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EDITORIAL

ARTICLES

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What New Dimensions are Needed for Science Diplomacy?

Joy Y.Zhang, Bhaskar Balakrishnan, Ravi Srinivas and Trude Sundberg

'Can diplomacy be saved? Can diplomacy save us?' Thus was the opening of international relations (IR) scholars Costa M. Constantinou and James Der Derian's 2010 co-edited book, *Sustainable Diplomacies*. The two questions were rooted in shared concerns as well as a shared hope among IR and diplomacy experts. At the onset of the twenty-first century, the prestige and impact of conventional statecraft of diplomacy seemed to have 'sunken lower than probably any time in recent history'. But there was an emerging recognition that diplomacy has become ever more important in negotiating alterity and risks so that 'rival entities and ways of living can co-exist and flourish' (Constantinou and Der Derian, 2010, 2-3). It was also around the same time that the *Madrid Declaration on Science Diplomacy* was launched, and that the Royal Society in London and the American Association for the Advancement of Science published *New Forntiers in Science Diplomacy,* which expanded the roles of science diplomacy and reoriented its relations with the state and the society (S4D4C, 2019, Royal Society and AAAS, 2010).

The two questions Constantinou and Der Derian put forward may have gained more resonance a decade later, when a global pandemic urged coordination and collaboration in an ideologically divided world, and when incidents like Hurricane Ian in North America, extreme heatwaves in Europe, and deadly flooding in Pakistan underlined the critical role of climate diplomacy.

This global re-awakening to the need for 'effective' science diplomacy also highlights many of the limits in its current conception and practices. While diplomacy remains one of the most ancient forms of statecraft, the delivery of diplomacy, including science diplomacy, no longer hinges on state or institutional actors, but can be shaped and conducted by diverse actors articulating various private and public interests. The rise of actors from the Global South, the emergence of new and disruptive technologies, and new conflicts of ambition underlines the importance of science diplomacy and complicates its delivery. More importantly, how science is organised and who manages its framing and delivery are also changing. We need to unpack the idea of 'science diplomacy' through examinations of past and emerging experiences: What does it mean to different communities? What are its real-life impacts on the wellbeing of communities, international relations, and the development of science and innovation? Who are the emerging actors and leaders? What are the new norms and expectations of science diplomacy in global politics? And finally, is their 'good' science diplomacy and how can we promote it?

In short, what are the old and new lessons, and what new dimensions of science diplomacy should we explore in the future?

This special issue originated in a panel discussion on science diplomacy organised by the newly founded Centre for Global Science and Epistemic Justice (GSEJ) at the University of Kent for the European Association for the Study of Science and Technology's 2022 annual conference, quite befittingly in Madrid. With the help and support from RIS colleagues, the discussion soon moved beyond the seminar room. The result, as presented in this special issue, is an empirically rich and conceptually provocative collection of reflections on the ongoing experimentations and innovations in science diplomacy in Asia, Europe, and North America. The scope of this volume covers all three types of science diplomacy as defined by the Royal Society and AAAS in 2010. While Whitesides, Zhang, Xie and Sundberg respectively bring in new insights on 'science for diplomacy', contributions from Balakrishnan, Tewari and colleagues shed new light on 'diplomacy for science'. Arguably 'science in diplomacy' is an underlying theme for all papers, but Robinson, Rofe and Höne's piece presents a fresh take on how science diplomacy can be better incorporated into higher education.

Conceptually, this special issue presents a progressive exploration of the dimensions of science diplomacy. To comprehend what is needed for future science diplomacy, the special issue starts with diagnostic examinations of how its conventional practice has become constraining in the contemporary world. Science diplomacy as a modern concept has predominately been a Western discourse since the beginning of the 20th century. The global diffusion of science and technology, along with its governing structures was once seen as a fast track to modernisation (Drori et al, 2003). But since the late 1960s and early 1970s, the emphasis on science and technology in global politics has shifted from development to building national competitiveness (National Research Council of the National Academies, 2002).

This facilitated the creation of what science historian Whitesides calls the 'empires of mind', in which advanced countries shape access to knowledge through proprietary rights and classification. Through his 'access-based' historical review of the US's global outreach, Whitesides demonstrates the delicate balancing act science diplomacy has to play in the triad relations between promoting public knowledge, enforcing rights in commercial research, and protecting national security.

Zhang shares Whitesides' view that new science diplomacy is needed to promote democratic access and the production of knowledge globally. Zhang warns of a 'hegemonic paradox' in science diplomacy by state actors, both in the Global North and in the Global South. That is, 'while it purports to have levelling effects and to cultivate mutual appreciation between advantaged and less advantaged societies, in practice, it often re-affirms and perpetuates power imbalances.' How science authorities get trapped in this hegemonic paradox is demonstrated through her analysis of the COVID vaccine diplomacies deployed by the US and China. She argues for a decolonial approach that necessitates a bigger role for Track II diplomacy where technical options can be 'nested' in partner countries through multi-level social and scientific engagement.

Sneha Pal, Sweta Bawari and Devesh Tewari's discussion on how the Golden Triangle Partnership is reinvigorating Ayurveda, the ancient Indian system of medicine, offers a hopeful story. The authors believe the founding of a WHO Global Center of Traditional and Complementary Medicine in India in 2022 signals a potential 'breakthrough for

the advancement and global acceptance of Traditional and Complementary medicine systems. But to what extent can this impact be realised and sustained internationally will hinge on the quality of multi-stakeholder involvement. This is a point underlined by both Xie's and Sundberg's empirical studies on water diplomacy.

Xie's long-term engagement with hydro-diplomacy in the Ganges-Brahmaputra-Meghna (GBM) basin reminds us of sociologist Ulrich Beck's thesis that contemporary (environmental and climate) risk will forge new norms in global politics and nurture a new generation of 'Homo cosmopoliticus' (Beck 2016, 189). She deftly explains a layered entanglement in which a diversity of epistemic communities from the public and scientific sphere, can significantly expand conventional 'unidirectional' diplomatic efforts in mitigating cross-border natural and anthropogenic disasters. In other words, while *raison d'état* may dictate national authorities' short-term exploitative foreign policy strategies, *modus vivendi,* the societal drive for co-existence may enable a new outlook on the whys and hows in negotiating conflicting understanding of natural risks with international counterparts.

Sundberg's report on the water security project with stakeholders in Bangladesh, India (Kolkata), Sri Lanka and Nepal further substantiates this point. They drew on Spanish science diplomat, Marga Gual Soler's (2020) characterisation of global challenges, 'they all have scientific dimensions, transcend national borders, and no country or sector will be able to solve them alone', but offers an empirically tested remedy to one of Soler's key concerns that scientific and diplomatic communities 'remain largely siloed educationally and professionally'. Sundberg, along with their collaborators in Germany, the US and India took on the endeavour in 2018 to develop a community-based multi-disciplinary approach in South Asian communities. This includes creating conflict resolution platforms between experts, authorities, civil society actors and marginalised communities, and translating codified scientific knowledge into socially embedded solutions. To some extent, Sundberg's project highlighted the much-undervalued role of *social* research in *science* diplomacy. It brings social research from the background of Track II diplomacy to the foreground.

But for science diplomacy to acquire new dimensions and to fulfil its new socio-political roles, spontaneous and sporadic initiatives are not enough. We need to systematically re-think how the idea and practice of science diplomacy can be better instilled in future generations for whom both science and diplomacy will only become more critical to ensure sustainable peace and prosperity. Balakrishnan's and Robinson and colleagues' contributions to this volume elucidate the necessity, feasibility, and perspicacity of a proactive approach to these issues.

Balakrishnan's discussion on the Ukraine war draws our attention to the inseparable interconnections between scientific commons and global stability. The paper outlines the war's damage to all three pillars of science diplomacy through a succinct review of new challenges in strategic areas, such as the international space programme, nuclear technology, climate change, the Arctic and cyberspace. Science and politics are not easy bedfellows, but they are also inseparable: while science is a core enabler of political agendas, politics is ingrained in scientists' research vision. Balakrishnan's paper demonstrates that the active political dismantling of scientific cooperations underlines their power and values. Science diplomacy is most needed where it is most threatened.

But the practice of avant-garde science itself is no longer a privilege of professional scientists with formal support from established institutions. The science diplomacy module developed by Mark Robinson, Simon Rofe and Katharine Höne at the Centre of International Studies and Diplomacy at SOAS in London embodies an ambition of forging an 'ethics of solidarity' among students for better design, development, and delivery of science diplomacy in the future. This pedagogical experiment points to possible avenues in overcoming the 'empires of mind' and the 'hegemonic paradox' embedded in conventional science diplomacy.

It's impossible to fully accommodate the plethora of debates and experiments in science diplomacy around the world in one special issue. We hope our diverse, yet limited discussions serve as a provocation. The importance of effective science diplomacy in a 'post-truth' world plagued by rising populism and global challenges cannot be overstated. When editing the special issue, we also had an acute awareness that while science diplomacy could be transformed and expanded in its scope, we must also be cautious of not over-applying this concept in a ubiquitous manner. For this would render both the roles of science and diplomacy in resolving real-world concerns into a vacuous tokenism. The limits of conventional state-led science diplomacy and the emerging bottom-up initiatives do not indicate a de-professionalisation of science diplomacy. Rather, it points to an ongoing metamorphosis in which contemporary science diplomacy ups its game in its complexity and sophistication.

Diplomacy, as the Duc de Broglie has been attributed of saying, is 'the best means devised by civilization for preventing international relations from being governed by force alone' (Roberts, 2009). Science diplomacy has always been an evolving practice, because of our developing understanding of what constitutes a 'force'. It was once limited to the military power of sovereign states, then expanded to the financial leverages of commercial empires, then the force of epistemic hegemonies. Science diplomacy has always had problem- solving and relation- building as its key elements. But whose problem and what relations are themselves open to contestation? As the papers in this special issue demonstrate, new dimensions of science diplomacy emerge out of a renewed understanding of these contestations.

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ARTICLE

Empires of the Mind and Trickle-Down Science: COVID-19 and the History of Global Scientific Relations

Greg Whitesides*

Greg Whitesides

When the COVAX global vaccine programme fell short of expectations, reactions varied- from astonishment on the part of the initiative's founders to frustration on the part of certain African heads of state and dismay on the part of world leaders.[1] But it should not have been a surprise and the resulting frustration had to be familiar; the distribution of global vaccines follows the framework established since WWII, academic knowledge of the virus is available, the invested biomedical companies protect their intellectual property, nations compete to use vaccines for international influence and the global system struggles to address the needs of the poor. This is not new: advanced nations gradually restricted access to research with commercial or national security applications during the cold war, creating "empires of the mind" through proprietary rights and classification. At the UN Conference on Science and Technology for Development (1979), for example, African delegates criticized the new system of "trickle-down science," but the Trade-Related Intellectual Property Rights agreement (1995) strengthened it over a decade later. Today, scientific, and technical cooperation is shaped by the extent to which knowledge is considered an international public good, commercial property, or state secret, and thus negotiating between these overlapping spheres is essential to successful diplomacy.

In the 21st century, scientific knowledge and advanced technology exist in three social contexts based on their

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level of access: public, commercial, and classified. Recognizing the distinction is important because diplomacy is often concerned with securing or limiting access and each context requires unique statecraft. Public knowledge is information that is published and available – this is the traditional approach to scientific research and openness remains a defining academic characteristic of science. Other knowledge is removed from public access: commercial research and development (R&D) is protected by patent law and intellectual property rights, while national security research is classified and protected by legal enforcement. Diplomacy has a historical role in promoting public knowledge, but it is also required to enable partnerships or enforce rights in commercial R&D, while collaboration in national security research represents the highest form of international relations.

This paper presents short histories of these "empires" and illustrates how access to COVID-19 vaccines reflects "trickle-down science." This U.S. diplomacy history is relevant to the diverse readership of *Science Diplomacy Review* in a variety of ways.[2] First, the structure of international scientific relations established after World War II remains intact and the United States played the central role in creating classified and proprietary spheres of research; as such, navigating the contemporary geopolitics of science requires understanding this history. Of course, intellectual property rights are no longer "American" or "Western;" instead, nations with innovative domestic sectors – such as Brazil, South Korea, or South Africa – support protections for commercial research. The history also reveals shifts in global science; collaboration on COVID-19, for example, demonstrates the growing prominence of Asian nations, who have eclipsed traditional scientific powers like Germany and France, while the United States has walked away from a leadership role in global public science, providing an opening and opportunity for others. Finally, American science diplomacy impacted nearly every nation over the past 70 years – over two dozen are included in just this brief – and additional research and collaboration is needed to present this history from multiple perspectives.

The Public Sphere of Science

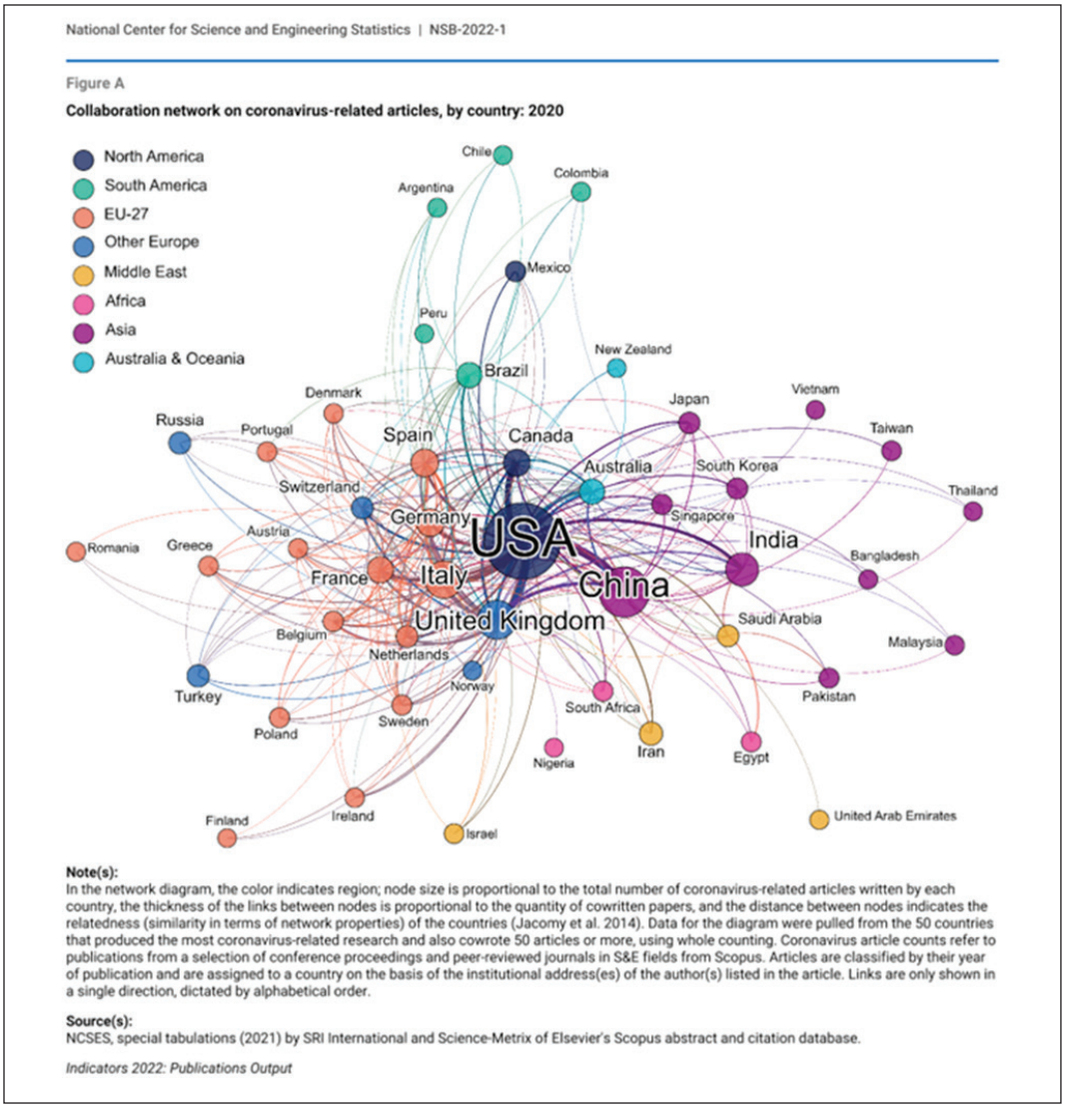
The scientific community and research began globalizing in the 17th century. The scientific process created both new knowledge and new social groups. The experimental method, historian John Henry reminds us, is "a means for generating and maintaining consensus in a self-ordering community without arbitrary authority"[3]. Over the next two centuries, scientific research remained an elite activity with little connection to industry, as individuals crossed international borders and shared research, creating the periodic chart of elements, forming national unions and inaugurating the First International Polar Year (1882-1883).[4] Scientists published their research as an international public good and government interest remained slight until the 20th century; instead, state support for research demonstrated national advancement. Thomas Jefferson wrote that scientific "correspondence is never interrupted by any civilized nation," while the British Admiralty instructed its Captains, "expeditions on behalf of science and discovery have always been considered by all civilized communities as acting under general safeguard."[5] This history of independence influenced academic conceptions of science, especially sociologist Thomas Merton's ideals of universalism, communism, disinterestedness and organized skepticism.[6] National scientific

groups formed the International Council of Scientific Unions in 1931 – now known as the International Council for Science – while nations institutionalized global science and technical relations in the ashes of World War II.

The United Nations hoped to prevent future conflict, aid development and cooperatively manage scientific and technical relations through a suite of new specialized agencies. Within five years, the system included the Food and Agricultural Organization (FAO, 1945), the Educational, Scientific and Cultural Organization (UNESCO, 1945), the International Civil Aviation Organization (ICAO, 1947), the World Health Organization (WHO, 1948) and the World Meteorological Organization (WMO, 1950). However, national interests could override internationalism; fears of competition and limited funds, for example, hampered attempts at establishing a global research network, when France suggested a system of UN laboratories, the United States and Great Britain disapproved (a suggestion to create international diplomatic passports for scientists also failed).[7] Nor was the new system immune to politics; early attempts to control atomic energy succumbed to the cold war, the United States refused to ratify the WHO until it renounced socialized healthcare and the Soviet Bloc withdrew from the organization when the United States blocked the admission of China, North Vietnam and North Korea.[8] But even cold war adversaries participated in the International Geophysical Year (1957-1958), a crowning achievement in science diplomacy and a demonstration of the power of coordinated global research.[9] Finally, the United Nations Environmental Programme (UNEP, 1972), which began by regulating pollution, endangered species and ozone, became more politically contested after the cold war, in part because of erratic American leadership. Nonetheless, the UN system remains a symbol of rationalism and democratic dialogue as well as the preeminent space for cooperatively managing global scientific and technical relations.

The public sphere of science is global and involved in diplomacy in the 21st century. Science scholar Caroline Wagner suggested contemporary research networks, such as those in seismology or medicine, function as a "New Invisible College" that can benefit the disadvantaged, multiple countries, for example, aided in identifying the SARS virus genome within weeks in 2003.[10] A recent National Science Foundation graphic on COVID-19 collaboration illustrates the "college" in action in 2020.[11]

As presented, the size of the node indicates the number of coronavirus-related articles written by each country while the thickness of the links is proportional to the number of co-written papers. Thus, the United States and China published the most articles and researchers from over forty countries collaborated in the first year of the pandemic. Although collaboration often occurs without diplomatic input or oversight. Diplomacy does have a critical role in promoting engagement, including facilitating the movement of scientists, specimens and equipment as well as offering the use of national resources such as ships, satellite imaging or medical facilities. At the same time, diplomats and scientists need to be cautious in politically tense situations: the U.S. National Academy of Sciences and their Iranian counterparts downplayed cooperation to reduce domestic criticism and warned against politicizing scientific outreach.[12] Tensions can also arise if scientists rely on government or corporate funding, which may influence research agendas, or if the research has commercial



or national security applications, in which case it may be removed from the public.

The Commercial Empire of the Mind & Trickle-Down Science

The twentieth- century commercial fusion of science and technology introduced a new ethical approach to research. While the scientific community emphasized openness and publication, commercial R&D is rooted in the ethics of trades and business, which have a long history of ownership, secrecy, and property rights. This entailed two interpretative changes: first, that scientific knowledge is proprietary; second, that proprietary scientific knowledge is an engine of national prosperity. The patenting of penicillin, for example, provided an early precedent in WWII; the United States allowed private firms to patent government-sponsored research, even though the British – the original discoverers – did not; at the end of the war, American

companies refused to share the secrets of mass-production, requiring global customers purchase penicillin rather than produce their own, upsetting the "moral economy of science."[13] But the United States intertwined commerce, science and geopolitics throughout the cold war: American geologists surveyed strategic materials overseas, using their influence to alter mining codes; agricultural scientists collaborated on the Green Revolution in Mexico, the Philippines and India to ward off starvation and promote economic liberalism; corporate biologists prospected for indigenous genetic resources in Costa Rica; and hundreds of American scientists and engineers worked for twenty-five years on a Saudi Arabian science and technology programme after the OPEC oil embargo.[14] At home, American administrations focused on stimulating domestic innovation, helping drive revolutions in computing, telecommunications, satellites, biotechnology and pharmaceuticals, while American diplomacy emphasized protecting intellectual property overseas. The growth in commercial research and intellectual property rights meant that more applied knowledge, industrial 'know-how' and engineering – information necessary for development – became inaccessible, creating trickle-down science and technology.

The developing world has struggled to access advanced science and technology for over half a century. After a decade of requests, the UN held its first Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas in 1963. Although developed countries pledged to share research and products, intellectual property disputes arose and the Group of 77 formed the following year; among its concerns was access to science and technology as part of the "common heritage" of mankind. Fifteen years later, the UN held a second conference on Science and Technology for Development (1978), but members could not agree; the journal *Science* editorialised: "The message from developing nations was explicit: that they will no longer accept the trickle-down method of scientific and technological transfer that suits the advanced countries." Yet they had little choice: the Group of 7 nations, for example, established joint research ventures (the "Versailles Economic Summit Science and Technology Initiative"), leading political scientist David Dickson to argue G7 nations facilitated "access by international capital to the basic science needed for its high technology industries while tightening the terms and conditions under which this access would be granted to others."[15] Intellectual protections tightened in the late 1980s, as the United States used trade sanctions to enforce software and pharmaceutical rights against South Korea and Brazil; after the cold war, most nations accepted American patent positions and the new World Trade Organization's Trade Related Property Rights Agreement (1995). This history may instill cynicism about the international willingness to share the benefits of science and technology with the developing world, especially given the experience of the COVID-19 pandemic.

The distribution of COVID-10 vaccines illustrates contemporary "trickle-down science," as fewer than 15 per cent of people in low-income countries had received a dose as of March 2022.[16] The World Health Organization's COVAX programme, which hoped to pool global resources and share vaccines, struggled to overcome "vaccine nationalism," as wealthier nations signed advance purchase agreements with pharmaceutical companies to vaccinate their domestic populations first, forcing COVAX to shift to a donation structure.[17] Intellectual

property rights concerns also arose: the pandemic caused a spike in coronavirus-related patents, jumping from around 200 per year between 2005-2018 to over 1400 in 2020, with most of the applications related to detection and prevention rather than treatment.[18] Although some companies signed an "Open Covid Pledge" to waive rights during the pandemic, neither pharmaceutical companies nor their governments supported patent reprieves at first; the United States eventually announced support for waiving patent protections at the WTO meeting in May 2021.[19] After 100 countries, led by India and South Africa, petitioned to produce mRNA vaccines, the WHO established a technology-transfer hub in Cape Town, but Moderna, Pfizer and BioNTech demurred; Afrigen Biologics and Vaccines, the South African participant, chose to copy the Moderna vaccine because of the amount of publicly available information and the company's pledge not to enforce patents (although it later filed an application in South Africa).[20] Afrigen received support from the public sphere of science – including researchers at the U.S. National Institutes of Health – and achieved success in replicating the vaccine in 2022, but the company is hesitant to infringe upon Moderna patents and scaling up production presents unknown difficulties. Patents are not the only problem; one study on the COVAX programme concluded it was "the inaccessibility of knowledge that is not in the public domain and know-how which is the true barrier to expanded manufacturing capacity for vaccines."[21] Although it remains unclear what will happen – none of the companies had allowed a compulsory license to make vaccines as of March 2022 – the achievement remains significant; Gerhardt Boukes, Chief Scientist at Afrigen, declared: "We didn't have help from the major COVID-vaccine producers, so we did it ourselves to show the world that it can be done, and be done here, on the African continent."[22] Indeed, the distribution of COVID vaccines illustrates the importance of self-reliance and the need for more South- South cooperation in science and technology.[23]

The National Security Empire of the Mind

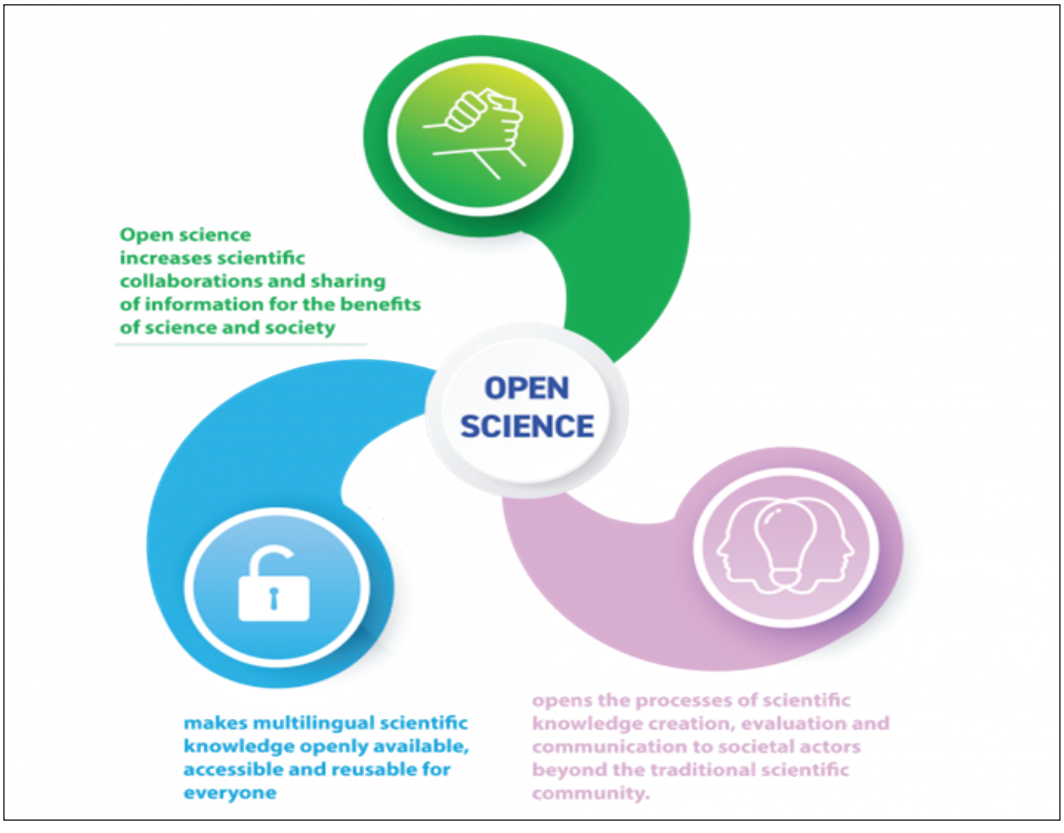
World War II transformed the importance of R&D to national power as well as the role of scientific cooperation in international relations. Research on chemical weapons and aeronautics entangled science, the military and industry in the first world war, while allied partnerships on submarine detection and gas defense hinted at things to come. In 1940, the British enticed American support by offering scientific and technical advancements (the Tizard Mission); the United States, British and Canadians collaborated on atomic energy and other projects during the conflict, while the Soviets began spying on the Manhattan Project after being excluded. Throughout the second world war, the United States funded research critical to victory and the atomic bomb and destruction of Hiroshima testified to the effectiveness of the approach. Only this time the science and engineering would have to be secret; Truman's press release on Aug. 6, 1945, acknowledged the new era:

> It has never been the habit of the scientists of this country or the policy of this Government to withhold from the world scientific knowledge. Normally, therefore, everything about the work with atomic energy would be made public. But under present circumstances, it is not intended to divulge the technical processes of production or all the military applications[24]

Wartime research required a re-interpretation of science: some scientific and technical knowledge was necessary for

national security and/or dangerous and thus should be removed from the public sphere for public safety. Within a few years of the war's conclusion, the United States restricted access to certain knowledge, whether through classification or export controls.

Scientific and technical cooperation and non-cooperation were essential to cold war relations. Because nuclear weapons prohibited direct U.S.-Soviet confrontation, the two adversaries fought to demonstrate scientific and technical superiority, which bolstered claims of leadership and secured allies. The United States classified research with national security implications and formed the Coordinating Committee on Multilateral exports – or CoCom – with European allies to deny engineering and advanced technology to the communist bloc; one study suggests CoCom set back Soviet avionics and computers decades.[25] After the launch of Sputnik, the United States formalized scientific cooperation within NATO, creating the Science Committee in 1958. During the Vietnam war, the United States offered research centers to solidify relations with key Asian allies: a joint U.S.-Thai study on cholera led to the SEATO research laboratory before escalation, while the United States helped establish the Korean Institute of Science and Technology and a Philippine nuclear science center at the height of the conflict. At the same time, collaboration in national security science – nuclear weapons research for example – represented the height of international relations and differences in access caused diplomatic problems: the unique American classified collaboration with Great Britain upset the French,



undermining NATO. Additionally, when smaller NATO countries suggested a broader collaboration, the United States, Great Britain, and West Germany vetoed the proposal.[26] Diplomacy smoothed over differences at the end of the cold war and the Alliance established the NATO Science and Technology Organization in 2010, which facilitated co-operation on COVID-19 both within the alliance and around the world.[27]

Conclusion

The structure of international scientific relations established since WWII presents opportunities and challenges for science diplomacy. While intellectual property rights can be a barrier, knowledge can still move between spheres: patents, for example, eventually expire, and access may be achieved beforehand through licensing, though COVID-19 vaccines illustrate the difficulties. Even national security research can be privatized or made available, whether naval depth charts during the cold war or the Global Positioning System after and the military offers a useful blueprint for goal-oriented, directed innovation. Of course, most global scientific cooperation still occurs in the public sphere of science, though diplomacy and the international system can further engage.

The public sphere of science remains the primary sphere of international collaboration. The challenge, especially for countries in the developing world, is to become networked into the global scientific community and then attract attention and resources to work on a local problem; diplomacy should prioritize policies that foster engagement with the large global community of researchers willing to help. Additionally, many national governments, including those in the European Union, fund foreign researchers (the U.S., by contrast, requires principal investigators to be American citizens for funding). The international system also plays a key role: although the WTO supports patent enforcement, UN specialized agencies promote access; UNESCO, for example, advocates for an "Open Science" ideal.[28]

This 21st-century "openness" harks back to traditional ideals and includes free scientific publications, transparency in research data, open-source software and source codes and access to educational resources. Of course, scientific knowledge and the scientific community cannot compel national action, considering the varied responses to global warming or COVID-19. Instead, diplomacy is required to share knowledge and convince different stakeholders to find agreement: the Montreal Protocol, for example, took years of diplomacy to achieve international – and industrial – support for regulations to limit ozone-depleting substances.[29]

Diplomacy can promote also international cooperation in commercial research, even between former adversaries and contemporary rivals. When the Soviet Union collapsed, U.S. agencies promoted partnerships between Russian and American researchers, eventually establishing the International Science and Technology Center (1994) to redirect former weapons scientists and promote commercial research.[30] By the late 1990s, the Center welcomed a wide variety of partners, including 3M, Lockheed-Martin, Shell, Hitachi, Samsung, the Lawrence Livermore Laboratory and the European Center for Nuclear Research; by 2014, it had supported 2,700 projects at a cost of $870 billion.[31] A more recent example was the Clean Energy Research Center (CERC) established by the U.S. and the People's Republic of China in 2010. CERC expanded even as international climate negotiations stagnated; by 2014, more

than eighty Chinese and forty American organizations participated.[32] Guided by predetermined intellectual property agreements, participants received over a dozen patents without conflict in the first few years.[33] The CERC concluded in 2020 and may provide a model for future international cooperation in commercial research, including within the developing world.

Finally, an access-based history also helps explains a paradox of the 21st century: scientific and technical knowledge is both more globalized and restricted at the same time; globalized via academic networks, restricted by intellectual property rights and patents. Classification and proprietary rights withdraw knowledge from the public; in the 1960s, members of the G-77 spoke about science and technology as the "common heritage" of mankind, but today we cannot even know the full scope of human knowledge, much less make it available as part of a shared humanity.

Endnotes

1 For reactions from Clemens Auer, the EU's chief vaccine negotiator; Seth Berkley, head of the Vaccine Alliance and COVAX co-founder; and Ghanian Vice President Mahamudu Bawumia, see Adam Taylor, "Why COVAX, the best hope for vaccinating the world, was doomed to fail," *Washington Post* (Mar. 22, 2022). See also Ana Danaiya Usher, "A beautiful idea: how COVAX has fallen short," *The Lancet* 397 (June 19, 2021): 2322-2325.

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3 John Henry, 2008. *The Scientific Revolution and the Origins of Modern Science* New York: Palgrave Macmillan,, p.53.

4 On scientists crossing borders during the Seven Years War, see Gavin de Beer. 1960. *The Sciences Were Never at War*,London: Nelson & Sons.

5 For Jefferson, see "From Thomas Jefferson to John Hollins, 19 February 1809," available online at: https://founders.archives.gov/documents/Jefferson/99-01-02-9834. The Admiralty is quoted in A. V. Hill, "The International Status and Obligations of Science," *Science* 38 (Feb. 1934), 146-56, quote on 146.

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[31] Caroline Wagner, et al., 2002. *U.S. Government Funding for Science and Technology Cooperation with Russia* (Arlington, VA: RAND Science and Technology Policy Institute, 2002); and Loren R. Graham and Irina Dezhina, *Science in the New Russia: Crisis, Aid, Reform* (Bloomington: University of Indiana Press, 2008), esp. 142-44. Interestingly, today, the ISTC does not list Russia on its website (accessed 7/2/2022): https://www.istc.int/.

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ARTICLE

The Hegemonic Paradox of Science Diplomacy and Its Contemporary Challenges: Lessons from the COVID Pandemic

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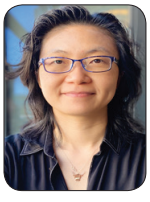

Joy Y. Zhang

The COVID-19 pandemic underlined the importance of science diplomacy in combating global health inequality and in promoting transnational solidarity in a coordinated response to the virus. Yet it also accentuated an epistemological struggle in global politics (Irfan, Jackson and Arora, 2021; Tung, 2022; Zhang and Datta Burton, 2022). This is to say, while the pandemic seems to have re-affirmed the efficiency and necessity of top-down socio-political enforcement of public health measures (e.g. mask- wearing, vaccination and restriction of movement), it also made visible the social skepticism and resistance towards a hegemonic global technology of control (Zhang, 2021; Ascione, 2022). Recognising the postcolonial public sentiment towards technological support is important. Through a historical examination of how *science for diplomacy* is practiced and a contemporary analysis of China's and the US' vaccine diplomacy, this paper argues that, for science diplomacy to be effective in a postcolonial world, a corresponding paradigm shift of science diplomacy is needed. More specifically, this paper points out that to overcome the embedded 'hegemonic paradox' in traditional science diplomacy, one needs to shift from the conventional (or hegemonic) mindset of 'prescribing solutions'. Instead, we need a de-colonial approach that does not nullify the agency of local communities but bases its episteme on the lived experiences of these communities. Relatedly, this would underline the importance of going beyond state-led initiatives and

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bringing 'Track II diplomacy' from the background to the foreground.

Vaccines have become emblematic of such power struggles (Hofmanner, 2022). On the one hand, vaccine diplomacy is deployed by countries such as the US and China as a proxy competition for global influence (Kumar, 2022; Tung, 2022; Leigh, 2021). On the other hand, both countries have encountered social backlash in recipient communities. As the paper demonstrates, China's vaccine diplomacy represents a vaccination success but a diplomatic failure. It is a vaccination success for, in 2021, China accounts for 'nearly half of all doses' of the COVID-19 vaccine delivered globally (Mallapaty, 2021). Yet despite projecting itself as an alternative global leader, China had little success in turning its vaccine diplomacy into gaining sympathy or friendliness among recipient countries in the Global South (Zhang, 2021). For example, LAPOP's Americas Barometer 2021 suggested that in Latin America, trust in the Chinese government fell from 47per cent in 2018/19 to 38per cent in 2021 (Nolte, 2022). In Asia, some who have received China's vaccine considered it to be an 'inferior' product (Marlow, Mangi and Lindberg, 2020; Butt, 2021). Similarly, the conventional political rhetoric of 'the U.S. swoops in to save the day' embedded in the US's vaccine diplomacy was 'greeted with knowing cynicism' in Latin America and, to President Biden's frustration and perhaps puzzlement, with African countries' rejections of additional American donations (Weeks, 2021, Abutaleb, 2021). To interpret this social skepticism and resistance as merely vaccine hesitancy that is related to safety concerns or to public understanding of science, in general, is an oversimplification. As I have argued elsewhere, in many Global South communities' vaccine hesitancy is not only reactive but also 'selective'. This is to say public reservation to a particular inoculation programme may not necessarily be a blanket vaccine denial, but a selective rejection of the social conditions that the vaccines are rolled out (Zhang, 2021). The second half of the paper explains in greater detail how the presence of 'choice' within Global South communities has been a crucial yet largely ignored factor in the success of vaccine diplomacy, particularly in light of the growing decolonial mentality that emphasises self-determination and individual agencies in these regions.

The paper is structured as follows: It first elucidates an embedded hegemonic paradox of science diplomacy through a brief historical review. This section highlights that the underlying mindset for both American and Chinese science diplomacy has been about 'hegemonic prescription of solutions'. Despite recent recognition of the importance of 'Track II diplomacy', the capacity for societal engagement remains low for both countries. This sheds light on the empirical examination in the subsequent section which identifies where and how vaccine diplomacy failed. Most prominently, through China's varied experience in the Philippines, Pakistan and Serbia, and through the US experience in Latin America and Africa and shifting domestic debates, the paper underlines how the perception of 'choice' and respect of (individual or collective) agency played a critical role in vaccine uptake and its associated diplomatic outcomes. Finally, the paper concludes with a section on what lessons can be drawn to reshape how we approach science diplomacy in the 21st century.

An Embedded Hegemonic Paradox of Science Diplomacy

In its essence, science diplomacy is about recognising scientific power imbalance

across nation-states and using science as a vehicle to ameliorate the socio-political consequence of that power imbalance. In practice, as the Madrid Declaration on Science Diplomacy described, it refers to 'a series of practices at the intersection of science, technology and foreign policy' (S4D4C, 2019). Nations deploy science diplomacy to assert both their scientific prowess and their values globally, in which old friends get rewarded and new friends are made (Aspinall, 2022). However, a hegemonic paradox in science diplomacy is that while it purports to have levelling effects and to cultivate mutual appreciation between advantaged and less advantaged societies, in practice it often re-affirms and perpetuates power imbalances.

Modern science diplomacy consists of three separate strands (Royal Society and AAAS, 2010: 1) *Science in diplomacy,* which denotes incorporation of scientific expertise in foreign policy strategisation; 2) *Diplomacy for science,* which focuses on using diplomatic and policy leverage to promote transnational scientific collaborations; and 3) *Science for diplomacy,* which uses science to improve international relations, and employs both formal diplomatic effort (Track I diplomacy) and non-state actors (Track II diplomacy) to resolve socio-political tensions through scientific and technological exchanges. In this sense, science for diplomacy both resorts to and generates soft power (Turekian et al, 2015).

Science diplomacy is of course, not exclusive to Western countries. The People's Republic of China is not new to science diplomacy. Yet similar to other non-Western emerging powers, China's trajectory of science diplomacy has replicated rather than reformed the hegemonic logic. Arguably China's science diplomacy can be traced to the 1970s with examples of the Tanzam Railway, which, along with China's other foreign aid initiatives at the time helped mainland China to get enough votes to be admitted into the UN. Yet despite its anti-imperialist intention, the project effectively adopted 'colonial work models' (Monson, 2018: 218). In 2011, Chinese officials declared that science diplomacy had become 'the forefront' of China's foreign policy (Xinhua News Press, 2011). This is reflected in China's expanding programmes of providing scientific expertise and relevant material supports to public health programmes in Africa and along its 'One Belt and One Road' initiative (Killeen et al, 2018; Montgomery and Qin, 2021). Yet as China is perceived by many as replicating neo-colonial behavior in these regions and lacking respect for local rights, the effects of its science diplomacy have been discounted (Ezekiel, 2022). This point is further discussed in the next section.

Historically, vaccine diplomacy has always been the best example of the third strand, 'science for diplomacy' and it is not immune from the hegemonic paradox. The creator of the world's first vaccine, British scientist Edward Jenner famously stated that 'the sciences are never at war' before his French medical colleagues during the Napoleonic Wars. Jenner pioneered Track II science diplomacy by being an unofficial ambassador between the two warring countries (Hotez, 2014). France's foreign policy also took advantage of Louis Pasteur's rabies vaccine by building laboratories throughout its colonies to improve relations with local communities (Mihm, 2021). At the beginning of the 19th century, US President Thomas Jefferson deployed vaccine diplomacy to Indian tribes through the Lewis and Clark expedition. In the 20th century, the polio vaccine played a prominent role in US-Soviet science diplomacy in the cold war era (Hotez, 2017). However, as France's colonial medical campaigns in Cameroon, the Central African Republic,

Chad, the Republic of the Congo and Gabo were perceived as coercive by the locals, distrust still overshadows present- day vaccine uptake (Lowes and Montero, 2021). Similarly, science historian Niels Brimnes' (2004, 200) study on colonial India's resistance to smallpox vaccination in the eighteenth and nineteenth centuries, cautioned a generalisation of resistance to (Western) 'medical benevolence' as 'popular resistance fed by prejudice, superstition and an ingrained aversion to change'. Instead, his study drew attention to the alienating side-effects of effectively dictating medical solutions to the indigenous population (Brimnes 2004: 200).

It is important to note that science diplomacy, in addition to its varied forms, has a wide range of social, political and economic goals. Every science diplomacy initiative should be evaluated in its own socio-political context. However, it is safe to say that the above discussion points to an irony embedded in a conventional logic that 'science is universal and unifying' and can be a vehicle to bridge socio-cultural divides (Gianotti, 2018). That is, it is not uncommon to paradoxically exacerbate alienation between two societies for being perceived as coercive or autocratic. The reason, as shown through the brief historical review above and further demonstrated in the analysis of COVID-19 vaccine diplomacy below, is a hegemonic logic of prescribing solutions without sufficient engagement with or respect for self-determination and (individual or collective) agencies in the recipient communities.

The problem of the hegemonic paradox, embodied in conventional science for diplomacy projects, is more tangibly felt in an age of decolonial movements, which have given rise to a renewed consciousness of defending individual rights and indigenous agencies. In fact, scholars from both international relations and science and technology studies have pointed out that in the contemporary world, science diplomacy has become ever more intertwined with public policies, and its efficacy hinges on the ability to engage with diverse communities (see Anderson and Adams, 2008; Brummer et al, 2022; Zhang and Datta Burton 2022). Yet, despite the fact that historically, 'science for diplomacy' emphasises the role of non-state actors and despite revived interest in Track II diplomacy in recent debates (see Turekian et al, 2015; Campbell, 2015; Boyd et al, 2019; Melchor, 2020; Montgomery and Colglazier, 2022), much of the practice and discourse of science diplomacy effectively remains restricted to elite actors and to state-to-state framing. For example, in a move to expand its Track II diplomatic outreach, the United States created new science diplomacy positions in the Silicon Valley to work with Big Tech companies, 'as pseudo-nation states' (Montgomery and Colglazier, 2022). In fact at the American Association for the Advancement of Science's founding of the Centre for Science Diplomacy in 2008, the emphasis on Track II diplomacy was clear. Its mission was to serve 'as a catalyst between *societies* where official relationships might be limited and to strengthen *civil society* interactions through partnerships in science and technology' (Campbell, 2015, emphasis added). Yet in recent years, its mission statement has been revised to 'strengthen interactions and partnerships between the scientific and diplomatic communities' (AAAS, 2022). As the paper later demonstrates, this reversal from relying on official and institutional channels aggravates the effects of the hegemonic paradox in science diplomacy. Studies on COVID responses have highlighted the importance of understanding and being empathetic to collective psychologies in Global South

communities (Blume, 2022), and the value of mobilising non-state actors (e.g. civil societies, scientists and social scientists) in 'nesting' science diplomacy with local norms and social mentalities, so to promote public health outcomes (Bentkowska, 2021; Paniagua, 2022).

In what follows, I draw attention to the top-down approach in both China's and the US's approach to COVID-19 vaccine diplomacy and the critical role of 'choice' in vaccine uptake. It is only through a close examination of how hegemonic paradox comes into being and its impact on real-world crises that we can start to identify how to overcome it.

Coercive Inoculation or Vaccine Diplomacy? Reflections from the COVID Pandemic

At first glance, the US and China may provide an interesting contrast as global powers. While the US is commonly perceived as an 'old' global power with waning yet still significant soft power, China is an emerging economy that still struggles with a chronic image problem on the world stage. While the US, similar to other Western countries, has historical baggage of racial and colonial exploitation, China, although not without controversies, has been keen to project itself as more sympathetic to Global South countries. But, as this section demonstrates, the outcome of both countries' vaccine diplomacy is discounted by the hegemonic paradox. That is, contrary to their aim of improving their respective image and gaining public confidence globally, in many cases, their vaccine diplomacy was met with social distrust and sparked further vaccine hesitancy.

China was very adept at marketing its inactivated virus vaccine and publicly staging its international deliveries in the early phase of the pandemic (Nolte, 2022). In contrast to the First World luxury associated with Pfizer and Moderna vaccine's ultra- cold storage requirement, China seemed to offer more practical hope for resource- poor countries. In addition, different from many Western countries hoarding billions of doses of excess vaccines, China was among the first countries that shipped their vaccines worldwide.

At the state-to-state level, China's vaccine diplomacy was successful in leveraging policy changes, such as pressuring small states to sever diplomatic ties with Taiwan (Horton and Parks, 2021), making Brazilian authorities re-invite Chinese telecommunications giant Huawei in the country's 5G auction (London□o and Casado, 2021) and directing the Algerian government away from criticism on Xinjiang human rights issues (Smith, 2021).

Yet at the social level, for many Asian communities, China's top-down vaccine diplomacy seems to re-confirm rather than revise the image of a coercive state. In extreme cases, it has reversed the willingness for vaccine uptake. For example, the Philippines, a key player in the South China Sea territorial disputes, has been one of China's strategic targets for vaccine diplomacy. At the beginning of the pandemic, one survey found 94 per cent of the Filipino hospital staff were willing to take COVID jabs (Robels, 2021). Huang Xilian, the Chinese ambassador to the Phillippines, was keen to publicise 'many memorable "Firsts" that China's vaccine diplomacy has achieved: 'China was the first country to donate test kits, the first country to dispatch anti-pandemic medical expert team to the Philippines, and also the first country to issue special permit for the Philippine military air crafts and vessels to land and dock in China for the transportation of medical supplies' (Embassy of PR China, 2022). The 600,000

doses of CoronaVac donated by China enabled the Philippines to kick off its national vaccine rollout on 1 March 2021 (DOH, 2021). However, despite the appeal from the hospital's director to 'separate the vaccine from our politics', when the Philippines government dictated that hospital staff would be given only Chinese vaccines, the Philippine General Hospital's Physicians Association announced that 95per cent of hospital staff disapproved of being vaccinated with the China made product (Robels, 2021). Even in traditionally pro-China countries, China's official push for its vaccine had some backlash. In Pakistan, for example, Chinese vaccines were quick to receive approvals from Pakistani authorities. But in the first two months of its vaccine rollout, when China's Sinopharm vaccine was effectively the only choice, uptake was low. Those who were 'offered the Chinese vaccine felt they [were] being given an inferior product' (Marlow, Mangi and Lindberg, 2020). It is worth pointing out that at the time of this comment, clinical trials were still ongoing, and it would be at least another six months before efficacy data was circulated (Lee, 2021). Thus, Pakistan's reaction further underlined that China's vaccine diplomacy did not remedy but rather reignited social skepticism.

What needs to be highlighted is the absence of choice in the two cases, which turned China's science diplomacy into a reminiscence of technological imperialism. As I argued previously (see Zhang, 2021), what China and the two recipient countries' governments miscalculated is that the minute a technical solution is perceived as being 'imposed' upon a population, it ceases to be a practice of science diplomacy but turns into hegemonic oppression.

This point can be further demonstrated through a counter-example of the persistent popularity of Chinese vaccines in Serbia. As part of its extended 'Health Silk Road' along its Belt and Road Initiative in Central and Eastern Europe, Serbia was not only among the first to receive vaccines, but almost a year after the roll-out began, China's Sinopharm jab remained the most sought- after jab (Leigh 2021, Aspinall, 2022). The think-tank Belgrade Fund for Political Excellence observed that even 'the suspicion that people who receive the Chinese vaccine will not be able to travel freely to EU countries did not discourage Serbian citizens from getting the shot' (Vladisavljev, 2021). In fact, the perceived lack of support from the EU and other Western manufacturers played a key role in the Serbian embrace of Chinese alternatives (Milenkovic, 2021). Yet it is also very important to highlight that at the beginning of the vaccine roll-out, Serbia was also 'the only country in Europe where citizens can freely choose which shot they wish to receive'. This included Pfizer-BioNTech, Oxford-Astrazeneca, China's Sinopharm and Russia's Sputnik V (Euronews, 2021).

Some may argue that the level of individual autonomy in the case of vaccines in recipient countries is a matter of domestic politics rather than part of the donor country's foreign policy. However, effective science diplomacy has always involved and should involve working *with* partner countries to 'nest' a technical option into local society, rather than parachuting it in with instructions (Bentkowska, 2021). In other words, for the exportation of technical solutions to be a practice of science diplomacy rather than a hegemonic imposition, it cannot be limited to state-to-state deal-makings, but necessarily needs to be able to speak to social context. The discussion around the US vaccine diplomacy further reinforces this point.

In comparison to China, the US had a 'late start' in vaccine diplomacy (Kumar, 2021). When the Biden administration

turned to this issue in the second half of 2021, the US also had reputational damage to repair. Similar to other Global North countries, American hoarding of vaccine doses was seen as exacerbating global inequality. Given the rampancy of virus mutation and expanding influence of China and Russia, political observers urged that the US 'must' step up its science diplomacy to plug humanitarian crises and 'must become the Vaccine Arsenal of Democracy' (Shah, 2021; Castro, 2021).

Yet Biden's pledge to double the US' donation to more than 100 countries to achieve the goal of vaccinating 70 per cent of the global population within a year soon met with setbacks (Miller, 2021). In May 2021, political scientist Greg Weeks (2021) observed that US vaccine diplomacy in Latin America was failing and cautioned that instead of employing the old rhetoric of 'the U.S. swoops in to save the day', vaccines should be framed in 'a broader policy of engagement' (Weeks, 2021). While Biden was openly frustrated at South Africa turning down US donations, other African countries like Naibia, Zimbabwe, Mozambique, and Malawi also asked to hold off sending more shots because they could not use the supplies they had (Chutel and Fisher, 2021). Donations of soon-to-expire vaccines and flawed supply chains were part of the problem (Economist, 2021). As many studies have shown, much of vaccine skepticism in Africa was rooted in deep- seated distrust of medical authorities associated with coloniality (see Lederer, 1998. Bachynski, 2018, Noko, 2020).

Zain Rizvi, research director at Public Citizen, a US organisation working on equitable vaccine access, observed that the hegemonic paradox embedded in American vaccine diplomacy soon turned the focus to realising American vaccination targets. The challenges in African countries were 'weaponized' to shift the blame to marginal groups (Abutaleb, 2021). In a *Washington Post* interview, he said, 'you don't say Canada doesn't deserve vaccines because there are hesitancy challenges… but somehow it's acceptable to do that on the African continent' (Rizvi in Abutaleb, 2021). A recent study by the University of Tokyo among 600 Japanese also suggested that in case of trust deficiency, having vaccine options promotes vaccine uptake (Aoki, 2022). Similarly, a July 2022 article published in the Proceedings of the National Academy of Science in the US has demonstrated that vaccine choice is an 'essential component' in getting over vaccine hesitancy in America (Hughes, 2022). In fact, following this finding, US authorities approved Novavax, a protein vaccine developed through a more 'classic' approach in comparison to mRNA-based vaccines (e.g. Pfizer/BioNTech and Moderna) and adenovirus carrier ones (e.g. Johnson & Johnson and AstraZeneca). The vaccine carried the hope that the diversification of choice would incentivise uptake (Lowe, 2022). To paraphrase Saad B. Omer, Director of the Yale Institute for Global Health's comment on vaccine diplomacy's setback in Africa, why should the US be surprised that they needed a more empathetic approach in these countries when respecting differentiated preferences and individual agency was also key to mitigate vaccine hesitancy in the US? Communities in the Global South are arguably more sensitive at being dictated to either by a Western power, another Global South power, or their own government (Zhang and Datta Burton, 2022). One should be also reminded that Cote d'Ivoire became 'a model for managing vaccine hesitancy' after additional financial support from the World Bank enabled the country 'to diversify its vaccine supply sources' along with better distribution logistics and awareness-raising (World Bank, 2021).

Debates on US vaccine diplomacy also highlighted that it may paradoxically suppress rather than incentivise cross-nation synergy. In fact, prior to the COVID-19 pandemic, Africa was a 'hegemonic priority' in US global health diplomacy for at least 20 years (Fideler, 2020). The decisions on what gets prioritised and how, not only deepened African countries' dependency on high-income countries, but also generated criticisms over the effective approach of 'securitizing' health to protect developed countries against the spread of infectious disease (Fideler, 2020). Global inequality exposed by the COVID pandemic and the Western government's inability to move beyond a Eurocentric view of global health has led global public health scholars to call for a 'decolonisation' of US health diplomacy. Instead of conventional 'top-down global health governance and programming', the US should learn to 'enter the global stage with humility to learn from and work with countries as equal partners' (Irfan, Jackson and Arora, 2021). This echoes Ghanaian historian of medicine Samuel Adu-Gyamfi's (2021) rebuff of Western framing of slow vaccine rollout as an African failure, and argued that Africa does not need Western elite's lecturing on vaccination, rather 'it needs an autonomous public health system' that can 'name their own public health goals'. In other words, while the US may be frustrated at the slow progress of its vaccine diplomacy, African institutions may also feel frustrated. Similarly, with China's aggressive campaign of promoting its own vaccines over international competitors, doctors in the Philippines and the general public in Pakistan had their own choice delimited and were subjugated to hegemonic interests.

To be sure, social resistance to vaccines is shaped by a range of factors. The success of science diplomacy also hinges on a number of issues. The lesson is not to draw a linear connection between the two, rather, draw attention to China's and the US' shared ignorance of the importance of respect for the agency and their shared lack of interest in societal engagement in their vaccine diplomacy. This ignorance makes visible the hegemonic paradox embedded in science diplomacy and its real-world implications. That is, it may further hinder rather than facilitate vaccine uptake while also exacerbating societal divides. Some may defend parachuting instructions into a foreign population as a pragmatic approach in times of crisis with limited resources. But previous studies have shown that societal engagement is even more paramount in the effective delivery of collective response in a crisis, especially when society's compliance and cooperation are needed (Gálvez-Rodríguez *et al.*, 2019; French, 2011; Han *et al.*, 2020). Respecting agency is different from offering whatever a group may want or from total anarchy. It is about seeing each other as equals in finding the course of collective action. Science diplomacy should be the emissary rather than the closure of that decision process.

A Paradigm Shift for Science Diplomacy?

Arguably, the COVID-19 pandemic has, more than climate change, brought science diplomacy and its real-time social consequences to the global public. With the increasing recognition that global challenges need to be addressed collectively across cultural and political divides with the aid of technical advancements, science diplomacy will only become more central to international politics. Yet modern science diplomacy remains a Western-centric discourse with an embedded hegemonic paradox. As rightly pointed out by Sinha

and Goveas (2021), the 'claim that science diplomacy is universal is debatable', for most of the existing discussions on how science diplomacy can and should be done are formulated by Western science authorities, chiefly in the US and the UK (see also Adamson and Lalli, 2021; Irfan, Jackson, and Arora, 2021). Although non-Western countries such as China are active players in this realm, it mainly follows and reinforces a linear vision of science and political authorities and superiorities. As such, as this paper argues, science diplomacy embodies a hegemonic paradox. That is to say, while it purports to bridge international socio-political divides through collaborative knowledge production and application, in practice, it perpetuates structural violence and social inequities across the globe. COVID vaccine diplomacies from China and the US, as analysed in this paper, are the latest example of this hegemonic paradox. 'A truly global/inclusive outlook on science diplomacy' remains to be developed (Sinha and Goveas, 2021; ECHOES, 2020).

The call for a decolonial approach to science diplomacy is not new. But what would a decolonised science diplomacy look like? There is and shouldn't be a conclusive answer to this. As the paper has underlined earlier, similar to all political and scientific endeavours, the appropriateness of any science diplomacy initiatives necessarily needs to be organised, carried out and assessed in its specific context. Thus, instead of attempting to compile a list of broad-brush principles, I consider a more modest approach that focuses on key areas for further action would be more useful for practitioners. More specifically, this paper carries two action points. One is to take the agency of partner countries seriously by replacing a top-down 'solution prescription' mentality with a willingness to work with partner countries into 'nesting' technical options into their social context. To break away from 'unidirectional and Eurocentric approach' to science diplomacy, the first step would be to be able to be responsive to the societal concerns and desires of partner countries (Anderson in ECHOES, 2020, 9). Naturally, being responsive does not mean to accommodate all requests unconditionally, but it refers to the diplomatic willingness and capacity to work with relevant communities on how science diplomacy can be better delivered. Relatedly, a diversification of actors could also help future science diplomacy avoid the hegemonic paradox. Allowing expertise from non-state actors (e.g. civil societies, scientists and social scientists) to play a more prominent role in shaping the delivery of (Track II) science diplomacy would be key. This would also help science diplomacy to be better embedded in multiple aspects of societies, rather than initiatives led by national authorities.

But the discussion in this paper is far from exhaustive. Thus in lieu of a conclusion, this paper ends with an invitation, an invitation for more research and discussion on how science diplomacy can be better conceptualised for the 21st century. A paradigm shift does not necessarily mean a radical overturning of principles. Rather it requires the courage to re-examine power structures and make adjustments when it no longer reflects circumstances.

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ARTICLE

Partaking Indian Traditional Medicine Systems in Global Diplomacy

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Introduction

Ayurveda, the ancient Indian system of medicine is recognized globally due to the presence of various vital elements like elements of health, qualitative strength, and important signs for consistent operations of life. The World Health Organization (WHO) has encouraged health-related programs for every person in each country and is constantly involved in work related to mankind (Chaudhary and Singh, 2011). Ayurveda encompasses basic fundamental knowledge of health, therapeutics and pharmaceutics. Classical books of Ayurveda contain a complete compilation of healthcare and are addressed in the first schedule of the Indian drugs and cosmetics act, 1940, as trustworthy textbooks of Ayurvedic medicine for licensing of Ayurvedic drugs (Malik, 1940, 2008).

In India, the Ministry of AYUSH (Ayurveda, Yoga and Naturopathy, Unani, Siddha & Sowa Rigpa and Homoeopathy) is playing a vital role in the upliftment of traditional medicine globally. Several academic and research institutions are dedicatedly

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involved in promoting Ayurveda in the country (Chaudhary and Singh, 2011). The government of India has recognized Ayurveda as one of the authentic and deep-rooted systems of medicine to be actively pursued in the country. The purpose of medicine has been defined as "to comfort constantly, to heal frequently, and sometimes to cure". The roles of healthcare providers and organisations have increased along with definitions of health as more parts of life are now connected to medical intervention (https://www.healthknowledge.org.uk/). Services that are statutory and voluntary foster health. The sustainability and quality improvement goals are strongly linked with the efforts to keep patients out of hospitals by strengthening home care. Most people consider sustainability initiatives in healthcare as a component of a larger societal plan to cut carbon emissions and stop global warming. The actions to improve the environment will also improve human health, such as in the cases of metabolic disorders and mental health (Thompson and Ballard, 2011).

Education in the Ayurvedic system of medicine in India is regulated under Indian Medicine Central Council Act, 1970. Herbal medicines that fall under the Ayurvedic system of medicine are so far regulated under chapter IV A of the Drugs and Cosmetics Act (Chaudhary and Singh, 2011). For the externalization and strengthening of traditional medicines, in the year 2003, participation was requested to evolve and enhance health research efforts, human resources and exchange of information knowledge on traditional medicines at the 56th Session of the WHO Regional Committee for Southeast Asia. In this meeting, it was decided that measures should be taken to conserve traditional knowledge. In the 9th meeting of the Health Secretaries held in July 2004 (convened by WHO), it was recommended that the WHO South East Asia Regional Office (SEARO) facilitate the preparation of standard regional perspectives that specialize in the burden of disease, related health research and development, IPR, public health, incentives for innovation, traditional systems of medication and, capacity building to be presented to the Commission on Intellectual Property Rights, Innovation and Public Health (CIPIH) (Chaudhary and Singh, 2011; World Health Organization, 2011). In compliance with the resolution in which the role of traditional medicines in human wellbeing and health has been duly appreciated, the WHO Strategy for Traditional Medicine (2002–2005, 2005–2010) has been framed which acknowledges the widespread use of traditional medicines worldwide.

The Millennium Development Goals, the United Nations Organization's Decade for "Education for Sustainable Development," the European Union's sustainability strategy, the Global Environmental Outlook of the United Nations Environment Programme (UNEP), and the ten Principles of the UN Global Compact, all aim to achieve sustainability. Concerns with respect to healthy lifestyles, preventive medical approaches, safe environments, and early warning systems represent these concerns.

WHO and Traditional Medicine

World Health Assembly resolution (WHA 56.31) assigned specific roles and activities to member states which form the premise for the strengthening of traditional medicine globally and for the Ayurvedic system of medicine in India, in particular. The term Ayurveda is made up of the words Ayu (life) and Veda (knowledge), and as such, it deals with variety of aspects related to health and wellbeing, such as happy life, sustainable happiness, and

longevity. It has been acknowledged and legitimized as one of the formal healthcare systems of the country in India's post-independence period (Sharma 2001). It can be inferred that the Indian subcontinent has had a vibrant and uninterrupted knowledge tradition from the vast amount of literature, spanning more than three millennia, on various elements of managing health and wellbeing, both in Sanskrit and regional languages of the subcontinent (Sharma 1992). Since the late nineteenth century, contemporary Ayurveda has been structured and institutionalized in areas including education, therapeutics, pharmacopeia, and product manufacturing. However, it is unclear whether the Ayurvedic pharmacology or the comprehensive knowledge of Ayurveda was assembled by putting together bits of data and information gained over time (like) approach used to understand holism. Therefore, using the same techniques and tools that focus on cells and molecules to the complex holistic principles of Ayurveda can be rather difficult (Payyappallimana and Venkatasubramanian 2016).

The role of the Ayurvedic system of medicine in healthcare and in translational medicine is of prime importance for overcoming wide range of lifestyle diseases, malnutrition, and related illnesses. The traditional systems of medicine in general, and Ayurveda and Unani system of medicine also play a very pivotal role in trade and export. This can also contribute to the augmentation of the economy of the country. In addition, the most important aspect of this is in cutting- edge research. Therefore, it is highly recommended to improve the quality of research in the field of Ayurveda, Unani, and other traditional systems, particularly from the government institutions and academia. More efforts are needed to attract young scientific minds to take up Ayurvedic research irrespective of their disciplines. In this context, the initiative of WHO in 2022 for the establishment of the Global Centre for Traditional Medicine (GCTM) in India is a commendable step in this direction and can become a milestone for research in traditional medicine. Hence, appropriate human resources will be required to improve the standards of Ayurvedic research, globally.

In order to frame proper guidelines and streamline the regulation of herbal products used in traditional medicine, the role of WHO has been identified (Organization, 2004). Its main role is to facilitate interested member states in formulating national policies and regulations on traditional, and complementary medicine, and promoting the exchange of knowledge and collaboration on national policy and regulation of traditional medicine among member states. In addition, technical support for developing methodologies, ensuring product quality, efficacy and safety, preparation of guidelines, and promoting exchange of information to member states in defining indications for the treatment of diseases, are amongst some major roles of WHO in this regard.

Integration of Medicine and Diplomacy

Conceptualization of the relationship between contemporary medicine, contemporary science, and conventional medicine was developed by Professor R. A. Mashelkar, former Director General of the Council for Scientific and Industrial Research (CSIR). This is known as the Golden Triangle Partnership concept. Through untiring efforts of AYUSH, CSIR, and the Indian Council of Medical Research (ICMR), the Golden Triangle Scheme is intended to introduce standardized, safe, and effective Ayurvedic products for

specific disease conditions (Chaudhary 2011). The project sought to ensure high-quality, safe, and effective products at affordable cost (Banerjee, 2009). Products should be better than those currently in the market for various illness and ailments. The Government of India has financed a number of joint scientific and ayurvedic research initiatives involving networks of institutions under the "Science Initiative in Ayurveda" research programme. It is crucial to set up processes to make sure that such initiatives combine and grow (Patwardhan, 2010).

In addition to Ayurveda, various other medicine systems such as Unani, and Traditional Chinese Medicine also play important role in promotion of health, globally. Especially, Yoga and Traditional Chinese Medicine are extensively employed all around the globe and in Africa, for health benefits (Hu and Venketsamy, 2022).

Yoga plays a significant part in promoting the sustainable development goals (SDGs) through education. Yoga instructors are renowned for spearheading ground-breaking initiatives to restore rivers and forests in support of the SDGs (Agoramoorthy, 2015). While some advocate forest conservation to remind followers of the need of protecting the environment, others host large-scale yoga camps in support of river cleaning and tree planting initiatives across India (Swamy and Agoramoorthy, 2022). The appeal of the Hon'ble Prime Minister of India to declare 21st June as International Day of Yoga was applauded globally by over 150 member states of the United Nations, and now every year this day is globally witnessed and celebrated as the International Yoga Day. In addition to this, government of National Capital Territory of Delhi conducted a flagship programme named "Delhi Ki Yogshaala" in which, through Delhi Pharmaceutical Sciences and Research University (DPSRU), Yoga instructors were made available to the general population of Delhi without any cost. This also benefitted thousands of people of Delhi.

In order to establish and regulate regional and peripheral centers for pharmacovigilance of the Ayurvedic medicinal products, WHO has supported four capacity development training programs as a part of the Drug Free-Community (DFC) program in India, in the year 2010 and 2011. Additionally, the Ayurvedic Clinical Trial project also serves as a long-term initiative for the generation of evidence-based data on the efficacy of traditional Ayurvedic medicines (Singh *et al.*, 2009; Chaudhary and Singh, 2010). Ayurveda, Yoga, Naturopathy, Unani, Siddha, and Homeopathy are all well recognized and practiced complementary and alternative medicine systems in India (Geneva, 2000; Debas, Laxminarayan and Straus, 2006). With rapidly increasing markets in North America and Europe, these systems are acknowledged on a global scale and play a crucial role in disease prevention in developing countries across Asia, Africa, and Latin America.

According to an agreement between the WHO and the Government of India, the establishment of WHO Global Centre for Traditional Medicine with a $250 million investment from the Government of India is underway. This worldwide knowledge center for traditional medicine intends to harness the power of traditional medicine from around the world using cutting-edge science and technology to benefit both human and environmental health. The WHO Director-General, Dr. Tedros Adhanom Ghebreyesus stated that "traditional medicine is the first line of treatment for millions of people around the world for various diseases[1]"

The present WHO Traditional Medicine Strategy (2014–23), which aims to harness its control button and promote the effective use of natural and plant- based medicines, was developed in part as a result of the 67th World Health Assembly decision on traditional medicine. This strategy has been extended up to 2025, by which time a successor strategy will be evolved. These global trends are especially important for India because of its multifaceted medical tradition, which includes the complementary and alternative healing modalities of Ayurveda, Yoga, Naturopathy, Unani, Siddha, and Homoeopathy, collectively known as AYUSH. For example, the Mudaliar Committee was the first to advocate vertical healthcare systems using native physicians (Srinivasan, 1995; Rudra *et al*., 2017).

The Ministry of AYUSH has been a stepping stone and have paved path for improving the quality and standards of Ayurvedic and other Indian traditional medicinal products, and hence, their export potential, particularly to the US market. The Pharmacopoeia Commission for Indian Medicine & Homoeopathy (PCIM&H) and the American Herbal Pharmacopoeia, USA, signed a Memorandum of Understanding (MoU) on September 13, 2021, which is a cooperative endeavor to significantly increase the export potential of the medicinal products with origins from Ayurveda, Siddha, Unani, and Homeopathic system of medicines.[2]

The potential of Indian Industrial, Scientific and Medical institutions to improve healthcare has been highlighted by various national health policies including the National Health Policy (1983), National Education Policy in Health Sciences in 1989, and the National Health Policy (2002), particularly given the dearth of modern healthcare in rural India. The paradigm change in government strategy since independence has been concentrated on developing such schools to generate licensees; standardizing curriculum; and conducting drug research for mass manufacture and patenting (Vaidya, no date; Abraham, 2005; Priya and Saxena, 2010).

After 2005, the National Rural Health Mission (NRHM) promoted the distribution of AYUSH medications and the co-location of providers at public health facilities to be used in the interest of "mainstreaming" policy. During India's 12th Five Year Plan, the Department of AYUSH also introduced the National AYUSH Mission, whose goal is to make healthcare accessible, sustainable and inexpensive (Singh, Yadav and Pandey, 2005; Sujatha, 2009; Lakshmi *et al*., 2015).

The National Sample Survey Organization (NSSO), Government of India, carried out a nationwide cross-sectional household survey in the year 2014 as the basis for the analysis of the use of traditional medicines (Rudra *et al*., 2017; Sangar, Dutt and Thakur, 2019). For this survey, a stratified multi-stage sampling approach was used, and a total sample size of 65,932 households (36,480 rural and 29,452 urban) with 333,104 people (189,573 rural and 143,531 urban) were recruited. The study collected data on patients' health and use of healthcare services, as well as details on the types of outpatient and inpatient treatments they received. Fifteen days prior to the survey, 93.4 per cent and 93.5 per cent of patients (people reporting illness) in rural and urban India, respectively, received allopathy-based outpatient care, while during the same reference period, AYUSH care was utilized by roughly 6.7 percent and 7.1 percent of patients in rural and urban India, respectively. Indian system of medicine

(ISM) is a main part of AYUSH with 3.45 per cent usage of AYUSH treatment in both rural (8.8 per cent) and urban India (8.1 per cent) (Rudra *et al.*, 2017; Sangar, Dutt and Thakur, 2019). It is noteworthy that during the recent COVID-19 pandemic, substantial rise was recorded in using Ayurvedic and other traditional medicines which should be studied further.

Ayurveda received top priority from WHO in its traditional medicines (TRM)-related operations within the Indian setting. WHO is primarily considering funding and encouraging studies that support the safety, efficacy, and standardization of Ayurvedic herbal remedies. Several WHO guidelines have been compiled. With the slogan "Health for All," WHO recognized the importance of traditional, alternative, and complementary medicine (CM) systems in the healthcare systems of both developing and developed countries in the Alma Ata Declaration, 1978. Later, the Traditional Medicine (TRM) Program of the WHO tackled this issue globally from a variety of angles, including herb production, manufacturing, distribution, and creation of recommendations for the general public in TRM. To define the parameters of TRM/CM strategy and the actions required to accomplish these national objectives, governments must have the political will and the power to make decisions. A national policy is a statement of the objectives for enhancing the role of TRM/CM in the national healthcare delivery system, assuring the establishment of regulatory and legal mechanisms for promoting and maintaining good practice of efficient TRM/CM therapies, as well as fostering research and educational initiatives (https://www.who.int/initiatives/who-global-centre-for-traditional-medicine). In India, there is a growing demand for AYUSH to be mainstreamed, especially to maximize provider complementarity and responsibilities within the established healthcare system. However, factors including the availability of infrastructure and human resources, socioeconomic conditions, treatment costs, patterns of morbidity, and the political economics of healthcare services will have an impact on this. It is encouraging that the Indian government have been so forward-thinking in institutionalizing AYUSH healthcare (Raut and Khanal, 2011; Nandha and Singh, 2013; Samal, 2015b) and now, after the constitution of the Ministry of AYUSH, outstanding work is being carried out for mainstreaming Indian traditional medicine.

Ayurveda and the World

The main reasons why Ayurveda is becoming more popular around the world are its holistic therapeutic approach, wide and sophisticated intellectual underpinnings, and the roots of its remedies running down to the prehistoric times. Despite the changes in the environment, lifestyle, culture, and disease patterns, the ideologies of Ayurvedic medicinal system and healing ability of its formulations from the past still hold true today (Mukherjee *et al.*, 2017). By balancing the physical, mental, and spiritual aspects of human life, the Ayurvedic system takes a holistic approach to healing. The science of Ayurveda is exceptional because it offers the chance to have a long, healthy life (Krishnamachary *et al.*, 2012).

The Ministry of AYUSH have signed several MoUs with various countries for cooperation in the field of traditional medicine and Homoeopathy in order to promote and establish AYUSH in the international practice of medicine. In addition, several academic chairs for different systems have also been formed for inculcating Ayurveda,

Unani, Homeopathy, Siddha and Yoga throughout the world. Some of these countries include Hungary, Mangolia, China, Japan, Malaysia, Brazil, Sweden, Serbia, Latvia, and Nepal. This certainly has benefitted Indian Traditional Medicine in general and Ayurveda in particular. Here it is noteworthy that AYUSH is rapidly burgeoning on global scale since the Ministry of AYUSH came into being in the Government of India.[3]

Research on Ayurveda has become more vigorous over the past few decades. As a result, interdisciplinary research programs have become copious and have resulted in excellent number of compounds, products, and procedures. People accept Ayurveda because of its usefulness, compatibility, traditional value, affordability and accessibility (Mukherjee and Houghton, 2009). Role of Ayurveda in preventive health care has substantially increased, and it came to limelight specifically in the prevention of infectious diseases during corona virus pandemic.

There are some extremely useful regulations for "Botanical Drug Development and Herbals". Numerous multi-ingredient products are provided in the Ayurvedic Formulary, along with a compelling justification for their use in the Ayurvedic classics (Mukherjee, 2005). Various traditional formulations are protected by patents in both India and the US (Patwardhan, 2005, 2015). New avenues for scientific investigation are becoming available as this old medicinal system continues to receive increasing amounts of scientific confirmation. Thus, prospects for a better healthcare system for serving millions of people with a hope for an effective and safe therapy are provided by the integrated evidence-based research in Ayurveda (Katoch *et al.*, 2017).

Interaction of Traditional System of Medicine with Western Medicine had a significant impact on Ayurveda (Weiss, 2009). Increase in the translations of classical Ayurvedic treatises in English and other languages was witnessed towards the end of the 19th century (Panikkar, 2002; Stunkel, 2012). The practice of Ayurveda remained popular among Indians, and treatises were still being written (Mukherjee *et al.*, 2017). Many of the fundamental ideas found in the classical texts of Ayurveda and other medicinal systems like Yoga and Naturopathy are being put to use and many of them are advocated in the implementation and planning of state programmes (PIP). At the same time, the Government of India has acknowledged a few Ayurvedic principles and therapies as possible interventions for several common health issues. These include Rasayana Chikitsa (rejuvenative therapy) for senile degenerative illnesses and Ksharasutra (medicine-coated thread) therapy for anorectal procedures. While each AYUSH system has advantages of its own, pairing them, like Ayurveda and Yoga, can boost overall national health indicators. The AYUSH sector has numerous opportunities to support public health research. The National Health Programme (NHP) 2017 places a strong emphasis on complementary medicine and traditional wisdom. In the context of knowledge of Ayurveda, drug-related research that incorporates pertinent contemporary methodologies, probing into concepts of plant biology through 'omics' approaches, chemo-biology, and phyto-informatics needs to be started. The lessons learned through initiatives like the Science Initiatives in Ayurveda and the New Millennium Indian Technology Leadership Initiative point to the urgent need for an interdisciplinary approach to AYUSH research. Consequently, guidelines for new drug research addressing its quality,

safety, and potency are useful in the study of classical Ayurveda formulation (Delhi, 2001).

India is becoming a major worldwide player in many fields, thanks to its diverse impact on global culture. The Ayurvedic industry in India has expanded to the Middle East, Africa, Europe, North America, and Asia Pacific. India exports herbal medicines to the large number of nations. More than 2000 natural herbs have been recognized for treating various diseases, and some of the herbs in India are used in the manufacturing of edible products and tea. The demand for Ayurvedic medicine has increased over time due to the promotion of organic remedies. Natural herbs are thriving in Africa and the Middle East, and this have certainly reduced the need for synthetic pharmaceuticals (Bhattacharya *et al.*, 2021). Efforts by the Government of India in popularizing AYUSH systems and Yoga is commendable, particularly in establishing various AYUSH chairs in large numbers of countries which are expected to promote these systems. The AYUSH Ministry has the enabling environment, the best leadership, and the best policies to support this. It's time to show how AYUSH systems can help to improve health indices. Priority must be given to the creation of a critical mass of exceptional physicians and researchers from the fields of modern health sciences and AYUSH systems. Institutions and professionals dedicated to AYUSH practices and research are ubiquitous in India. Global popularization of Yoga is also a major breakthrough and plays an important role in diplomacy. State governments like the Government of National Capital Territory of Delhi through its first Pharmaceutical Research University in the Country i.e. Delhi Pharmaceutical Sciences and Research University, are providing free Yoga instructors and promoting the people of the state for practicing Yoga for physical and mental wellbeing. This is an astonishing initiative and can be adopted by other countries too.

By 2050, the global market for herbal goods is anticipated to reach $5 trillion. The use of herbal treatments would increase, especially in developing nations. The European Union is the largest market for herbal products worldwide. The export of Indian goods to nations like Germany, France, Italy, and the Netherlands has also grown. Germany and Nigeria were the two biggest buyers of Ayurveda and Unani medicines in 1992–1993 respectively, but their importance in terms of exports of Indian Ayurvedic and Unani goods has significantly reduced. In 1996–1997, Russia was the primary importer of and market for Ayurvedic and Unani goods. One of India's most crucial trading partners for finished Ayurvedic and Unani products is Russia (Ravishankar and Shukla, 2007).

Conclusion

The primary source of inspiration for traditional medicine's drug research has been Ayurveda and other classical and folklore information. It is of prime importance to preserve medicinal plants and record priceless traditional knowledge. With its extremely rich and diverse flora and even rich traditional knowledge of its therapeutic uses, India has tremendous opportunities to take the lead in promoting human health and longevity. Approximately 3.5 billion people in the developing nations utilize plant-based medications for their primary healthcare according to the WHO. The majority of medications that are now being used in the therapeutic settings are of natural origin. Prioritizing research in this arena should take into account AYUSH systems' successes in promoting mother

and child health, healthy ageing, and non-communicable disease prevention. The recent establishment of the WHO Global Center of Traditional and Complementary Medicine in India can be a breakthrough for the advancement and global acceptance of the Indian Traditional and Complementary medicine systems and can serve as a milestone for diplomacy for member states in general and Southeast Asian countries in particular.

Endnotes

1 For details visit: https://www.who.int/news/item/25-03-2022-who-establishes-the-global-centre-for-traditional-medicine-in-india.

2 For details visit: https://pib.gov.in/PressReleasePage.aspx

3 For details visit: https://pib.gov.in/PressReleasePage.aspx?PRID=1754957.

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ARTICLE

Water-Related Science Diplomacy: The Silver Lining to Sino-Indian River Sharing?[1]

Lei Xie*

Lei Xie

Introduction

One of the largest water basins in the world, the Ganges-Brahmaputra-Meghna (GBM) between China, Bangladesh, Nepal, Bhutan and India, provides rich water resources for the generation of hydropower. Located on the upstream, China's plans and construction activities for hydropower have raised lots of controversies with its neighboring state India. India has started to accuse China of unilaterally exploiting water on the upstream fearing that insufficient water resources are available for its water supply since the first decade after 2000 when China's hydropower scheme had only started. In such a process, we see complex science-politics connections in the development of hydro-diplomacy, and no consensus reached on the effects of China's use of water on the upstream (Xie and Jia, 2018). From the Indian side, it was feared that China's water use on the upper stream would have a detrimental impact on India. China has frequently been accused of unilaterally using water resources for infrastructure construction or diverting water to tackle water scarcity in other parts of the country (Panda, 2017). India fears that the planning of the Zangmu dam would help the Chinese to divert water from Tarlung Tsangpo and that water flow would be substantially affected in the Brahmaputra. According to such a view, being on the upper stream, China's unilateral use of water on the upstream might obstruct India's development, as

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1. The opinions expressed in this publication are those of the authors. They do not purport to reflect the opinions or views of the International Hydropower Association or its members.

well as the wellbeing of people in the lower stream areas.[1] Nevertheless, some Chinese scholars indicate that there is very little extent of water quantity competition between China and India. Water from China's mainstream Yarlung Zangbu River contributes 14.61 per cent of the total annual runoff of the Brahmaputra River. River runoff of the Ganges Delta drainage system is mainly generated in India, Nepal, Bhutan and Bangladesh (91.12 per cent), and the contribution of water from China is small in terms of the total natural runoff (8.88 per cent). Therefore, it is predicted that water from China has little impact on the development of water resources in India (Xie and Jia, 2017). China had denied the possibility of its hydropower construction schemes impacting India's accessing water from downstream, and authorities in Beijing had relied on its public statement to pass the message that this run-of-the river project does not store water.[2] However, the Beijing government felt that it had experienced lots of difficulties conveying the conclusion to India that no harm would be posed by access to water from the upstream. However, this response was greatly challenged by political elites including scholars, senior officials and the media, some of whom went so far as to describe it as 'meek' and insufficient to defend India's interests.[3]

At the same time, China sees Indian key politicians deliberately mobilising media campaigns to purposefully politicize the water issue by portraying it as a national security issue (Jiang et al., 2017; Xie and Warner, 2021). The Indian securitisation frame is viewed by the Chinese government as fueled by nationalist sentiments and thus Beijing had become more convinced of its securitization acts being legitimate (Xie et al., 2018). In addition, in both countries, the development of hydro-diplomacy shared the common feature of being non-transparent. China exhibits a higher degree of secrecy in the making of relevant policies and in making policy information accessible to the public, while India demonstrates a lesser degree of secrecy in this area. For instance, non-governmental stakeholders in India feel that they enjoy a certain degree of policy access (Xie and Warner, 2021).

The diplomatic interactions between the two largest powers in Asia have not gone through smoothly and the different border alignments adopted by India and China further complicate this process when both countries had shown barely any gesture forming an agreement in the management of the shared river basin. Diplomatic cooperation has been very slow, which impedes water disaster science diplomacy. Both governments in India and China are aware that upstream countries do not necessarily have to consult with their downstream neighbors before accessing the transboundary river in their own territory (Xie et al. 2018). Neither state seems interested to promote river basin-scale water management that incorporates all relevant riparian states. In addition, India shares a river with Bangladesh as an upstream state, where it has accessed water unilaterally without prior consulting with its downstream neighbor. Critics speculate that India shows reluctance to promote the management of the Brahmaputra by including all relevant riparian states (Xie et al., 2018).

However, one key issue lies in disaster mitigation. Within the India border, the upper Brahmaputra basin is prone to natural disasters and environmental stresses, such as floods, droughts, and bank erosion, and creates an environment of uncertainty and sets the basin back in terms of socio-economic development (Johnson and Hutton, 2014). It is thus

crucial that diplomatic collaboration is further developed to mitigate disasters for the vulnerable communities which mostly locate in the Northeast of India.

The nature of water diplomacy has been explored from different angles, especially by examining power struggles between great powers (Xie et al., 2018), international peacemaking and conflict resolution (Huda and Ali, 2018) as well as scientific assessment of water vulnerability as a key factor affecting countries' development of hydro-diplomacy (Varis et al., 2014). Few have examined features of science diplomacy and how it is used by non-government stakeholders in Sino-Indian water sharing negotiations. Past literature informs us that the use of science and the exchange of science-based analysis is a universal language and the use of science paves way for communication (Marco and Bona, 2018), and it facilitates the formation of a shared understanding of science that is useful to bring about political consensus (De Lange et al. 2005; Dimitrov, 2006), and could further improve the quality of complex environmental policy decisions (Ehrlich and Ehrlich, 1996). Specifically, in the scholarship of hydro-diplomacy, the practices of science- based diplomatic activities are seen to benefit international cooperation on the water in a multi-faceted fashion, including promoting communication and understanding between riparian states (von Stein, 2008), serving to enhance trust (Milman and Gerlak, 2020), representing a key international norm for mitigating conflicts among countries that share rivers. Therefore, in this study, we aim to examine the following questions: in the diplomatic cooperation between China and India, what science diplomacy has been developed on water sharing? To what extent the decisions on information sharing has been viewed as science-informed activities, and to what extent do science-based diplomatic activities promote trust building between the two countries?

This article is structured as follows: the second section outlines a literature survey that reviews the conceptualization of science diplomacy and the features of science diplomacy on water sharing. In the third section, the methodology for this study is explained. In the fourth section that follows, empirical findings are analyzed before concluding remarks are made in the last section.

Literature Review of Water-related Science Diplomacy

Water Culture and Values

Both China and India, ancient civilizations with long histories, cherish water and particularly share long agricultural history that heavily relies on water. However, each has developed distinctive water values that view water-human relations differently. The traditional Chinese culture highly values water as an important element of nature. Ancient Chinese philosophies have specified water as a vital resource for humans. For instance, Taoists sought harmony between human beings and nature (tian ren he yi), where the focus is not on the characteristics of human beings, but on natural ones. This way of thinking has led to humans paying respect toward nature, which differs significantly from the anthropocentric view that is demonstrated in contemporary China. Strong emphasis is placed on viewing water from a utilitarian and economic perspective. In recent times water is prioritized as an economic resource that supports agriculture, industries, navigation or energy generation. Chinese domestic critics have highlighted this weakness in China's prioritizing of its water management and governance only

for economic purposes. Such prioritizing has also already been shown to have limitations in practice (Cai, 2007).

In India, religion has played a significant role in how water is viewed. Since ancient times, Hinduism views water as a primordial spiritual symbol (Baartmans, 1990; Joshi and Fawcett, 2001). Water was considered sacred and the source of life, serving to purify individuals. Such culture views water as not being polluted (Zawahri and Hensengerth, 2012; Joshi and Fawcett, 2001). Indian indigenous cultures also view water with vivid distinctive values. Before colonial times, indigenous people's water values are often combined with diverse socio-economic and cultural identities, such as those identified in the mountain communities (Sati, 2020).

However, with the gradual transformation of the Indian society, these indigenous water identities have also become weakened (Vagholikar and Das, 2010), along with the newly introduced modern technologies to manage water resources (Zawahri and Hensengerth, 2012). Similar to Chinese society, in resource management, the Indian state has shown similar interest in a utilitarian principle in water management, favoring industry; preferring modern intensive agriculture and commercial exploitation of resources (Williams and Mawdsley, 2006). Such a change is also suggested by British colonial influence that emphasizes harvesting economic benefits from water uses. This was also made possible by the use of science and technology promoting and transforming the management of water from traditional manual methods (Shah et al., 2019; Harding, 1994).

Therefore, India and China share the feature of exploiting water resources which are increasingly linked to economic developmental policies. In such processes, governments have shown a strong focus to develop construction infrastructure for irrigation (Shah, 2011). Such a utilitarian approach toward water resources is also seen in the government's focus on preventing water- related disasters.

Defining Science Diplomacy

Science diplomacy (SD), which includes disaster-related science diplomacy, refers to diplomatic activities that are based on scientific information, which broadly include 'knowledge produced through systematic methods' (Miltan and Gerlak, 2020, 138). SD is thus often constituted by the production of data and the analysis of knowledge. In practice, SD displays a mixture of research, policy and practice representing a mixture of both scientific activities and diplomacy.

Scholarship generally agrees that gaps exist between practice and theoretical development in science diplomacy. Although SD can be witnessed in diplomatic processes, the concept of SD has not yet been advanced sufficiently and it remains rather ambiguous (Kontar et al., 2018; Kelman, 2017). Nevertheless, compared with conventional diplomatic activities, SD is recognized by two features:

First, SD suggests actions toward mitigating natural and anthropogenic disasters that pose threats to human society. This feature distinguishes SD from conventional diplomacy in that such processes are 'specifically and unidirectional' driven by an intention to enhance disaster resilience (Kontar et al., 2018; Kelman, 2017), rather than politics- driven (Cuny, 1983; Hewitt, 1983, 1997; Lewis, 1999; Wisner et al., 2004). However, it can be noted that this normative approach to defining SD does not consider conditions where SD takes place. The boundary between politics and science is a very blurred one and can hardly be distinguished. The politics

that promote SD may be pertinent for characterizing SD.

Second, SD is recognized by the involvement of various actors, most often scientists and experts. Haas (1992) specifies that a group of experts exist as transnational actors. They play an active role in defining the cause-effects of problems and the framing of policy agenda, including re-defining national interests in international negotiation. However, for various experts to be involved, SD needs to take place in an open and transparent process with little secrecy in decision- making.

Water-related Science diplomacy

Water-related knowledge is a particular body of knowledge, displaying complicated information, and poses challenges for effective SD to be formed. Water science is complex because our value systems differ and our understanding of water management also differs. Indeed, water problems are social problems defined by complex values across social, economic, political and environmental scales (Timmersman, 2005; Ehin, 2003). Hence, scientific knowledge of water displays a high degree of pluralism constituted by collaborative scientific disciplines as well as the combination of scientific and social information (Krueger et al. 2016). Therefore, in pursuit of local solutions to water dilemmas, the process of gaining water knowledge often involves deliberation and negotiation, where science should be co-produced with its users (Lepenies et al., 2018).

Scholarly work shows that water-related SD can be adopted to serve national interests, before or during diplomatic negotiations (Cascão & Zeitoun, 2010). Indeed, as Agnew emphasizes, state territories are seen as fixed units of sovereign space; and sovereignty is to be exerted in all cases (Agnew 1994). National foreign policy principles have directly impacted the production of scientific knowledge on water sharing, especially in areas where international cooperation is required. Globally, science is believed to be maneuvered and to serve national interests. Using the case of the development of postwar meteorology cooperation across the world, Miller (2001) suggests that science is purposefully integrated by the American government for use in diplomatic activities. In addition, diplomatic activities over the management of transboundary water basins are strongly affected by national interests, where states deliberately impact on knowledge construction and shape social norms, values and choices in favour of their interests at the transboundary level (Sumit et al., 2020).

Indeed, although scholarship generally agrees that the use of science for dialogue is a fundamental aspect of hydro-diplomacy (Wilder et al., 2019), there is a lack of empirical findings on how water- related science diplomacy (WRSD) can contribute to resolving conflicts. Milman and Gerlak (2020) note that the production and use of science in different contexts differ. Hydro-diplomacy is thus made more complicated due to the co-existence of different knowledge. There is also lack of successful cases to understand the role that epistemic communities play in water conflicts and whether WRSD necessarily leads to smoother hydro-diplomacy.

This article will focus on two dimensions of water- related science diplomacy, which is closely linked to the development of hydro-diplomacy between the two countries. One, both countries display concerns on preventing drought and flooding disasters. Hence, a key feature of WRSD between China and India lies in the development of approaches securing human safety from such disasters. Second,

as Sino-India relations have shown signs of uncertainty, another aspect identified in water- related science diplomacy developed between China and India evolves around the issue of water quantity and security.

Methodology

In early 2014, the author managed to conduct fieldwork in both countries. Being Chinese in origin, the author's research trip to investigate the subject was keenly observed by both the Indian and Chinese authorities. She drew the attention of government officials in both countries who used the opportunity to seek intellectual information from the other side. Later on, for various related research projects, interviews continued till 2019 when online communication was adopted. Nevertheless, when the author invited potential participants for the project, she experienced difficulties in including government officials from both countries. In India, there has been a positive response from government officials but in reality, they were not keen to participate in the project, although they deny that the issue of river sharing is censored. On China's side, it was more evident that the Chinese officials did not want to disclose any information and hence had firmly declined the invitation to participate in the project. Compared to India, the discussion of the water sharing issue is conducted in a secretive manner (Xie and Warner, 2021).

First-hand interviews were conducted with NGOs and scholars in both countries, with the invited participants likely to have been invited to previous policy consultations of a similar kind. Environmental activists in India generally enjoy more opportunities for pursuing activism around transboundary water management issues than their counterparts in China. Hence more interviews with activists were conducted on the Indian side. In India, with regard to the issue of water management, the Brahmaputra basin receives less attention than the Ganges, which India shares with Bangladesh. Indian NGOs as well as India-based INGOs have shown little interest in China's impact on the upper stream for India's water management, whereas much greater concern is shown for how India's

Table 1: Interviewees' Information

Participants	Location	Occupation
Interview 1	Beijing	Professor in International Relations, University
Interview 2	Shanghai, SASC	Research Professor in International Relations, Research institute
Interview 3	Phone interview	NGO
Interview 4	Beijing	Professor in Hydrology, Research institute
Interview 5	Shanghai,	Professor in IR, University
Interview 6	Shanghai,	Professor in IR, Research Institute
Interview 7	New Delhi	WWF India
Interview 8	New Delhi	International Rivers, India
Interview 9	New Delhi	Professor in IR, University
Interview 10	New Delhi	Retired government official
Interview 11	New Delhi	Professor in IR, Research Institute

water usage from the Ganges affects Bangladesh in the lower stream.[4]

An Empirical Study of China-India Hydro-diplomacy

Forms of SD over Water

SD has been a major narrative in China's interaction with India for its diplomatic activities over the Brahmaputra. From China's point of view, it enjoys the full right to access and exploit water resources that are located within its territory before it flows downstream into India. Although China had shown no intention to inform the downstream countries of the Brahmaputra prior to its hydropower development projects, Beijing had shown commitment in providing disaster mitigation notices to protect human security for the potential victim, especially where the vulnerability exists in India. In 2000, the Chinese authorities sent warnings to the Indian government about the likelihood of landslides. Subsequent talks on the issue between the two nations led to an agreement over the Brahmaputra River. In 2002, a Memorandum of Understanding was signed that requested China to provide annual hydrological information on the Yaluzangbu/Brahmaputra River in the flood season. It was agreed that China would provide India with information on water level, discharge, and rainfall frequently (twice a day from June 1st to October 15th) each year in respect of three hydrological stations situated on the mainstream Brahmaputra river.

A Joint Expert Level Mechanism (JELM) was set up at a ministerial level. This mechanism is led by the Ministry of Water Resources in both countries, with participation by hydrologists from both countries. It provides a platform for communication to take place, where cooperation has been limited to China's unilateral provision of hydrological information. JELM was also established at the ministerial level in 2006.[5] Between 2006 and 2014, 8 meetings of the JELM were held for the purpose of helping India to use the data it was receiving to develop effective flood forecasts (Ministry of Water Resources, River Development and Ganga Rejuvenation, 2016).[6] It should be noted that this mechanism was primarily composed of state-sponsored experts and hydrologists. It served to guarantee that the bilateral cooperation excluded the involvement of experts who have no affiliations to either state. With respect to the established mechanism, compliance with the Memorandum of Understanding as well as with the Joint Statements had been positive. In 2017 the mechanism was paused when the Doklam military standoff over the Chinese construction of a road in territory disputed by India took place (PTI 2019). India subsequently suffered from flooding. In 2018, a year later, the JELM has been resumed.

Nevertheless, it should be noted that the JELM, as part of the SD over water, have led to a better understanding of the data, such that they can be used by the Indian authorities to formulate flood forecasts (Ministry of Water Resources 2014). However, the development of SD over water had neither been smooth nor had it generated positive effects for the unstable foreign relations between China and India. In fact, both the Indian and Chinese governments had shown intentions to politicize SD which had impaired the certain level of trust brought by JELM. In 2017, the Modi government started to show no signs of accepting the agreement previously agreed for JELM and had pressed for all-year hydrological data from China. For the Beijing government, in a situation where no water competition exists, Modi's gesture on the issue of water

availability had become a battlefield and Modi might take radical securitization actions. Indeed, in 2017, when Sino-Indian relations had turned sour, the Chinese government unilaterally stopped with SD, a sign that the hydrological data had been used by the Chinese government as bargaining chips in the disputes over territory (Xie et al., 2018; Xie and Warner, 2021; Ho et al., 2019). Therefore, the SD over water between India and China had become more complicated and uncertain as an outcome.

Perception of the Participants of the SD between India and China

When assessing the effects of SD over water developed between India and China, it is important to consider the reactions from both epistemic communities within the two countries. Since negotiation is conducted behind closed doors, these government units publish very little information on the issue (Prasai and Surie, 2015). Both governments had kept information about the SD in secretive way, disclosing very limited information on the activities and rationale of SD processes. Interestingly, different reactions had been shown, with the Indian epistemic community being far less satisfied than those from China. This contrast again illustrates that the SD over water had been complicated by domestic politics and water management style within each country as well as the foreign relations between China and India.

Views from Chinese relevant experts

In China, only a few government units on the national level have been involved in SD, including the Ministry of Foreign Affairs and experts from the Ministry of Water Resources. As with other foreign policies, in the development of SD, the Beijing government had also constantly consulted IR scholars when aiming to develop a negotiation plan with India. Interestingly, these two groups of scholars had shown slightly different understandings of the issue of river sharing and the development of SD.

Overall, both groups of experts have been informed by Chinese scientists that no major risks exist for the China side. They have generally accepted the official discourse of the cause-effect phenomenon and they also confirm that state media are the primary apparatus to communicate information on China-India's sharing of the Brahmaputra water resources. In one early statement, a Chinese spokesman stated that 'China's use of water resources on the Yaluzangbu River is rather low, with an overall exploitation rate of less than 1per cent.'[7] This led the group of social scientists to believe that the planning and management of the water resources of the region is full of promising economic benefits for Tibet as well as the whole country. This group of scientists also believed that within China's border, the Brahmaputra River runs through in mountain area in Tibet, hence the development of hydropower had posed limited threats to human security within the region.[8]

Very few challenged the official narrative from the Chinese government. One IR scholar confirms that Beijing's decision to develop hydropower is the correct one. According to one expert, 'I heard from CCTV news that new hydroelectricity projects are to be built in Tibet….this may be signs of national government's initiative to invest in the region'. For social scientists, the issue of understanding the effects of river sharing had been difficult to understand. In an interview, an IR scholar was concerned about the effects of China's unilateral

development of hydropower on the upstream, worrying whether such projects would divert water from India, and further deteriorate Sino-Indian relations. It is surprising that the interviewees had shown little interest to investigate the issue at hand before providing evidence to government consultations. Indeed, Tibet is remote and not easily accessible for scholars from Beijing or the east coast where consultation is likely to be conducted, posing difficulties for them to conduct fieldwork in the region. Adding to such difficulties for scientific investigation, an IR scholar from Beijing adds,[9] 'study on the Brahmaputra River is highly challenging. This major river has many tributary branches, and each is given different names within China and India, [making it difficult to understand the geographies of the shared river].

In contrast, some concern had been shown for the Indian side fearing the possibility of flash flooding, mostly among the Chinese hydrologists, while the IR scholars had shown very limited awareness of it. Nevertheless, these hydrologists were confident that by providing hydrological data, such disasters could be largely mitigated. In sum, both groups of scholars show consensus on the judgements of the risks involved in the river basin of Brahmaputra within the territory of China. The consensus among this group of scholars agrees that Indian media have exaggerated the seriousness of the water issue and framed China as a threat (Jiang et al., 2017). Overall, the Chinese experts had shown very little concern about disaster mitigation over the issue of river sharing. Hence, their understanding of the importance of SD is very limited. They believe that the Sino-Indian foreign relations had affected other initiatives including science-based diplomatic activities, negating expectations that SD would have any positive effects in improving Sino-Indian relations.

Views from Indian Civil Society

In contrast, Indian scholars have shown strong disapproval of the SD developed between China and India. This group of experts is made up of more diversified actors, including those who show interdisciplinary knowledge of water management and NGOs. Compared with Chinese scholars, they also seem more active in providing policy recommendations based on their own research.

Indian experts have also challenged the Indian government's overall assessment of risks, contradicting the Indian government's intention in mitigating disasters. Instead, this group of experts suggests that such activities could be a disguise for the national Indian government's plan to develop hydropower in Northeast India where the Brahmaputra runs through. Indeed, a group of scholars and Indian NGOs have noticed that in order to analyze water demand from India, the Indian government's focus only lies on the prevention of floods as the only disaster, and highly relies on data from the monsoon season. However, India is also vulnerable to drought, hence a broader range of base data is needed, including rainfall data, evapo-transpiration data, temperature data, river discharge as well as land terrain data of the dry season.[10] The fact that the Indian governments, especially the Nehru administration had restricted information disclosure on the Brahmaputra had led some Indian scholars to suggest that the Indian government had secretly agreed with the Chinese government on a deal that would allow both sides to continue their hydropower development

on the river, while maintaining national sovereignty or international relations (IR), including policies for managing the rivers and hydrological data for the planning of water resources (such as stream and sediment flow, water withdrawal, and usage) (Prasai and Surie, 2015).

In addition, the Indian epistemic community also challenges whether the data provided by the Chinese government is sufficient for preventing flooding. This is because data is missing from specific locations within Chinese territory, which could prove to be key to predict flash flooding in India. Hence, some scientific experts dismiss the usefulness of the data provided from China's side, disagreeing with the Indian government's judgements of the situation (Ghosh et al., 2019).

Therefore, the Indian epistemic community points out that cientific understanding is lacking, so limited data has been collected as a result of limited knowledge of the relationships between river flows and components of river ecology (Smakhtin and Anputhas, 2006). In addition, ineffective management has occurred among different government departments or agencies responsible for water-related disaster control. Such a situation has led to insufficient use of data (Price et al. 2016), and the lag in capacity to build hydrostations appears to explain why an insufficient quantity of data is available for analysis (Shrestha et al., 2015).

In addition, the epistemic community in India also criticised India's water management policy-making processes which display a lack of public participation (Grumbine et al., 2013). In their view, in many cases, India's Environmental Impact Assessment laws have been the primary legal document adopted to defend citizens' environmental rights (Grumbine and Pandit, 2013). In many cases, the absence of legitimate channels for the articulation of grassroots opposition has unfortunately led to violence and radical actions (Huber and Joshi, 2015). Clashes have occurred when central authorities promote the exploitation of water resources without compliance with environmental laws or relevant legal regulations (Nandimath, 2009), leading to tensed local-central government relations.

Overall, the Indian experts are more equipped with scientific knowledge on river sharing. They are more aware than their counterparts in China of the significance of science-based knowledge in decision-making.

Concluding Remarks

This article analyzes the forms and features of SD developed between China and India. The empirical data bring us insights to better understand the views and ideas of elite experts on the heatedly debated issue of Sino-India water sharing. China and India have displayed a different understanding of water-related science and what information exchange could be of help when dealing with conflicts arising from disputes over transboundary waters (see Table 2). A review of diplomatic activities indicates that this is a positive yet rather discordant process that shows very slow progress. Although both sides agree to develop SD that aims to alleviate natural disasters, there are signs that the diplomatic processes had been manipulated by governments. Apart from the sensitive issue of border alignment between the two countries, the fact that such a diplomatic process is kept rather secretive with limited disclosure of information and very few participants, has also impeded the positive effects that such diplomatic activities could have.

The empirical findings also highlight the complex process of developing SD. As the case indicates, the formation of

Table 2: A Comparison of Different Positions From Chinese and Indian Participants

	China	India
Expertise displayed in SD	Narrow, subject focused	Relatively broad
Ability to critically view government's position	Relatively low	High
Understanding of SD in Sino-Indian water sharing discussions	Limited understanding, focusing on marginal issues that are key to SD	Relatively high understanding of the scope and key concerns in SD

water-related knowledge itself is rather complicated by two factors. Water-related knowledge incorporates the use of technical issues that are not immediately understood by lay persons. Depending on the scientific method and data collection, the scientific analysis may lead to different results and conclusions. Second, on the issue of river sharing, water-related diplomacy also requires basin-scale of consideration which poses challenges to the sovereign system. The consideration of national interests, especially when demands arise for exploiting their water resources, further complicates the formation of objective knowledge on river basins. In the case of China and India when sharing the Brahmaputra, information disclosure is another issue that brings difficulty to SD. This is because river characteristics leave India in a disadvantaged position possessing asymmetry in information relative to China, therefore impeding the effective development of scientific knowledge. In addition, in countries where existing foreign relations are sensitive, SD over water does not necessarily serve to provide a platform for trust building. As shown in the case of China-India water interactions, such diplomatic activities may very well be politicized which could lead to even strained relations.

In the hydro-diplomacy conducted between China and India over the sharing of the Brahmaputra River, WRSD seems to have developed in an unsmooth fashion and has played a rather indirect role in facilitating both countries to resolve tensions. Nevertheless, the development of SD and WRSD, in this case, reflects how complicated SD can be and that the result of SD may be uncertain. As discussed in the early section of this article, more knowledge and empirical findings are needed to understand the role of WRSD in hydro-diplomacy. Therefore, for scholars and policymakers, SD represents an applicable approach when promoting WRSD in hydro- diplomacy. The concept is useful for us to develop a better understanding of the forms, characteristics and developments of diplomatic activities, which has been elusive for academia as well as practitioners. From the perspective of conceptual discussion, it is useful to clarify that the formation of consensus in scientific knowledge is an essential part of SD when aiming to relieve disasters and the process of forming the scientific knowledge may represent a political process itself. For effective use of science in hydro-diplomacy, it is crucial to effectively generate knowledge in a legitimate and transparent fashion that can be shared

across nations. Accordingly, in practice, developing WRSD should be an open process that allows information disclosure to the public and the incorporation of various stakeholders, including epistemic communities as well as NGOs, civil society and the concerned communities.

Endnotes

1. Chellaney, Brahma "China's hydro-hegemony," The New York Times, 7 February, 2013, http://www.nytimes.com/2013/02/08/opinion/global/chinas-hydro-hegemony.html (accessed on 5 August 2015).
2. 30/01/2013 http://mo.ocmfa.gov.cn/chn/jbwzlm/fyrth_1/201301/t20130130_7646966.htm accessed 7th Nov 2022
3. See for instance, http://www.indembsofia.org/joint-declaration-by-the-republic-of-india-and-the-peoples- republic-of-china/
4. Personal interview with WWF India; see also Price *et al.* Attitudes to water in South Asia, 2014.
5. The Indian side is led by the Commissioner, Ministry of Water Resources, while in China it is led by the Director, International Economic and Technical Cooperation and Exchange Center, Ministry of Water Resources.
6. From both sides, there is very little information on the information of participants to the JELMs. Based on published information and image, the JELM is often joined by no more than 10 people from each side.
7. The speech was given by an official Chinese spoke person in a journalist conference 2 Mar 2012.
8. Interview with participants no. 1.
9. Interview with participants no. 1.
10. Interview with participant no. 8. 2015.

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ARTICLE

Re-imagining Science Diplomacy: Learnings from a Bottom-up Water Security Project

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Introduction

Science diplomacy (SD) has historically had an invaluable role in helping address and solve a wide range of international and national issues and conflicts. Since the start of the COVID-19 pandemic, we have seen an unprecedented media presence of science combined with a high (and acknowledged) reliance on science in informing policy decisions. This is occurring at a time when climate change is having detrimental impacts and remains an unresolved issue,which is increasing diplomatic tensions across the world. Whilst there have been important changes to approaches within SD to adapt to and address our current challenges, many would agree that the ongoing pandemic has laid bare a range of limitations to the current way SD works in practice across the world (see among others Zhang, 2021; Ascione, 2022).

I argue that we now have a unique opportunity to re-imagine SD in a way that helps us address the complex issues we are facing globally, regionally, nationally and locally. Here, I will set out learnings from work done on water security issues in the area of Kolkata Municipal Corporation as well as a project involving NGOs, stakeholders and academics in Bangladesh, India (Kolkata), Sri Lanka and Nepal. Using experiences from these two projects the article will set out key aspects a reimagined SD could consider to be able to address conflict coming out of social and biophysical problems such as water insecurity. Water security is here defined as the

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lack of access to and availability of enough water of adequate in a person's daily life (Mukherjee et al, 2020). Challenges related to water security issues are growing and give rise to conflicts within countries and across international borders. This makes water security, and attempts to solve this, a useful area to learn from when we want to reimagine SD which at its very essence is an international issue, and policymakers need to simultaneously solve global issues such as climate change as well as local issues. As such it is a large issue that is entangled in political conflicts across borders and continents, which here is argued to make it an important case study for Science Diplomacy. The projects discussed did not involve foreign policy actors directly, however, they focused on resolving issues pertaining to the scarcity of good-quality water across the communities and countries involved. They both also involved collaboration across communities and stakeholders (including minoritized communities, NGOs, experts and authorities) as well as the creation of suggestions for policies and spaces for conflict resolution at local, national and international levels. As such this work can be helpful when reimagining SD so far that it focuses on creating, informing and facilitating cooperation and collaboration across scientific experts, NGOs, policymakers and affected communities (in line with definitions of SD by AAAS).

Our work on water security in these areas started in 2018 when a core interdisciplinary team of researchers including Trude Sundberg from the University of Kent, Subham Mukherjee and Birgitta Schutt from Freie Universitat Berlin and Pradip Sikdar at the Indian Institute of Social Welfare and Business Management started discussing new and more holistic ways of researching water security. This is an area that traditionally has been dominated by scientific disciplines such as Physical Geography and Hydrology. Since then, we have carried out a long-term collaborative, community- driven research project using both quantitative and qualitative methods from sciences and social sciences (results have been published among others in Mukherjee et al, 2020 and 2022).

The work discussed here is twofold, firstly including a project done in Kolkata Municipal corporation and secondly a set of GCRF- funded workshops. The workshops were coordinated with our team, and Dr Debanuj Dasgupta (University of Santa Barbara), as well as with NGOs representing different parts of the LGBTQIA+ communities from the beforementioned countries in South Asia. The aim of the workshops was to help identify and create a network that together can consider sustainable solutions to water insecurity for these communities. The particular activities and impacts relevant to this article include;

Organising discussions identifying water security issues and potential solutions with disadvantaged LGBTQIA+ communities, water security experts and local stakeholders in Dhaka and Kolkata (including local authorities and entities working on water treatment in Kolkata Municipal Corporation) among others.

Creation of physical spaces for communication and interaction between experts, authorities, NGOs and minoritized communities, with a focus on LGBTQIA+ communities in the above mentioned international GCRF- funded workshops.

Enabling spaces for collaboration and creation of solutions, exemplified by the creation of a map of public toilets accessible to LGBTQIA+ populations in Dhaka Bangladesh.

Skill building, across these different

groups and stakeholders, of knowledge of water security issues from different vantage points, from those experienced by water treatment workers to water scientists to everyday life issues experienced by LGBTQIA+ individuals.

Creating networks and platforms for communication that can be used for ongoing collaboration and conflict resolution if and when water insecurity issues come up.

In our work specific to Kolkata Municipal Corporation, we worked with LGBTQIA+ NGOs and communities and created ongoing communication pathways between representatives from these communities, scholars in water security and local authorities working on water issues. Furthermore, our work, including social and bio-physical factors of water security, entails bringing affected communities into the research design, data collection and analysis meaning that science communication and collaboration are built into all stages of our work. This, what we call a bottom-up approach, entails building solutions to water insecurity through research and communication in collaboration with affected communities based on their lived experiences, scholarly experts as well as other stakeholders. We define it as bottom-up because knowledge and solutions are built from the ground up, rather than being imposed by national and international experts, politicians and policymakers.

All our approaches have at their core a focus on including affected communities, and we are currently in the process of setting up an institute in Kolkata, where we can run more workshops and create more permanent physical spaces for communities to come together[1] Crucially our project has shown the importance of intersecting characteristics such as gender and religion in shaping and influencing Water Insecurity. We have also been able, with the help of our collaborative methods, to better understand the intra- city and intra- neighbourhood variations in Water Insecurity enabling us to provide policy recommendations and design locally adapted, and community- supported, solutions.

In our project, we are interested in the Global South, with a focus on a megacity that faces similar problems to other cities in other parts of the Global South. The project has at its core a bottom-up approach, where affected communities are involved in defining key questions and solutions. We, essentially, take an interdisciplinary approach combining water science with social scientific approaches. The work has a focus on LGBTQIA+ communities to understand the importance of gender in defining and shaping water insecurities. This project identified a strong need for peaceful collaboration and resolution in the design of sustainable solutions. The findings and learnings made here were made through collaboration. However, our work highlighted a strong need for SD, a more sophisticated SD that can play a role at multiple governance levels, here exemplified by a need for local and bottom-up approaches.

The Importance of the Regional and Local

In our work, we argue that the resolutions to national and international issues such as water insecurity need to be identified and resolved with communities at local and regional levels to be sustainable. This rests on the assumption that sustainable policies and solutions only can be achieved when they are seen as legitimate in the communities they are implemented, and if they are fitting to solve the issues at hand. The latter, in our approach, is achieved through understanding the complexity

of lived experiences of stakeholders and affected communities and by including interdisciplinary approaches. In our project the solutions found were to work closely with local affected community members, to help identify the key barriers to addressing water insecurity, and crucially establish links between the affected communities and local governments and NGOs. To us, this has shown the potential of local solutions, rather than top- down nation-state models to address issues. It has also shown that diplomacy is not only occurring between nations, but between localities in different parts of the world, and across levels such as the UN and local governments. In our work, we saw localised solutions to issues such as public toilets and accessibility for LGBTQIA+ individuals in Dhaka being created through interaction and collaboration facilitated in our workshops. Thus, locally adapted solutions coming out of a regionally, but internationally focused collaboration, resulted in local solutions driven by NGOs representing minoritized communities. As a result of our workshop series, they were able to communicate with local authorities, and outline their needs built on learnings about water security and potential solutions coming out of the workshop.

Traditionally SD has focused on informing and supporting nation-states in their foreign policies. However, Track II diplomacy redirects this focus towards including civil society (S4D4 among others). However, in work on redefining and discussing the future of SD, we find a continued focus on foreign policy, which we, here, argue needs to include the local, and a new type of international policy that is not constrained by a focus on traditional foreign policy. This position comes out of our experience in Water Security studies, an area that addresses issues created by global, national, and local constraints, which necessitates new approaches to diplomatic and political work. This is in line with arguments found in political science that call for an adaption of foreign policy as a field in the age of Globalisation as internationalisation and global issues now permeate all policy areas (Neuman, 2015). Both S4D4C (2019) and the Royal Society (2010) fail to go far enough in their imagination of the future of SD in this regard, with S4D4C stating:

"Science diplomacy, in the context of this Declaration, is understood as a series of practices at the intersection of science, technology and foreign policy. The renewed interest in science diplomacy comes in response to identified challenges at the interface of science and foreign policy, where a greater scientific voice could both add value to bi- and multilateral discussions and decisions about our shared global concerns. Joint science diplomacy objectives are possible where actors converge around such common challenges". (S4D4C, 2019)

In our work, we found that a focus away from the nation-state as the starting point to solve Water Security at the local and international has allowed new tools and solutions to develop as well as new ways of identifying issues, creating solutions, and communicating science to communities and local policymakers. Here, we argue that inclusion of stakeholders, scholars and communications from local, regional, national, and international levels is key in addressing some of the challenges raised within the SD communities such as the one stated by Soler (2020) "Global challenges share three characteristics: they all have scientific dimensions, transcend national borders, and no country or sector will be able to solve them alone. To reverse climate change, provide sustainable energy to billions of people, or end the COVID-19 pandemic and prevent the next one,

strengthening the links between science and foreign policy will be imperative" (Soler, 2020, p2).

Resolutions through Collaborative, Bottom-up Approaches

SD declarations such as S4D4C (2019) and the Royal Society's (2010) highlight collaboration as key in SD. In our project, collaboration with different stakeholders, scholars and affected communities was found to be invaluable. As shown above collaborative research and workshop approaches have brought about international networks and collaboration as well as local solutions as the one mentioned in Dhaka. To us, collaboration means a bottom-up approach, where key communities have been part of the research process, including data collection and analysis. In our project key communities have included local government members, NGOs, and loose groups of community members from marginalised groups that are particularly affected by water insecurity (e.g., the hijra communities in Kolkata). Working together and creating platforms for communications collaborations and problem solving come out of common understanding of the issues at hand. This has been a missing key in water research thus far, as traditional solutions would be shaped by experts in a top-down manner. We have seen over time how this has failed to address local conflicts, tensions and social inequities leading to a lack of solving water insecurities.

Crucially, our project is focused on finding designs and water management processes that are sustainable and come out of local practices. In our example mentioned above, it was shown how work occurring in our workshop series brought about work on increasing accessibility to public toilets for LGBTQIA+ people in Dhaka, Bangladesh. In our work in Kolkata Municipal Corporation, to give another example, our work has helped local authorities adjust water management related to portable water and public tap systems as a result of our collaborative research. Another crucial part of our research has been on developing meeting places locally for resolving issues and collaborating to solve and process conflict peacefully. This is crucial, as it allows for adaptation to needs as they arise, as well as creating a culture of collaboration in the communities. Furthermore, it is counter to traditional, colonial, and hegemonic practices of universal and top-down solutions that are unfit for the local circumstances. This comment is in accordance with authors such as Ezekiel (2022) who call for solutions coming out of the Global South, and for transnational and local assemblages of knowledge. Fundamentally, bottom-up projects like ours go beyond time- limited traditional approaches to capacity building and have at their core a drive to build lasting knowledge of and understanding of what works in a particular local setting and skills in resolving issues across affected communities, stakeholders, NGos and authorities.

Decolonising and Queering Approaches to SD

The projects discussed in this article are based on Water Security, an area that is argued to be relevant to SD studies due to its importance to national and international policymakers, and by being transnational in its essence as Water Security issues occur due not only to local or national constraints but also global and transnational issues. In our project, a

transgression of disciplinary boundaries as well as collaborative research design including a range of actors are seen as key in identifying and creating solutions to Water Security issues. This approach includes a giving preference to questioning of taken-for-granted traditional, Western-based, concepts of science, seen as core to queer methods, allowing us to capture and convey the complexity of water security issues to a range of different stakeholders. This became one of our key project outcomes as it allowed for communication to be had across members of LGBTQIA+ communities and local authorities. Furthermore, working across disciplines such as physical geography, Sociology, Geology and Water Science in and of itself brought about discussions in the project team about how to design and carry out a robust research project. Adding to this, working with, and including experiential knowledge from community members, among others, who live and breathe the consequences of water insecurity made us question and adjust our approaches overall. To give an example, without this discussion, and a subsequent adaptation to our research design we would never have understood the importance of what type of work different members of the community have (and their schedule) when it comes to experiences of abuse when standing in line for the water needed for their household or going to a public toilet. This was achieved by engaging with and opening up our understanding of what questions to ask, what and who matters in research rather than carrying out a standardised survey questionnaire, using common approaches to testing water and creating recommendations on this basis. Instead, we changed our approach and carried out group work, with researchers as participants, to understand the role and daily life of those living in marginalised and water- insecure areas. In this way queering, seen as appreciating the complexity of issues and considering the views of those with lived experiences, as well as including and linking local actors with international and regional organisations and experts brought about coordination and collaboration to work towards better outcomes.

In other words, this is a call for an adaption of the traditional focus on rationality, and universality that is often found in purely scientific research and SD approaches, as found for example in (Royal Society, 2010). Based on our experiences of collaborative, interdisciplinary research, communication and work we call for an invitation of experiential knowledge, decentering the Western experience as universal and questioning of taken-for-granted research approaches as ways we can identify and create collaborations and lasting resolutions to challenges and conflicts. The latter are key aspects of decolonial and queer approaches to research (Brown & Nash, 2010), and are aspects that may be helpful when reimagining SD.

Conclusion

This comment has aimed to point out three central learnings from a collaborative, interdisciplinary project on Water Insecurity in Kolkata and South Asia. Through working collaboratively at local, regional, and international with affected communities, and in particular LGBTQIA+ communities, we have designed new solutions to water insecurity that bring communities into the solution building. Although SD was not defined as a core approach of the study, SD is central in Water Security as a transnational set of problems that often necessitates solutions and policies at local, regional, national, and international levels.

I argue here that there are three main learnings from this project that can feed

into a reimagined and more sophisticated version of SD. Firstly, the need to look beyond nations and nation-states and towards the local and regional, and the complex ways in which these are linked internationally and to international organisations when we consider how we do SD. This call is related to moving beyond a focus on the statecraft of SD occurring only at the nation-state level, and towards statecraft that can move between the local, regional, national, and international as and when needed. Secondly, a call for bottom-up approaches that are locally adapted and created in collaboration with affected communities and areas. Thirdly, a need to decolonise SD and rethink what is taken for granted ways of doing science, in particular moving beyond rational, conform and univeralising approaches in order to create a new and more powerful SD in times when we face complex and unprecedented challenges.

Throughout the comment, I have shown that social research approaches can play a crucial role in helping shape a more sophisticated SD, one that is adaptable to context and complexity. Our research, whilst interdisciplinary at its heart, benefitted deeply from including social research methods. This was true because of social research's familiarity with decolonising and queering methods that can inform and help drive peaceful collaboration and resolution in SD. But it was also crucial because of the centrality of context in social research. In our case, this has meant the inclusion of intersectionality and the history of social categories into physical geography in a way that has not been done before (Mukherjee et al, 2020, 2022) while at the same time understanding the religious, economical and political constraints within which water insecurity is created, experienced and impacts how communities respond to policy solutions.

Now, why is this important in a comment on SD? Social Research is at its heart a field of research that aims to understand how the social context is related to, shape and form how humans behave and interact (or transact - see Shilling, 2022). Some of the crucial tenets of diplomacy are how to achieve peaceful collaboration and the resolution of conflicts. To achieve this an understanding of the socio-cultural, economical and political is key and would provide a new dimension to the kind of statecraft needed in future SD. For our project, this means understanding the role and meaning of water in the local religions in our area of interest on the one hand, and the economic constraints of the inhabitants and the local government on the other. I would argue that SD approaches would benefit strongly from taking these contextual dimensions into account as the failure of doing so could mean one would fail to fully understand the circumstances of a particular challenge and concern. In our case, we local level of diplomacy and collaboration. We did so by building understanding and conflict resolution platforms in the communities that included restorative communication where people from different backgrounds can raise issues and collaborate from their own positionalities. In addition, we design solutions to water insecurity that adapt to internal differences within neighbourhoods and deprived areas that are adapted to the different backgrounds and populations living in the affected areas.

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Endnote

[1] See here for more information on the institute: https://iisredelhi.org/.

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ARTICLE

Science Diplomacy and the Russia-Ukraine War

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Introduction

The present armed conflict in Ukraine began on 24 February 2022 with the Russian announcement of "special military operations" in Ukraine. Russian missiles and airstrikes hit across Ukraine, including the capital Kyiv, followed by a large ground invasion from multiple directions. Russian attacks were initially launched on a northern front towards Kyiv, a north-eastern front towards Kharkiv, a southern front from Crimea, and a south-eastern front from Luhansk and Donetsk. Ukrainian forces mounted a strong defence, bolstered by support from NATO and EU countries who strongly condemned the Russian actions. Russia's advance towards Kyiv stalled by March, with Russian troops retreating from the northern front by April. The Russian military strategy changed from a quick seizing of Kyiv to a more gradual and sustained offensive aimed at taking control of areas to the East and South coast of Ukraine. On the southern and south-eastern fronts, Russia captured Kherson in March and then Mariupol in May after a siege. On 19 April, Russia launched a renewed attack on the Donbas region, with Luhansk Oblast fully captured by 3 July. Russian forces continued to bomb both military and civilian targets far from the frontline. Ukrainian forces launched counter offensives in the south in August, and in the northeast in September. Soon after, Russia annexed the four partially occupied Ukrainian oblasts of Luhansk, Donetsk, Zaporizhzhia and Kherson.

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The invasion has provoked widespread international condemnation of Russia. The United Nations General Assembly passed a resolution condemning the invasion and demanding a full withdrawal of Russian forces. Many countries imposed sanctions on Russia, as well as on its ally Belarus.

Meanwhile, the conflict has disrupted foodgrain exports from both countries through the Black Sea ports, leading to concerns over food shortages, especially in Africa and the Middle East. About 7 million people have been displaced within Ukraine, and 8 million more have moved across borders to Poland and neighbouring countries to the West. Along with the launch of the special military operations, Russia announced the recognition of two breakaway regions of Ukraine - the Luhansk People's Republic (LPR), and Donetsk People's Republic (DPR) as independent states. Earlier in 2014, these areas had de facto set up independent administrations, while the Crimean Peninsula was annexed by Russia.

The EU and the US imposed economic sanctions on Russia covering; finance, energy, technology, dual-use goods, industry, transport, and luxury goods. Russia responded by cutting oil and gas distribution to EU countries and also required trade payments with Russian currency. The conflict between the two countries transformed into a multi-state conflict. International reaction was divided, with NATO and EU and their allies strongly condemning Russian actions and bolstering the defence of Ukraine with the substantial military, economic and political support. On the other hand some countries such as China and North Korea took the side of Russia, while a large number of countries avoided taking sides while expressing concern over the impact of the conflict on peace and stability. They also called for a return to a rule-based international order based on respect for the sovereignty of states. The simultaneous emergence of tensions in the Indo- Pacific over China's aggressive stance especially over Taiwan has complicated the matter further, with prospects of Russia and China drawing closer together against the US, NATO, and the EU.

The imposition of sanctions by western countries on Russia has already caused setbacks to collaboration between Russian entities and their western partners. Gas supplies from Russia to European countries have been disrupted, causing concerns over energy availability and shortages as the winter season approaches. The sharp division over the conflict led to highly charged situations in various forums such as the UN Security Council, the G20, etc. The polarization caused by the conflict has, for example, led to the 10th NPT Review Conference being unable to agree on an outcome document. The ability of the international community to tackle global challenges has been adversely impacted, and this article examines some of these problems in the field of science and technology cooperation.

One commentator regretted the collateral damage to international scientific cooperation.[1] This could affect projects such as the International Space Station (ISS), CERN, the European Laboratory for Particle Physics. and the international LIGO Scientific Collaboration. Russia recently decided to terminate its participation in the space station after 2024, although this decision is not final. CERN will no longer allow Russian institutes to participate after its contracts with Russia expire that year. The European Space Agency has excluded Russia from its planned ExoMars rover project. Russia will also not be able to use the European XFEL facility in Germany. Such large, expensive international projects are needed in many

disciplines and are beyond the capacity of individual nations. Russian involvement in these big projects is therefore essential.

Impact on Science Diplomacy

The three classic pillars of Science Diplomacy are all impacted by the conflict. Firstly, Diplomacy for Science, whereby diplomacy is engaged to bring about large-scale science collaboration has been affected. An example is the International Space Station (ISS) project which was a notable achievement after the end of the Cold War. Russia has announced it might withdraw from this project after 2024 and if this happens the future of the project will be in doubt. Another example is the Centre for European Nuclear Research (CERN) where pressure is building up to suspend the participation of Russia, an observer state.

The second pillar, Science for Diplomacy, involves the use of scientific collaboration to improve relations between countries. The pressures to apply sanctions and restrictions on Russian scientists working with their western counterparts are counterproductive and will only make problems worse. On the other hand, allowing exchanges and collaboration between scientists on both sides of the divide will help bridge communication gaps and provide alternative channels of interaction. The US has announced measures that would permit non-governmental institutions and scientists to decide on interacting with Russian counterparts while limiting government to government interactions to those in fulfilment of concluded agreements.[2]

The third pillar, Science in Diplomacy, involves scientific inputs into foreign policy- making and international negotiations. Global challenges in areas such as climate change, pandemics, cyberspace, oceans, outer space, etc. require science-based inputs and can benefit from expertise from all countries. It makes sense therefore to decouple global discussions on these challenges from the conflict. In the past, some countries have often argued for not bringing political issues into technical forum discussions, and this principle should be applied here also. We now look at some specific cases where Science Diplomacy challenges have arisen already.

Impact on Science

While Russia's war on Ukraine has the heaviest impact on Science in Ukraine, impacts have been felt across the world. In Russia, scientists are facing boycotts and sanctions. The crisis has already affected international research collaborations in physics, space, climate science, food security and energy. A prolonged conflict could trigger a significant realignment of international scientific collaboration patterns.[3]

Ukraine's national science capacity and infrastructure has been severely damaged and there has been a movement of over 20000 researchers fleeing the conflict. Researchers in Russia have been cut off from international research and many researchers have left for better prospects elsewhere. European and US organizations have cut ties with Russian science, including cancelling joint projects. Sanctions have affected research institutions and infrastructure.

The Russian Academy of Sciences called for peace and continued scientific cooperation between Russia and other parts of the world. The statement urged the scientific community "to refrain from positions and actions dictated not by the interests of science, but by the political environment and the acuteness of the situation." In line with the call, many organizations have not yet moved to put

an end to scientific cooperation with the aggressor state. The European Molecular Biology Organization (EMBO), the CERN equivalent in biology, condemned the war but has not frozen ties with Russia.

The war is likely to have a far-reaching effect on the world's response to climate change. It has contributed to the largest energy shock in decades, driving up oil and gas prices and reshaping the global energy system, with both positive and negative consequences for the transition to cleaner energy. Tensions might affect the United Nations climate-convention talks and undermine global cooperation on climate-related issues. The global attention to Ukraine, reduction in aid flows and rising interest rates to curb inflation and the global economic downturn, would impair development funding and impact the achievement of the SDGs.

Support to Ukrainian Science

International support for and solidarity with Ukrainian scientists has grown. Expressions of support and solidarity have come from the National Academies of Sciences (USA), and the G7 science academies. The leaders of the national science academies of the United States, Ukraine, Poland, Denmark, Germany, the United Kingdom, and ALLEA (The European Federation of Academies of Sciences and Humanities, representing more than 50 academies from over 40 countries in Europe), have developed an action plan for the international science community to build a strong science, innovation, research, and training system in Ukraine. An initiative ScienceForUkraine, run by volunteer scholars and students has been set up to support the Ukrainian academic community in surviving the war and to help ensure the continuity of Ukraine's science and strengthen its presence in the international science arena.

The Prime Minister of the UK announced on 28 June 2022[4], a series of measures to support Ukraine's Science & Technology and research sectors. Ukrainian academics will be supported in the UK under the 'Researchers at Risk' programme which launched in March 2022 with total funding of GBP 13 million, and over 75 UK Universities have joined the scheme. The SNSF (Switzerland) allocated a total of CHF 9 million[5] to support researchers affected by the war in Ukraine in collaboration with Scholars at Risk Switzerland.

Greater Role for China

The strains in Russia's science cooperation with the EU and NATO have given a push to Russia-China cooperation including in science and technology. China's rise as a science and technology superpower has already elicited growing concern, especially in the US and the EU. A natural consequence of these tensions would be that Russia and China would seek to intensify science and technology cooperation. China is already competing in high-technology areas with the United States and is intensifying cooperation with Russia in security, trade, energy supplies, artificial intelligence, 5G, space research, and biotechnology. Previously, during the Cold War period, China and the Soviet Union were isolated from the world market of technology. In the 1970s China embarked on reforms and strengthened its engagement with Western countries in Science and Technology and built up a formidable national ecosystem. Today, in light of deteriorating relations with the United States, a certain strategic alignment is emerging.[6] The U.S. and the European Union's decoupling from business with China and imposing economic sanctions on Russia pushes the two countries to examine the potential of their cooperation

more closely. Given China's massive economic and scientific capacity and Russia's strengths in areas such as military equipment, aerospace, infotech, new materials, etc. such cooperation could take on increasing momentum. This could have wide- ranging economic and security implications for Europe and Asia.

Nuclear Technology

The fallout of the Ukraine conflict has led to Russia blocking the adoption by consensus of the final document of the 10th NPT Review Conference[7], due to references to the Ukraine conflict. There was one silver lining. Russia and the United States committed to the full implementation of the New START Treaty and to pursue negotiations in good faith on a successor framework to New START before its expiration in 2026, in order to achieve deeper, irreversible, and verifiable reductions in their nuclear arsenals. However, in February 2023, Russia announced its suspension of participation in the New START Treaty and further negotiations. This negative development could lead to further escalation in nuclear arms levels among Russia, US and China.

Ukraine Nuclear safety

There has been deep concern over the effect of the military actions around the nuclear power plant at Zaporizhzhia, Europe's biggest nuclear power plant.[8] On 25 August 2022, the power supply to the plant was briefly disrupted, putting at risk the cooling systems for the reactors and the spent fuel tanks. On 29 August, it was reported that two shells exploded near a spent fuel storage building at the plant. Fortunately, both parties agreed to allow an IAEA team to visit the facility and the last remaining operating reactor has been safely shut down. The remaining problem is the integrity of the spent fuel storage systems, and the security of the reactor containment domes. It is hoped that this cooperative approach will build confidence between the warring parties, and the establishment of a permanent IAEA monitoring mission in Ukraine will result in an agreement to avoid any military actions around the facility and ensure an adequate level of safety and security.

ITER

The International Thermonuclear Energy Reactor (ITER) is the world's largest nuclear fusion experiment, involving 35 nations — including Russia, the United States and China focused on controlled fusion processes to create clean, almost limitless energy on Earth. To date, Russia's invasion of Ukraine has not resulted in any notable changes to the organization's work. Throughout ITER's history, political differences among its members have never affected the collaborative spirit. Russian participation is through an international agreement and the US has stated it will respect such agreements. So, one can hope that ITER will be a place where collaboration can continue.

CERN

In a statement, on 8 March, CERN said that its governing, 23-nation governing council decided to suspend Russia's status as an observer to the organization. In addition to freezing cooperation, CERN will comply with EU sanctions on Russia, which include a ban on technology exports. This means Russia will no longer be able to attend open sessions of the CERN Council and will lose its "special right" to attend restricted sessions on the Large Hadron Collider, the world's largest and highest-energy particle collider. There will also be no new collaborations with Russian institutions, however, the 1100

scientists that have 'user status' at CERN and are affiliated with Russian academic and scientific institutes will be able to continue their work. Russian scientists were among the biggest users of the labs and were contributing to many small-scale experiments as well as the development of the Linear Accelerator 4, designed to boost negative hydrogen ions to high energies.

XFEL

Another European mega-science project, the EU's X-ray Free-Electron Laser (XFEL), said it will not start new agreements with Russian institutions and suspend existing ones. XFEL, which enables the mapping of atomic details of viruses, the filming of chemical reactions, and the study of the interior of planets, counts Russia's Kurchatov Institute for nuclear research among its members.

The Arctic

The Arctic's main governing body, the Arctic Council, is composed of 8 members who are the Arctic littoral states, 6 permanent non-governmental participants, and 13 non-Arctic states as observers, including India. Russia is the Chair of the Council for 2021-23 and will be succeeded by Norway in mid 2023. The US and five other member countries of the Arctic Council have issued a joint statement against the Russian aggression in Ukraine calling it a grave impediment to cooperation in the Arctic as well. They have refused to attend the meetings under the chairmanship of Russia and have paused the participation in the Arctic Council and the subsidiary bodies. This is a serious setback to Arctic cooperation. However, some activities may continue, such as regional fisheries management which is legally binding between European countries and Russia. Other technical areas such as Arctic monitoring systems and climate science may require continuous engagement with Russia as well.

The melting Arctic connects North America, Asia, and Europe and is opening up new sea routes. The region contains 30 percent of the gas and 16 percent of the total oil resources on the planet. These factors make the Arctic a new geopolitical hotspot. The entry of China into the Arctic Council with observer status has changed the dynamics in the region. China is trying to exploit new Arctic Sea routes. The economic sanctions on Russia are pushing it to enhance its ties with China. The establishment of the Northern Sea Route from the Bering Strait to the Barents Sea can be a win-win situation for both Russia and China and can also serve strategic purposes amid the Sino-US and Russo-US rivalries. However, in the scientific field, Russia- China cooperation may have only limited growth.

The Antarctic

The Antarctic has been regarded as a prime example of success in science diplomacy. The Antarctic Treaty System (ATS), regulates international relations with respect to Antarctica, setting aside the continent as a scientific preserve, establishing freedom of scientific investigation, and banning military activity, for the purposes of the treaty system. As of 2019, the treaty has 54 parties. The Antarctic Treaty System's yearly Antarctic Treaty Consultative Meetings (ATCM) are the international forum for the administration and management of the region. 29 of the 54 parties to the agreements (including India) have the right to participate in decision-making at these meetings. The meeting of the Antarctic Treaty Consultative Parties (ATCPs) in Berlin in June 2022, was marked by tensions over Ukraine – including a walkout from a meeting involving Russian

representatives. One issue involved Ukraine's polar vessel, the Noosfera, and whether it would be able to return safely to its besieged home port of Odessa after being stranded in Chile since March. Russia and China have been opposed to marine protection area (MPA) proposals in certain portions of the Southern Ocean. The Berlin ATCM represented a breakdown in the relationship between some parties and Russia. China and Russia contend that they have valid concerns about the wider ramifications of fisheries conservation, resource management and wider treaty aspects. Russia's 2021 Action Plan sets out its objectives, and those include securing unimpeded access to the region and its resources. These ambitions together with the tensions over Ukraine are a challenge to the ATCP mechanism.

Climate Change and Energy impacts

The war in Ukraine is pushing climate action aside while most countries are falling short of their climate goals. The US has opted to resume oil and gas drilling in public lands in response to high gas prices. Greenhouse gas emissions rebounded to their highest level in 2021 as economies started recovering from the Covid-19 pandemic. The Intergovernmental Panel on Climate Change (IPCC) released a new scientific report which stressed that many of the impacts of global warming are simply "irreversible" and already beyond the ability of many people to cope with Germany announced that it would build two liquified natural gas terminals as part of an effort to replace Russian gas with fossil fuels from elsewhere. Despite the Ukraine conflict, cooperation and solidarity are most urgently needed in order to address the greatest threat confronting global civilization, namely global warming. Across Europe, climate change was regarded as the top-most perceived threat even at a time of pandemics.

However, despite the obvious importance and urgency of climate action, the Group of 20 Environment Ministers meeting in Bali was unable to agree on a joint communique, amid objections over the language used on climate targets and the war in Ukraine. Some countries objected to previously agreed language in the Glasgow climate pact and past G20 agreements on efforts to limit global average temperature rises to 1.5 degrees Celsius.

The U.S. passed a new Inflation Reduction Act on August 16, 2022, an important step towards changing the sources of its energy supplies to reduce carbon emissions. The U.S. and European strategic partners are seeking to reduce their dependence on Russian oil and gas exports and a shift towards renewable sources of energy is important for energy security reasons as well as for reducing the impact of climate change. At the same, there are serious limits to how fast the supply of renewable energy can be increased using existing technologies. However, research and development into low carbon energy sources including solar energy and carbon capture technologies hold out promising possibilities, provided sufficient funding can be made available, and the resulting products and services are widely accessible and affordable.

Outer Space

The International Space Station (ISS)[9] has long been a fine example of collaboration and cross-border cooperation. Five space agencies participate in the orbiting space lab: NASA, Roscosmos, the Japan Aerospace Exploration Agency, ESA, and the Canadian Space Agency. Since its construction began in 1998, the ISS has conducted scientific research and carried

out a host of valuable, nation-agnostic experiments. Roscosmos indicated that it may not continue to help operate the ISS. This could result in the station having to be decommissioned before its scheduled end date of 2031. On 3 March, the Director General of Roscosmos said that Russia will stop its space cooperation with the United States and will no longer deliver rocket engines to the U.S., nor will it provide maintenance. The uncertainty around Russia's continuation in the ISS project encouraged private sector actors to fill the void and keep the ISS operational. Currently, Russian spacecraft anchored to the ISS are used to alter the station's trajectory and flightpath, which is necessary to ensure that it can continue to orbit the Earth effectively.

Due to high costs and technology, space should ideally be an area of cooperation among countries. Transferring knowledge and technology is a key to managing space peacefully. However, competition among international actors and significant nations around the globe could bring problems such as weaponizing outer space with high-tech arms and an increase in space debris. Space rivalry will become more complex and uncontrollable, especially since many private sectors and developing countries show their interest in space.

The European Space Agency (ESA), while applying EU sanctions imposed on Russia said that the ExoMars program — a collaboration with Roscosmos to look for signs of past life on Mars — will likely be delayed beyond 2022.

Lower Space

The region between 30 to 200 km above the earth where atmospheric density drops off, is now becoming an area of contention. Hypersonic cruise missiles (HCM) and Hypersonic glide vehicles (HGV)s are being developed by many states, as these systems are manoeuvrable during flight and can evade ballistic missile defences. For early detection and targeting, space-based sensors and systems are essential, and the race to put more and more such sensors into low earth orbits will gain momentum. The Ukraine conflict will increase motivation to develop these new weapons systems and countermeasures. The proliferation of satellites in low earth orbit due to commercial space activities requires international cooperation to manage, but this is less likely to be forthcoming.

Human Health and Biosciences

The 75th World Health Assembly (WHA75), meeting in May 2022 adopted by vote a Ukraine-led resolution, which focused on safeguarding technical global health cooperation and called on Russia to cease attacks on hospitals and healthcare facilities. Through the resolution, the Assembly called for WHO to provide an assessment of the direct and indirect impacts of Russia's aggression on the health of the people of Ukraine, in the region, and globally by January 2023. The resolution also describes the aggression as fitting "exceptional circumstances" — meaning that the Assembly could potentially suspend Russia's voting privileges and services. The resolution passed with 88 Member States voting in favour, while 12 voted against and 53 abstained. Russia put forth a similar resolution expressing concern for health conditions and attacks on civilians in Ukraine without naming an aggressor. That resolution failed.

However, in a positive development the WHO's Intergovernmental Negotiating Body (INB) on pandemic prevention, preparedness and response held its second meeting in Geneva from 18-21 July 2022 and agreed, by consensus, that they will work to conclude a new, legally binding

international pandemic agreement.[10] They are working to conclude this agreement in May 2024. The next meeting of the INB will be held in December 2022, and the INB will deliver a progress report to the 76th World Health Assembly in 2023.

Cyberspace Issues

Exploitation of the cyber domain in the ongoing Russia-Ukraine war raises serious concerns not only for the warring states but is also a threat to the international community due to the nature of cyber interconnectivity. This means that the threat posed by cyber-attacks needs to be addressed seriously to avoid any unintended consequences. The cyber element was in full swing even before Moscow's ground operation was launched. Several cyber-attacks have been launched on Ukraine's critical infrastructure, government, and business agencies. Ukraine has set up an IT Army which has been successful in launching cyber-attacks against Russia's critical information infrastructure and other targets of strategic importance, e.g., Russian satellites. Cyber-attacks have escalated beyond borders. Russian hackers have also attempted to penetrate the networks of NATO and the militaries of several eastern European countries as well. These attacks are an attempt to dissuade the countries supporting Ukraine militarily and economically, and ongoing NATO membership negotiations. The deployment of non-state actors by both parties (Russia and Ukraine) has blurred the lines between 'cyber war' and 'cyber terrorism'. This ambiguity between state and non-state actors has increased the chances of unintended escalation or spread of this conflict.

Russia's 2020 nuclear declaratory policy states that the state holds the right to use nuclear weapons under a range of contingencies, such as attacks on critical governmental or military sites. Similarly, the US has stated that a cyber-attack on nuclear Command, Control, and Communication (NC3) facilities can constitute a non-nuclear strategic attack, and therefore, will justify the use of nuclear weapons as a response. NATO also reiterates the same approach by reserving the right to respond with conventional weapons if subjected to a powerful cyber-attack. These directives suggest that cyber-attacks risk escalating into physical conflict, including a nuclear one.

Given the complicated nature and evolving dynamics of cyber warfare, it is vital for the global community to form a broader international security regime and frame a code of conduct for states which are actively involved in this domain. This can be done by identifying critical infrastructures that are crucial to national security which either remain beyond the ambit of a cyber-attack or are placed in the maximum retaliation category. States should adopt responsible behaviour in the application of such technologies. The risk of inadvertent escalation should be reduced. There is a need to expand the scope of the Additional Protocol I to the Geneva Convention on international armed conflicts to include specific prohibitions on cyber-attacks on infrastructure and facilities that serve the basic needs of the civilian population, including power, water, and health services. Significantly, Russia had withdrawn its ratification of the Additional Protocol 1 in 2019. Voluntary guidelines adopted by a few countries would not be a substitute.

The Ukraine conflict has accelerated three significant trends in internet governance. It has increased the role of non-state actors in state-level war. Secondly, it has highlighted the importance of information networks in physical conflicts.

Thirdly, it has accelerated the divide between the United States, Europe, Russia, and China.[11] The internet has rendered conflicts complex and interdependent, because of the unprecedented range of interventions available. The rising interdependence of global networks, and free access to them from anywhere in the world, has enabled remote engagement in wars far away while the nature of the internet makes final attribution impossible. The Ukraine conflict is an example of the internet's weaponization in physical warfare. The ISP offices within occupied cities in eastern Ukraine have similarly been rerouted to Russian networks, securing Russian informational control over the regions. This highlights the importance of security and control over the national telecommunication channels. The war in Ukraine has drawn an even more explicit curtain between national internet regimes. Russia has banned the majority of Western technology companies and media outlets while Ukraine and the West have banned Russian state media sites. The national boundaries no longer end at the border, but now extend into media spheres in any geography with an internet connection. The conflict has drawn a sharp line between the fragmented financial, informational, and infrastructural realities in Europe and the United States, against Russia and China.

Russia's vision of the internet is strongly in favour of a more nation-state-controlled governance model. Several developing countries may find this model attractive. Russia seeks to give primacy on Internet governance processes and authorities to the UN's International Telecommunication Union (ITU), instead of giving multistakeholder bodies a major role. Russia had also put forward a candidate for the ITU secretary-general in September 2022. The growing commonality between Russia and China on Internet governance is reinforced by the Ukraine conflict.

Oceans

As a result of the Ukraine conflict, Russia announced a new Marine Doctrine on July 31. The new doctrine is more militarized and seeks to strengthen Russian presence and activities on the high seas. It plans to develop existing bases in Syria, Sudan, and Vietnam and create new bases in the Asia-Pacific Region, the Mediterranean, the Red Sea, and the Indian Ocean. The doctrine identifies India, Iran, Iraq, and Saudi Arabia as priority states, for military and military-technical cooperation. Russia has identified vital areas of the oceans for itself. These include internal and territorial waters, the exclusive economic zone of the country and its continental shelf, as well as the Arctic basin, including the waters of the Northern Sea Route (which runs along the country's northern coast), the Sea of Okhotsk and the Russian sector of the Caspian Sea. Loss of control over any one of these may endanger the national security of Russia and the very existence of the state, and therefore the security of these regions is protected by nuclear weapons. Russia also plans to take full control of the Northern Sea Route, and its Arctic straits, and to designate it a national transport communication route, under the command of the Northern Fleet as before but also the Pacific Fleet. Russia officially declares the Kerch Strait (between Russia and Ukraine), to be part of its territorial waters. Russia is likely to declare the Black Sea area around Crimea as national waters. The new doctrine indicates that Russia will strengthen its military presence on the world's oceans. In some sea areas, Russia will seek to dictate conditions, including by military force and nuclear threats, increasing the risks of confrontation.

However, Russia's key handicap of lack of land access to warm water ports from its mainland remains.

Conclusions

The Ukraine conflict has resulted in new challenges to science and technology cooperation especially in dealing with global; challenges and managing global commons. It is especially damaging as Russia has built up a substantial capacity in science and technology and a strong industrial base capable of contributing to human progress. Programmes such as the ISS are in danger, and Russian cooperation in areas such as human health, climate change and energy transition, and nuclear technology are critical. The diversion of valuable economic and scientific resources for military purposes and the growing cooperation between Russia and China ranged in confrontation against the US and its allies could further damage science diplomacy in the future. The interconnect between tensions in Europe and in the Indo-Pacific region could amplify adverse trends. The best that one can hope for at the moment is to insulate as much as possible, science and technology cooperation from the rising geopolitical tensions. As 2022 draws to a close, the war in Ukraine continues, with an increasingly severe impact on the population during the winter months, with disruptions in fuel and electricity supply.

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9. The International Space Station (ISS) is the most politically and legally complex space exploration programme in history. It involves five participating space agencies: NASA

(United States), Roscosmos (Russia), JAXA (Japan), ESA (Europe), and CSA (Canada), and fifteen partner countries, The 1998 Space Station Intergovernmental Agreement sets forth the primary framework for international cooperation among the parties. A series of subsequent agreements govern other aspects of the station, ranging from jurisdictional issues to a code of conduct among visiting astronauts. The station has since been continuously occupied since 2000 the longest continuous human presence in low Earth orbit of 420 kms.

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ARTICLE

Science Diplomacy Higher Education – Today and Tomorrow

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Introduction

Understandings of Science Diplomacy (SD) are much debated: the discourse is far from defined, with a multitude of stakeholders emerging from a variety of practitioner and conceptual backgrounds. Nonetheless, there is an identifiable discourse on the emergence of SD as both practice and topic of debate within diplomatic studies, along with its integration into relevant higher education curricula, in the fields of politics, international relations, diplomatic studies programs and the natural sciences. In fact, the discourse and practice of SD have reached a level of maturity that necessitates the integration of SD into relevant curricula in order to offer students an engagement with emerging practices. In contrast to summer schools and shorter courses, the integration of SD into relevant degree programmes offers a sustained and longer-term engagement and a critical engagement with both the practice of SD and the relevant academic discourses on SD.

The Centre of International Studies and Diplomacy (CISD) at SOAS, University of London has operated several master's levels degree programmes both face-to-face and online since 2013. Within these programmes there was the opportunity for an SD module as an element in three online master's degrees with the

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University of London as the awarding body. The authors Mark Robinson and Katharina Höne under the guidance of the founder of the CISD online masters' programmes, J Simon Rofe have been responsible for the introduction of the module with the title 'Global Challenges: Science Diplomacy'. Our collective aim has been to blend SD content with the established methodology of the 'International Relations' Model (Rofe, 2011) to produce a rewarding student experience.

It was seen as both timely and vital that this course be added to the CISD portfolio, in line with the Centre's work towards building on its reputation as a centre of global excellence for diplomatic studies. The Centre's appreciation of diplomatic studies is a deliberately interdisciplinary one; this does not just extend across the social sciences where diplomatic studies has traditionally resided but includes a broader understanding of Global Diplomacy (Holmes & Rofe, 2016). Operationally, there have been collaborations with different academic fields: for example, with colleagues at the Royal Veterinary College in supervising a project entitled 'Elephant Diplomacy', and with Zoroastrianism studies at SOAS in developing a Muslim Minorities MA programme.

The development of the SD module provided a vehicle for exploring questions underpinning the evolution of SD education and training, its key lines of argument and framework for analysis, and potential future directions. In this article, we share experiences as well as larger conceptual and theoretical points regarding SD's place in the higher education sector.

Our rationale for the dedicated introduction of a formal SD module into higher education is threefold. Firstly, as Tim Flink (2021) noted in the agenda-setting powers of SD, it is a necessary and timely topic for students of diplomacy since it provides opportunities to meet the 21st century's 'wicked' problems, where the geopolitical issues of the day are intrinsically linked to issues of science. Secondly, we know from previous studies that there is a demand from students, expert practitioners, and academics for more understanding of the field. Meyer et al., (2021) provided insights from two European Projects into the variety of SD trainings available. These ranged from short in-person practitioner's trainings and interactive online seminars to Massive Open Online Courses (MOOCs). However, no European institutional provider offers a route to the formal award of a qualification at the postgraduate level that includes a dedicated SD element. Thirdly, there is an increasing pool of high-quality evidence-based SD material for students to engage with, as the reading list of the module attests to.

This article, firstly, examines the target student body while providing a context to higher education in the 21st century. It then outlines the development of the SD module, covering the pedagogic approach, module outline, learning outcomes, and assessment. The article ends by considering how the module provides a creative opportunity to shape future online higher education with examples of SD immersive student learning opportunities. The SD course syllabus is included as an appendix.

Setting the Scene for SD Higher Education

The article begins by considering the learning needs of our students. A majority, but by no means all of the student body come from *Generation Z* - a term explored in the comprehensive research of Chloe Combi (2015). In short, the term refers to the demographic of those born between the

mid-1990s and early-2000s and therefore comprises the group of people in their early twenties in the 2020s. Importantly *Generation Z* is often considered to be 'digitally native' (Prensky, 2001); while a debated term, it refers to a widespread, but not universal, familiarity with digital technologies. *Generation Z* is an important dimension to consider here also as their members are already populating undergraduate courses, and some will flow on to become postgraduate students, and from there potentially teachers and SD academics, and practitioners of tomorrow. Equally, the issues of SD are very much to the fore with this demographic: they have grown up in an era of Climate Change discourse, Global Pandemics (SARS & then COVID-19), CERN's particle accelerator and continuous human habitation in space in the International Space Station. As such SD is more relevant to *Generation Z* than any other generation, given the globalised, multi-cultural and divided tech-driven world they will live in.

To appreciate the value of the SD module, we situated its development in their increasingly tailored, student journeys. Brandon Carson (2017), a pioneering learning strategist, explains that *Generation Z* intellectually inhabits online domains that interest, connect, entertain, and challenge them. Educational design, therefore, needs to address and complement a range of content providers that vie for their attention. Engagement of *Generation Z* with the topic of SD is vital in both its study and in addressing it. Furthermore, it is important to make a link between SD discourse and how the module addresses it. The content must be cognizant of contemporary changes to have credibility with a knowledgeable and demanding body of learners. Importantly in contemplating the design, development, and delivery of the module at the micro level, the distinction between student and teacher was deconstructed, not least because the nature of the subject requires mutual learning but also to deliver a reflective pedagogy. At a macro level, many of the science- driven solutions to global problems require global solutions. These are issues that span borders and demand a multilateral approach; the latest thinking and leadership on this - such as the recent International Institute for Applied Systems Analysis 'Vienna Statement on SD', that emphasises the need for multilateralism is featured (IIASA, 2022) and the anticipatory approach championed by the Geneva Science Anticipator in their Breakthrough Radar needs to be reflected in the course material (GESDA, 2022).

Pedagogic Approach

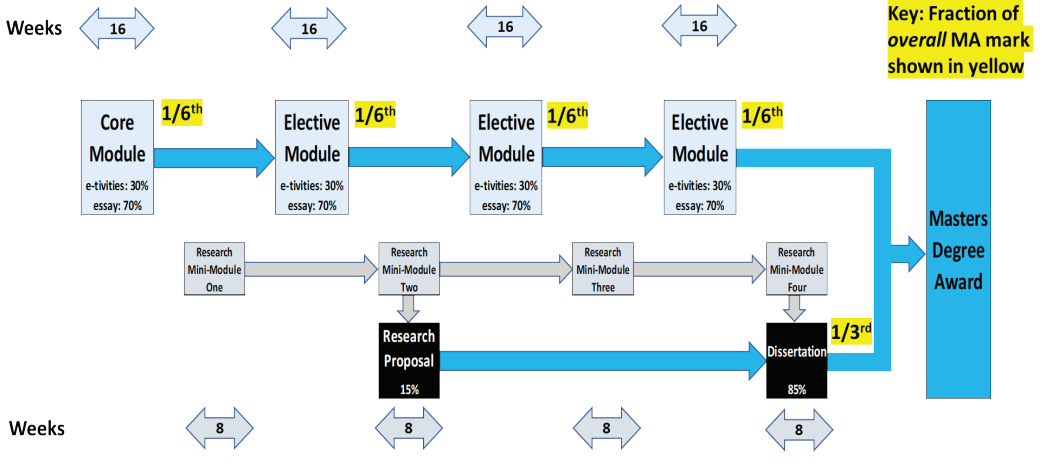
The pedagogy underpinning the SD module is based on the IR Model (Rofe, 2011). The 'IR' in the IR model is referenced primarily to 'Intellectual Reflection' as the underpinning quality of critical thinking for learning. The approach proposes the 3Ds' of Design, Development and Delivery as guiding the process of optimal course design. The approach has antecedents in Gilly Salmon's 5 Stage model for online learning (2005), and particularly her identification of e-activities (2002) while also drawing on John's Biggs work on teaching for quality learning at university and later with his ideas on constructive alignment (Biggs, 2003 and 2014). The IR model has its disciplinary heritage in the broad field of International Studies of which International Relations, very often referred to as 'IR', is the most prominent discourse and sits alongside Diplomatic Studies. Demonstrating the intellectual reflection that is prescribed by the model it provides direct linkages between a disciplinary perspective and a pedagogic philosophy.

Under the auspices of the IR Model, the team worked with students under the 'freedom to learn' mantra of Rogers and Freiberg, 1994. This approach enables collaborative learner-led exploration, as such freeing learners from their instructors' preconceptions; something that is particularly vital for this subject area. So, in all aspects of the 3Ds, the overriding aim was to work cooperatively with learners to help improve overall understanding of what SD can achieve. Equally, the seminal *Pedagogy of the Oppressed* by the educational critic Paulo Freire (1970: pp 74-76) inspired our thinking with respect to considering generative themes that will help further free learners – aided by innovative new techniques – to decode complex SD issues and encourage further learning. Freire's later, *Pedagogy of Freedom: Ethics, Democracy, and Civic Courage* (1998: p 116) article rouses the powerful idea of encompassing 'the ethics of solidarity.' The SD course purposely showcases topics that demonstrate how SD practitioners address global issues for 'the benefit of all mankind'. As such the course delivers a constructive learning experience with acknowledged normative and positivist approaches that actively reflect on the importance of the subject in the manner in which it is taught (Salmon, 2005: pp 201-218; Baume, 2009: pp 11-13 and 40-42 and 2011: p 9).

Building out from these foundational works, the IR model's approach sees learning as a partnership that respects a diversity of views and backgrounds. As an example, the course engages students with the diversity of SD definitions and concepts and asks to find their own voice within this debate. Similarly, SD is interdisciplinary, and students' diverse previous education experiences are brought into dialogue with each other. Moderated student discussions in supported and dedicated forums are one of the cornerstones of these practices within the IR Model.

The module's applicability is demonstrated in being offered across three distinct postgraduate programmes: 1) the MA in Global Diplomacy, 2) the MSc in Security & Strategy and 3) the MSc in Global Energy & Climate Policy. In each

Figure 1: MA in Global Diplomacy Structure



case, it builds upon the core modules accounting for a 1/6th fraction of the overall mark required for the award of a master's degree; the overall structure is shown in figure 1.

Module Outline

The module addresses SD in relation to global challenges, and asks key questions as enablers of learning: 'how has globalization changed the way in which diplomacy is practiced?' and 'how can the use of SD foster more effective diplomatic practices?' The module focuses on both the key building blocks of SD: its antecedents conceptually and empirically; and its evolution by looking at SD as a form of and vehicle for Soft Power. Learners look at both state and non-state led practices in SD. This necessarily draws on an expanded understanding of the Global Diplomacy (Holmes and Rofe, 2016) which recognises a plurality of actors across a 'sciencescape' including diplomats, IGOs, elite scientists, field scientists/observers NGOs, MNCs and academics. Our identification of the 'sciencescape' blends theory and practice in both subject matter and pedagogy thus equipping learners with a rounded academic foundation and the skills they need to develop as practitioners. Here, our article draws on the identification of a 'scape or ecosystem as a means of departing from monolithic categorisations of diplomacy as a state-based activity (Holmes and Rofe, 2016).

Learning Outcomes

The module design has at its core seven learning outcomes (LO) which, on successful completion of the SD module a student will have mastered, see table 1. The importance of establishing learning outcomes is to meet institutional quality

Table 1: SD Module Learning Outcomes

LO Number	LO Description
LO 1	Demonstrate an understanding of the practice of SD in a historical context.
LO 2	Demonstrate an understanding of the accepted typology of SD and their commonalities, differences and practical implications
LO 3	Demonstrate an understanding of the relationships between the theory and terminology of public diplomacy, SD and global challenges
LO 4	Acquire an informed insight into the practice of SD including diplomacy actors, international organisations and negotiations
LO 5	Identify different types of and case studies of SD
LO 6	Develop the ability to craft SD strategies for a given context
LO 7	Develop the ability to think critically, and to write analytically, with proper reference to academic source materials about SD

assurance requirements while also sharing with students from the outset a clear statement of the goals of their endeavours.

Dual factors have underpinned the LO development. Firstly, their achievement is a mechanism for learners to progress through the subject matter, while secondly, they are formulated as the achievable and realistic goals to arrive at via the IR Model's carefully deployed points of assessment.

Assessment

The module employs a range of student-focused assessments known as 'e-tivities' that are specifically designed to meet the programme's learning outcomes. The e-tivity is based on Gilly Salmon's (2002: pp 10-36) 5- stage model of e-learning that utilises a clear format that states to the students the 'Purpose' of the e-tivity, the 'Task' at hand, the contribution or 'Response' type and the 'Outcome'. Rofe (2011: pp 103-117) outlines the purpose of this approach to assessment under the rubric of *assessment for learning*. The e-tivities simultaneously provide formative and summative feedback - as feedforward - to students as a means of monitoring their progress and encouraging areas in which they can improve. For the SD module, the six e-tivities are shared here. Not only is the timing of the points of assessment considered but their relative weighting – escalating towards a substantial piece of writing giving scope to learners to explore their thinking. This equally provides low- risk assessments at the outset of the learning which maximises the opportunities for engaging with feedback as feed-forward.

- E-tivity 1, Access and Socialisation, is purely formative and has a 0 per cent assessment weighting.
- E-tivity 2, Library Information retrieval results in a 500-word submission and has a 5 per cent weighting of the overall course assessment.
- E-tivity 3, Literature critique (directed) results in a 500-word submission and also has a 5 per cent assessment weighting.
- E-tivity 4, Essay Proposal results in a 1500-word submission and has a 15 per cent weighting of the overall course assessment.
- E-tivity 5, Literature critique (bespoke) results in a 500-word submission and has a 5 per cent weighting of the overall course assessment.
- E-tivity 6 is the substantive piece of assessment and is in line with the established pattern for all of the modules on the Global Diplomacy programme: a final essay component that is based on feedback received from an earlier submitted research proposal (e-tivity-4). The pedagogic value of this component of the module serves to illustrate the students' ability to critically analyse course content gathered over the whole 16-week course. The word count is 5000 words and has a 70 per cent weighting of the overall course assessment.

Future Online SD Higher Education Opportunities

There are numerous reasons why the SD module shared here is the most appropriate vehicle for improving e-learning participation in the future. Firstly, the author's experience with science, technology, engineering, and mathematics (STEM) related *Generation Z* summer school classes. In short, these courses only go so far: without the necessary intellectual context, a stand-alone summer school-type course only reveals part of what SD can offer. Learners in the summer school/ short course environment, in completing group projects use with consummate

ease a range of digital technology to research, script and present their work – showcasing their default digital skills and predilections. They demonstrated a keen desire to present their projects in a highly professional manner. They will eagerly respond to innovation providing we sensitively design courses that engage closely with them and respect them, stretch them, are compatible with a mobile platform they regularly use, are relevant to what they care about and what they believe will fit into their lives and develop them as individuals (Fromm and Read, 2018, p 25). The second reason why the SD module is an apt vehicle for improving e-learning participation is the subject matter itself. While many would agree that SD is an interesting topic, interest can be transitory. It is by working collaboratively between all learners, that assessments are aligned to address climate change mediation scenarios or arms reduction verification talks, or space exploration collaboration negotiation, that depth is added to the analysis and the topic is brought to life and made memorable. This led us to propose that utilising the vast opportunities for connection and experiential learning of digital tools will reinforce this positive effect along similar lines of those promoted in the three case studies cited by Saranne Weller in *Academic Practice* (2016: Chapter 5, pp 84-93). One prospect is that a climate change negotiations simulation exercise may allow students to A) play the role of policymakers in their own countries/regions to bring their first-hand knowledge; see figure 2 and/or B) play policymakers in other countries/regions to gain a wider perspective and crucially to transformative education (Freire, 1970: p 58), challenge their own assumptions; see figure 3. Switching roles can be achieved now through video conference calls with tutors playing key protagonists. What is new here is that, in the future, the scenarios could be set by artificial intelligence algorithms that know what took place in the actual negotiations, and through virtual reality, students would be '*in* the negotiating room' reacting in real- time to what they see before them.

Improvements in video conferencing services, hastened by their enforced use through the COVID-19 Pandemic offer the opportunity to develop diplomatic skills in the absence of face-to-face meetings. In reaction to the COVID-19 pandemic, video conferencing has more firmly become part of diplomatic practice. Most practitioners and scholars agree that video conferencing is not a replacement for face-to-face meetings. Such meetings are usually less amenable to building trust, reading body language, and corridor diplomacy. Yet, they offer opportunities regarding fostering greater inclusion and having instantaneous meetings in the face of emerging crises. Some argue that the future of diplomacy will be hybrid – utilising both forms of meetings as needed and having meetings that combine online and in-situ attendance (Bjola and Manor, 2022; Kurbalija and Höne, 2021). Video conferencing has become part of the diplomatic toolkit and students can benefit from understanding its opportunities (Danielson and Hedling, 2021) and shortcomings and the additional skills required to run successful online and hybrid meetings through simulation.

Beyond the familiar video conferencing, we might also look to the emerging opportunities offered by artificial intelligence (AI) and virtual reality (VR) technology. Hansen (2008: p 29) points out that realistic avatars could be created around the negotiating table that would sit, stand, gesture, and speak in real-time response to the students' actions. Avatars also offer the opportunity of

Figure 2: Climate Change Negotiations; Students Role Playing their Own Nation's Representatives

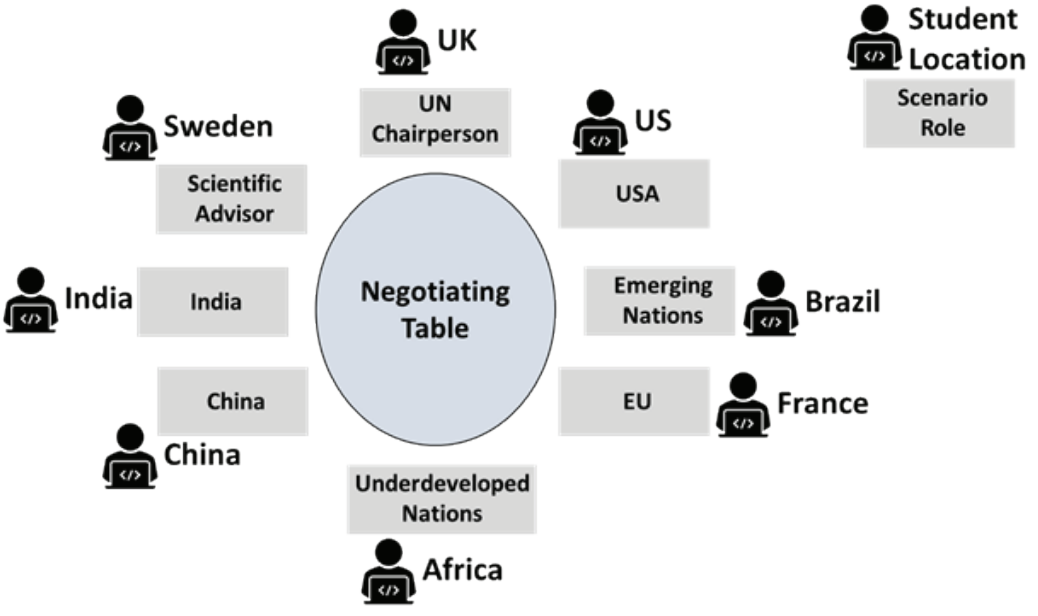
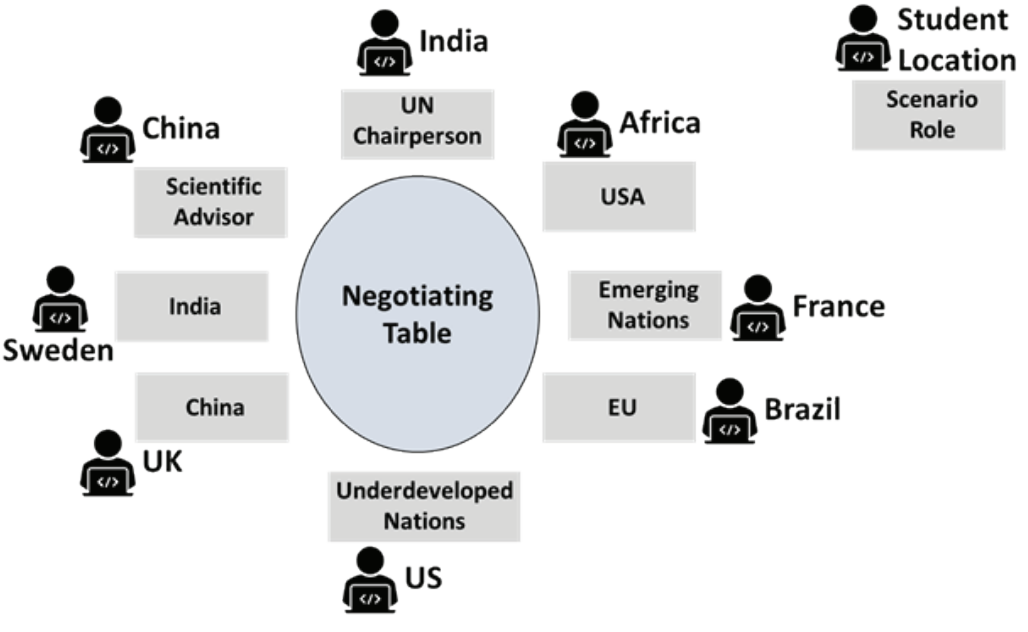


Figure 3: Climate Change Negotiations; Students Role Playing Other Nations Representatives



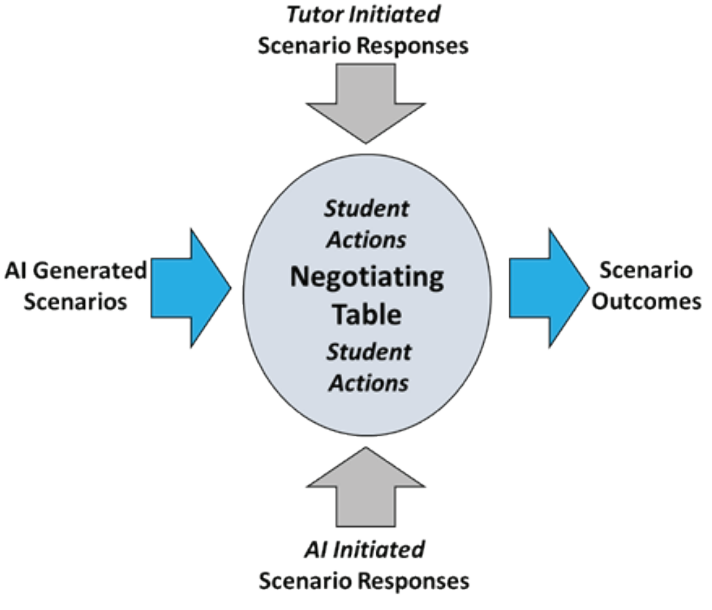
putting students into shoes quite different from their own, regarding, for example, gender, race, and nationality. VR is not yet used by diplomatic practitioners, it is however explored, in the related contexts of mediation (Gregory, 2020) and humanitarian action (ICRC, no date). VR is discussed as 'the ultimate empathy machine' (Alsever, 2015).

A novel *combination* of tutors (physically located wherever they may be) *and* AI algorithms would then generate responses to nudge students' actions. Tutors would have authority over the AI but would be freed up to conduct higher- level interventions leaving routine responses to the system. Students would directly experience the results of their actions when playing their own nations and – by being able to switch roles in other scenario runs – better appreciate the stance of others. The exercise would also allow students to fit in the shoes of the UN chairperson and the independent scientific advisor. The ease of transition between roles and scenarios and the quality of the learning experience would hearten values in the students such as respect for diversity and tolerance of others, all important attributes of a diplomat.

At the end of each scenario run, debriefing by tutors would allow AI to run 'what if' playbacks to demonstrate how outcomes could have changed depending on adjustments to students' inputs. A 'Climate Change Negotiators Champions Board' would rank cohorts' collective efforts against peers. This will provide students with a memorable experience *and* would allow them to directly learn how to manage the intricacies and multi-dependencies involved in SD practice; a powerful winning combination and hence a goal worth pursuing; see figure 4.

The challenge of this innovation is how we can build into the design thought-provoking themes that will inspire students to want to learn more. Paolo Freire strikingly cited generative themes as crucial in his case for the practice

Figure 4: SD Module, Climate Change Negotiations; Relationship Between AI, Tutors, and Students



of freedom overcoming the banking concept of education as an instrument of oppression (1970: p 75). The same is true today and applying this to the design will lead students on a journey where they will want to decode complex situations and understand the underlying reasons, and through that understanding learn what is important and why and how they can be dealt with.

Margaret Hansen, (2008: p 35) points out, in her review of the use of these innovative technologies in healthcare, that the relevance and benefits to the higher education environment continue to be contested. She reminds us that there "is always a case for more empirical research in order to unearth the pedagogical outcomes and advantages associated with this e-learning technology". Also, we can ask ourselves why should we take these ideas further? What is in it for us as individuals and as a professionals? We would argue that it is all too easy to hide behind processes and effectively do nothing when the evidence of the use of these technologies in wider society is increasingly all around us.

Rogers (2003: pp 191-196) sets out the five-stage process that communities embark on before adopting any innovation: awareness, interest, evaluation, trial, and eventual adoption. Future iterations of the SD module could certainly trail innovative ideas to improve student immersion in the future in their Virtual Learning Environment (VLE) or Content Management System (CMS). The SD module design purposively allows this development as advancements in technological know-how making its implementation more straightforward. It is of note that the price of innovative technologies such as these is reducing while their performance and reliability are both steadily increasing (Carson, 2017: p 9 and pp 119-121).

To be clear, we are not proposing that the whole SD module embrace this deep immersive learning trial but rather only elements (such as the example climate change negotiations) that naturally lend themselves to it. The course will therefore fully embrace 'blended learning', defined by Sam Brenton (2009: p 86) as 'mixed-mode' learning, not to be fashionable, but because the idiom neatly encapsulates how we live our lives: a complicated tapestry of online and face-to-face encounters.

Rather like the argument that 'cloud computing' is coming to a user whether the user wants it or not, we would argue that a versatile, immersive, creative and dynamic learning environment is coming to online higher education (and arguably all higher education) whether teachers and institutions want it or not. The question is not *if* or even *when* but rather *who* should lead its development. Our case is that it should be led by SD academics and teachers (rather than IT- savvy platform experts), as these developments are best led by subject experts who apply new technology based on overall learning objectives. The technology needs to match the immersive learning that will help to meet the learning outcomes, not the other way around.

This SD module can and should be a flagship in the practice of freedom in higher education and therefore aims to awaken the critical consciousness of participants. This is the high bar we should aim for in future online applications as to fail to do so, to simply be silent observers, will be to surrender this territory of a student's mind to gaming and entertainment applications. The opportunities that the future development of SD higher education provides are many and worthy. Achieving these goals will then, in turn, energise the whole topic of SD in the very cohort that is vital to its delivery for us all.

Appendix – Course Syllabus

The syllabus is spread over twelve topics that include questions that guide both the students and tutors in each area and quiz topics that help check understanding.

1. Introduction to SD

This topic introduces SD and places it in the context of participants' overall understanding of diplomacy. It also offers a historical perspective on SD which will help to put other case studies discussed later in the module into context.

Guiding Questions: How does SD fit within the diplomatic practice? What elements of SD seem familiar and what seems new compared to traditional definitions of diplomacy?

Quiz: In no more than 50 words describe how SD fits within your understanding of diplomacy.

2. SD in the context of Public Diplomacy, Soft Power, and Globalisation and its changing practice

While SD goes beyond public diplomacy and is not limited to soft power, both offer important ways of anchoring many examples in the practice of SD. Further, SD in its current form, cannot be understood outside of the possibilities and pressures of globalisation and how multipolarity and institutional inertia are contributing to global collaboration challenges.

Guiding questions: How does SD relate to globalisation and its challenges? What elements of SD can best be described as public diplomacy and the application of soft power?

Quiz: In no more than 50 words give an example of how SD reflects notions of public diplomacy and soft power.

3. National approaches to SD

Countries are important SD actors. While we can identify common elements to countries' SD practices, there are variations and style and national priorities. As part of this topic, we look at various national approaches to SD with the aim to distil commonalities and differences between countries. National approaches to SD are context-specific and need to be understood within the background of a countries' history and overall diplomatic practice.

Guiding Questions: What are commonalities and differences in the SD practice of countries? What explains these differences?

Quiz: In no more than 50 words explain what you have identified as possible common denominators in countries' approaches to SD or provide an example of SD practice from your own country.

4. Definitions of SD: Engaging the three-part typology of *Science in Diplomacy*, *Diplomacy for Science* and *Science for Diplomacy* as well as other approaches

In 2010 the Royal Society and the American Association for the Advancement of Science (RS/AAAS, 2010) developed a typology of SD consisting of three elements: *Science in Diplomacy*, *Diplomacy for Science* and *Science for Diplomacy*. This typology is helpful in making sense of the variety of SD approaches. At the same time, there are those that criticise the three-part typology as too restrictive and offer alternative views on SD.

Guiding questions: What are the key characteristics of the three-part typology of SD suggested by the Royal Society and AAAS? Can you name an example for each? What is the main critique of the typology?

Quiz: In no more than 50 words, explain what Turekian et al. (2017) mean by "toward a pragmatic reframing" of SD?

5. Case study for *Science in Diplomacy* – informing foreign policy objectives with scientific advice: *Climate Change and the role of the Intergovernmental Panel on Climate Change* (IPCC)

This topic uses the IPCC as a case study for *Science in Diplomacy*. It sheds light on the interactions between scientists and diplomats as part of the IPCC process. It also highlights the role of scientific advice as part of the climate change negotiations under the UN Framework Convention on Climate Change (UNFCCC).

Guiding questions: What is the role of scientists as part of the IPCC and UNFCCC processes and to what extent does scientific advice play a part in the climate change negotiations?

Quiz: In no more than 50 words explain the role of the IPCC as part of the global climate change negotiations under the UNFCCC.

6. Case study for *Diplomacy for Science* – facilitating international science cooperation: *CERN*

The RS/AAAS (2010) joint paper covered in Topic 4 challenged the romantic notion of the scientist as a lone creative genius. In today's world, the scientific enterprise is premised on the need to connect with the best minds in each field; the emphasis being on the necessity to work in well-funded groups with cutting-edge equipment that is needed to tackle today's global problems. The necessity for international collaboration is exemplified in the high- energy physics research field where CERN plays a leading role.

Guiding questions: What features of high energy physics research make international collaboration a necessity and what has CERN provided to the research community that makes it a success? What other areas of science require an international collaborative approach to meet their research goals?

Quiz: Give an example of a field of science and/or a specific project that needs international collaboration to meet its research needs and explain why that is the case.

7. Case study for *Science for Diplomacy* – the soft power of science cooperation: *Space Exploration*

In this topic, we focus on space exploration and its soft power potential. In doing so, we show how science can be used to promote peaceful relations: *Science for Diplomacy*.

Space is termed as the final frontier of exploration for mankind. Space exploration started during the intense rivalry of the Cold War. Despite the militarisation of Space, it has also seen iconic collaboration between states. The potency of science, as a real and/or perceived, impartial back channel for building trust and understanding between countries is enhanced by self-evident successes that the International Space Station (ISS) and several NASA, Chinese Space Agency, and European Space Agency missions epitomise.

Guiding questions:

What factors allow and encourage nations to collaborate on expensive space projects such as the ISS when they are fierce rivals in many other domains? What role can SD play in enhancing the soft power of nation states? Conversely, how do deteriorating international relations between states adversely affect science collaborations?

Quiz: Provide two examples of where SD has played a role in enhancing the soft power of a nation state.

8. Case studies in Science Diplomacy: *actors*

In topic three, we looked at national approaches to SD and thereby shed some light on states as SD actors. This topic focuses on individuals as actors of SD. It sheds light on scientists as diplomats as well as diplomats and policymakers that engage in SD. As part of this topic, we provide examples of state and non-state actors.

Guiding Questions: What are the different ways in which individuals play a role as science diplomats: nationally and in the international arena?

Quiz: In no more than 50 words describe one way in which individual scientists can get involved in SD.

9. Case studies in Science Diplomacy: *institutions (such as the role of AAAS, UNESCO, and others)*

SD is also driven by several important institutions. As part of this topic, we provide examples in order to distil key findings on the role of institutions in SD.

Specialised intergovernmental agencies, as part of the UN system such as UNESCO, the Food and Agriculture Organization, the World Health Organization, etc. all at least have partly scientific aims. These UN organisations have steadily been added to and now include a plethora of UN bodies such as the IPCC for Climate Change (discussed in topic 5), the UN Foundation who manages progress on the UN Sustainable Development Goals (on behalf of the UN General Assembly). Also, project- specific Intergovernmental Organisations (IGOs) have been created such as CERN (discussed in topic 6) and ITER (for Nuclear Fusion Energy). Influential national organisations which are part of the SD landscape include the US National Science Foundation. Non-governmental organisations which play a leading role in SD practice include the American Association for the Advancement of Science (AAAS), the Royal Society in the UK and leading science funding bodies such as the Welcome Trust in the UK and the US- based Bill & Melinda Gates Foundation. The renowned International Institute for Applied Systems Analysis in Vienna has also acknowledged the growing importance of SD in the international community (IIASA, 2021).

Guiding Questions:

What role do international institutions play in SD? What advantages and disadvantages do intergovernmental organisations have over nationally led SD initiatives?

Quiz: List three reasons why international institutions are an important part of SD.

10. Case studies in SD: *negotiations (such as those that led to the founding of CERN and the agreement of the Antarctic Treaty and the formation of the Arctic Council)*

Topic 6 emphasised that the large resource needs of science research were the driving force behind collaborative agreements. To meet these needs, the parties must form alliances and negotiate agreements and start-up conditions which are fair, promote trust and foster a culture of mutual support. The agreements must also allow flexibility in problem solving, manage host state issues and emphasise the primacy of the state and the needs of other stakeholders who may support the endeavour.

Examples of successful negotiations include those for CERN, the Human Cell Atlas Project, the International Space Station, the SESAME light source project in Jordan, the Antarctic Treaty, the Arctic Council, and the International Brain Initiative. Examples of science collaborations that have failed during the set-up phase include the Superconducting Super Collider planned in Texas in the late 1980s.

Guiding Questions: What are the key enablers for international science collaboration and how do negotiation teams exploit the opportunities they provide? What barriers to international science collaboration exist and how are they overcome?

Quiz: List five key enablers for successful international science collaboration. How are they different from regular negotiations?

11. SD in the context of mis- and disinformation

In recent years, the term 'fake news' has become prominent together with the concern raised by many as to how to address misinformation and disinformation in public debate. Scientific knowledge and scientists play a special role in this regard. Hence, as part of this topic, we explore the role of scientists in addressing these delicate issues.

Guiding Questions: What is the role of scientists in addressing fake news and misinformation?

Quiz: Describe one way in which scientists can address fake news and misinformation and the challenges they face in doing so.

12. SD and contested future(s) of global governance: the future role of scientists and scientific advice in the relation between states

Concluding the module, we zoom out again and look at SD to reflect on the future of diplomatic practice and international systems. Looking up at the ISS offers inspiration to many as a beacon of higher-level collaborative human behaviour. Similarly, CERN inspires people that there is a better way to collaborate in peace on the fundamental questions of nature. ITER provides hope of a carbon-free commercial power source for the benefit of mankind. The SD that led to these collaborations may be adaptable in wider domains such as the urgent need for humanity to make progress in delivering on the UN sustainable development goals.

Guiding Questions: How do you see the future of SD in global governance? What part can SD practitioners play in helping nation states and international organisations in delivering on the UN sustainable development goals?

Quiz: What is your main takeaway from this module regarding what SD can contribute to making our world a better place for future generations *or* do you conclude that SD, as debated by Lloyd Davis and Robert Patman (2015), is a 'false dawn' of tangible diplomatic progress?

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Strengthening Multilateralism Through Science

Sneha Sinha*

Sneha Sinha

The ongoing Ukraine war and the COVID-crisis together with growing geo-political tensions, techno-nationalism, protectionism, misinformation, and disinformation calls for 'reformed' multilateralism. The response to COVID-19 has shown several successful efforts towards international cooperation (Brown & Susskind, 2020; Mizutori, 2021). But at the same time, it brings forth multiple failures of global cooperation and the multilateral system. However, it is important to note that multilateralism faced crisis even before the pandemic.[1] The response to the COVID-19 outbreak underlined the key role of science and technology in finding solutions, which is also central to most of the twenty-first century societal challenges like climate change, disease outbreaks, as well as achieving sustainable development goals. The Goal 17 of the Agenda 2030 also calls for 'revitalising' Global Partnerships which cannot be seen as an independent goal. Rather, it is key to the implementation of all SDGs. As these challenges transcend national boundaries, requiring more coordinated action guided by informed decision making, science emerges as a tool for strengthening multilateralism (Muller, 2021). The significance of science for environmental multilateralism was further stressed during the Fiftieth anniversary of United Nations Environment Programme, Stockholm+50 and the Seventy-Seventh UN General Assembly.

In this context, on 29-30 November 2022 UNEP and the Czech Presidency of the Council of the European Union co-organised a Conference on 'Strengthening Multilateralism through Science' in Brussels in hybrid format.[2] The two-day long event brought together representatives from international and European Union institutions, including politicians, civil societies, academia, and youth. The

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Conference aimed to address the triple planetary crises of biodiversity loss, climate change and pollution, through a stronger science policy interface for informed multilateral action. The three sessions of the conference focused on High level Political Panel on Science Diplomacy, Science and Global Cooperation and From Science to Zero Pollution Actions.

Science diplomacy is not a new concept and there has been several examples and case studies which clearly state its significance since the Cold-War period. During the last decade Science Diplomacy has re-emerged as a significant tool for addressing global challenges, including the Global Commons. Growing geopolitical tensions and the diversity of issues and challenges faced in the Global South, it is critical to have a more pragmatic understanding of science diplomacy. The European Union has attached great importance to science diplomacy. Given its growing significance, the UNEP conference had a dedicated session on science diplomacy.

The COVID-19 pandemic caused a setback in the progress of SDGs. During the first session, UNEP's Executive Director, Inger Andersen discussed the lag in efforts towards reduction in emissions as well as in the protection and restoration of nature. She emphasised the role of science to ensure faster multilateral actions, the need for transparent, accessible, inclusive science together with greater engagement across disciplines with multiple stakeholders - including scientists, indigenous women, and youth for improving science-policy interface. Recognising the role of technology, she also underlined the potential negative impact of technology. Jiri Kozak's, First Vice Minister of Foreign Affairs, Czech Republic remarks focused on the role of science diplomacy and greater dialogue between science and diplomacy. He further emphasised the key role of science in achieving SDGs and the critical role of the younger generation scientists and diplomats in future. The Deputy Minister of the Environment, Czech Republic, Jan Dusik, highlighted the issues and challenges of integration of science in policy making and called for science 'in holding policy accountable' and 'finding smarter solutions to speed up transitions'. Emerging challenges call for restructuring the curricula of education accordingly and greater communication.

Speakers recognized the issues, challenges, and threats to multilateralism, with greater fragmentation, growing competitiveness and interconnected nature of global challenges. For ensuring an inclusive multilateral approach, a systemic response based on trust, confidence and integration was required. Therefore, the role of science diplomacy and international cooperation in closing the gap between science and policy uptake was underlined. The need for scientists, diplomats, and policy makers to leave their comfort zone was stressed to further the role of science for multilateralism and vice versa. However, it was considered important to understand the limitations of science in politics and ensure its ability to inform international treatises, negotiations, and conventions. They called for a rational approach to tackle misinformation and disinformation which could lead to anti-science movements that jeopardises the support and effective implementation of policies.

The theme of the second session was 'Science and Global Cooperation'. The session discussed how effective global cooperation on science could be strengthened for achieving the Agenda 2030. The session also brought panellists from research, academic and financial institutions, recognising their role in leveraging global cooperation. Underlining the lack of communication between academia and policy-making, panellists stressed the role of academia in decision

making. Issues of inter-disciplinarity and strategic autonomy were seen as threats to global collaboration among universities. The shift from financing fossil fuels to active investments in climate and environment sustainability was underlined, along with the greater role of science in better informing investments in developing future infrastructure. Apart from public investments, the role of the private sector was also highlighted. Efforts towards global cooperation need to be speeded and scaled up through greater synergy between science and policy. The need for data was emphasised for science cooperation to build bridges as well as for a robust interface between science and policy, together with sharing best practices and strengthening the national science policy ecosystem. Human knowledge, ingenuity, technology, and cooperation could transform societies and economies, securing a sustainable future. Major shifts in investment and regulations are key to just and informed transformations that could overcome inertia and opposition from vested interests. The role of scientific and educational organisations, governments, individuals, civil societies, youth groups, NGOs, private sector, financial and inter-governmental organisations and local communities were considered equally important.

The last session focused on how science could address the issues of pollution. Panellists discussed the limitation of science communication and a need for science to address knowledge gaps and called for a constant dialogue to convince people why such policy decisions are required. It was noted that the role of youth in effective policy making and finding innovative solutions is immense and lay at the centre of the multilateral system. Speakers gave several examples of successes of science and multilateralism in addressing challenges of chemical and air pollution, largely limited to the European context. But they also highlighted the need to reflect on the parameters of measuring such successes and stressed on tackling pollution in an integrated way, by taking note of diversities across the globe. The panellists focused on creating effective science-policy bridges to address long-term objectives. At the same time, they stressed greater global responsibility arising from the export of several banned chemicals and fertilizers to the countries of the Global South, which lack regulatory framework and legislations.

During the COVID-19 pandemic one saw how science became central to global efforts, together with speeding up the process of developing a vaccine. There were examples like the Global Alliance for Vaccines and Immunization (GAVI), which in partnership with the Coalition for Epidemic Preparedness Innovations and the World Health Organization made vaccines available for several developing and low-income countries. However, we did see threats to multilateralism with the United States withdrawing from the World Health Organization during the pandemic and growing 'vaccine nationalism' which intensified the inequities in vaccine availability between countries. Recurrent emergence of new variants continues to pose global health risk, especially to the Global South countries which were unable to vaccinate their populations due to its limited availability.

In order to address the global societal challenges and achieve the Agenda 2030 during the decade of action, given the setback in progress towards SDGs, the Conference was very timely and significant. It emphasised the role of science in strengthening multilateralism and how multilateralism could advance science. Science diplomacy emerges as a tool for strengthening science and policy, and international cooperation in science

and technology towards effective informed decision making, which could further strengthen multilateralism. Science being a unifier with a common language, could play a significant role in building bridges and synergies.

With the publication of the 'New Frontiers in Science Diplomacy' more than a decade ago, science diplomacy is growing in stature both in academic and policy domains. There have been scholars who have criticised the AAAS and Royal Society's three-dimensional definition of science diplomacy and emphasise on a more pragmatic and inclusive approach to science diplomacy. There is a need to acknowledge the regional/local context, especially with respect to the Global South which is equally diverse. Some of these aspects were discussed during the conference. At the same time, issues of collaboration and competition also need to be considered. Significance of informed and evidence-based policy making cannot be sidelined, which further strengthens and leads to greater acceptability of international negotiations and treaties. Techno-nationalism and protectionism are emerging challenges to science for multilateralism. The Conference addressed several issues and provided recommendation for tackling climate change, biodiversity loss and pollution. However, greater participation and more views from the Global South would have enabled a more 'inclusive' event, which largely provided a European perspective. Inclusion of the Global South could lead to specific recommendation which are necessary for their greater integration and to bridge the existing gap.

Endnotes

[1] The report is available at https://www.ohchr.org/en/stories/2021/09/covid-19-presents-case-renewed-multilateralism-says-experts-report.

[2] The recordings of the event is available at https://www.unep.org/events/conference/strengthening-multilateralism-through-science.

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G20: Call for Papers

G20 is gaining importance as a global platform for articulation of economic, social and development issues, opportunities, concerns and challenges that the world is confronting now. Over the years, G20 has witnessed a significant broadening of its agenda into several facets of development. India is going to assume G20 presidency in 2022 which would be important not only for the country but also for other developing countries for meeting the Sustainable Development Goals and achieving an inclusive society. India can leverage this opportunity to help identify G20 the suitable priority areas of development and contribute to its rise as an effective global platform.

In that spirit, Research and Information System for Developing Countries (RIS), a leading policy research institution based in New Delhi, has launched a publication called G20 Digest to generate informed debate and promote research and dissemination on G20 and related issues. This bi-monthly publication covers short articles of 3000 to 4000 words covering policy perspectives, reflections on past and current commitments and proposals on various topics and sectors of interest to G20 countries and its possible ramifications on world economy along with interviews of important personalities and news commentaries.

The Digest offers promising opportunities for academics, policy makers, diplomats and young scholars for greater outreach to the readers through different international networks that RIS and peer institutions in other G20 countries have developed over the years. The interested authors may find more information about the Digest and submission guidelines on the web link: **http://www.ris.org.in/journals-n-newsletters/G20-Digest.**

Guidelines for Authors

1. Submissions should contain institutional affiliation and contact details of author(s), including email address, contact number, etc. Manuscripts should be prepared in MS-Word version, using double spacing. The text of manuscripts, particularly full length articles and essays may range between 4,000- 4,500 words. Whereas, book reviews/event report shall range between 1,000-15,00 words.

2. In-text referencing should be embedded in the anthropological style, for example '(Hirschman 1961)' or '(Lakshman 1989:125)' (Note: Page numbers in the text are necessary only if the cited portion is a direct quote). Footnotes are required, as per the discussions in the paper/article.

3. Use's' in '-ise' '-isation' words; e.g., 'civilise', 'organisation'. Use British spellings rather than American spellings. Thus, 'labour' not 'labor'. Use figures (rather than word) for quantities and exact measurements including per centages (2 per cent, 3 km, 36 years old, etc.). In general descriptions, numbers below 10 should be spelt out in words. Use fuller forms for numbers and dates— for example 1980-88, pp. 200-202 and pp. 178-84. Specific dates should be cited in the form June 2, 2004. Decades and centuries may be spelt out, for example 'the eighties', 'the twentieth century', etc.

Referencing Style: References cited in the manuscript and prepared as per the Harvard style of referencing and to be appended at the end of the manuscript. They must be typed in double space, and should be arranged in alphabetical order by the surname of the first author. In case more than one work by the same author(s) is cited, then arrange them chronologically by year of publication.

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As part of its ongoing research studies on Science &Technology and Innovation (STI), RIS together with the National Institute of Advanced Studies (NIAS), Bengaluru is implementing a major project on Science Diplomacy, supported by the Department of Science and Technology. The programme was launched on 7 May 2018 at New Delhi. The Forum for Indian Science Diplomacy (FISD), under the RIS–NIAS Science Diplomacy Programme, envisages harnessing science diplomacy in areas of critical importance for national development and S&T cooperation.

The key objective of the FISD is to realise the potential of Science Diplomacy by various means, including Capacity building in science diplomacy, developing networks and Science diplomacy for strategic thinking. It aims to leverage the strengths and expertise of Indian Diaspora working in the field of S&T to help the nation meet its agenda in some select S&T sectors.

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