and Geopolitics: Implications for Global Health Security and Scientific Collaboration**. *Bioethical Inquiry*. <https://doi.org/10.1007/s11673-024-10379-3>

Kondakci Y, Zare MN, Khorasgani MSG, Kızıllan P (2024) **International research collaborations: A comparative study on the lived-experience of academics in Iran and Türkiye**. *Higher Education Quarterly*, e12561. <https://doi.org/10.1111/hequ.12561>

Krasnyak O (2024) **Conceptualising International Cooperation in Science and Technology: A Heuristic Model for Russian-South Korean Space Cooperation**. *Korea Observer*, 55(3): 355–377. <https://doi.org/10.29152/KOIKS.2024.55.3.355>

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Pan M, Huntington HP (2024) **China-U.S. cooperation in the Arctic Ocean: Prospects for a new Arctic exceptionalism?** *Marine Policy*, 168: 106294. <https://doi.org/10.1016/j.marpol.2024.106294>.

Puaschunder JM (2024) **Science Diplomacy Online: Implementing Sustainable Development in the Virtual World.** In: Filho WL, Kautish S, Wall T, Rewhorn S, Paul SK (Eds.) *Digital Technologies to Implement the UN Sustainable Development Goals.* World Sustainability Series. Springer, Cham. [https://doi.org/10.1007/978-3-031-68427-2\\_16](https://doi.org/10.1007/978-3-031-68427-2_16)

Ratzlaff A (2024) **The New Silk Road in Science: China's Science Diplomacy in the Americas.** *Research Publications*, 66. [https://digitalcommons.fiu.edu/jgi\\_research/66](https://digitalcommons.fiu.edu/jgi_research/66)

Rizzo G (2024) **Science diplomacy – Who are the scientific attachés?** *The Marie Curie Alumni Association Blog*, 4 Jul 24.

Rolli F, Rivoira G, Halilaj O, Ghribi M (2024) **Blue Economy in the Mediterranean: The Role of Science Diplomacy to Advance Research Infrastructures and Promote Employment Through Capacity Building and Skills Development.** In: Leal Filho W, Salvia AL, Eustachio JPP, Dinis MAP (Eds.) *Handbook of Sustainable Blue Economy.* Springer, Cham. [https://doi.org/10.1007/978-3-031-32671-4\\_49-1](https://doi.org/10.1007/978-3-031-32671-4_49-1)

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Šime Z (2024) **Project Archetypes of the European Research Area: exploring the occasional engagement patterns of the European southern neighbourhood.** *Latin American Journal of American Studies*, pp. 210–257. <https://dx.doi.org/10.51799/2763-8685v4n1008>

Stoett P, Scrich VM, Elliff CI, Andrade MM, Grilli NM, Turra A (2024) **Global plastic pollution, sustainable development, and plastic justice.** *World Development*, 184: 106756. <https://doi.org/10.1016/j.worlddev.2024.106756>.

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Voth-Gaeddert L (2024) **Improving Use of SMART Goals in Science Diplomacy: An Overview of Concepts and Approaches.** <https://doi.org/10.31235/osf.io/m682d>

Zha Q, Li X (2024) **How Canadian Universities are Caught in Geopolitical Tensions: Perspectives of Faculty of Chinese and Non-Chinese Origins.** *Canadian Ethnic Studies*, 56(2): 131–155. <https://dx.doi.org/10.1353/ces.2024.a934426>.

# Call for Proposals //

## **India Sri Lanka Joint Call for Workshop Proposal**

Last Date: October 15, 2024

Further information at: <https://onlinedst.gov.in/Projectproposalformat.aspx?id=2352>

## **Indo-Russian Joint Research Call for Proposals**

Last Date: October 31, 2024

Further information at: <https://onlinedst.gov.in/Projectproposalformat.aspx?id=2191>

## **Indo-Danish Joint Call for Project Proposals**

Last Date: November 1, 2024

Further information at: <https://onlinedst.gov.in/Projectproposalformat.aspx?id=2350>

## **Swiss Government Excellence Scholarships 2025-2026**

Last Date: November 11, 2024

Further information at: <https://www.sbf.admin.ch/sbf/en/home/education/scholarships-and-grants/swiss-government-excellence-scholarships.html>

## **DBT-EU Joint Call on HORIZON-CL5-2024-D3-02-03**

Last Date: February 4, 2025

Further information at: <https://dbtindia.gov.in/sites/default/files/Revised%20DBT-EU%20joint%20call%20WEBNOTICEWP%202023-24.pdf>

## **CSIR-EU MSCA-SE Call Guidelines and Announcement**

Last Date: February 10, 2025

Further information at: <https://www.csir.res.in/news-calls-and-events/call-guidelines-and-announcement-csir-eu-co-funding-partnership-under-eu>

# Forthcoming Events //

## **Inaugural workshop for the Raiffa Center for Science Diplomacy**

Date: October 17-18, 2024

Further information at:

<https://iiasa.ac.at/events/oct-2024/inaugural-workshop-for-raiffa-center-for-science-diplomacy>

## **27th International Congress of History of Science and Technology**

Date: June 29-July 5, 2025

Further information at:

<https://www.ichst2025.org/>