Science Diplomacy and Global Environmental Change

in Latin America and the Caribbean

CASE STUDIES

Science Diplomacy Center

IAI Inter-American Institute for Global Change Research

InnSciD Innovation and Science Diplomacy School

USP

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Collection of Case Studies on Science Diplomacy in the Americas

This collection of case studies is part of the materials for the Science Diplomacy Course of the IAI's Science Diplomacy Center. It is the result of a collaborative effort between the Center for the Study of International Negotiations (CAENI) of the University of São Paulo (USP) and the Inter-American Institute for Global Change Research (IAI). It brings together researchers, fellows from the IAI's STeP Program, and decision-makers across the Americas to explore the dynamic interface between science, policy, and international cooperation.

Innovation and Science Diplomacy School (InnSciD) and the Center for International Negotiation Studies (CAENI), University of São Paulo

InnSciD is the flagship initiative of CAENI, based at the Institute of Advanced Studies at the University of São Paulo (IEA-USP). While InnSciD focuses on science and technology policy through science diplomacy and innovation, CAENI is an interdisciplinary research center dedicated to foreign policy, international cooperation, and international negotiations. The center promotes capacity building, research, and scientific communication, and serves as a hub for science diplomacy at USP.

Inter-American Institute for Global Change Research (IAI)

The Inter-American Institute for Global Change Research (IAI) is an intergovernmental organization with 19 Member States in the Americas that promotes transdisciplinary research and the open exchange of knowledge. The IAI supports the development of public policies based on scientific evidence to address global environmental challenges through collaboration between scientists, governments, and civil society stakeholders. The IAI Directorate also hosts the Belmont Forum Secretariat.

Science Diplomacy Center (SDC), IAI

The SDC is an initiative of the IAI focused on capacity building at the science-policy interface in the Americas. The SDC supports the development of new leaders through training programs, collaborative networks, and applied research projects in science diplomacy. It promotes multi- stakeholder dialogue and decision-making informed by scientific evidence, with special attention to regional contexts and priorities regarding sustainability, equity, and inclusion. The SDC also actively contributes to designing strategies for using science to develop innovative public policies based on cooperation between scientific communities, governments, and international organizations.

About the collaboration

This publication results from an open call for papers organized jointly by CAENI/USP and the IAI. The call invited science-policy professionals and academics involved in science diplomacy practices in Latin America and the Caribbean. The selected contributions highlight diverse experiences and emerging models of scientific cooperation aimed at addressing urgent socio-environmental issues. The cases were chosen with a focus on strengthening multilateral governance, promoting inclusive policy processes, and fostering the role of science in sustainable development.

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PRESENTATION

This compilation is part of the materials prepared for the Science Diplomacy and Innovation course developed by the Science Diplomacy Center of the Inter-American Institute for Global Change Research (IAI), in partnership with the University of São Paulo (USP).

The IAI is an intergovernmental organization dedicated to scientific excellence, international cooperation, and capacity building. Its mission includes the full and open exchange of scientific information relevant to global change, in pursuit of the vision of a sustainable Americas.

To advance this mission, the IAI established the Science Diplomacy Center (SDC), a pioneering initiative in Latin America and the Caribbean (LAC) designed to strengthen the ability of its Parties to achieve the objectives outlined in the IAI Strategic Plan and the Sustainable Development Goals (SDGs).

In this context, the SDC provides training materials focused on promoting science diplomacy training, best practices, and activities. By providing participants with a set of tailor-made training materials, the SDC seeks to enable professionals and institutions throughout the Americas to better understand and implement science diplomacy practices, tools, and processes, and to contribute to the development of more effective public policies and international science-policy collaborations.

The training material as a whole consists of three independent but interrelated elements:

- this Case Studies booklet;
- an online course;
- a set of in-person simulation exercises.

The online course, together with the case studies, presents the main concepts about science and innovation diplomacy as a negotiation activity, with a special focus on sustainable development. In this scenario, the online course can be an entry point to the in-person courses offered by the IAI, when the concepts are mobilized and deepened through simulation games.

The structure of this Case Studies Booklet is as follows:

- Introduction, where we present a brief summary of the main concepts and ideas of science and innovation diplomacy, their presence in Latin America, and an introduction to the case studies;
- A series of 17 case studies, which aim to stimulate discussion based on real-world examples;
- Conclusion and final comments;

Definitions: Science Diplomacy and Innovation

Science diplomacy, broadly understood as a closer relationship between foreign policy and science, has become a topic of interest in International Relations, as well as an important element of political strategy for a better international integration of countries. At the same time, innovation diplomacy is the conjunction of diplomacy with national innovation systems, which broadly encompass the entire research and development ecosystem, including government, universities, the market, and civil society. This is considered essential for achieving long-term social and economic development.

There is no single theoretical definition of the concept of science diplomacy, but it is generally understood to encompass a set of practices aimed at scientific collaboration between nations with the intention, first, of addressing transnational problems and issues, and second, of initiating or intensifying diplomatic ties (Fedoroff, 2009). The emergence of a more globalized world has created the need for complex networks of international cooperation for the more efficient management of transnational issues related to the environment, health, security, among others, creating incentives for various forms of interaction between the realms of diplomacy and scientific research.

Science diplomacy is sometimes seen as a practice centralized within the nation-state, i.e., as a dimension of foreign policy, while at other times it is referred to as a complex network of decentralized and multi-level cooperation and innovation policies, involving both states and subnational entities, the private sector, and civil society. However, in both cases, it is emphasized that science diplomacy is characterized by its strategic and institutionalized character (Ruffini, 2017; Turekian, 2018). The strategic dimension is linked to the creation of long-term objectives, often associated with ideals of national and/or social interest.

A key characteristic of science diplomacy, derived from the complexity of transnational challenges themselves, is its inherent transdisciplinarity. In the context of global governance of issues as diverse as the environment, food and energy security, global public health, etc., it is essential for policymakers to design well-informed agreements and commitments that address the complex interplay between biological, geochemical, climatic, economic, and social systems (Royal Society, 2010).

The typology developed by the AAAS has become classic for its comprehensiveness and for describing the main activities carried out at the intersection of science and diplomacy. According to this typology (Royal Society, 2010), the practices of science diplomacy fall into three different categories:

Science in diplomacy: when diplomats seek information from the scientific community to optimize foreign policy decisions, for example, when scientists provide technical input to diplomats when negotiating environmental, trade cooperation agreements, etc.

Diplomacy for science: when diplomats seek to promote their national scientific communities by encouraging interaction with foreign scientific communities, for example, through agreements on scientist mobility, visas, exchange programs, financial aid, among others.

Science for diplomacy: when the scientific communities of two (or more) countries work to initiate, intensify, or improve diplomatic relations (also called forefront diplomacy). This case is typical of countries experiencing diplomatic tensions or lacking significant diplomatic interactions, which find in scientific cooperation a “neutral” area suitable to serve diplomacy as a tool for easing tensions or initiating and deepening cooperation agendas.

Although science diplomacy is mostly seen as a cooperative endeavor, some consider it to be a competitive activity. Hence, as a cooperation instrument, science can, on the one hand, increase shared interests between countries. On the other hand, as a tool for competition, it can be an instrument to enhance relative capabilities. When Science engages with economic competition, creating value and increasing relative efficiency, these developments are framed as innovation.

Innovation can be understood as the products or production processes, developed with new knowledge or an innovative combination of existing knowledge and introduced into markets and social life (OECD, 2018). In this dynamic framework, interactions between science, technology, and the market are not confined to linear trajectories but are instead fluid, adaptable, and frequently unpredictable. This model of innovation ecosystems recognizes the diverse array of actors contributing to innovation, transcending traditional boundaries and involving different segments of society.

Innovation Diplomacy, therefore, encompasses a larger number of actors than those initially mobilized by science diplomacy, while bringing the market competition to the negotiating table, even when it is aimed at cooperation. In the economic realm, the goal of cooperation is better competition. By intertwining scientific and economic strategies with diplomatic initiatives, international actors can foster sustainable development, catalyze technological progress, and fortify their roles on the world stage. This tension between competitive and collaborative approaches, coupled with the active involvement of the private sector, reinforces the potential for shared prosperity and global progress.

Consequently, science and innovation diplomacy (S&ID) serve as conceptual frameworks to describe and analyze a set of actions that occur at the intersection of science and a specific set of public policies, and can be used as important tools for understanding, intervening and practicing. Consequently, while science diplomacy (SD) tends to bring a more cooperative approach, innovation diplomacy (ID) performs a competitive one.

Although there is a common core to the concept, the narrative of innovation diplomacy has been developed differently by Global South and Global North countries. Global North authors tend to emphasize the economic and competitive elements, as highlighted by scholars such as Jos Leijten (2017) and Kristen Bound (2016), to underscore the multifaceted nature of innovation diplomacy. Simultaneously, drawing from Cruz Jr. (2011), Global South countries, such as Brazil, tend to leverage their diplomatic resources to align with their productive-technological profiles.

This strategic alignment empowers them to redefine their international position in the dynamic landscape of the global division of labor and to move towards sustainable development goals. In this sense, innovation diplomacy serves as a crucial bridge between science, sustainable development, and economic perspectives, particularly when considering the unique context of Global South countries.

Science and Innovation Diplomacy in the LAC region

The S&ID landscape in Latin America is marked by a variety of national initiatives, that have been crafted across Latin America and the Caribbean (LAC), highlighting opportunities for collaboration and development.

In Colombia, the Ministry of Foreign Affairs has issued comprehensive guidelines on science, education, and culture, although there is no specific reference to science or innovation diplomacy. Still in Colombia, the University of Llanos, in collaboration with the Ministry of Foreign Affairs and Colciencias, has launched a Science Diplomacy Program aimed at fostering global collaboration among Colombian scientists. In 2015, Cuba and the United States experienced a significant diplomatic thaw, with Cuba's Academy of Sciences and the American Association for the Advancement of Science playing pivotal roles in promoting collaborations in science, technology, and innovation.

In Mexico, science and innovation diplomacy have gained prominence, led by the Mexican Secretariat of Foreign Relations through agencies such as the Institute of Mexicans Abroad, the Mexican Agency for International Development Cooperation, and the National Council of Science and Technology. Meanwhile, Chile introduced a "Science Diplomacy Formation" course through the Diplomatic Academy Andrés Bello in 2019, while Paraguay incorporated science and innovation diplomacy into its Foreign Affairs Services in response to the COVID-19 pandemic, with the aim of enhancing ambassadors' effectiveness in their roles.

Since 2017, Brazil's Ministry of Foreign Affairs has been working on an Innovation Diplomacy Program that specifically addresses the typical needs of developing economies. This specific framework understands that innovation diplomacy and its instruments should be mobilized not only to enhance international cooperation, but also to transform the technological and productive profile, better positioning the country in competitive markets in the future, with a focus on sustainable development.

In addition, numerous organizations are actively engaged in producing policy reports and memoranda. These documents serve as informative resources for policymakers in both government and the private sector. Prominent initiatives in this realm encompass the Latin American and the Caribbean Open Science Forum (CILAC), the São Paulo School of Advanced Sciences on Innovation and Science Diplomacy (InnSciD SP), and the Regional Leaders Summit (RLS-Sciences). Furthermore, three specific initiatives deserve attention at a different level: Porto Digital in Recife, Brazil; the Bolivian Observatory of Science (BOS); and the Uruguayan Technological Consulate in San Francisco.

However, despite the growing number of national initiatives, Latin America lacks a more solid framework for science and innovation diplomacy across the region. Thus, there is room for improvement in the level of institutionalization and coordination among LAC countries to further bolster science and innovation diplomacy efforts. In this regard, the Science Diplomacy Center created by the Inter-American Institute for Global Research Change represents an important step towards improving science and innovation diplomacy as effective foreign policy tools in American countries.

This material analyzed science and innovation diplomacy efforts in light of the Sustainable Development Goals (SDGs) of the UN Agenda 2030. It emphasizes cooperation and diplomacy as crucial for tackling issues such poverty and climate change, and highlights the importance of financial resources, innovation, and interdisciplinary collaboration for sustainable development.

In parallel, studies on development and technology in Latin America assess macroeconomic barriers, while exploring successful cooperation models and the role of scientific diasporas in promoting science diplomacy, proposing governance schemes for coordination. Taken together, these research efforts underscore Latin America's increasing focus on innovation and scientific collaboration to address regional challenges, reflecting a proactive stance towards technology, innovation, and sustainable development through science diplomacy within and beyond governmental frameworks (Da Silva et al., 2021; Oliveira, 2021; Figueroa et al., 2022; Torres-Atencio et al., 2023; Piñeros-Ayala, 2022; Echeverría-King, Gonzalez & Andrade-Sastoque, 2022).

The Case Studies: A Brief Description

Given the challenges faced by scientists and policymakers, this work sought to adopt an integrated approach between the academic framework of science diplomacy and real-world cases, with a focus on global environmental change (GEC) in the LAC region. The proposal is to provide a toolbox of academic concepts in accessible language and apply them to real cases, enabling readers to identify best practices in science diplomacy and situations where science and diplomacy could have collaborated more effectively in solving problems. The exercise of extracting lessons from real-world negotiations allows policymakers to relate the literature on science diplomacy to the daily realities of their work, providing an opportunity to truly bridge the gap between science and the people who implement public policies at the local and international levels.

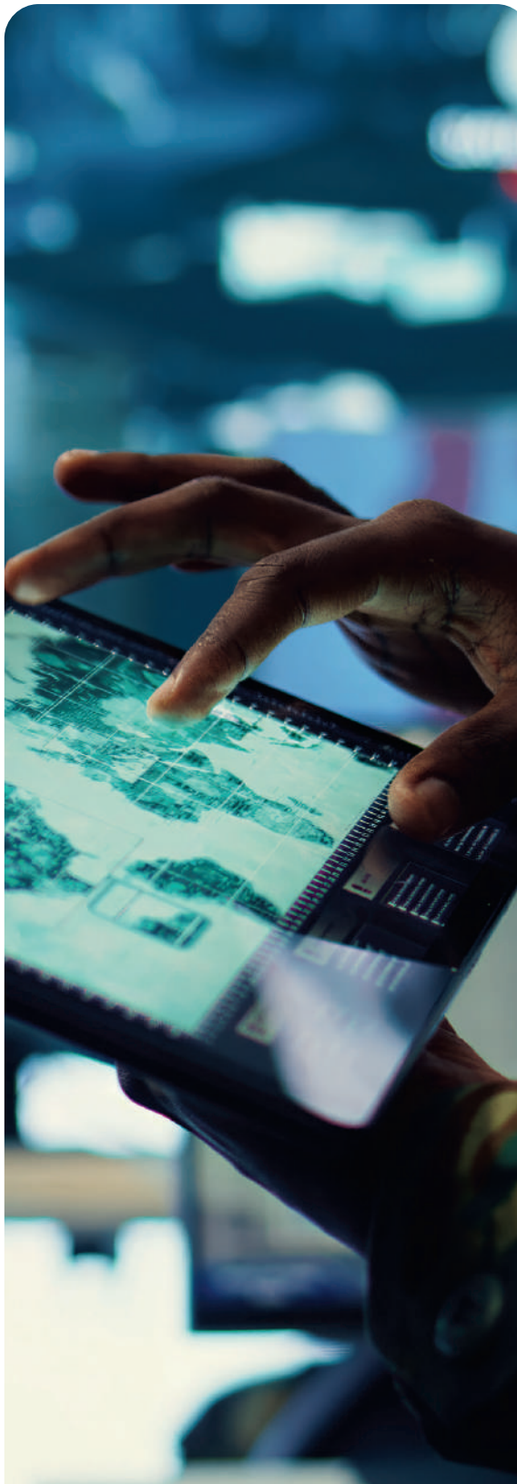
The case studies were selected to represent a broad range of real-world examples of the implementation of Science Diplomacy, Science Advisory, and Innovation Diplomacy. Although these and other related concepts tend to be understood by the academic literature as different and independent, the case studies show that in practice they tend to be closely intertwined, and it is sometimes hard to distinguish one from the other in concrete public policy applications.

This reflects the plurality of views on science diplomacy, and particularly that shared by the IAI, which highlights the centrality of Science Advisory in mobilizing science diplomacy, including science advisory at multiple levels of governance. The degree of success of these initiatives were also considered in the selection of cases - some more successful than others. This allowed for a variety of mechanisms and contexts to be portrayed, analyzing their effectiveness, relevance and appropriateness.

The cases also seek to reflect not only different examples within the traditional AAAS taxonomy on science diplomacy, but also implementations that fall outside these categories. While the traditional taxonomy has been useful for framing the interaction between governments and scientists, it does not encompass other societal actors participating in the public policy cycle, such as businesses and NGOs, that interact with both government agencies and the scientific community. As science diplomacy and Science Advice evolve, existing taxonomies for describing the complexity of these interactions will need to be refined, and practical observations will be crucial in this task.

Another important aspect that the work tries to highlight is the connection of the cases to the Sustainable Development Goals (SDGs) mentioned above. There are three reasons for emphasizing the SDGs: first, they represent the major global challenges of our time; second, they permeate the daily lives of most policymakers and are easily identifiable; and lastly, we are far behind in their full implementation, originally set for 2030. According to the UN, “of the 140 targets, half of them show moderate or severe deviations from the desired trajectory. Furthermore, more than 30 percent of these targets have experienced no progress or, even worse, regression below the 2015 baseline” (UN, 2023).

The cases are structured to assist in navigating the document, with an Overview, an Executive Summary, and a Public Policy Takeouts section that reflects on how to improve the interaction between science, diplomacy, and public policies. This is an invitation for policymakers directly involved in similar negotiations to increasingly make use of science and innovation diplomacy tools and apply them in their daily work.



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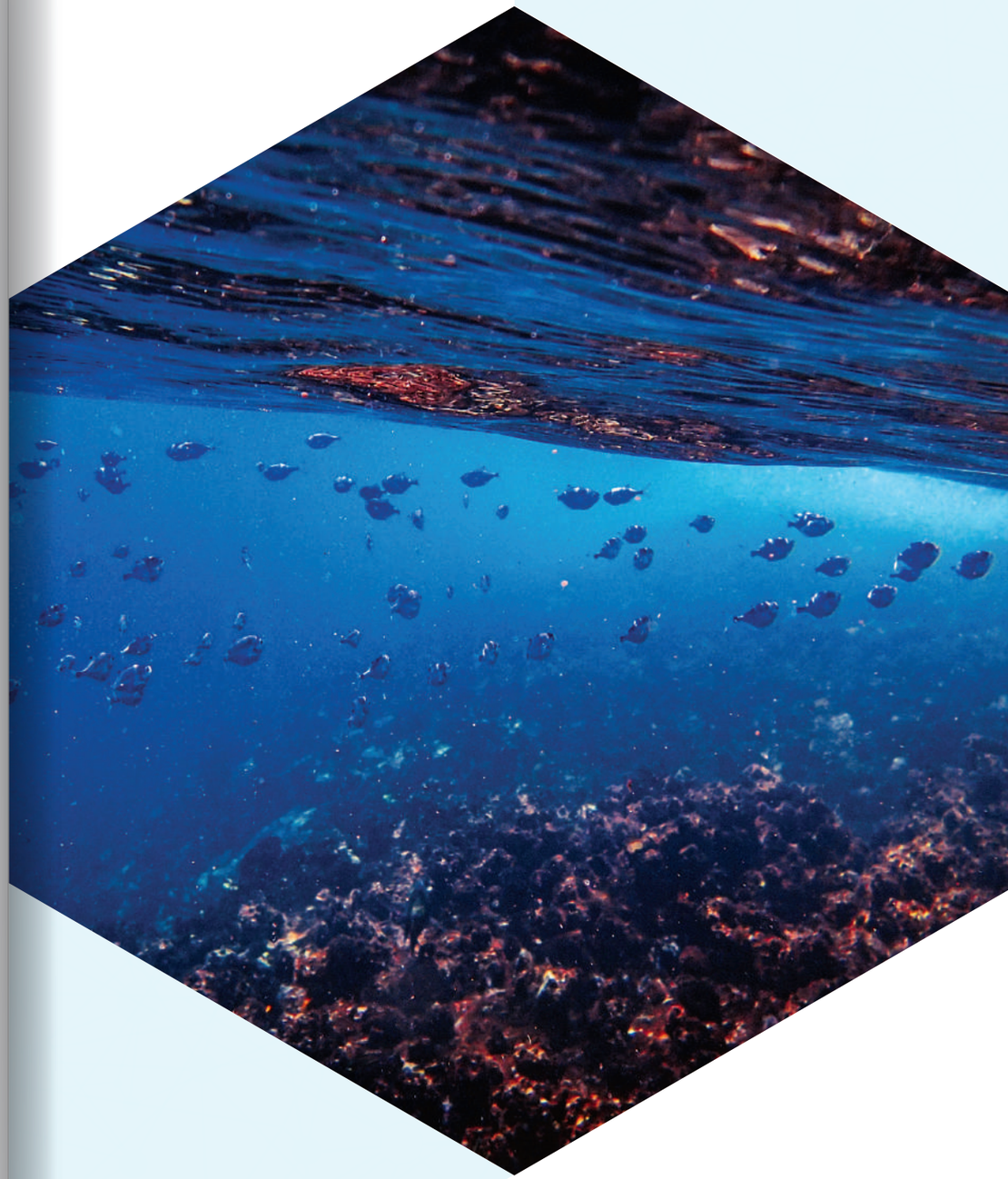

1

Ocean Science Diplomacy in Latin America CMAR: The Largest Marine Protected Area in the Region

Countries:
Colombia, Costa Rica, Ecuador, and Panama.

Science for Diplomacy

In the case of CMAR (Eastern Tropical Pacific Marine Corridor) in Latin America, "Science for Diplomacy" is the primary focus.

- Diplomatic Cooperation: The case study emphasizes diplomatic collaboration as the key driver for uniting Ecuador, Costa Rica, Colombia, and Panama in establishing and managing the corridor.
- Negotiation of Agreements: Diplomatic negotiations and agreements, such as the San José Declaration in 2004, are highlighted as the cornerstones of CMAR's foundation.
- International Organizations: The involvement of international organizations, such as the United Nations Environment Program (UNEP), the International Union for Conservation of Nature (IUCN), and Conservation International (CI), underscores the importance of diplomacy on a global scale.
- Joint Governance Structure: The establishment of a governance structure with political and diplomatic authorities, the Regional Ministerial Committee, demonstrates the central role of diplomacy in guiding scientific recommendations.

Executive Summary

The CMAR (Eastern Tropical Pacific Marine Corridor) is a voluntary regional cooperation mechanism created by **Ecuador**, **Costa Rica**, **Colombia**, and **Panama** to manage and protect one of the world's most productive and biodiverse oceans.

Despite the absence of a coherent, overarching regional ocean governance framework, during the last two decades, the **CMAR** has provided an unprecedented basis for scientists and diplomats to work hand in hand under a common governance structure. It established an exemplary intergovernmental strategy for managing the area's ecosystems with the support of non-governmental organizations (NGOs) and international cooperation agencies. The first steps date back to 1997, when **Costa Rica** and **Ecuador** initiated diplomatic and scientific exchanges. In the early 2000s, these efforts were joined by **Colombia** and **Panama**, leading to the formal creation of the **CMAR** in 2004. Despite being a non-binding agreement, collaboration between member states and other stakeholders has continued and expanded. In fact, in a major announcement at the **Glasgow COP26**, **Ecuador** and **Colombia** announced a further expansion of their protected areas of 60,000 and 160,000 sq km, respectively.

Keywords: Ocean diplomacy; biodiversity; fisheries; protected areas; ecological connectivity.

Introduction

Oceans are one of the largest and most influential global commons. The livelihoods of more than 3 billion people worldwide rely on oceans (nearly 200 million jobs depend on marine environments), and they are fundamental to planetary biodiversity, climate regulation, transportation, tourism, and culture (UN, 2020). Given that more than 80% of the countries in the world have marine borders, oceans are also essential to international law and diplomacy.

In the Eastern Pacific, off the coasts of South and Central America near the equator, lies one of the world's richest and most biodiverse marine areas. Four countries, namely Ecuador, Costa Rica, Colombia, and Panama have voluntarily cooperated since the 1990s in what constitutes a pioneering example of Ocean Science Diplomacy in the region. Through desk research of primary and secondary sources, gray literature, and international conventions and treaties, this case study showcases the Eastern Pacific Marine Corridor (CMAR), one of the world's largest global marine protected areas. By analyzing its goals, milestones, and current challenges, this study draws on key policy insights and recommendations relevant to other science diplomacy efforts beyond the scope of ocean and biodiversity conservation.

Conservation strategies are traditionally designed and enforced at the national level. Still, due to their transboundary nature, the need to encompass the full extension of ecosystems and wildlife migratory routes has led to international regulations and tools to protect marine areas and resources. Two of the most relevant examples are the 1972 UN Conference on the Human Environment, which recommended that governments to set aside protected areas for ecosystems of international significance, and the 1982 UN Convention on the Law of the Sea, which created an Exclusive Economic Zone (EEZ), an area of 200 nautical miles (370 km) extending from every country's coast within which governments have the sole right to engage in economic activities such as fisheries. The overlapping EEZs of Ecuador and Costa Rica in the Pacific Ocean, originating in the Galapagos and Cocos Islands, respectively, were the starting point for a significant international conservation initiative.

Importance of the Area and CMAR Development

The Eastern Pacific Region near the coasts of South America is one of the most ecologically productive and economically significant regions for fishery biomass production and exploitation. Peru and Chile alone account for more than 10% of the global marine catches (FAO, 2020). Here, cold and nutrient-rich oceanic waters, carried by the Humboldt Current, combine with the fresh waters from the estuaries on the Ecuadorian and Colombian shores, causing an intensive increase in ecological productivity. Similar upwelling zones—places where deep oceanic currents rise—are also found along the Central American coast, such as in the Costa Rica Thermal Dome case, creating high productivity areas off Costa Rica and Panama.

These ecosystems provide direct and indirect benefits for approximately 3.5 million people and their local economies, based mainly on tourism and fishing, where nearly 48,000 artisanal fishermen depend on marine resources and on over 250,000 tourists who visit the corridor every year, contributing to additional income sources in local communities (GITEC & MarViva, 2015).

The islands in the region are major biodiversity hotspots, three of which have been declared World Heritage Sites by UNESCO, with the Galapagos Archipelago being labeled as a 'unique living museum and showcase of evolution' (UNESCO, 2022). These islands are fundamental for ecological connectivity and are an integral element of migratory corridors for species such as marine mammals, turtles, sharks, and rays. One example illustrating the region's ecological connectivity are the humpback and the blue whales, traveling to tropical seas during their breeding season, and found on the coasts of Central and South America, the Galápagos Islands, and the Costa Rica Dome. This is also reflected in the rationale that explains why the Galapagos and Malpelo islands have been designated as Sensitive Sea Areas to be protected from vessel strikes on cetaceans, fishing, and pollution. The Eastern Tropical Pacific Corridor also plays a significant role for smaller or less charismatic organisms that may go unnoticed. Recent studies have shown that these protected areas form a relatively well-connected network, with Malpelo and Gorgona acting as stepping-stones between coastal and offshore regions such as the Galapagos, making them crucial dispersal centers for coral larvae and other marine species (Enright et al., 2021; UNESCO, 2021).

The origins of the CMAR can be traced back to 1997, when formal diplomatic approaches between Costa Rica and Ecuador started to discuss their overlapping marine territories. However, science diplomacy would play a significant role in shifting the development of negotiations between the two countries. For years, marine experts, biodiversity conservation scientists, and environmental organizations have advocated for the creation of a wide range protected area in the region. In 2001, a decisive step forward was made when both Ecuador and Costa Rica signed a joint declaration agreeing to study a proposal presented by the United Nations Environment Program (UNEP), the World Conservation Union (IUCN), and Conservation International (CI) for the creation of a Marine-Island Conservation Corridor that would connect Cocos Island in Costa Rica with the Galapagos Marine Reserve and National Park in Ecuador.

A group of experts from Latin American and the Caribbean (LAC) met again the following year at UNESCO. This dialogue broadened the proposal to encompass Malpelo Island—in Colombian marine territory—under the idea of creating a new transboundary space, the "Galapagos-Cocos-Malpelo Triangle", to be one of the World Heritage Marine Sites (CMAR, 2022). At the Sustainable Development Summit 2002, the President of Ecuador put forward the idea of a strategic alliance between the aforementioned countries, now including Panama, working with civil society and international organizations such as CI, IUCN, UNESCO, and UNDP.

This initiative was formalized in 2004 with the signing of the San José Declaration by the four countries, in which they affirmed their interest in the "preservation and maintenance of essential ecological processes, the conservation of biodiversity, and the connectivity of ecosystems present in the region of the Marine Biological Conservation Corridor between the Cocos, Galapagos, Malpelo, Coiba, and Gorgona Islands" (San José Declaration, 2004 p. 1), to be known as the Eastern Pacific Marine Corridor (CMAR).

Because ecosystems all over the globe are divided by political borders, efforts to protect natural areas have long acknowledged the importance of transboundary conservation approaches to foster cooperation between neighboring states. Protected areas, as defined by the International Union for Conservation of Nature (IUCN), are "clearly defined geographical spaces, recognized, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values" (Day et al., 2021 p. 9). In the case of Marine Protected Areas (MPAs), protected areas encompass both horizontal and vertical spaces, i.e. inland waters, marine and coastal areas on the one hand, and the seabed, sub-seabed, and water column itself, on the other.

Within the CMAR, there are five distinct MPAs, declared by each one of the four member countries, and all of them except Gorgona Island are on UNESCO's World Heritage Sites list:

1. Cocos Island National Park and its Submarine Mountains Management Marine Area, Costa Rica
2. Coiba National Park, Panama
3. The Galapagos Marine Reserve, Ecuador
4. Malpelo Flora and Fauna Sanctuary and the Yurupari National Integrated Management District, Colombia
5. Gorgona Island, Colombia

Figure 1. *Area in the Eastern Pacific where the CMAR (in yellow) is located. The five core areas and their surrounding Exclusive Economic Zones (dashed lines) can be seen. Adapted from: cmarpacifico.org*

The respective member states initially established each MPA and they were then integrated into the CMAR as a "Core Area" (see Figure X). Each Core Area is surrounded by an Exclusive Economic Zone (EEZ). Accordingly, while each state has the sole right to exploit resources (e.g., fisheries) within its EEZ, after the establishment of the CMAR, the states have committed to work together to define whether and to what extent such exploitation activities are permitted. In practice, this has been achieved by a hybrid governance framework that brings together scientific, political, and diplomatic expertise.

Science Diplomacy and Current Challenges Faced by CMAR

Critical elements of ocean science diplomacy were already at the heart of the SJD almost two decades before the concept of science diplomacy gained prominence. From the outset, it was clear that three key aspects needed to be integrated for the CMAR to be effective: science, governance, and diplomacy. The SJD not only acknowledged that "coastal and marine biodiversity resources have an incalculable strategic, economic and social value," hence highlighting the need to guarantee the sustainable use of these resources for food security, development, and the well-being of the region and the global community, but also recognized the corridor as "an opportunity to strengthen relations of mutual cooperation and solidarity" between the four signatory countries (SJD, 2004, p. 2).

Two classic examples of ocean science diplomacy are international regulatory frameworks for fish stocks and the establishment of outer limits beyond 200 nautical miles (Polejack, 2021). Both mechanisms have been at the very core of CMAR since its inception. As previously noted, the discussion about Ecuador's and Costa Rica's maritime boundaries set in motion the creation of the Corridor. With regard to fish stocks, the CMAR also established a regional framework to manage the area in accordance with the national policies of the member states and international conventions and agreements. In this context, the SJD addressed technical, financial, and diplomatic cooperation among the governments involved, the role of international and non-governmental organizations (NGOs), multilateral agencies, and interested countries, as well as the dissemination of information about the corridor's scope and work. Moreover, amidst a fragmented ocean governance framework in the region, where different mandates, conventions, and mechanisms apply only to certain countries, CMAR has established contacts and held meetings with several regional fisheries organizations and is working toward cooperation agreements with other international bodies (Enright et al., 2021).

Despite its non-binding legal nature, the CMAR has successfully implemented a transboundary governance scheme that combines diplomacy and science. Accordingly, a two-way mechanism was created for the management, coordination, and follow-up of the Marine Corridor (see Figure X). A political level called the Regional Ministerial Committee, comprising the Ministers of Environment of the four Eastern member countries, acts as the highest decision-making authority of the CMAR. The Regional Ministerial Committee is responsible for providing guidelines and political support to the Corridor implementation process in compliance with the policies and directives of each country and the related international framework. The Committee receives permanent support and advice from the foreign ministries of the countries involved.

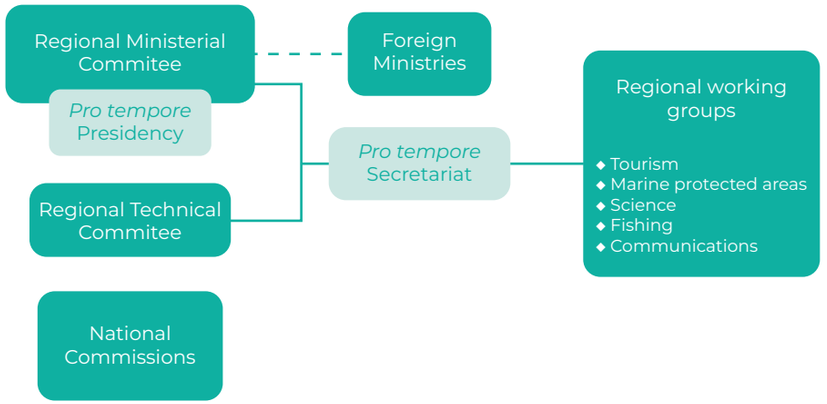

Figure 2. *Structure of the CMAR. Adapted from CMAR (2019)*

In close cooperation with the Regional Ministerial Committee, the Scientific and Technical Level, known as the Regional Technical Committee, is responsible for implementing conservation and management strategies. The Regional Technical Committee is formed by a delegate from each Ministry of the Environment and a Technical Secretariat. The latter has focal working groups in charge of key topics such as tourism, science, and communications. In addition, there are three supplementary bodies: the pro-tempore Presidency and the Technical Secretariat, appointed for two years and rotating among the four countries, and a Technical Advisory Group, guiding and preparing scientific and technical inputs and proposals for the Corridor's management.

Under this scheme, the Marine Corridor not only serves to achieve ecosystem and biodiversity protection goals but also facilitates cooperation, exchange of experiences, and mutual assistance among member countries, promoting new transnational partnerships among non-governmental, international, and multilateral organizations, as well as the private sector and local communities.

The region's main prevailing challenge is related to unsustainable fishing practices, such as overfishing, illegal or undeclared fishing, and bycatch (i.e., the incidental catch of non-target species), aggravated by the increasing pressure from international fleets. In the absence of a more comprehensive ocean governance framework, countries have addressed with the control of high seas fisheries in a rather individualized manner, limiting their capacity for monitoring and enforcement and providing them with inadequate resources and funding (Arauz et al., 2017; Enright et al., 2021).

One notable example is finning, in which the shark's fin is sliced off while the rest of the body is discarded into the sea. Such cases continue to occur in protected and international waters in the CMAR's area of influence. In 2021, 3,493 shark fins and 117 kilos of fish bladders were confiscated by Colombian authorities en route to Hong Kong (France24, 2021). Earlier, in 2017, in a case that received international media coverage and generated a global backlash, the Ecuadorian authorities captured the Chinese-flagged vessel Fu Yuan Yu Leng 999, which was carrying 572 tons of fish, including 7,639 sharks and 537 bags of shark fins, along with other protected species and juveniles (Bonaccorso et al., 2021).

Figure 3. *Shark bodies found on the Fu Yuan Yu Leng vessel in 2017. Source: Galápagos National Park Directorate (galapagos.org)*

Since the CMAR is made up of several national protected areas, the regulations on resource use and fishing communities differ depending on the circumstances and particularities of each MPA and the different management plans developed by each country. Tensions have arisen between artisanal fishermen, industrial fisheries, and the environmental authorities that issue fishing licenses and control what fishing practices are allowed and where.

Another significant challenge in the area is the degradation of coral reef ecosystems, present in all 5 PMAs of the Corridor. These ecosystems host around 25% of the world's marine biodiversity and provide a variety of services to coastal communities including food, income, tourism, and cultural values (IUCN, 2021). However, coral reef ecosystems are severely threatened by the compound effects of diverse drivers, including ocean warming and acidification, marine heat waves, sea level rise, fisheries and overharvesting, pollution, and destructive shoreline activities (IPCC, 2022).

Tourism is also exerting increasing pressure in some of the MPAs. In the Galapagos Archipelago, which concentrates more than 80% of the touristic activities in the CMAR, unrestricted tourism growth threatens to become counterproductive, with several concerns surrounding the issue that over-tourism might become a problem in the future. For instance, in Santa Cruz, one of the islands in the Galapagos Archipelago, energy consumption quadrupled between 2001 and 2015, while the population increased by only by 44% in the same period (FIC & Lavola S.A., 2021).

Climate change threatens to further exacerbate the aforementioned challenges. Even slight alterations in the marine currents could significantly affect ecosystems in a very short time. Changes in the Humboldt Current could lead to warmer waters, reducing algae, seaweed, and coral reef populations. Since they are the basis on which a myriad of other species depends, fisheries and the livelihoods of coastal communities could be directly impacted.

Conclusions

By their very nature, conservation efforts are complex. Because they require a wide array of stakeholders to commit and cooperate at different—and often unaligned—governance levels, they have been a source of conflict in many regions around the world, when the interests of local communities clash with those of national governments, when different stakeholders relying on the same resources are unable to agree on common rules of use, or when governance platforms fail to effectively lead dialogue and find common ground . In this context, the Eastern Pacific Marine Corridor stands as a significant example of international marine cooperation in Latin America and the Caribbean, where science diplomacy has successfully used the inherent interconnectedness of marine commons as a basis to build trust and find a common language for states to work on shared interests.

Another factor in CMAR's success has been the effective integration of the diplomatic and scientific levels in the management of the corridor from the very outset. This has made it possible to generate well-grounded scientific progress. Science diplomacy has provided the process with the necessary pragmatism to consolidate concrete advances in international law and cooperation between states. The relative stability and sustainability that CMAR has enjoyed over time has also allowed new transboundary cooperation initiatives to emerge, such as the PACIFICO platform, which has expanded the management of the corridor to include civil society organizations and private actors and has helped to endow it with a long-term strategic management vision.

Nevertheless, several issues remain unresolved. The first concerns the lack of an overarching legal framework governing the corridor and the overlap of (inter)national mechanisms. This is by no means an issue that is unique to the CMAR. The international community has already initiated negotiations to develop a new legally binding conservation instrument for marine biodiversity on the high seas (Harden-Davies, 2021), where science diplomacy is expected to play a major role. Another fundamental but significant diplomatic gap yet to be resolved is that, to date, there is no official delimitation of the corridor itself given that the San José Declaration did not address such matters, thus remaining a pending task.

In recent years, the CMAR has been praised and even promoted globally as a hopeful step for biodiversity conservation in the fight against climate change. However, this contrasts with how little the corridor is known in the countries behind it and the limited engagement of local actors in its governance. In this regard, the involvement of local actors was not sufficiently contemplated when the CMAR was established and could contribute significantly to a better understanding of the problems at hand.

Public Policy Takeout

Leveraging the ongoing global discourse on marine areas beyond national jurisdiction, CMAR can elevate its role in science diplomacy. This could catalyze the creation of a new regional or international legal framework, supported by multilateral organizations such as UNEP and IUCN. This framework should encompass solutions for enforcement challenges, including stable resource allocation for monitoring vast marine areas within the corridor and legal mechanisms to combat fishing exploitation that impacts protected species. The following questions provide a basis for discussion and could lead to some ideas for policymakers at governmental and non-governmental organizations to achieve these goals:

- Given the CMAR's success in combining diplomacy and science in transboundary governance, how can the CMAR effectively establish a joint enforcement mechanism for international waters within the corridor?
- Based on the insights from the CMAR case study, what strategies should be employed when designing its mechanism for addressing enforcement challenges in marine areas beyond national jurisdiction?
- The CMAR's governance structure integrates diplomacy, science, and cooperation. How can the CMAR inform the stable allocation of control and monitoring resources and equip itself with legal tools to combat fishing exploitation that affects protected species?
- The CMAR has successfully extended its governance system to civil society organizations and private actors through the PACIFICO platform. Nonetheless, restructuring the governance structure of transnational initiatives can be challenging. Drawing on the findings of the CMAR case study, what are some of the implications that could arise from such restructuring processes?
- Given the contrasting global recognition and limited local engagement of the CMAR, how can CMAR foster multidisciplinary and transnational dialogues to raise awareness of its activities and achievements among residents of member countries across the Latin American and Caribbean (LAC) region?

CMAR: Fertile ground for international cooperation

Since its inception, the CMAR has become consolidated as a successful international cooperation and science diplomacy platform by serving as a basis for further governance and financing initiatives.

PACIFICO Platform

In 2012, four national environmental funds[1] from three member states joined the CMAR. They created the PACIFICO platform[2] to mobilize financial resources to implement conservation actions in the CMAR with a 25-year planning horizon (ACRXS, 2016).

The platform's work focuses on identifying investment needs and guiding the actions to be financed in five components:

1. Consolidate the maintenance of biodiversity and its ecological processes
2. Climate change
3. Models for development of sustainable production
4. Capacity building
5. South-South Cooperation

The Americas for the Protection of the Ocean

In 2022, a coalition of nine American countries, also known as the "Americas for the Protection of the Ocean", signed a joint declaration with the aim of coordinating actions to contribute to the protection and sustainability of ecosystems and to improve the governance of marine protected areas along the Pacific coast of the Americas. The coalition, led by Chile and Canada, comprises Costa Rica, Colombia, Ecuador, Mexico, Panama, Peru, and the United States.

The coalition explicitly states its willingness to create "a space for collaboration, cooperation, and coordination at a political level on Marine Protected Areas" and recognizes the importance of "national, regional, and global networks and initiatives of Marine Protected Areas and Other Effective Area-Based Conservation Measures, enhancing and strengthening existing ones such as the Marine Corridor of the Eastern Tropical Pacific (CMAR)".

[1] Natural Heritage (Patrimonio Natural, Colombia), Forever Costa Rica Association (Costa Rica), Action Fund (Fondo Acción, Colombia), and Natura Foundation (Fundación Natura, Panama)

[2] PACIFICO Foundation: *https://redpacifico.net/*

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2

ARPIP: Recognizing Indigenous Knowledge and Practices in Environmental Change Governance

Countries: Amazonian countries (Bolivia, Brazil, Colombia, Ecuador, Guyana, Peru, Suriname, and Venezuela).

Executive Summary

The value of indigenous knowledge for biodiversity conservation and climate action has increasingly been recognized internationally for the alternative views and approaches it provides to human relationships with ecosystems.

Its origins in ancestral times and its survival in the face of mounting colonial experiences up to our days are proof of its resilience and sustainable foundations vis-à-vis the more short-term practices developed by extractivist economic activity. Latin America and the Caribbean is the cradle of over eight hundred indigenous groups representing 58 million people (ECLAC, 2014).

Intending to translate indigenous knowledge on climate change mitigation, in 2022, the Amazon Cooperation Treaty Organization (ACTO) created the Amazonian Regional Platform of Indigenous Peoples (ARPIP) to amplify the claims of the indigenous communities from its eight member countries: 420 Indigenous Peoples, or around 10% of the total Amazonian population. ARPIP is the first regional and government-backed initiative in the world promoting the engagement of Indigenous Peoples in climate governance decision-making. It is a project co-funded by Eurocli-ma+, the European Union's flagship program for climate change and environmental sustainability in Latin America.

Keywords: Indigenous knowledge; climate change mitigation; Indigenous rights; environmental diplomacy.

Diplomacy for Science

For the Amazonian Regional Platform of Indigenous Peoples (ARPIP), the main approach is "Diplomacy for Science", because:

- **Recognition of Indigenous Knowledge:** ARPIP is driven by diplomatic efforts to recognize and promote the inclusion of Indigenous knowledge in climate change mitigation.
- **Policy Integration:** Diplomacy is essential to integrating Indigenous perspectives into national and international policies, highlighting their unique contributions to environmental governance.
- **Global Cooperation:** ARPIP's collaboration with international partners demonstrates diplomacy's role in fostering cooperation and support for Indigenous climate action.
- **Inclusive Climate Diplomacy:** ARPIP is a pioneering example of diplomatic efforts aimed at incorporating Indigenous groups into climate governance decision-making, aligning with global climate objectives.
- **Participating Countries:** Amazonian countries (Bolivia, Brazil, Colombia, Ecuador, Guyana, Peru, Suriname, and Venezuela)

Introduction

In 2015, the Agenda 2030 was adopted with the central principle of “leaving no one behind” in implementing the Sustainable Development Goals (SDGs). Under this premise, the Paris Agreement recognized in Decision 1/CP.21 that, as a common concern of humankind, when taking action to address climate change, the rights of indigenous peoples and local communities should be respected, promoted, and considered with an emphasis on their participation in science, technology, and other practices. Although there is no universally accepted definition for ‘Indigenous Peoples’, the term usually refers to those social and cultural groups who inherit and practice their ancestral heritage and relationship with the environment, accounting for 370 million people across 70 countries, or 5% of the world’s population. In Latin America, these figures stand at almost 45 million Indigenous Peoples, accounting for 8.3% of the region’s population (ECLAC, 2014).

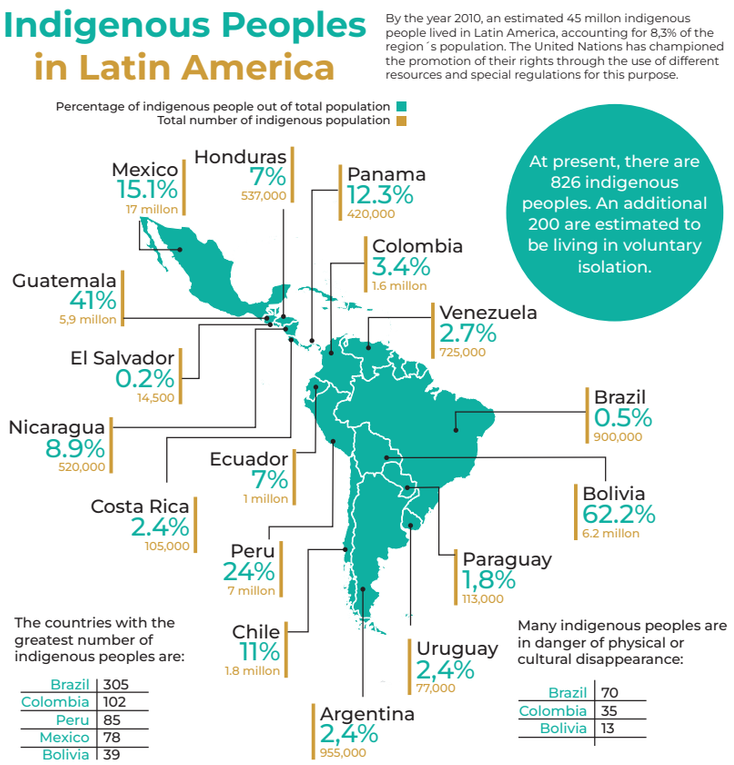

Figure 4. *Indigenous population by country in Latin America. Source: ECLAC, 2014.*

Indigenous Peoples are often marginalized from environmental decision-making processes or assigned minor roles that fail to integrate their traditional knowledge and values (Zurba & Papadopoulos, 2021). However, there are increasing efforts to acknowledge their participation, following the recommendations of the UN Declaration on the Rights of Indigenous Peoples (UNDRIP). In 2015, under the auspices of the United Nations Framework Convention on Climate Change, the Paris Agreement established the Local Communities and Indigenous Peoples Platform (LCIPP). This global initiative aims to connect and collect the experiences, knowledge, best practices, and lessons learned on climate change mitigation and adaptation from the perspective of Indigenous Peoples.

As an emerging foreign policy domain, the potential of science diplomacy and its environmental diplomacy dimension remains untapped, specifically in Latin America and the Caribbean. Although the region hosts many international and regional instruments for scientific cooperation, it has not yet developed its total capacity to implement the SDGs and indigenous knowledge systems. Therefore, incorporating marginalized groups —like Indigenous Peoples— in the production and communication of science, technology, and innovation should be a goal of science diplomacy for environmental governance.

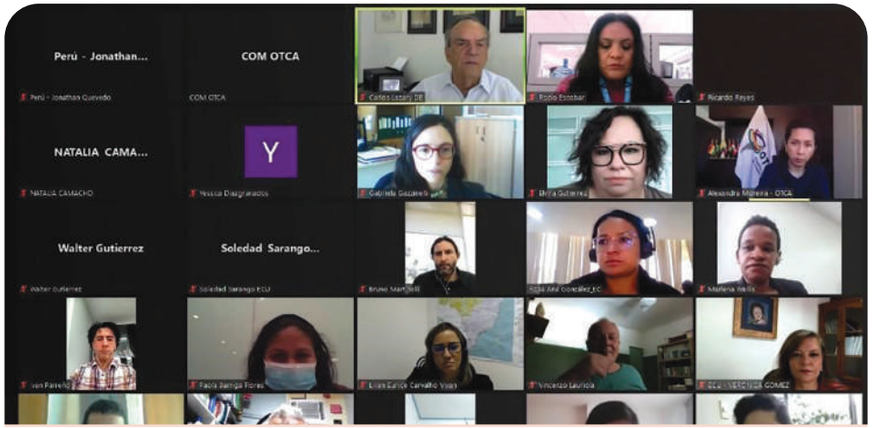

Figure 5. *Participants at the online kick-off meeting of the Amazonian Regional Platform of Indigenous Peoples. Source: ACTO, 2022.*

Inspired by the LCIPP global platform, in April 2022, the Amazon Cooperation Treaty Organization (ACTO) announced a groundbreaking mechanism to enhance the participation of Indigenous Peoples from its member countries: Amazonian Regional Platform of Indigenous Peoples (ARPIP). The unofficial presentation took place at an international meeting held in Santa Cruz de la Sierra (Bolivia) on “Indigenous knowledge for the proper management of biological diversity and quality of life in the Amazon Region” part of ACTO’s Biomaz Proj-

ect for biodiversity conservation in the presence of representatives from nine indigenous communities, scientists, Indigenous Studies experts, civil servants, and policymakers. The official launch of ARPIP took place on July 28, 2022, in an online ceremony with over 40 representatives from the Ministries of Foreign Affairs of the member countries.

The Amazonian Treaty Organization: A *sui Generis* Institution

The Amazonian Regional Platform of Indigenous Peoples is an initiative by the Amazon Cooperation Treaty Organization (ACTO), the first socio-environmental bloc of Latin American states promoting South-South cooperation and the principles and priorities of the Amazon Cooperation Treaty (ACT). The Treaty's origins can be traced back to 1978, when eight countries signed it with the goal of advancing sustainable development in the Amazon territories. ACTO was founded in 1995 as a body for the uniform implementation of the commitments laid down in the Treaty. The organization is articulated by a Permanent Secretariat, which facilitates information exchanges between member countries and monitors compliance with the ACTO mandates and the Strategic Cooperation Agenda (SCA).

Dating from 2010, the SCA includes a section on Indigenous Affairs describing the organization's objective to involve indigenous and tribal communities in managing their lands and protecting their traditional knowledge. Hence, the creation of ARPIP represents a step beyond paternalistic patterns: the active empowerment of indigenous groups in knowledge sharing, decision-making transcending the well-being of their communities, and the establishment of the SCA (i.e., the Strategy for Indigenous Climate Action in the region).

ARPIP was developed with the support of EUROCLIMA+, the EU's environmental program in Latin America, and implemented by the Spanish Agency for International Development Cooperation (AECID), the Economic Commission for Latin America and the Caribbean (ECLAC), and the German Corporation for International Cooperation (GIZ). Therefore, it represents a South-South and North-South initiative showcasing environmental diplomacy.

Figure 6. *Principales resultados esperados del proyecto ARPIP. Fuente: EUROCLIMA+, 2022.*

Indigenous Participation in Environmental Diplomacy in Latin America and the Caribbean

The recognition of Indigenous Peoples is an ongoing historical endeavor. In 1989, the International Labor Organization (ILO) adopted Convention No. 169 on Indigenous and Tribal Peoples, recognizing for the first time their collective rights based on their differentiated identities, common origins, territoriality, language, and culture (ECLAC, 2014). This decision was strengthened in 2007 by the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP). In the context of COP26 in Glasgow (2021), a joint statement was released by governments and private organizations recognizing the tantamount guardianship of Indigenous Peoples over the world's forests and announcing a USD 1.7 billion bill (2021-2025) to support and accelerate the advancement of indigenous political recognition and rewards for their protection of 80% of biodiversity worldwide (Raygorodetsky, 2018). More symbolically, COP26 designated August 9 as the new International Day of the World's Indigenous Peoples. Notwithstanding the promises that COP26 would be the most inclusive summit, it ended up with a relatively low admission rate of non-Western NGOs, which in the case of LAC reached 8.1% of the total admitted NGOs, to the detriment of Indigenous Peoples.

At the regional level of LAC, most countries recognize the rights and ancestry of their national indigenous groups in their constitutions and as part of the Inter-American Human Rights System of the Organization of American States (OAS). In addition, fifteen LAC countries have ratified ILO Convention No. 169. Yet, some of the limitations of science diplomacy, framed by political instabilities, ideological fragmentation, budgetary constraints, and the redundancy or gaps of high-level fora that the region faces (Gual-Soler, 2021), make it even more challenging to identify multilateral spaces where Indigenous Peoples can be rendered more visible.

Nonetheless, as reported in the UNESCO Science Report 2015, several initiatives promoting indigenous knowledge have gained momentum in the past decade at a national level. In 2006, the Bolivian Morales government introduced a program for the Protection, Recovery, and Systematization of Local and Ancestral Knowledge for Social and Productive Development that led to the drafting of a Law for the Protection of Indigenous Knowledge. The program's goals were considered a priority for the Vice-Minister of Science and Technology and were included in the National Science and Technology Plan (2013), where local and ancestral knowledge was considered central to Science, Technology, and Innovation (STI) policymaking. Before 2013, Peru was the first country in the region to legally protect indigenous knowledge through the Protection Regime for Traditional Knowledge (2002). In 2013, Mexico's National Council for Science and Technology (CONACYT) researched Indigenous and Intercultural Education, a strategic area to ensure the positive returns of STI to deprived groups. In this regard, Ecuador not only awards the highest protection to ancestral knowledge regarding STI but also promotes it through research programs of

the Ministry of Higher Education, Science, and Technology, including Research and Innovation in Knowledge Dialogue (2013) and Traditional Knowledge and Climate Change.

In practice, high-impact achievements remain limited due to weak global commitment. According to the International Work Group for Indigenous Affairs (IWGIA), the Intergovernmental Panel on Climate Change (IPCC) report on climate change mitigation in April 2022, as well as the contributions and inequalities of Indigenous Peoples in the face of climate impacts, continue to be homogenized under the vulnerabilities faced by other groups, such as women and poor populations, thus failing to distinguish them from civil society. This issue signals a persistent ignorance of the context-specific demands of indigenous groups related to, but not limited to, colonial and environmental injustices, land claims, and value systems linked to their symbiotic relationship with nature. The lack of awareness of the specificities of indigenous communities is, however, acknowledged by the authors of the IPCC report, which calls for the progressive recognition of indigenous knowledge, technologies, and governance principles, including their community-based practices (i.e., forest management), with a particular emphasis on indigenous women as critical stakeholders in climate change mitigation. Nevertheless, the IPCC report would only do so in a relatively generalized manner, failing to illuminate the benefits of indigenous participation in climate change mitigation initiatives.

The lack of recognition of Indigenous Peoples can have severe consequences, not only in terms of endangered human heritage but also for the physical security of community members, given their close relationship with ecosystems. Indigenous Peoples have often been persecuted for their engagement in climate activism. The creation of platforms like ARPIP may, therefore, make these threats more visible –both human and natural disaster-related. In addition, such platforms could provide Indigenous Peoples with a safe space to speak out and engage in environmental science diplomacy and extend the outreach of their activism. Thus, future science diplomacy efforts in LAC should be designed to focus on the inclusivity of marginalized groups such as Indigenous Peoples that go beyond invitations to participate in climate governance panels or obtaining consent for the development of any kind of activity in their lands, as enshrined in the principle of Free, Prior and Informed Consent (UNDRIP), which is usually mistaken for “veto power”. Indigenous Peoples should be involved in decision-making processes by official authorities.

However, beyond their inclusion and representativeness, there is also a need to destigmatize indigenous knowledge for its non-usage of the Western scientific method and political practices as ‘para-diplomacy’ (Álvarez & Ovando, 2022) and to explore the possibilities that it offers for global environmental protection. Although it cannot be generalized, many Indigenous Peoples guide their relations with, and understand nature as, something they belong to. This contrasts with Western anthropocentrism, which separates nature from humanity and depicts the former as a resource for to be exploited by the latter. Therefore,

the horizontality that indigenous value systems present between humans and the planet is an example of a valuable approach to Environmental science diplomacy.

Hence, science diplomacy must shift its understanding of science, technology, and innovation from Western methodologies and concerns to include indigenous knowledge. The aim should be to prevent the exoticization and the reduction of indigenous participation in environmental governance to “complementary” or substitutive perspectives. Evidence from past experiences of climate diplomacy indicates that to achieve increased participation of Indigenous Peoples, participatory instruments need to be reviewed to accommodate indigenous political culture in a less paternalistic manner where Indigenous Peoples feel acknowledged. Adeyeye, Hagerman, and Pelai (2019) suggest that indigenous representatives should be involved in designing environmental governance and diplomacy spaces. Other experts signal that further change is also needed in global climate finance (Zapata & Grouwels, 2022), of which, in 2022, an average of just 2% was accessible for small farmers, Indigenous Peoples, and local communities (FAO, 2022).

Furthermore, it is essential that when including Indigenous Peoples and knowledge in science diplomacy and climate change mitigation, we do not neglect that they are not only valuable knowledge sources as recognized in the 2030 Agenda for Sustainable Development but that they are also targeted by SDG 4 - Quality Education and, ideally, should also be targeted by Goal 10 - Reduced Inequalities, Goal 8 - Economic Growth and Decent Work, and Goal 13 - Climate Action for their specific rights and vulnerabilities.

Looking ahead, at the global level, indigenous engagement and knowledge of environmental conservation in science diplomacy appears to be on the rise. The Amazonian Regional Platform of Indigenous Peoples will be presented at COP27 in Sharm el-Sheik, Egypt. Showcasing such initiatives on global platforms may set an example and serve as inspiration for more comprehensive and different types of networks within and beyond Latin America and the Caribbean.

Conclusions

Multilateral science diplomacy in Latin America and the Caribbean, particularly climate diplomacy, is at an embryonic stage of development due to the region’s complex political and economic situation. Consequently, the involvement of minority and marginalized groups like Indigenous Peoples is practically non-existent. At the state level, Indigenous Peoples’ rights are recognized in constitutions, and there are increasing efforts to increase their participation in STI sectors. The Inter-American Human Rights System recognizes their rights at the regional level, but their inclusion in decision-making processes and multilateralism remains scarce or ineffective. Inspired by the Local Communities and Indigenous Peoples Platform (LCIPP), the Amazon Cooperation Treaty Organization is the first regional actor approach Indigenous Peoples through

climate science diplomacy by creating the Amazonian Regional Platform of Indigenous Peoples (ARPIP).

Among the most common reasons why the scientific community excludes Indigenous Peoples from policymaking is the prejudice that traditional knowledge is less reliable because it lacks objective methodology and replicability. Nonetheless, the scientific and governmental communities seem to be increasingly receptive to indigenous and civil society claims for their voices to be heard, in line with the principles enshrined in the United Nations Declaration on the Rights of Indigenous Peoples (United Nations, 2007) and the urgency to "leave no one behind" underscored in Agenda 2030. ARPIP is a clear example of this change of mindset and the revalorization of indigenous knowledge on climate change mitigation and biodiversity conservation at the regional level.

Public Policy Takeout

In light of the shortcomings of environmental change governance in Latin America and the Caribbean, future multi-stakeholder initiatives should be designed following inclusive strategies that increase the representation and decision-making power of indigenous communities to ensure respect for their territorial rights, starting with their participation in the initial plans. The following questions are a basis for discussion and could lead to some ideas for policymakers at governmental and non-governmental organizations to achieve these goals:

- Most professional communities are not familiar with the different indigenous communities in their country/region and the differences and similarities in their relationship with nature and the environment. Can you say the same about your community?
- How aware do you think your community is of any sustainable indigenous practices that can be used in environmental change governance?
- Consider what mechanisms you would use to ensure an equitable representation and participation of indigenous communities and the impact of their traditional knowledge, in a regional multi-stakeholder (i.e., governments, private corporations, civil society) environmental diplomacy summit.
- Why is it important to devote more research to understanding the concept and best practices of 'indigenous diplomacy,' and how can the findings be effectively shared with national governments and the private sector?

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3 Andean Plan on Health and Climate Change 2020–2025: Advancing Environmental Public Health in South America

Countries: Bolivia, Chile, Colombia, Ecuador, Perú, Venezuela.

Executive Summary

Climate change is compounding the structural vulnerabilities faced by Andean countries, particularly issues related to poverty and inequality.

The disruption of physical, biological, and ecological systems caused by climate change has necessitated a broader perspective on health, encompassing both human and non-human elements such as environmental health, planetary health, and One Health.

Latin America has played a pioneering role in health diplomacy since the 19th century, a facet of science diplomacy focused on improving health policies. On April 16, 2020, the Andean Health Organization-Hipólito Unanue Convention, in collaboration with the Pan-American Health Organization (PAHO), endorsed the Andean Plan for Health and Climate Change 2020–2025 (APHCC).

The APHCC not only seeks to acknowledge the profound connection between climate change and global health but also provides actionable measures for climate change mitigation and adaptation. It advocates for gender and intercultural approaches in research, facilitates the dissemination of findings for policy development, and elevates the role of health in the regional integration of these nations through collaborative efforts that involve multiple sectors, stakeholders, and interdisciplinary approaches.

Keywords: Climate change; environmental public health; health diplomacy; Andean Community; Latin America.

Diplomacy for Science; Science in Diplomacy

The preference for "Science in Diplomacy" within the Andean Plan on Health and Climate Change (APHCC) is illustrated by several distinctive features:

- **Convergence of Expertise:** It brings together scientific, health, and diplomatic domains to maximize regional capacity for problem-solving.
- **Evidence-Based Diplomacy:** Scientific findings are used to inform diplomatic negotiations and enrich decision-making processes.
- **International Collaborations:** The Plan fosters global partnerships to develop targeted solutions for the unique health and climate challenges of the Andean region.
- **Research-Driven Strategy:** Scientific knowledge serves as a compass for guiding diplomatic strategies and achieving sustainable outcomes.
- **Local–Global Synergy:** It aligns regional health and climate goals with the global agenda, promoting coordinated progress.
- **Elevated Prestige:** It raises the international standing of the region through science-driven diplomatic initiatives.

Introduction

The well-being of individuals and the quality of their environment are intrinsically linked to social factors such as age, gender, race, and socioeconomic class. Climate change-induced environmental transformations not only exacerbate existing disparities but are also primary disruptors of physical, biological, and ecological systems. Water, soil, and air pollution, coupled with extreme weather events, serve as catalysts for the spread of vector-borne infectious diseases, physical injuries, mental health disorders (PAHO, 2021), food insecurity, and forced migration (ORAS-CONHU & OPS, 2020). Despite the evident link, it is noteworthy that strategies for controlling and managing health issues often overlook the pivotal role of environmental determinants. Incorporating these determinants into health management strategies could substantially reduce the burdens and costs for both the healthcare sector and the population at large (PAHO, 2021: 6).

Much like the sanitation crises faced by South American cities in the early 20th century, the COVID-19 pandemic has underscored the critical importance of universal access to high-quality healthcare and international cooperation in addressing transboundary challenges that pose a significant public threat. Additionally, although further scientific research is required, there is already growing recognition of the influence of climate change on the global spread of COVID-19, driven by its exacerbation of inequalities within and between nations and intersecting with various identity factors such as age, race, gender, and socioeconomic class. Notably, the COVID-19 outbreak coincided with one of the hottest years on record in the Anthropocene, 2020, further straining the resilience of populations in the face of these concurrent health and climate crises. Extreme weather events impede people's ability to comply with pandemic containment measures, at times forcing them to relocate, while also reducing their access to healthcare, disrupting supply chains, and causing infrastructure damage.

Consequently, policies designed to control the spread of disease, while effective to a certain extent, may inadvertently heighten vulnerability to extreme climate events, thereby amplifying the impact of climate change on public health (Ford et al., 2022; Gupta, Rouse & Sarangi, 2021).

Environmental public health is a critical facet of public health that examines the impact of environmental factors on human well-being, spanning all levels of governance. Within the Americas, substantial knowledge gaps hamper governments' ability to take decisive actions in strategic areas. Existing policies geared toward inclusivity and equity often remain informal, ambiguous, and unenforced, as highlighted in a report by PAHO (2021: 7). In this context, science diplomacy emerges as a valuable platform, offering an avenue for individuals from diverse backgrounds within the academic and policy realms to collaborate and address pressing concerns at the crossroads of environment, health, and climate change in the region. Both governmental and non-governmental organizations have increasingly embraced health diplomacy, promoting a multifaceted approach that involves negotiations at multiple levels and involving multiple actors, all aimed at shaping a policy landscape for health, given its global, transboundary, and public nature (Kickbusch, Buss & Silberschmidt, 2007: 230-232).

The World Health Organization (WHO) stands as one of the most prominent international health diplomacy institutions, closely followed by the United Nations General Assembly and the Human Rights Council. Taking a more capacity-building and people-centric approach, the WHO leverages health diplomacy as a tool to:

- Ensure health security and promote public health.
- Foster improved relations between states and the commitment of a wide spectrum of stakeholders to collaborate on improving health.
- Attain outcomes that are characterized by fairness and align with poverty reduction and increased equity goals.

However, as is often the case in diplomacy, the motivations behind health diplomacy have come under scrutiny. Feldbaum, Kelley, and Michaud (2010: 83) highlight that stakeholders may engage for various reasons; they might be driven by altruism, aiming to promote health equity and humanitarian principles, while simultaneously pursuing their own interests, particularly economic and national security interests. This could include safeguarding intellectual property and supporting the pharmaceutical industry (S4D4C, n.d.). Since it is unrealistic to expect that these specific interests will fade away, as suggested by the WHO (n.d.), it is crucial that the acknowledgment of health as a universal human right, at the very least, prompts states and other stakeholders to reassess practices and policies. The focus should instead prioritize objectives linked to poverty reduction and the reduction of inequalities.

Examples of how science diplomacy could contribute to the health sector through the convergence of the scientific and diplomatic fields (The Royal Society & AAAS, 2010) touch upon:

- Data collection and information for better policy making [Health in diplomacy]: i.e., sharing of best practices during Covid-19 to curb the global spread of the virus.
- Diplomatic relations between countries [Health for diplomacy]: i.e., international cooperation on global or regional health may lay the groundwork for more friendly relations between countries in other sectors.
- Health science and infrastructures [Diplomacy for health]: i.e., multilateral dialogue offered by international institutions like the World Health Organization and the signing of treaties to cope with transboundary or global health issues that require complex partnerships.

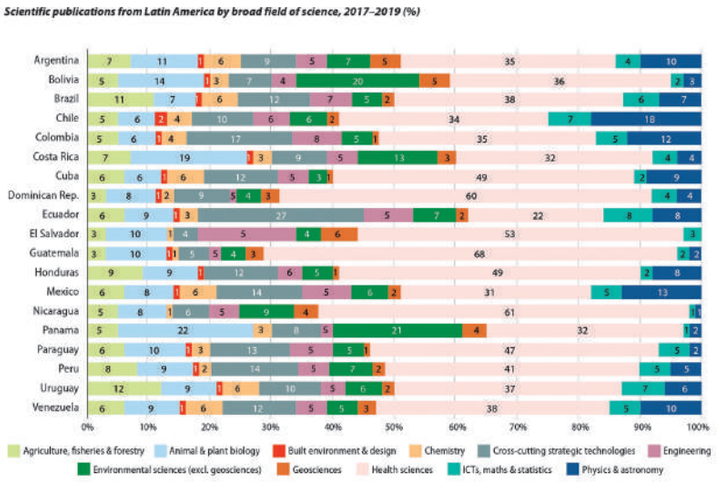

Figure 7. *PScientific publications from Latin America by broad field of science, 2017–2019 (%). Source: UNESCO Science Report 2021.*

Regardless of the perspective from which health diplomacy is examined,, it emerges as a strategic soft power tool that nations employ to bolster their international standing. As succinctly put by a former US Senator, "You don't go to war with someone who has saved the life of your child" (Frist, 2007, cited in Feldbaum, Kelley, and Michaud, 2010: 83). A noteworthy example is Brazil's emergence as a global leader in health diplomacy, largely due to its proactive efforts against tobacco in international forums (Kickbusch, Buss & Silberschmidt, 2007: 231). Similarly, Cuba's cadre of medical professionals, often referred to as the "army of white coats," has earned the country international respect for their commitment to providing humanitarian aid in disaster-stricken areas since the 1960s (Feinsilver, 2010).

Nevertheless, despite these remarkable instances, science diplomacy in Latin America has a relatively low profile, hampered by political fragmentation, limited financial resources, overlapping and underutilized multilateral platforms (Gual-Soler, 2021: 4), and inadequate investment in research. A 2019 article in RYCIT noted that the region's research community only contributes a mere 3.7% of the global research output, a stark contrast to Europe's 30%. However, there is a silver lining in that a 2019 UNESCO Science Report highlighted that a significant portion of the region's research output is concentrated in the biological and medical sciences. While some of this research is co-authored with international collaborators, indicating independence from external influences, this also correlates with lower citation rates (Leta & Araujo, 2021: 2).

Indeed, the health sciences in Latin America and the Caribbean possess considerable untapped potential, as exemplified during the COVID-19 pandemic.

The region experienced a surge in publications, with 1,291 new articles published between January 1 and July 31, 2020, demonstrating the ability of the research community and institutions to respond effectively to the virus (Espinosa et al., 2021).

This case study delves into the prospects for diplomatic initiatives at the intersection of health and climate, with the aim of fortifying environmental protection and public health. It does so through an analysis of the Andean Plan for Health and Climate Change 2020-2025, a collaborative effort between the Andean Health Organization-Hipólito Unanue Convention and the Pan-American Health Organization (PAHO). This plan serves as the collective agenda for Andean countries, including Bolivia, Colombia, Ecuador, and Peru, in addition to Chile and Venezuela. It is designed to address the challenges posed by climate change and its consequential health impacts, in line with global frameworks such as the 2030 Agenda for Sustainable Development, the 2015 Paris Agreement, the Sendai Framework for Disaster Risk Reduction (2015), and the climate change governance instruments adopted by the partner nations.

Furthermore, the Andean Plan for Health and Climate Change is reinforced by the United Nations' recent adoption in 2021 of the right to a clean, healthy, and sustainable environment (United Nations General Assembly, 2021). This provides a robust foundation for its objectives and underscores its significance in addressing the critical issues at the crossroads of health and climate in the Andean region.

Andean Health Diplomacy

In the 19th century, Latin America pioneered health diplomacy, outpacing Europe by convening three interstate conferences (Montevideo, 1873; Montevideo, 1887; and Rio de Janeiro, 1888). These conferences culminated in the establishment of the world's oldest international health agency in 1902, originally known as the International Sanitary Bureau (ISB), now recognized as the Pan-American Health Organization (PAHO). This institution precedes the formation of the World Health Organization, which was founded in 1948.

The creation of the ISB was a response to the pressing need to organize and standardize the various quarantine protocols used in South American coastal cities. These cities were experiencing significant influxes of migrants carrying diseases such as cholera, yellow fever, and the plague. A noteworthy innovation of the ISB was its ability to facilitate dialogue between medical professionals and governments, thereby addressing challenges that required the expertise of both the scientific and policymaking communities. These early experiences set a precedent for international health cooperation and contributed to the professionalization of the medical field (Herrero & Tussie, 2015: 263-264).

During the 1960s, in the context of the Cold War, South America underwent a shift toward emphasizing social policies, which left a lasting impact on the field of medicine until the debt crisis of the 1980s. However, during the 1990s, health

regained prominence in cross-border initiatives, particularly within the newly formed Andean Community and Mercosur, reinvigorating regional health cooperation.

The Andean Community, established in 1969, was created to intensify the integration efforts among the Andean nations. During the early 1970s, it made significant strides in regional collaboration by adopting two pivotal agreements. Firstly, the Hipólito Unanue Agreement, also known as ORAS-CONHU, gave rise to the Andean Health Organization (AHO). This organization became responsible for harmonizing health policies across its Andean member countries, subsequently expanding its influence to include Venezuela and Chile. In parallel, the Andres Bello Convention, initiated in 1970, laid the groundwork for the coordination of health and education policies, as well as the integration of education, science, technology, and culture within the Andean countries. Notably, this convention expanded its reach to include other nations such as Chile, Cuba, the Dominican Republic, Mexico, Panama, Spain, and Venezuela.

The current Andean Plan for Health and Climate Change 2020-2025 (APHCC) is a reaffirmed recognition by the ORAS-CONHU countries of the most prominent health challenges posed by climate change in the region. The Plan is an update of the priorities and commitments laid down on the Andean Strategy for Health Sector Disaster Management 2018-2022. The APHCC is implemented by the Andean Health Committee for Emergency and Disaster Risk and Climate Change in partnership with the ORAS-CONHU Executive Secretary, which is shaped by the Andean Ministers of Health and the PAHO/WHO. The Plan recognizes the need for multidisciplinary, intersectoral and multilevel cooperation, to strengthen human resource capacities, monitor the spread of epidemics and other health hazards, increase the investment in public policy research, revalorize the knowledge of Indigenous Peoples, and building climate-resilient and sustainable health services. The Andean Plan provides goals, examples of best practices, and indicators for each of these strategic lines of action. Furthermore, the APHCC also calls for a change in monitoring and data collection coordinated by the ORAS-CONHU Executive Secretary together with the Andean Committee and the PAHO to transcend national boundaries and to enable regional integration (ORAS-CONHU, 2020: 63-65).

According to experts, the most effective approach to reducing vulnerabilities arising from the intricate interplay between climate and health crises is twofold: raising awareness and implementing policies that target environmental factors that amplify climate risks. These encompass critical issues like deforestation, greenhouse gas emissions, protection of natural habitats, biodiversity, and pathogen transmission (Gupta, Rouse & Sarangi, 2021: 7).

In the context of global agendas, Morton, Pencheon, and Bickler (2019) propose a holistic strategy that moves beyond addressing health and climate as separate issues encapsulated in specific Sustainable Development Goals (Goal 3 - Good Health and Well-being and Goal 13 - Climate Change). Instead, they advocate for integrated approaches that foster cross-dialogue among all SDGs to tackle the intricate intersectoral and interdependent challenges. These principles encompass the concept of planetary health, coined in a 2015 joint report by the Rockefeller Foundation and The Lancet. This concept expands on the traditional, individual-centered definition of health by the World Health Organization (WHO) as the “absence of disease or infirmity.” Instead, it presents planetary health as the “highest attainable standard of health, well-being, and equity worldwide,” achievable through “prudent attention to the human systems —political, economic, and social— that shape the future of humanity and to the Earth’s natural systems defining the sustainable environmental boundaries for human flourishing” (Whitmee et al., 2015). This concept underscores the vital connection between human health, ecosystems, and the environment, emphasizing that the thriving of natural systems is a prerequisite for human well-being.

The concept of One Health (Cook, Karesh & Osofsky, 2004) underscores the same interdependence between human health, ecosystems, and the environment, while several related concepts, such as EcoHealth, One Welfare, and One Wellbeing, have emerged from this overarching idea. Collectively, they advocate for a more comprehensive understanding of health and its inextricable link to the environment, highlighting the need for a holistic approach to safeguarding the well-being of our planet and its inhabitants.

One Health was only formally introduced into the PAHO agenda for Latin America in 2021, denoting a “comprehensive approach to addressing health threats at the human-animal-environment interface.” This delay in adoption was primarily attributed to various challenges such as language barriers, political nuances, and economic constraints. It is important to note that the underlying concept was already a familiar one in the region under different local terms like “Saúde Única,” “Salud Única,” and “Une Seule Santé” (Pettan-Brewer, 2021: 12). These terms capture the holistic understanding of human-ecosystem interactions, a perspective deeply rooted in Latin American indigenous communities since ancient times (Pettan-Brewer et al., 2021: 3).

Efforts to overcome these obstacles have led to the establishment of transnational networks dedicated to knowledge dissemination, training, and awareness raising, such as One Health Latinoamérica, Ibero y el Caribe (OHLAIC). OHLAIC encompasses all Spanish and Portuguese-speaking countries in Latin America and champions a cooperative, rather than competitive approach to tackling health-related challenges within the region and beyond. These transnational networks simultaneously contribute to regional integration across various domains. Nevertheless, moving forward, they will need to devise strategies to address persistent financial and epistemological constraints (Pettan-Brewer et al., 2021: 14)

Conclusions

Health diplomacy in Latin America has a rich history, dating back to the 19th century, predating the establishment of the World Health Organization. The early recognition of the cross-border spread of communicable diseases, much like today's global health challenges, led to international cooperation in the Andean region.

The Andean Plan for Health and Climate Change 2020-2025, developed by the Andean Health Organization and the Pan-American Health Organization, seeks to address the risks and vulnerabilities arising from climate change's impact on the environment and, consequently, on public health. While not explicitly stated, the underlying philosophy aligns with the concepts of 'planetary health' and 'one health,' emphasizing the interdependence between human health and the health of ecosystems and the environment, advocating a holistic approach.

Latin American health diplomacy offers avenues for improving international relations and regional integration, but its success relies on a comprehensive, interconnected, and cross-sectoral strategy. Additionally, the scientific community should devise a robust dissemination strategy to maximize its influence and unlock its immense potential in the fields of health, environmental sciences, and biology. Furthermore, it is vital to recognize that some of the cooperative, ecosystem-centered approaches to health and the environment being rediscovered by scientists, have been integral to indigenous cultures and knowledge for generations. This signifies an untapped source of locally crafted and sustainable solutions to current challenges. Therefore, Latin American science diplomacy should embrace these solutions, integrating local expertise, and reducing reliance on foreign ideas and infrastructure.

Public Policy Takeout

In the LAC region, the intersection of health and climate diplomacy possesses significant historical context and relevance. Initiatives such as the Andean Plan on Health and Climate Change are poised to tackle these complex challenges by promoting regional integration through science diplomacy. This approach ensures interdependent collaboration between scientific communities and governments, ultimately working towards a holistic 'one health' framework. The following questions are a basis for discussion and could lead to some ideas to achieve overcome key global challenges:

- With the aim of establishing regional transnational networks for the exchange of knowledge at the health-climate change nexus and the international promotion of Latin American scientific outputs, how can these networks be structured and facilitated for maximum effectiveness?
- It is essential to promote cooperation and facilitate dialogue among Latin American scientists and diplomats within their respective domains to enlarge the number and diversity of profiles capable of disseminating the regional scientific contributions to public (environmental) health. What approaches can be taken to encourage this interdisciplinary collaboration?

- Health crises preparedness and strengthening epidemiological surveillance are critical to mitigate some of the risks posed by insufficient infrastructure. How can regional cooperation contribute to enhancing risk monitoring, and what are some of the mechanisms that could be implemented to effectively translate the results into multiregional open data sources?
- Mainstreaming the notions of planetary health, One Health, etc. through local, national, regional, and supranational projects, plans, and strategies to adapt and mitigate climate change, how can these concepts be effectively integrated into existing projects and strategies?
- Some of the key priorities discussed in this case study include directing more scientific and political efforts to include indigenous communities and their traditional knowledge about health and the environment in the formulation and implementation of public health policies and health diplomacy, reducing neocolonial epistemological approaches to health and climate challenges. What other specific steps can be taken to incorporate indigenous knowledge and promote cultural sensitivity in these initiatives?

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Additional Resources

Covid-19-Climate-Diplomacy: *https://n9.cl/52euei*

4 Peace Parks in the Cordillera del Cóndor: A Transboundary Initiative for Peacebuilding and Biodiversity Conservation

Countries Involved: Peru and Ecuador
Mediators: Argentina, Brazil, Chile, United States

Science in Diplomacy

In the context of the Peace Parks in the Cordillera del Cóndor, "Science in Diplomacy" plays a crucial role:

- **Integrated Approach:** Combines scientific knowledge with diplomacy, offering a comprehensive framework for managing transboundary protected areas.
- **Conflict Resolution and Scientific Collaboration:** Science serves as a diplomatic tool to b ridge gaps between countries and between conservation and economic interests. Scientific findings inform negotiations.
- **External Support and Oversight:** Partnerships with organizations such as the International Tropical Timber Organization (ITTO) and Conservation International enhance conflict resolution efforts and environmental protection, while also facilitating monitoring and evaluation.

Executive Summary

This case study explores the role of science as a diplomatic tool for environmental peacebuilding through the Cordillera del Cóndor Peace Park, a transboundary protected area shared by Ecuador and Peru. After decades of armed conflict between the two countries, the 1995 Presidential Act of Brasília, brokered by Argentina, Brazil, Chile, and the United Nations, ended hostilities.

The resulting peace agreements laid the foundation for a cooperation area along the shared border, demarcated to protect endemic biodiversity and engage Indigenous communities in reinforcing international commitments and sustainable resource use.

However, internal tensions emerged between actors favoring environmental preservation and those aligned with the mining sector, which allegedly carried out illegal activities in violation of the peace agreement and the UN Declaration on the Rights of Indigenous Peoples (2007). As a result, the creation of the peace park faced significant challenges.

On one hand, it failed to achieve long-term environmental conservation due to insufficient planning and monitoring mechanisms. On the other, it did not fully ensure lasting peace, as it inadvertently undermined Indigenous rights, leading to renewed internal conflicts. Nevertheless, the initiative demonstrated the potential of science diplomacy to foster trust and cooperation between governments, and laid the groundwork for broader protected areas such as the Cóndor-Kutuku Conservation Corridor.

Keywords: Peacebuilding; biodiversity conservation; environmental peacebuilding; science diplomacy; Indigenous Peoples.

Introduction

The potential for violent conflict due to environmental change was first reported in 1987 by the Brundtland Commission in "Our Common Future". Despite growing evidence, experts on climate change remain very cautious about making direct links between climate change and increased conflict (IPCC, 2022a: 4-54). Psychological research suggests that propensity for conflict and violence increases with the discomfort caused by climate change (i.e., higher temperatures) on individual behavior (Anderson & Bushman, 2002, in Koubi, 2019: 346). Moreover, qualitative evidence also supports that climate change reduces the effectiveness of ongoing peacemaking efforts and the capacity to control the spread of conflict across borders, for instance, due to forced human displacements. Scientists and practitioners contend that these limitations stem from the lack of climate-sensitivity in peacemaking initiatives to the multiple dimensions (social, economic, and political) of conflict (Kramer, 2019).

Figure 7. *The Andean Corridor in Ecuador. Source: Nature and Culture International (2018).*

Climate change effects are said to be more likely and severe in agriculture-dependent regions, where destructive events like drought and floods can have a devastating impact on the local economy, driving poverty levels up (Krampe, 2019). According to the IPCC (2022b), a twofold increase from a 2% very high risk of extinction for endemic species is expected if global temperatures rise between 1°C and 1.5°C, but these numbers could also increase tenfold if temperatures surpass 1.5°C. Loss of biodiversity makes humanity as a whole more vulnerable to other climate adversities, given that ecological crises alter the availability of natural resources, including water and food. Food and water insecurity are, in fact, on the list of main climate-related drivers of social tensions and conflict between social groups (Koubi, 2019), already affecting millions of people in Africa, Asia and South America (IPCC, 2022b: 9). These are even more immediate for indigenous peoples because of the interdependence of their livelihoods on ecosystems (IPCC, 2022b: 12). Additionally, warfare exposes biodiversity hotspots that jeopardize natural habitats and conservation policies (Hanson et al., 2009).

As a result, over the past decades, the world has witnessed an increased focus on climate change in foreign policy agendas. As noted in a 2007 US report, climate change is considered "potentially the greatest challenge to global stability and security, and therefore to national security" (CNA Corp. 2007). In this unfortunate scenario, science diplomacy offers a glimmer of hope. By using science as a common language, societies have the potential to reduce the animosities indirectly fueled by climate change and other overlapping drivers. This case study analyzes a particular application of science diplomacy for peacemaking and conflict resolution between Ecuador and Peru over the delimitation of their common border across an environmentally fragile area.

Geopolitical Background

Ecuador and Peru have a long history of transboundary conflict dating back to the eve of their independence from Spanish colonial rule in the 19th century, when the two countries began to argue over the delimitation of their shared border. These tensions reached their peak in 1941. The military encounter was followed by the adoption of the Rio de Janeiro Protocol in 1942, which did not achieve its peace-building goals, and new conflicts broke out throughout the 1980s and the early 1990s. The definitive ceasefire was reached through international mediation by Argentina, Brazil, Chile, and the United States, which led to the signing of a peace agreement between the parties: the Presidential Act of Brasilia (1995). The agreement not only aimed to cease the hostilities between the two neighboring countries, but also to preserve the endemic biodiversity across the border, along the Cordillera del Cóndor region.

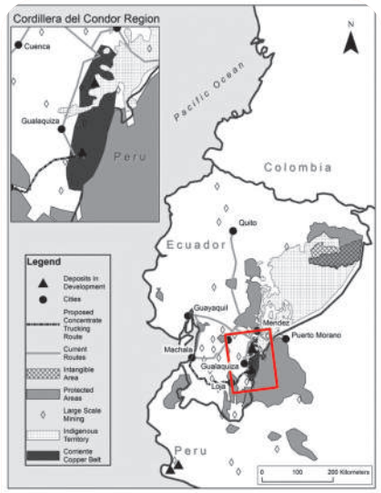

Figure 8. *Protected areas in the Cordillera del Cóndor. Source: Ali (2019).*

The Cordillera del Cóndor is a 160 km mountain range stretching from the Marañón River, where the Amazon River is born (United Nations Environment Programme, 2016: 70). As shown in Figure X, this transboundary cooperation region covers the Cóndor Park in Ecuador (2,540 hectares), the Peruvian Ecological Protection Area (5,440) and the extended Santiago-Comaina Reserved Area (1,642,570 hectares) (Alcalde, Ponce, Curonisy, n.d.). The territorial demarcation was based on the International Union for Conservation of Nature's (IUCN) Code for Transboundary Protected Areas and supported by the International Tropical Timber Organization (ITTO).

Environmental Peacemaking in Science Diplomacy

The field of environmental peacebuilding is a rapidly expanding interdisciplinary domain rooted in practical application and policy development. Its growth has been particularly significant since the mid-2000s, driven by the increasing impact of climate change on conflict dynamics. Given the expected worsening of climate change impacts in climate-driven conflicts, incorporating scientific language into diplomacy seems indispensable to prevent, reduce and end violence.

In this case study, the term 'environmental peacebuilding' is used as an overarching concept, although there are various related terms like environmental peacemaking, ecological diplomacy, science diplomacy, and peace ecology, which convey similar meanings. Specifically, 'environmental peacebuilding' is employed as an umbrella term to encompass "the various strategies and avenues through which the management of environmental concerns can be integrated into and contribute to conflict prevention, alleviation, resolution, and post-conflict recovery" (Ide et al., 2021: 2). This case study is, in fact, representative of the first generation of environmental peacebuilding literature of the early 2000s, which focused on transboundary water and conservation issues. Peace parks for environmental conflict resolution were popularized during this period, as mirrored in Saleem Ali's seminal work, which will also be used as to critically analyze the Cordillera del Cóndor.

Peace parks or parks of peace are a specific type of transboundary protected areas (TBPA), strips of land crossing national or subnational boundaries where biodiversity and cultural heritage conservation efforts are developed collaboratively. The International Union for the Conservation of Nature (2001: 5) distinguishes peace parks and emphasizes that they promote peace and cooperation through "trust[-building], understanding and reconciliation between nations, the prevention and resolution of conflict, and the fostering of cooperation between and among countries, communities, agencies and other stakeholders".

The biodiversity conservation mission of peace parks is based on the premise that the best remedy for conflict is to prevent it by promoting sustainable development and respect for human rights (Sandwith et al., 2001: 3-4) and that the parties will make a rational choice accordingly (Dupuy et al., 2015). Hence, peace parks serve as a compelling illustration of science diplomacy because they distinctly exemplify the three dimensions[3] of cooperation that can be fostered between the realms of science and diplomacy. Peace parks broaden the horizons and themes of foreign policy [science in diplomacy], they are instrumental in the improvement of interstate relations [science for diplomacy], and in turn, they promote scientific breakthroughs through the different projects and infrastructures required in, for instance, environmental conservation efforts [diplomacy for science].

[3] The Royal Society and The American Association for the Advancement of Science (AAAS) (2010). New frontiers in science diplomacy. Retrieved on November 10, 2022, from: *https://n9.cl/e0ivmb*

In light of the challenges of demarcating their shared border, Ecuador and Peru came to a mutual agreement to establish a peace park. In 1998, both countries requested the US to propose a border demarcation and established a protected transboundary area. The two countries agreed that the ecological parks on both sides of the border would be free of military presence and would allow the free circulation of people and trade. In practice, even if the resulting peace park managed to stop or significantly reduce the conflict, its success was limited by the undetermined role of the military, the lack of monitoring instruments and long-term planning, and the reliance on external donations for the maintenance of the park (Ali, 2019: 178-179). Thus, the TBPA ended up being an empty buffer zone rather than an active cooperative area, which, according to peace parks game theory, is a situation where the parties would presumably still abide by the agreement (Lejano, 2006).

Figures 9-12 *(left to right). Examples of endemic species from Cóndor Corridor: Forest falcon (Wikimedia Commons); Golden-plumed conure (Marco Salas from Birds of Peru); long-haired spider monkey (Wikimedia Commons); Andean bear (Wikimedia Commons). Source: Ponce & Ghersi (2003), Nature and Culture International (2018)*

The lack of active cooperation in the buffer zone does not, however, imply a lack of activity in general. Complex topography and geology, as well as a stable humid climate throughout the year, make the corridor a perfect refuge and transit area for many species, some of which are endemic to the Amazon and the Andes (ITTO, 2004: 7) such as those shown in Figures X to Z. Besides, and as recognized by the Shuar Federation (1964), both sides of the border are inhabited by indigenous communities that were shielded from Inca and Spanish colonization and are entitled to these lands. The region's indigenous cultures are over 1500 years old and possess extensive knowledge of the territory, its species, and sustainable methods of fishing, agriculture, timber harvesting, and hunting.

The Ecuadorian Shuar and Peruvian Wampis cooperate with one another and with international organizations like Conservation International, Amazon Watch, and the International Tropical Timber Organization (ITTO) on certain resource-related projects . The ITTO is an intergovernmental body established in 1986 under the UN Conference on Trade and Development to promote the

expansion and diversification of tropical timber trade from sustainably and legally managed forests, representing 90% of tropical timber and 80% of the world's tropical forests. The ITTO is the main provider of technical and financial support and a framework for developing conservation activities in the transboundary park. Moreover, a steering committee was appointed to supervise the execution of the Bi-National Development Plan spanning a ten-year period (1999-2009). This plan served as the primary political framework for governing projects and the sustainable utilization of natural resources within the Condor territories, ensuring adherence and compliance. For its part, Conservation International works to protect nature and promote environmental science and finance, raise awareness, and bring together governments, the corporate world, and Indigenous Peoples.

Within the Ecuadorian border region, the predominant inhabitants are the Shuar, who also have a presence in Peru. In contrast, the Peruvian side of the border is primarily populated by the Awajú and Wampis communities (Ali, 2019: 181). The projects conducted in the Cordillera del Cóndor engaged with these indigenous communities to integrate their knowledge into land-use management, striving to respect their identity (ITTO, 2004: 7-8). In this context, a good example of a specific science diplomacy initiative is the twin project 'Binational peace and conservation in the Condor Range Region' (2/00 (F) and PD 3/00), implemented between 2007 and 2010 by the ITTO and Conservation International on both sides of the border with the support of Fundación Natura (closed since 2012), the Ecuadorian Ministry of the Environment, and the National Institute for Natural Resources of Peru (INRENA). The original goals of the project were to provide a framework for the conservation of the corridor's biodiversity while strengthening the integration of Ecuador and Peru, by enhancing the sustainable management capacities of the local indigenous communities.

The project integrated the Cóndor Range into a transboundary scheme and created a shared biological information system developed by both parties. In addition, it also promoted inter-indigenous dialogues and meetings, and intergovernmental coordination between Ecuador and Peru. Fundación Natura played a crucial role in ensuring that the indigenous territory and a comprehensive understanding of life, encompassing aspects such as economy, spirituality, sacred ecological rituals, methodologies and knowledge, and equitable wealth distribution, were at the core of the project (ITTO, 2004). However, the project did not unfold as anticipated. The pacification of the border region facilitated encroachment into virgin areas and created new disputes over the possibilities for economic development offered by the newly accessible natural resources. The Peruvian government's subsequent decision to pursue mining and fossil fuel sector development in Condorcanqui province, where the Corridor is situated, undermined trust with the indigenous communities who were collaborative partners (Conservation International, 2010)

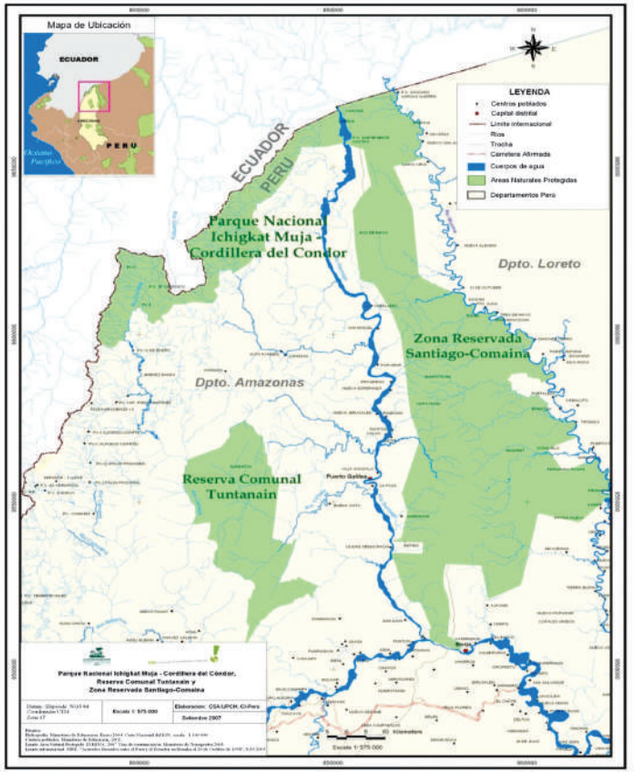

Figure 13. *Extended protected areas of the Ichigkat Muja National Park within the Cóndor Corridor. Source: ITTO (2009).*

The Peruvian Wampis and Awajún launched a significant anti-mining campaign within their territory, even documenting their efforts in a short film entitled "Amazonia for Sale[4]" to denounce the Peruvian government's violation of their land rights, as enshrined in the UN Declaration on the Rights of Indigenous Peoples (UNGA, 2007). The secretive and clientelist agreements signed by the government with the mining sector not only posed a threat to the indigenous communities' way of life but also jeopardized the integrity of the Ichigkat Muja National Park (ODECOFROC, 2010: 9). Part of the problem originated from the 1998 agreement, which not only failed to prohibit mining and other economic activities in the area, but also considered the construction of a transboundary road linking the two countries (ITTO, 2004: 8). Simultaneously, the Ecuadorian Shuar community actively engaged in ethnobotanical research with the pharmaceutical industry. However, conflicts arose within the community between those supporting socioeconomic development through pharmaceutical companies and tourism, and those in favor of extractive industries. The Inter-Provincial Federation of Shuar Centers opposed the latter (Ali, 2019: 181), emphasizing that mere governmental recognition of indigenous land rights was insufficient,

[4] See Amazonia for Sale: *https://www.dailymotion.com/video/xcdem0*

and that more extensive protection was necessary (ITTO, 2004: 9). Nonetheless, the completion of the Bi-National Development Plan also paved the way for ambitious long-term cooperation, notably the creation of the Condor-Kutuku Conservation Corridor. This corridor covers a larger area and safeguards shared vulnerable ecosystems such as mangroves, dry forests, low-lying rain forests, and paramos (Ponce & Ghersi, 2003).

While the transboundary park succeeded in achieving its peace-building objective between Peru and Ecuador, the preservation of biodiversity was hindered due to its dependence on private funding. This also led to the emergence of fresh internal conflicts involving indigenous groups, private companies, and the respective governments. Critics argue that one of the missteps in the peace park project was the absence of a designated role for military-style monitoring and peacekeeping, akin to having "green helmets" on both sides of the border (Ali, 2019: 179). The regulation of extractive mining activities remains an unresolved issue (Ali, 2019: 183). Furthermore, certain Wampi communities assert that they should be entrusted to oversee the projects they themselves have proposed.

From a theoretical perspective, environmental cooperation for peacemaking gains strength when it is supported externally (in terms of funding, mediation, or oversight), when common institutions are established to address conflicts, when mutual trust is nurtured, and when natural resources are jointly managed using sustainable and conflict-sensitive approaches (Feil et al., 2009, as cited in Ide, 2019). Additionally, as suggested by Krampe (2019), environmental peacemaking should incorporate a climate-sensitive viewpoint to assess the risks of renewed or intensified conflicts due to climate change. To achieve this, it's essential to involve multiple stakeholders and agencies in the development of long-term strategies.

Conclusions

Environmental peacemaking witnessed significant growth in the early 21st century, with a particular emphasis on transboundary water and conservation initiatives. This case study reflects the early wave of literature and science diplomacy efforts that placed environmental concerns at their core. Since 1998, Ecuador and Peru have collaborated with various international organizations to resolve a long-standing border dispute by establishing a transboundary peace park in the Cordillera del Cóndor, a biodiversity hotspot that is home to numerous indigenous communities. This case highlights the potential of peace parks to halt conflicts in the name of international peace and illustrates the vulnerability of nature to the ravages of war.

Furthermore, it reveals both the external and internal factors that constrained the success of the Cordillera del Cóndor peace park. On one hand, unexpected shifts in government policies, reliance on external donors, the lack of a long-term roadmap, and an unclear military role contributed to new hostilities. On the other hand, insufficient involvement of local communities in decision-making and violations of their land rights due to illegal mining activities hindered their identification with the project.

Nonetheless, the experience with the Cóndor corridor led to the expansion of protected areas, culminating in the creation of the Cóondor-Kutuku Biodiversity Conservation Corridor. Consequently, while peace parks may not serve as a universal remedy for conflicts in fragile environments and biodiversity hotspots, this case study underscores their capacity to significantly reduce tensions among nations or between them and corporate entities. It stands as a regional model, offering valuable lessons on the governance of environmental change, while serving as a guide for other Latin American and Caribbean nations, particularly those in the Amazon region seeking environmental protection.

Public Policy Takeout

Prior to the establishment of a peace park, whether for the primary purpose of environmental conservation or as part of broader conflict prevention objectives, it is essential to evaluate the willingness of the parties involved to shoulder the necessary responsibilities and ensure they possess the necessary resources to sustain the project throughout its lifetime. To secure long-term resources, diversifying the pool of financial sponsors may be a viable option. In a broader context, an assessment that accounts for the internal and external strengths and weaknesses of the various stakeholders, as well as the environmental threats and opportunities, using a game theory approach, can anticipate the possible future scenarios in the implementation of a peace park. The case of the Cóndor corridor offers valuable insights and considerations for future peace park proposals.

- How can communication channels be effectively established to engage and gather feedback from local communities to enhance the reliability of environmental peacemaking approaches?
- In the context of peace park efforts, which additional groups or concerns should be taken into account, such as the role of the military or gender perspectives, to ensure that a broader range of views and interests are considered? What are the potential benefits of including these groups?
- How can external monitoring and evaluation mechanisms, such as conflict mediation observers or the use of information technology like Geographic Information Systems and reporting tools such as SMART Conservation Tools, be applied to improve the implementation of peace parks, whether for environmental protection or conflict prevention purposes?
- Given that climate change can impact peacemaking efforts and that conflict can harm delicate ecosystems, how can science diplomacy play a role in promoting a climate-sensitive approach that considers both environmental protection and climate change consequences in conflict resolution?

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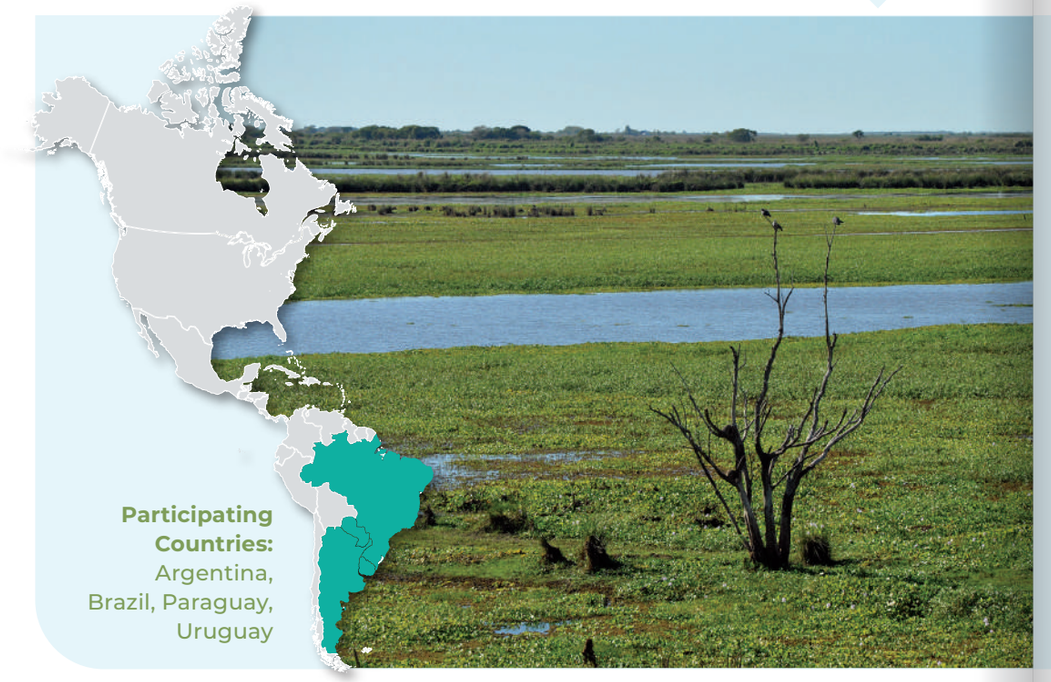
Environmental peace-building theories

Avoiding zero-sum game situations

Peace parks allow shared sovereignty of the environment, because it is based on science and can be de-politicized

5 The Largest Groundwater Reserve in the Americas: A Landmark Case of International Water Cooperation



Participating Countries: Argentina, Brazil, Paraguay, Uruguay

Executive Summary

Water has long been a focal point in international law and diplomacy. However, until recently, most agreements predominantly addressed surface waters, with only a handful globally addressing groundwaters.

Unlike other transboundary water bodies like rivers or lakes, which have clearly defined boundaries, aquifers are often less understood due to inadequate data and information, making their very existence less evident to all the sharing states.

As a result, science has played a pivotal role in facilitating dialogues among states sharing groundwater resources. Notably, the only example of such agreements in the Western Hemisphere was established in Latin America: the Guarani Aquifer Agreement, signed by Argentina, Brazil, Paraguay, and Uruguay. This case study illustrates a regional hydro-diplomacy initiative in which these four South American states have worked collaboratively to manage one of the world's largest known freshwater reserves. It underscores the fusion of scientific knowledge and multilateral cooperation in one of the few examples of its kind worldwide.

Keywords: Groundwater; transboundary resources; aquifer; hydro-diplomacy.

Science in Diplomacy

In this context, "Science in Diplomacy" is the predominant dimension, due to:

- A**quifer Management Complexity:** The intricate nature of groundwater reserves demands a comprehensive approach that blends scientific knowledge with diplomatic strategies to ensure sustainable management.
- **Conflicting Interests and Multilateral Cooperation:** The Guarani Aquifer spans four countries, each with distinct interests. Science in Diplomacy helps bridge these divides, facilitating collaborative negotiations and effective conflict resolution.
- **External Support and Environmental Oversight:** Collaboration with international organizations such as the International Bank for Reconstruction and Development (IBRD – The World Bank) and the General Secretariat of the Organization of American States (OAS) reinforces efforts in environmental protection and conflict resolution. Their impartial role supports vital monitoring and evaluation processes.

Introduction

Underground water is one of the most important freshwater sources on Earth. Worldwide, it accounts for approximately 99% of all liquid freshwater, 50% of water withdrawn for domestic uses, 25% of irrigation, and is a key resource for people living in rural areas without access to water networks or surface waters (UN, 2022). Aquifers have been called "invisible seas", as they sometimes comprise immense masses of water that can pass totally unnoticed due to their underground nature. An aquifer forms over hundreds or thousands of years when water seeps into the ground and is stored in deep layers within the grains of porous rocks or sediments (Figure 14).

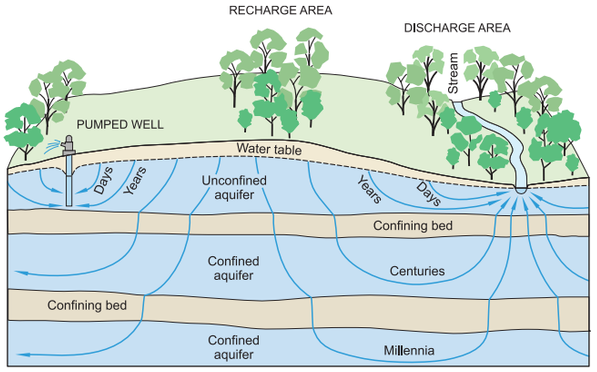


Figure 14. *Representation of different types of confined and unconfined aquifers (blue layers). The blue lines show the time required by water to reach different depths. Source: Winter (1999)*

Groundwater already accounts for 25% of global water use in agriculture, and the United Nations (2022) estimates that half of all the people living in urban settlements worldwide depend on groundwater sources, and this figure is increasing. Latin America and the Caribbean is no stranger to this trend. In many Caribbean countries, where surface water tends to be relatively scarce, groundwater represents about 50% of the water abstracted, such as Barbados and Jamaica, which rely heavily on groundwater resources as their primary supply (90% and 84%, respectively) (UN, 2022). This growing pressure on water sources, which exist and flow regardless of administrative barriers and borders, is already a source of global conflict.

Water-related issues, which can take the form of inter-state disputes have long been dealt with by international law in what has been termed water diplomacy or hydro-diplomacy. Transboundary water disputes have the potential to become disruptive factors for international peace and security, which can be exacerbated when the involved states have environmental, economic, and geopolitical interdependencies (Desai, 2021), which is very often in the case of large transboundary water bodies. Thus, water diplomacy aims to enable the joint management of water resources by facilitating and informing cooperation among a wide range of actors at multiple levels, combining technical and diplomatic tools to facilitate dialogue (Klimes et al., 2019).

In this case study, we present the steps taken by four South American countries, which, through the articulation of scientific knowledge and multilateral cooperation, have moved towards the joint and sustainable management of one of the largest groundwater reserves in the world, the great Guarani Aquifer. Through a review of the international agreements reached, as well as technical information on the status and uses of the aquifer by the countries involved, we will take a quick look at how hydro-diplomacy has contributed to sustainable water management in the region, as well as some of the challenges to be solved in the years to come..

Groundwater: A Hidden Global Challenge

Although Latin America and the Caribbean hold approximately 40% of the world's freshwater resources, due to the geographical and climatic heterogeneity within the region and the countries themselves, along with seasonal variations and precarious infrastructure, access to sufficient and adequate water resources is far from ideal in many areas. In fact, a recent report by the Inter-American Development Bank (Libra et al., 2022) indicates that, even though LAC is considered a water-rich region by many metrics, the percentage of the population that is affected by water stress is much higher than what is normally estimated: 35% of the population currently lives in areas with medium-high to very-high water stress levels[5]. Furthermore, Global Environmental Change is exerting increasing pressure on water resources worldwide. Higher water demand for agriculture and urban settlements, shifting rainy and dry seasons, more intense and prolonged drought events, and unregulated water use. These and other factors are putting great strain on available water resources, which in turn has the potential to fuel disputes over water between populations and countries.

Consequently, worldwide dependency on groundwater sources is also increasing, and in LAC, there are several countries already facing over-exploitation and contamination of their aquifers (UN, 2022), affecting both rural and urban areas. For instance, Mexico City, the second-largest urban center in the region, has been facing severe water rationing in recent years. In order to sustain the 21 million people living in the metropolitan area, the city extracts nearly twice as much groundwater as is naturally recharged. This over-extraction is causing urban soils to sink more than 40 cm per year, causing costly and widespread damage to infrastructure, including valuable architectural and touristic areas

[5] Water stress thresholds. Low: if total water withdrawals represent less than 10% of the total available renewable surface and groundwater resources; low-medium: 10% to 20%; medium-high: 20% to 40%; high: 40% to 80%; extremely high: more than 80%; and arid and low water use: basins with baseline available water < 0.03 m/year and baseline gross total withdrawal < 0.012 m/year.

(Chaussard et al., 2021). In Peru, the Caplina/Concordia Aquifer, the main water supply source for households and agriculture in several Peruvian and Chilean districts, has been over-exploited, causing groundwater depletion and seawater intrusion (Narvaez-Montoya, 2022). And in Jamaica, the main aquifer that supplies water to Kingston and St. Andrew is also contaminated by saltwater intrusion and harmful chemicals (Vazquez et al., 2022).

The Guarani Aquifer System (GAS) is a transboundary underground water system shared by four countries in Latin America, namely Argentina, Brazil, Paraguay, and Uruguay. It was named in honor of the Guarani indigenous peoples, native to the areas where the aquifer is located. It ranks fifth on the list of the world's aquifers in terms of capacity and is the largest freshwater reservoir in the Americas (van der Gun, 2022), covering an area of about 1.2 million km2 and containing a volume of nearly 30,000 km3 of water (Foster, 2009).

Most of the current exploitation of the aquifer takes place in Brazil, where 93.6% of the water is abstracted (80% in São Paulo State), while the quantities are much lower in the other three countries (2.8% in Uruguay, 2.3% in Paraguay, and 1.3% in Argentina); the predominant use is public water supply (80%), followed by industrial processes (15%) and geothermal spas (5%) (Gonçalves et al., 2020; PSAG, 2009). Nearly 15 million people live above the aquifer, while it is estimated that more than 90 million inhabitants could be indirectly benefiting from the aquifer's exploitation (Foster et al., 2009). Except for a few relatively small and isolated areas, the vast majority of the aquifer's waters are of excellent quality, for both human consumption and irrigation, and since it is a confined aquifer, the risks of contamination are low, all of which makes it a strategic water source.

Figure 15. *Área estimada del Sistema Acuífero Guaraní.*

Fuente: Autores, con datos de www.un-igrac.org

Science Diplomacy Leading to the Guarani Aquifer Agreement

Labeling aquifers as "invisible" waterbodies is by no means an overstatement. Despite their importance, to date, there are just a handful of agreements addressing transboundary aquifers in the world: two of them in Western Europe, three in the Middle East and Northern Africa, and only one in Latin America (UN, 2022). In fact, in comparison to other water bodies like seas and rivers, which have been at the center of modern international law since their origins, it was not until 2008 when the UN International Law Commission finally proposed a groundwater-specific legal instrument (Draft Articles on Transboundary Aquifers[6]), calling upon states to use transboundary aquifers in equitable, reasonable, and sustainable ways (Hirata et al., 2020).

Although some projections indicate that climate change may actually lead to increased precipitation and infiltration over the Guarani Aquifer (Wen-Ying Wu, 2021), increasing water demand, together with rapid urban sprawl (especially in Brazil), has already compromised more than 9,100 km of natural watercourses and sealed off extensive areas that were formerly groundwater recharge hotspots (de Olivera et al., 2023). In addition, before the 2010s, the understanding of the GAS was still limited, making it difficult to formulate sound management plans, much less at the international level. This is precisely one of the main goals of science diplomacy in general and science in diplomacy in particular: providing scientific evidence to inform and support decision-making in foreign policies and international agreements (AAAS, 2010).

As a result, in 2000, a multilateral project was formulated by the four neighboring countries, implemented by the Organization of American States with the support of the Global Environmental Facility, to enhance the hydrogeological understanding of the GAS, the socio-economic pressures, and the legal and institutional readiness for groundwater management and transboundary aquifer cooperation, concluding with the adoption of a Strategic Action Program (SAP) in 2009 (PSAG, 2009; Sindico et al., 2018). One of the other important results of the SAP was that it was decided that an already existing river basin treaty (La Plata River Basin Treaty, 1969) would serve as a basis for future actions regarding the Guarani Aquifer. As part of this treaty, a permanent international body was created in 1968 to coordinate all actions between the five countries located in the La Plata River Basin, which includes all the abovementioned countries plus Bolivia.

During nearly a decade, the SAP comprised regional and local projects directly and indirectly related to the GAS; the exchange of technical information among institutions in the four countries; pilot projects in different fields, including two cross-border city initiatives (see Box X.); institutional and social cooperation on themes relating to water resources; and the creation of networks for joint knowledge generation with universities and research foundations, social organizations, and environmental journalists in the four countries, along with the

[6] An online version of the Draft Articles on Transboundary Aquifers can be found here: *https://n9.cl/p6g5b*

creation of a fund to finance civil society initiatives aimed at dissemination and awareness-raising. Altogether, this sustained joint scientific collaboration and multi-stakeholder engagement "proved a key for building trust among participants in the different countries'', "strengthening the bonds'' between the parties, and "fostering a shared vision of the GAS" (PGAS, 2009. p. 33).

It was precisely in parallel with all these actions that the drafting and negotiation of the treaty took place. Talks had started in 2004, and within a year a first draft was ready, but differences over dispute settlement mechanisms led to a stalemate in the dialogue until 2010—interestingly, cooperation within the project never halted—when negotiations resumed and the four countries finally signed the Guarani Aquifer Treaty in San Jose, Argentina (Sindico, 2018). The treaty was internationally praised not only because it was one of the first to focus specifically on transboundary groundwater management, but also because it was the first in the world to take into account the UN's Draft Articles on the Law of Transboundary Aquifers and constituted an example of preventive diplomacy, that is, diplomatic action aimed at preventing the escalation of potential or ongoing conflicts.

Box 1. The Concordia-Salto Initiative

As part of the Guarani Project, two pilot studies on cross-border sites were implemented. One of them was between Uruguay and Brazil, and the other was the Concordia-Salto initiative between Uruguay and Argentina. This example is interesting for several reasons. During the Guaraní Project, a commission of experts and political representatives from both cities was established, meeting regularly and generating new information through joint monitoring activities. Contrary to what happens in many externally driven initiatives, the cooperation did not stop when the Guarani Project came to an end. In fact, the Commission continued without any written agreement under the leadership of its local members.

Then, in 2017, an agreement was signed between the two cities that now serves as the legal basis for furthering knowledge of the aquifer, fostering information exchange, and formalizing the already existing joint Commission, promoting environmental education, and raising awareness about the importance of groundwater.

Cross-border city diplomacy

Cooperation between cities is not new. However, in the last decade, new forms of city partnership have arisen, moving beyond more traditional approaches like city-twinning and evolving into more complex cooperation initiatives, built in partnership with multilateral organizations and increasingly intertwined with other governance levels (see case study X). In the case of cross-border cities, joint strategies based on shared transport infrastructure, natural heritage, and tourism have been implemented around the world to promote and facilitate dialogue and integration at the regional and international level (LISER, 2015).

Unfortunately, after the initial excitement that followed the signing of the agreement in 2010, a decade of what many consider to be disappointment unfolded. For the treaty to come into force, the parliaments of all four signatory countries must formally ratify it. The last country to complete the process was Paraguay in 2018 (Brazil had done so just a year earlier), but the agreement's entry into force was delayed again because Paraguay failed to deposit its official ratification document until 2020.

During these years, the momentum created by the GASP cooperation tended to dissipate. Paradoxically, as pointed out by Hirata et al. (2020), the fact that no relevant water or environm ental conflicts have yet emerged around the Guarani Aquifer has contributed to waning of the initial interest in the agreement. This could be contrasted, for example, with what has happened in the nearby Amazon Basin, where conflicts over the unsustainable use and deforestation of this transboundary biome have mobilized large amounts of resources and made front page news in the international media. Moreover, the interruption of funding sources after the end of the GASP, the large geographical area comprising the aquifer, and institutional dispersion and weakness in some of the member states have also contributed to slowing down the pace of progress (Hirata et al., 2020).

Nevertheless, in 2019, the Development Bank of Latin America (CAF) and the GEF green-lighted the project "Implementation of the Guarani Aquifer Strategic Action Program: Enabling Regional Actions", to provide continuity to the strategic plan approved in 2009 under the following lines of action: 1) consolidation of Transboundary Technical Cooperation; 2) design and field testing of a multi-purpose monitoring network; and 3) stakeholder participation, gender equality mainstreaming, dissemination and capacity building.

Sources: *Rivero-Godoy (2016); Sindico (2018)*

Conclusions

Unlike other transboundary water bodies, whose existence and extent are conspicuous and clearly identifiable, in the case of aquifers, the lack of data and even basic knowledge about their existence has hindered their comprehensive management, making science a key aspect of dialogue and cooperation between states sharing groundwater resources. To date, the Guarani Aquifer Agreement, signed in 2010 by Argentina, Brazil, Paraguay, and Uruguay, stands as the only example of its kind in the Western Hemisphere, in what constitutes a pioneering case of hydro-diplomacy worldwide.

The process that finally led to the signing of the agreement is exemplary in that it used scientific cooperation and information exchange (combining science in diplomacy and science for diplomacy) as a basis for building trust among the four states, allowing for the progressive strengthening of the bonds of collaboration that ultimately culminated in a binding international agreement. It is also noteworthy that this scientific cooperation never stopped, even at times when progress in the diplomatic sphere came to a complete halt for several years, demonstrating the crucial role that science can play as a facilitator of diplomatic dialogue.

As is often the case in large-scale, long-term processes such as this one, one of the greatest challenges has been to keep the interest and commitment of the parties involved alive. In this regard, the role of multilateral organizations as facilitators and co-financers has also been of great importance to ensure that the necessary technical and resource bases were in place to enable the various actors to go the extra mile needed to make the agreement a reality.

Public Policy Takeout

Given the significant role played by scientific cooperation in the agreement's formation, it is recommended that a permanent technical body be created, building on the expertise of the Guarani Universities Fund. Civil society organizations have been crucial in raising awareness about the aquifer, making them ideal partners for public engagement. Additionally, creating a network of non-governmental organizations and environmental funds, similar to the successful PACIFICO Platform and CMAR case study, can help mobilize additional financial resources for aquifer-related actions.

- Adequately allocating resources for citizen science projects, is critical for developing cross-border collaboration strategies that are coherent with needs and resources of the countries involved. In light of initiatives detailed in the case study, what strategies could be employed to enhance the longevity and impact of a technical body for scientific exchange? How might the proposed technical body ensure the long-term sustainability and effectiveness of its scientific exchange efforts?
- Drawing from the financial management practices highlighted in the PACIFICO Platform case study, what lessons can be applied to ensure effective resource allocation within the proposed network or platform? How can financial resources be efficiently allocated and managed within the proposed network or platform of non-governmental organizations and environmental funds?
- In the context of the challenges of cross-border collaboration, what mitigation strategies were implemented in the CMAR project, and how can these inform cross-border efforts related to the aquifer? What potential barriers or obstacles might arise in establishing cross-border collaborations for citizen science projects, and how can they be addressed?
- Drawing from the lessons learned and best practices highlighted in the PACIFICO Platform and CMAR case study, what actionable insights can be gleaned to enhance the implementation of socio-environmental projects and scientific exchanges that are applicable to the aquifer agreement's objectives?

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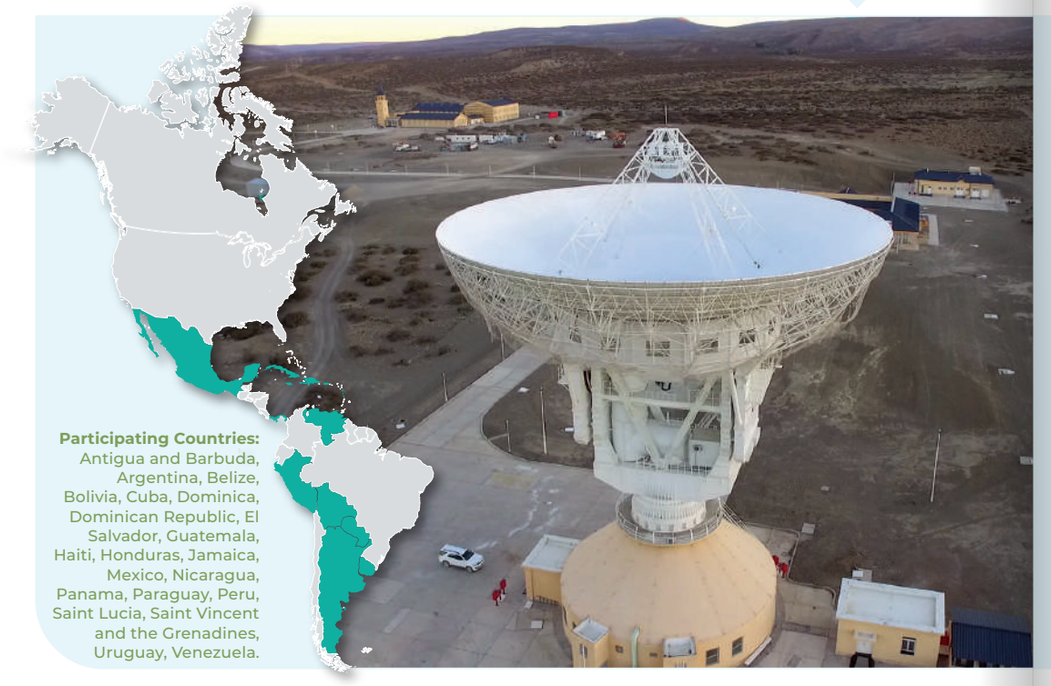
6 ALCE and the SIRIS Project: Advancing Space Diplomacy and Climate Change Cooperation



Participating Countries: Antigua and Barbuda, Argentina, Belize, Bolivia, Cuba, Dominica, Dominican Republic, El Salvador, Guatemala, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, Saint Lucia, Saint Vincent and the Grenadines, Uruguay, Venezuela.

Executive Summary

Following a period of relative inactivity, recent years have witnessed swift progress in space cooperation within the region, culminating in the establishment of the first Latin American and Caribbean Space Agency (ALCE) in 2021.

This significant development is rooted in a longstanding history of scientific diplomacy between states. A notable recent example of such collaboration is the SIRIS Project, a joint initiative funded by the Inter-American Development Bank. This project aims to create a digital platform for space cooperation, offering open access to satellite data to bolster climate resilience, disaster risk reduction, and public health efforts. While SIRIS and ALCE may appear relatively rudimentary when compared to other international counterparts like the EU Space Agency or the International Space Station (ISS), they represent a significant advancement in Latin American space cooperation. They offer valuable insights for science diplomacy initiatives in the region.

Keywords: Space exploration; satellite data; climate change adaptation.

Science for Diplomacy

In this context, "Science for Diplomacy" is the prevailing approach, as illustrated by:

- **International Collaboration:** Both ALCE and the SIRIS Project focus on diplomatic efforts to foster international cooperation in space exploration and climate change adaptation.
- **Cross-Border Science:** They emphasize science-driven collaboration across political borders, showing how diplomacy unites nations for scientific progress.
- **Peaceful Cooperation:** ALCE and SIRIS promote peaceful scientific ventures, highlighting diplomacy's role in fostering regional stability.
- **Balancing National Interests:** These initiatives navigate the challenge of harmonizing national priorities, showcasing how diplomacy ensures mutual benefits.
- **Stakeholder Engagement:** "Science for Diplomacy" underscores the involvement of diverse stakeholders in scientific cooperation, aligning with the inclusive ethos of ALCE and SIRIS.
- **Participating Countries:** Antigua and Barbuda, Argentina, Belize, Bolivia, Cuba, Dominica, Dominican Republic, El Salvador, Guatemala, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, Saint Lucia, Saint Vincent and the Grenadines, Uruguay, Venezuela.

Introduction

For decades, space cooperation in Latin America and the Caribbean has remained an elusive dream, marked by multiple comings and goings, bilateral agreements, and joint declarations, that never crystallized into a regional space initiative. Nevertheless, while space goals have not been achieved as high and fast as Latin American countries might have desired, their relative lack of resources has provided a breeding ground for numerous space science diplomacy efforts.

Recent years have seen a resurgence of interest in space and Latin American states have not remained unaffected by this trend. Between 2020 and 2021 there was an accelerated development of the will to cooperate in space matters, culminating in the joint declaration to create a Latin American and Caribbean Space Agency (ALCE), now in the process of ratification by more than fifteen states. Although some observers have responded to these developments with a certain degree of surprise and skepticism, behind this step lies a long history of cooperation, in the form of small scientific endeavors that, despite their modest scope, are successful examples of science diplomacy that have helped to build trust and lay the groundwork for the international agreements at the regional level.

Based on a review of scholarly literature, official press releases, and international agreements, this case study provides a brief overview of space exploration in Latin America, with emphasis on the steps leading to the creation of the ALCE and showcasing the SIRIS Project (Regional Integrated Satellite Information System), a regional scientific collaboration platform for sharing satellite data and open access to information. Thus, the study presents a concrete example of science diplomacy that has helped to create and sustain the bonds of trust necessary to move towards high-level space cooperation in the region.

Overview of Space Exploration in the Region

Although Latin American space technology has grown rapidly in recent years, in the short and medium term it is likely to remain dependent on major foreign powers (Froehlich & Amante Soria, 2021), unless radical changes are made to regional space policies. The importance of such changes becomes even more evident when considering the potential of the region, given the advantageous geographical location of many Latin American countries. Their proximity to the Equator provides ideal conditions for space launches, thus reducing the amount of fuel needed. This advantage has been used by France and the EU at their overseas launch facility in French Guyana and is also the reason why the US launch site is located in Florida. However, this potential has remained untapped until now.

Only three countries, Argentina, Brazil, and Mexico have developed certain, albeit limited, launch capabilities. Thus, locally built satellites in the region have

until now relied on partnerships with industrialized countries to be launched. This is explained in part by the immense gap in space funding between the Global North and the Global South. By way of comparison, while the highest budget allocated for space programs in 2021 was Brazil's, with USD 47 million (25th in the world), followed by Argentina (USD 47 million) and México (USD 8.34 million), in the same year the United States government allocated USD 54.6 billion, China USD 10.29 billion, and France USD 3.95 billion (Euroconsult, 2022; Mexican Finance Ministry, 2021; Statista, 2022).

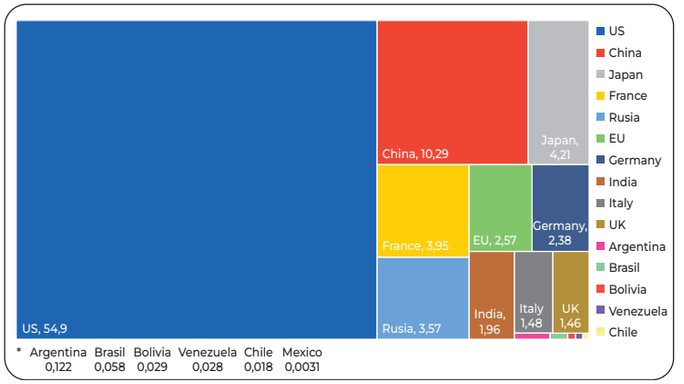


Figure 16. *Annual budget in billion USD (2021) allocated for space programs by country. Source: Authors, with data from Euroconsult, Statista, Mexican Finance Ministry.*

As of 2022, only ten countries have been able to launch satellites into space, and according to recent estimates, of the 4500 satellites in orbit as of 2021, only 66 belong to Latin American countries, representing less than 1,5% of the global total.

Argentina	34
Brazil	16
Mexico	8
Venezuela	2
Bolivia	1
Colombia	1
Chile	1
Ecuador	1
Paraguay	1
Peru	1
TOTAL	66

Figure 17. *Number of satellites launched by LAC countries. Sources: Dewesoft (2022) and Statista (2022)*

The top three countries on this list, Brazil, Argentina, and Mexico, have also been key players in regional space diplomacy. Brazil and Argentina began with space-related activities in the 1960s and created their current national space agencies in the 1990s, with CONAE (National Commission for Space Activities) and AEB (Brazilian Space Agency), respectively. Meanwhile, Mexico would not establish its Space Agency (AEM) until the 2010. The Mexican space agency is somewhat different in nature, since it was not created by the central government and did not have strong ties to the military sector, as was the case in Brazil and Argentina. Instead, the AEM came about as a multi-stakeholder cooperation between academia, the private sector, and civil society organizations and is currently a decentralized public body dependent on the Ministry of Communications. Other Latin American states have lagged relatively behind, with Colombia, Bolivia, Venezuela, and Ecuador establishing their national space institutions between 2006 and 2010 (Lelea & Arévalo Yepes, 2013), and some even more recently in the case of most Caribbean states.

The limited resources of Latin American countries have made them heavily reliant on international cooperation and foreign assistance in order to achieve their goals. Nevertheless, such gaps in funding and technological development have not meant that the LAC countries have remained absent from space initiatives. On the contrary, most countries in the region have long taken part in and cooperated in international platforms and space bodies and engaged in numerous bilateral cooperation agreements. For example, Brazil has had close and sustained space cooperation with China and the US since the 1980s, and has reached agreements with Canada, the ESA, Russia, and France, while Argentina has established cooperation agreements with the US, Russia, and more recently with Italy, the ESA, and Turkey.

Furthermore, Latin American countries have long participated in multilateral platforms such as the United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS), the UN Platform for Space-Based Information for Disaster Management and Emergency Response (UN-SPIDER), the Group on Earth Observations (GEO), and the International Astronautical Federation (IAF). There are also regional cooperation platforms for knowledge exchange, training, and education, most of which emerged in the last two decades, such as the Space Conference of the Americas (SCA), the Regional Center for Space Science and Technology Education (CRECTEALC) with headquarters in Mexico and Brazil, the Latin American Society of Remote Sensing and Spatial Information Systems (SELPER), the Latin American and Caribbean Space Network (RELACA-Espacio). Furthermore, space issues have also been included in the frameworks of regional economic communities, such as Mercosur and the Andean Pact, contributing to fostering regional space policies (Froehlich et al., 2020).

Latin American Space Diplomacy: A Matter of Necessity

Interestingly, the relative weakness of the space exploration ecosystem in the region has been fertile ground for South-South cooperation and science diplomacy, which emerged relatively early in the region. One notable example is the case of Brazil and Argentina, which have a long history of joint space activities since the end of the 1980s. This cooperation was kept in place and in 1996 both countries signed a declaration on Bilateral Cooperation in the Peaceful Use of Outer Space, allowing them to share information and testing facilities.

In fact, wider regional cooperation has been attempted more than once. Since the 1980s, there have been at least three major efforts to create a Latin American space body: the first proposal can be traced back to April 1982, during the preparation for UNISPACE 82, when Chile proposed the creation of a South American Space Agency (SASA), which was approved by all members but never became a concrete reality; ten years later, the idea of a Pan-American Space Agency, which would include the United States (US) and Canada, was brought up again at the Space Conference of the Americas, where some countries—most notably Brazil—rejected it and thus not approved; in 2011, it would be discussed again, this time within the framework of the UNASUR, but later withdrawal of several countries from the organization halted the initiative (Froehlich & Amante-Soria, 2021).

In 2020, there was a new proposal at the CELAC (Community of Latin American and Caribbean States) put forward by Mexico, where it called the other members to foster space cooperation through the development, among other things, of a Latin American and Caribbean satellite; later that year, a joint declaration on starting a long-term project whose main activities would be Earth observation, exchange of satellite images, and multisectoral dialogue; and then in October, Argentina and Mexico signed the “Declaration on the Constitution of a Regional Cooperation Mechanism in the Space Field” , committing to invite the countries in the region to join and establish the Latin American and Caribbean Space Agency (Froehlich & Amante-Soria, 2021).

Finally, in September 2021, the Constitutive Agreement of the ALCE was signed by seventeen states: Antigua and Barbuda, Argentina, Bolivia, Costa Rica, Cuba, Dominica, Ecuador, Guatemala, Haiti, Honduras, Nicaragua, Panama, Paraguay, Peru, Saint Lucia, Saint Vincent and the Grenadines, and Venezuela. After this signature, new members have joined the organization: Belize, Cuba, Dominican Republic, El Salvador, and Jamaica.

The roots of space law are inextricably linked to dialogue between sovereign states, and thus, diplomacy has played a central role in the process of creating space regulation frameworks and laws since the 1960s (Polkowoska, 2020). However, space diplomacy is not limited to the creation of agreements at the level of nation-states. On many occasions, the links created through networks of experts and scientific cooperation alliances, in what is known as science for diplomacy, are equally important. This was apparent in the case of the Inter-

national Space Station. Reflecting on the lessons learned throughout the development of the station, the partners agreed that one of the keys to the success of the program was having a "long-term shared vision that transcended domestic policies and fostered a shared destiny" (ISS, 2009 p. 2; Payette, 2012).

Thus, it could be argued that besides the ups and downs of national and regional politics, recent progress has also been possible thanks to joint scientific work in very concrete areas. As mentioned above, the shared needs in the region have helped to build bridges between researchers and have led to research and development partnerships between two or more countries. Such efforts have also contributed to building the necessary trust between countries and shown that joint space exploration in the region is not just an extremely complex and expensive dream, but rather a relevant and achievable prospect.

One of the objectives of the ALCE 2020 Constitutive Convention was to "promote the exchange of spatial information related to climate change (...), prevention, mitigation, restructuring and adaptation in the event of emergencies and disasters, (...) promote the use of satellite databases with free and open access for the benefit of the population of the member states (...) and, at the same time, the development of applications in conjunction with satellite transmission data" (ALCE, 2020 p. 4). It is precisely in this field that several Latin American institutions and scientists—under the coordination of the Mexican and Argentinian space agencies—have been closely cooperating since the mid-2010s.

Figure 18. *Screenshots of the SIRIS Platform. Users can access satellite data and create their own plots to retrieve and monitor information at the local, national or regional level.*
Source: proyectosiris.org

In 2017, the first steps were taken to create the SIRIS Platform (Regional Integrated Satellite Information System). SIRIS was the first initiative of its kind in the region, where a multinational platform comprising Argentina, Bolivia, Chile, Ecuador, Mexico, Paraguay, and Uruguay allowed for the direct exchange and cooperation of space technology and information. SIRIS follows in the footsteps of the ISAGRO Platform (Satellite Information for Agriculture) which had similar, although more modest goals, as well as a smaller geographical scope.

The project is a joint initiative of the CNAE (National Space Activities Commission of Argentina) and the AEM (Mexican Space Agency), funded by the IDB. Through open access to satellite data, it provides reliable and up-to-date information to institutions and decision-makers responsible for issuing warnings on climate-related or health risks. It will enable users in the agricultural sector, whether cooperatives, individuals, or associations, to use this product to better plan crop growing seasons, harvests and to adapt to climate change. It also seeks to improve agricultural, forestry and fish farming productivity and to prevent environmental risks by promoting and disseminating the use of cutting-edge technological products containing remote sensing information.

SIRIS provides access to satellite resources for priority tasks through digital components in four main topics:

- Agricultural Tools: information on relevant variables in the agricultural and forestry sectors; NDVI (index for estimating vegetation types and status); soil moisture; frost forecast.
- Fire Tools: allows monitoring of wildfires, provides access to systematized data on hot spots and burned areas, as well as other important meteorological variables.
- Hydro Tools: monitoring stream levels, flood events, and seasonal and historical droughts.
- Health Tools: offers a disease risk stratification map and spatially explicit information on socio-environmental and social indicators that predispose to the distribution of certain diseases at the national and regional levels, for example, the location of potential breeding areas for Aedes aegypti, the mosquito responsible for the transmission of several diseases such as dengue, Zika and chikungunya.

It also represents open access to data, not only for experts, but also for the average users and the producers in the field, allowing them to access information that could easily help them estimate their plot's performance or the risk of drought in the coming days or weeks, in an accessible and visually explicit format.

At this point, one of the greatest challenges is the continuity and sustainability of space cooperation initiatives. For the last two decades, the region has experienced strong political swings, with governments of the right and left publicly confronting each other, and there have been several cases of total or partial interruption of economic and diplomatic relations between states. The tensions or political closeness in the region are strongly reflected in Latin American space diplomacy. For example, the excellent climate of collaboration between Mexico and Argentina that allowed the first step towards the ALCE has

everything to do with the political affinity between the governments of both countries, and it likewise explains the non-participation of Brazil—a strong critic of the left-wing governments in the region—in the most recent cooperation agreements, most notably the ALCE.

In order for the ALCE to be legally constituted, ratification and diplomatic communication from at least 11 countries is required. So far, out of 20 countries that have expressed their adhesion, only five have completed all the steps: Mexico, Venezuela, Dominica, Saint Lucia, and Nicaragua. And there is no guarantee that the remaining fifteen will complete the process. The socio-economic context in the region and the world, and the social upheaval and massive protest movements that have taken place one after another in countries such as Nicaragua, Ecuador, Peru, Chile, or Colombia, have increased the pressure on how governments should prioritize the allocation of public resources, and space exploration is clearly not at the top of the list.

Another major challenge in a field as intensive in cutting-edge technology as space, is the dependence of the countries in the region on external services and resources. For example, as reported by the newspaper La Vanguardia, in 2020 Mexico still had to purchase satellite images from the European Space Agency to coordinate the response to hurricane Eta (Ribas i Admetlla, 2020). Thus, the inability of Latin American countries to complete the entire satellite design-manufacture-launch process remains a significant barrier. In this regard, the progressive creation of a network of nanosatellites for climate and geographical monitoring has been proposed as a medium-term solution. Although several countries in the region already have manufacture expertise, the launch technology of countries such as Argentina, and potentially Brazil as well, would be crucial to achieve this target.

Conclusions

After decades of waning interest, space has regained strategic importance in the international arena in recent years, not only for the usual geopolitical and military-strategic reasons, but also for environmental and economic ones. Both by necessity and by vocation, the LAC region offers all the conditions for the establishment of an international space initiative. In addition to the linguistic and geographical advantages, there is a long history of cooperation in the field of space science, which represents an enormous asset that should not be neglected. International experience has shown that space exploration is a long-term undertaking that requires continuous and stable work, and funding, in order to build the necessary critical mass of experts. In that sense, by far the greatest obstacle to effective space integration is the political turbulence in the region.

Accordingly, this is a case where science diplomacy, and more specifically science for diplomacy, has immense potential to provide solutions. The cases of CERN and SESAME have shown that sustained scientific cooperation bears fruit even when the political environment between the cooperating members might be tense or even ruptured. However, the legitimacy of these initiatives depends to a large extent on their not becoming a mere political platform with a scientific veneer. Furthermore, some scholars have pointed out that a public narrative and expectation for such international platforms to be instruments for purposefully bringing people and countries together has often been interpreted as a political agenda, thus undermining that very goal (Rungius, cited by Melchor et al., 2020).

The SIRIS project serves as a practical illustration of how scientific efforts can effectively fulfill local and international cooperation goals. It showcases how emerging actors and smaller stakeholders, as well as groups of experts from diverse nations can contribute to strengthening existing connections and establishing a regional space cooperation platform to address common regional challenges.

Public Policy Takeout

The resurgence of the global significance of space, driven by environmental and economic factors in addition to geopolitical considerations, positions the LAC region as an ideal locale for an international space initiative. However, stable funding and political stability are critical for sustained progress. Here, science diplomacy, shows great promise. The following questions serve as a foundational framework for discussion and the generation of innovative ideas:

- ALCE must consolidate itself as a credible and respected international body. To ensure independence from regional politics, what governance mechanisms and safeguards can be put in place to insulate ALCE from political fluctuations and ensure a focus on common scientific goals?
- In addition to thematic clusters and a multi-stakeholder network, what other strategies and initiatives can be devised to facilitate the open sharing of scientific knowledge and expertise among member countries, especially in areas such as climate change, disaster risk reduction, and ecosystem monitoring?
- Given the importance of sustainable funding and independent governance, what concrete steps and partnerships should ALCE pursue to secure financial support for its endeavors and ensure the long-term stability and autonomy of its scientific initiatives?
- In light of the growing trend of privatization in space exploration, what mechanisms and guidelines should ALCE put in place to encourage broad participation from various stakeholders and ensure a balanced approach that takes into account both public and private interests? How can ALCE promote transparency and responsible engagement in space activities?
- Recognizing the global nature of space data and the importance of international collaboration, how can ALCE establish partnerships and agreements to access data from international sources for the benefit of disaster management, climate change mitigation, and adaptation efforts?

- To further its objectives, what strategies can ALCE pursue to facilitate educational exchange programs, especially in STEM disciplines, to build a pool of talent and expertise for space-related projects and research in the region?

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7 Hydropower Plants in the Madeira River Basin, Amazon Rainforest

Participating Countries: Brazil and Bolivia

Science in Diplomacy

This is a case of "Science in Diplomacy" because it provides insights into how science diplomacy can inform policy in a two-level game:

- **Missed Opportunities for Scientific Frameworks:** The study highlights lost chances to develop a robust scientific basis that could have supported consensus-building and mitigated institutional conflicts—both domestic and international.
- **Bridging Policy Gaps through Expertise:** It emphasizes the role of science advisors and science diplomacy in improving cooperation and addressing socio-environmental concerns in complex infrastructure projects.
- **Science-Policy Interface:** The case underlines the need to integrate scientific expertise into policy formulation to close gaps between conflicting actors and support informed decision-making.
- **A Valuable Learning Case:** This case serves as a valuable resource for understanding the critical role of managing scientific and technical knowledge in shaping public policies that balance economic viability, environmental sustainability, and social well-being.

Executive Summary

The environmental licensing of two hydropower plants in Brazil was marked by controversy, including inter-bureaucratic disagreements, frictions with Bolivia, and alleged scientific imprecision that downplayed socio-environmental impacts. By highlighting some key moments in this two-level game, this case study illustrates some features of policy-making that science advisors need to be aware of.

Although currently stalled, there are talks between the two countries to negotiate the construction of two more plants on Bolivian territory by Brazilian companies. In this regard, these insights may prove valuable in preventing the recurrence of similar mistakes, and may even lay the foundation for a comprehensive framework to promote scientific cooperation in the Amazon region for future infrastructure endeavors. The structure of the case study is as follows: first, we present the domestic context and conditions in Brazil related to the construction of the dams; second, we offer an analysis of how different agencies in the government acted on behalf of different constituencies with conflicting interests, highlighting both the political and technical-scientific aspects at stake; third, we delve into how these issues were handled in the context of bilateral relations between Brazil and Bolivia; finally, we offer some insights into the lessons that this case may offer to students and practitioners of science diplomacy, both at the political and scientific levels.

Keywords: Environmental licensing; renewable energy; Amazon; science diplomacy; two-level game.

Introduction

In 2001, after a series of historic droughts, the Brazilian government imposed a policy of energy rationing in an effort to avoid a major power shortage. This policy became known as “apagão” or blackout. This situation was the result of years of underinvestment in transmission lines and new power plants, coupled with an overdependence on a few hydroelectric plants. According to the National Electric System Operator (Operador Nacional do Sistema Elétrico), hydroelectric power accounted for 90.4% of all energy generated in Brazil in 2001.

Brazil had been investing heavily on hydroelectric power plants as its main source of energy since the mid-20th century, due to the country’s enormous hydroelectric potential. The culmination of this policy was the construction of the binational Itaipu dam on the border with Paraguay by the military governments in the 1980s. But the “apagão” policy of 2001 led to enormous political pressure for new investments in the energy sector, including not only alternative sources to hydropower, but also the expansion of hydroelectric potential to decentralize and diversify the grid in the context of increasing demand in the Southwest region and urban growth of the North and Center-North regions.[7]

One of the most promising projects was the construction of the so-called “hydroelectric complex” on the Madeira River, in the southwestern Amazon. The Madeira River basin is a sub-basin of and the largest contributor to the Amazon basin, accounting for 20.1% of its territory. The source of the Madeira River is located in the Bolivian Andes, where it is called Beni. The river then flows northeast until it becomes a tributary of the Amazon River in the Brazilian Amazon rainforest. The Madeira River is the largest tributary of the Amazon River, carrying nearly 15% of its water volume. From source to mouth, the Madeira River spans approximately 3240 km, of which 1425 km are in Brazilian territory. Due to these and other geomorphic features, the Madeira River is highly attractive both as a source of hydroelectric power and as a waterway for transporting agricultural production.

The Madeira hydroelectric complex was first envisioned as one of the projects within the Initiative for the Integration of the Regional Infrastructure of South America (IIRSA), signed in 2000, and later incorporated into the Lula government’s major state-led infrastructure investment policy, the Growth Acceleration Program (Programa de Aceleração do Crescimento – PAC), in 2007. Among other goals, this project also aimed to respond to a century-old idea of further integrating the Amazon region with the rest of the Brazilian territory and economy.

[7] Since then, dependence on hydroelectricity has been on a slow but steady decline. In 2022, it accounted for 71.6% of the country’s energy consumption, due to increased investment in other sources, especially wind (13.2%) and thermal energy (10.7%).

The original projects for the Madeira hydroelectric complex comprised the installation of four new hydroelectric power plants (HPPs), two of which are now fully operational: the Santo Antonio HPP, with a reservoir area of 451.56 km² and an installed capacity of 3568 MW and the Jirau HPP, with a reservoir area of 361.6 km² and an installed capacity of 3750 MW. Both are located close to the state capital of Rondonia, Porto Velho. The other two are the Guajara-Mirim HPP (on the Mamoré River, a tributary of the Madeira), on the border with Bolivia, which will be managed as a binational dam along the lines of Itaipu, and the Cachuela Esperanza HPP, which is to be situated in Bolivian territory. Furthermore, the completion of the complex would turn the Madeira River into a fully navigable waterway, enabling the Amazon region to export production through a cheaper and more direct route to the Atlantic Ocean.

This project thus became an enormous political asset because it aligned with several of the main objectives pursued by the Lula government in particular, but also other Brazilian federal administrations in recent decades: South American regional integration; expansion of energy supply; economic growth based on state investment, especially in major infrastructure projects; partnership with civil construction companies which were central pillars of the government’s support base; further integration of the Amazon region into the national economy.

However, since their inception until now, the Santo Antonio and Jirau HPPs have been marked by countless controversies. As of today, the list of reported conflicts and negative impacts related to the dams includes threats to local biodiversity, accumulation of waste and sediments on the riverbed, flooding in urban areas, fragmented dialogue with local and indigenous populations, displacement of residents, illegal mining and poaching, unsatisfactory working conditions on construction sites, and tensions in bilateral relations with Bolivia.

One of the aspects that drew a lot of attention from political observers at the time was the environmental licensing process, which involved a very complex sequence of institutional and inter-bureaucratic disagreements and negotiations between the Ministry of Mines and Energy, the Ministry of the Environment, and the President’s Chief of Staff[8]. Of particular interest to us is the conflict resulting from accusations that the technical studies that served as the basis for the environmental licensing (called EIA/RIMA) contained imprecise scientific concepts and neglected relevant information in order to downplay the extent of the environmental and social impacts of the HPPs and obtain a quick clearance for the projects (Angelim & Ribas, 2022; Fearnside, 2013; Ishihara, 2015; Monteiro, 2011, Oliveira et al., 2008).

Domestic coalitions and environmental licensing in Brazil:

The five basic steps for the construction of an HPP in Brazil are: preliminary studies, inventory studies, technical and economic viability studies, initial project,

[8] In the Brazilian federal government, the Chief of Staff is the head of a specific ministry, called Ministério da Casa Civil, whose function is to help the President with political articulation. For lack of a better translation, by Chief of Staff we mean the ministry, not its head.

and executive/construction project (ISHIHARA, 2015). In addition, at least three different types of environmental licenses are required between those steps. In Brazil, the state agency responsible for expediting environmental licenses is IBAMA (Brazilian Institute of the Environment and Natural Renewable Resources), a regulatory body within the Ministry of the Environment (MMA). The three types of environmental licenses required are:

- Preliminary license, which approves the project's location and concept, validates its feasibility, and outlines the requirements for the subsequent steps. This permit is subject to the submission and approval of a set of environmental impact studies/reports called EIA/RIMA (Estudo de impacto ambiental/Relatório de impacto sobre meio-ambiente).
- Installation license, which grants authorization for the setup of facilities and the start of construction works.
- Operating license, which authorizes the start of the energy generation activities provided that all previous requirements have been met.

In January 2001, the Brazilian National Electric Energy Agency (Agência Nacional de Energia Elétrica – ANEEL), a regulatory body within the Ministry of Mines and Energy (MME), commissioned the inventory studies for the Madeira River, which were carried out by the civil construction company Odebrecht and the energy company Furnas, the latter a subsidiary of the then state-owned Eletrobras. These two companies would later on lead a consortium called "Madeira Energia" to bid in the 2007 public auctions for the concession of the HPPs. The inventory studies were subsequently delivered in November 2002 and approved by the federal government in December 2002.

In September 2004 IBAMA released the so-called term of reference, a document that by law must be used as a technical guideline to the environmental impact studies/reports (EIA/RIMA) that are required in order to obtain the preliminary environmental license. Furnas and Odebrecht carried out the technical and economic viability studies for ANEEL in 2005, which included the EIA/RIMA.

There was in fact a long and complex series of negotiations between the technical teams inside IBAMA (as well as external experts hired by the agency) and the experts commissioned by the companies to draw up the studies, regarding the necessary contents, technicalities and extension of the studies (Monteiro, 2011). However, in 2007, IBAMA published a technical note stating that the EIA/RIMA submitted by the companies did not meet the technical requirements of the term of reference. This, in practice, meant that the preliminary license would not be granted and that the public auction could not take place. A plethora of highly technical issues were the cause of disagreement, and many independent observers had noted throughout the process that the studies were insufficient to ensure a comprehensive understanding of all the social and environmental impacts caused by the dams.

One of the main issues was that IBAMA's terms of reference originally called for a study that encompassed the entire Madeira Basin inside Brazilian territory, which Furnas argued was infeasible. The parties were able to reach an agreement to limit the impact assessment only to the state of Rondonia. It has been noted by specialized literature that even the assessment of the area prescribed by the term of reference would still underestimate the environmental impact, since the natural, systemic area of the Madeira Basin also includes a considerable portion inside Bolivian territory.

In addition to the environmental impacts, many civil society organizations have pointed out the numerous social impacts of the construction of the dams. According to the social movements involved in the mobilization against the power plants, one of the main issues revolves around the disregard for the rights of the traditional Amazonian peoples. The concept of Traditional Amazonian Peoples includes not only indigenous peoples, but also riverine peoples (povos ribeirinhos), quilombola communities (descendants of formerly enslaved Africans) and other forms of culturally diverse social organizations that use forest resources as a means of social reproduction (Brasil, 2007).

The population in remote areas of the municipality of Porto Velho was particularly affected. The Mutum-Paraná district was completely flooded to make way for the Jirau reservoir, and its residents were relocated to a new district (New Mutum-Paraná) built by the consortium to accommodate them. However, residents reported that communication with the consortium was poor and fragmented, and that throughout the displacement process many of their questions and demands were completely ignored, including disagreements over the value of compensation for the loss of their property. In addition, anthropologists and other social scientists highlighted how displacement to a culturally meaningless place affected various aspects of these people's personal and social lives, a dimension that had not been taken into account by the EIA/RIMA, nor by the consortium at the time of displacement. This partly explains why many people later moved to other cities, mainly the state capital, which in turn faced urbanization problems caused by the sudden influx of new residents with very limited financial means.

As required by the environmental licensing regulations, four public hearings were held prior to the start of construction works of the HPPs, which was attended by citizens of Porto Velho, representatives of political parties and social movements, and university professors. The discussions in those public hearings were polarized between civil society representatives –who argued that the EIA/RIMA did not take into account social specificities of the territories where the power plants were to be built–, and federal and state government authorities –whose discourse highlighted the economic development opportunities that such power plants could bring to the region and to the country as a whole– (Stolerman et al. 2014).

Many, if not most, of the civil society organizations that were highly active in the process were committed to completely halting the construction and

operation of the two power plants. For example, the Independent Popular Forum of Madeira presented a determined opposition to any kind of negotiation to accept the licensing of the power plants. The Forum, an organization that brings together several social movements –such as the Organization of People Affected by Dams (MAB) and the Landless Workers' Movement (MST)– as well as indigenous peoples –such as the Ariramba and Kanindé peoples– presented a series of testimonies from the affected communities to stress the lack of communication channels between them and the companies responsible for the HPPs.

However, given the interest in advancing its economic growth programs, the federal administration had made it clear early on that approving the projects was a major priority, directly pressuring IBAMA to issue the preliminary permit. At this point, the licensing process turned into a tug-of-war between the Ministry of Mines and Energy (through its agency ANEEL) and the Ministry of the Environment (through its agency IBAMA) (OLIVEIRA et al., 2008). The inter-bureaucratic deadlock would only be broken after the intervention of the government's Chief of Staff (Ministério da Casa Civil), who pressured IBAMA to finally issue a preliminary environmental license for the Jirau and Santo Antonio dams. The license was granted with the condition that the companies comply with a list of 33 demands, by which IBAMA sought to compensate for the previously identified insufficiencies. Whether these 33 demands have been satisfactorily met to date is still a matter of debate.

At this point, it is interesting to highlight a fact that outside observers unfamiliar with the political process may not realize, which is that different ministries, bureaus, departments (or any department within governments, for that matter) are often responding to very different constituencies, whose goals and interests can sometimes be contradictory or conflicting. This case provides a very clear illustration of that. The Ministry of Mines and Energy has traditionally had institutionalized channels with energy companies (both state-owned and private), including companies responsible for managing the hydroelectric dams across the national territory. The Ministry of the Environment, on the other hand, has had more solid ties with environmental organizations spread across the country. This insight into the political process is valuable for negotiators to understand that states aren't black boxes with self-evident interests, and that they or their counterparts may face internal struggles because different segments inside their societies lobby more directly with different branches of government.

Soon after the preliminary license was granted, in late 2007, the government held the public bidding for the two HPPs. The consortium that won the auction for the Santo Antonio HPP was originally called "Madeira Energia" and was formed by the companies Odebrecht, Andrade Gutierrez, Cemig, Furnas, Banco Santander and Banif. Today, the company that operates that HPP is called "Santo Antonio Energia", and is mostly owned by Furnas Centrais Eletricas S.A., a subsidiary of Eletrobras, followed by other national investment funds.

As for the Jirau HPP, the winning consortium was originally formed by GDF Suez, Camargo Corrêa, and two different subsidiaries of Eletrobras (CGT and CHESF). The Jirau HPP auction was marked by even further controversies when the consortium decided to change the location of the dam 9 kilometers downstream from the original plan, which triggered even more complaints from opposing groups, since this was not contemplated by the EIA/RIMA studies. Today, the company that operates the Jirau HPP is called "Energia Sustentavel do Brasil", which is jointly owned by the French company Engie (former GDF Suez), Mizha Energia (a subsidiary of Japanese company Mitsui), and the two subsidiaries of Eletrobras (Chesf and CGT Sul).

Overall, Eletrobras and its subsidiaries are the main stakeholders in the Madeira energy complex (76,5% in the Santo Antonio dam and 40% in the Jirau dam). Eletrobras was originally a state-owned company, but became a fully public company in 2022, making it difficult to track all its national and international investors. However, the Brazilian federal government still owns approximately 45% of its shares, and is therefore one of the major stakeholders in the Madeira hydroelectric complex, together with the other private companies mentioned.

In addition, the BNDES (National Bank for Development), a state-owned development bank, contributed about half of the credit for the construction of the dams, while the other half was financed by other financial institutions, including the state-owned Caixa Econômica Federal and the mixed-capital bank Banco do Brasil, among other private financial institutions such as Santander, Bradesco, Unibanco. This model of investment heavily led by the state and state-owned banks and companies was typical of the PAC program and has been replicated in many other infrastructure projects.

After the auctions were concluded and contracts were signed, construction of the two dams began in 2008. Power generation began in 2012 at Santo Antonio and in 2013 at Jirau. Both HPPs were definitively concluded in 2016. Nevertheless, conflicts and controversies were present during the whole process and are still far from over. The quick solution implemented to break the EIA/RIMA deadlock ultimately turned into a cascade of long-term problems. One example is worth mentioning because of the social and media attention it has received.

In 2014, a series of floods affected several rural and urban areas in the state of Rondonia, including neighborhoods in the capital, Porto Velho. A major debate ensued as to whether they were caused by non-compliance with technical regulations or by the operators' negligence with regard to the water levels in the dams. On the scientific-technical front, the issue is still unsettled, as a number of studies have been commissioned by different teams on both sides of the dispute, some of which point to the dams as the cause of the floods, while others exonerate them and blame natural, albeit unusual, rainfall and river flooding. Because of the controversial way in which the environmental impact studies were approved in 2007, they were brought up again. Immediately after the floods, a coalition of organizations led by public prosecutors and attorneys

successfully obtained a series of court rulings that established the water levels at which the dams should operate and also ordered the consortia to submit a new EIA/RIMA (Brasil, n.d.; OAB/RO, 2014). This is also illustrative of how judicialized the problem of the Madeira HPPs has become, adding another layer of institutional complexity.

International dynamics and bilateral relations with Bolivia:

At the international level, the Madeira hydroelectric complex is implicated in the broader context of bilateral relations between Brazil and Bolivia. As mentioned before, the original concept of the project encompassed not only the two power plants near Porto Velho, but also one on the border between the two nations, (Guajara-Mirim), with an estimated capacity of 3000 MW, and one on Bolivian territory, around 20 km from the border with Brazil (Cachuela Esperanza), with an estimated capacity of 1000 MW. Having analyzed diplomatic cables from the Brazilian embassy in La Paz between 2006 and 2023, we concluded that negotiations for these two HPPs came and went, but for several reasons they failed to make significant progress. The general dynamics of the negotiations between the two countries were marked by Brazilian officials and companies trying to convince their counterparts to advance with the planning and execution of the projects, and the Bolivians wavering in their commitment to following through. Talks between the countries were stronger in the early stages of construction of the Brazilian dams (circa 2008), and then between 2010 and 2012. After that, negotiations waned, and the two HPPs are seldom mentioned in the media or by officials.

The perspective of Bolivian actors on the Madeira River complex varied over time and across different segments of society, but domestic coalitions formed along roughly the same lines as in Brazil. Overall, from the point of view of the government and the energy industry, there was an interest in negotiating the construction of the plants with the Brazilian government and companies, first as an option to increase Bolivia's energy supply, and second to guarantee cheaper and faster navigable access to the Atlantic through the waterway. At the same time, some organized sectors of civil society, including environmental and indigenous movements that were important constituents of the governing coalition, were highly critical of the socio-environmental impacts of the projects and actively articulated ways to hinder their progress.

It's worth noting that these perspectives were anchored in a broader context of energy policy reevaluation that Bolivia underwent during the 2000's. Since the so-called "gas war," natural gas, one of Bolivia's major exports, has been at the heart of the country's political discourse. Behind it was a strong political and popular pressure against the export-oriented exploration of gas by foreign companies. A popular uprising in October 2003 resulted in the ousting of President Gonzalo Sánchez de Lozada, and in March 2005 President Mesa faced considerable political pressure to approve a new General Hydrocarbons Law that would impose stricter regulations on foreign oil companies.

President Morales took office in January 2006 with the campaign promise to nationalize Bolivia's natural resources. This commitment led to the renegotiation of energy contracts with international companies operating in the country, including the unilateral nationalization of a plant that belonged to Brazilian mixed-capital oil giant Petrobras. A Brazilian diplomat referred to this as the most serious diplomatic conflict ever between the two nations (Carra, 2014) and the most significant one in the region during the 2000s, even though the presidents of Brazil and Bolivia were ideological and political partners in other arenas. In this context, the cooperative partnership between the two nations faced significant challenges that directly and indirectly affected the negotiations for the hydroelectric plants on the Madeira River.

Tensions between the countries were present since the early stages of the construction of the Santo Antonio and Jirau dams. For example, in a meeting of the Amazon Parliament (a non-binding cooperation group between legislatures of national and subnational Amazonian entities) in 2008, a Bolivian representative accused Brazil of ignoring international norms requiring the socio environmental impact studies to be prepared in partnership with Bolivia, since the hydric resources involved in the project were essentially transnational. This complaint was echoed by the Bolivian Minister of Foreign Affairs a month later, and it reveals that Bolivian officials were under pressure from sectors of their society regarding the environmental impact of the projects. In an attempt to appease the Bolivian complaints, the Brazilian Ministry of Foreign Affairs announced the formation of three bilateral technical commissions to assess the impact of the dams on fisheries, the health of the local population, and potential floods in Bolivian territory.

As already mentioned in the previous section, the EIA/RIMA conducted by Brazilian companies for the Santo Antonio and Jirau HPPs were restricted to a portion of the basin and to Brazilian territory. The companies, as well as the Brazilian authorities, claimed that there were no impacts to be accounted for on the Bolivian side. Again, this debate is full of technical and scientific controversies, since independent hydrologists and geomorphologists have disagreed with the EIA/RIMA and the official Brazilian discourse. The potential impacts inside Bolivian territory have often permeated the negotiations and relations between the two countries and are still a matter of disagreement between their governments and specialists.

In the negotiations for the Cachuela Esperanza and Guajara-Mirim HPPs, Brazil adopted a strategy of trying to persuade the Bolivians to diversify their energy sources, including with hydropower and biofuels. This was also framed as a way of deepening regional integration between their economies and infrastructure through the Madeira River complex. Furthermore, beyond the socio-economic benefits, they argued that shared used of the hydroelectric potential in the Madeira River basin could potentially address the concerns of the Bolivian authorities regarding the Jirau and Santo Antônio HPPs.

Of course, Brazil had vested commercial interests in exporting these solutions to Bolivia. Another major Brazilian interest was to import the excess energy that would be produced in Bolivia. However, much to the disappointment of the Brazilians, the Bolivian government appeared to be moving in the opposite direction, increasingly relying on purchasing thermoelectric plants to meet the growing domestic demand, many of which employed inefficient technology and came at inflated prices.

A major disagreement between the countries was that Bolivia was primarily interested in the stand-alone Cachuela Esperanza HPP. However, this project was likely to make electricity exports to the Brazilian market impractical due to its location and high transmission costs. On the Brazilian side, the main interest was in the Guajara-Mirim binational plant. Brazil believed that Cachuela Esperanza had limited economic viability if viewed independently, and saw it more as a concession to Bolivia. Eletrobras expressed interest in participating in the Cachuela Esperanza project in principle and offered to conduct studies to further analyze Bolivia's hydro potential, provided they were linked to the binational Madeira River project. The Bolivian authorities wavered between agreeing to the Brazilian offers and then halting negotiations before solidifying commitments, thus avoiding giving concrete indications of their actual intentions to establish such a partnership.

Another point of contention between the parties was the price at which Bolivia would sell the excess energy to Brazil. Brazil argued that, given its domestic prices, the prices Bolivia was asking were only realistic if both HPPs were executed. During the negotiations, the Bolivian vice-president emphasized that the Brazilian market was not their only option and suggested that Chile could be an attractive market for selling electricity. This suggests that Bolivia may have used restrictions on the HPPs, including environmental ones, to strengthen its position in the negotiations.

Finally, another aspect worth mentioning is that, at the time, Brazilian efforts to expand economic activities to neighboring countries received critical attention from several South American observers. Sectors of the Bolivian civil society and media took the view that Brazil was acting in a "sub-imperialist" manner. One instance was the article published in 2011 by Bolivian newspaper "La Razón", claiming that Bolivia had a constant trade deficit with Mercosur, and that agreements with the bloc had also jeopardized exports to other nations. This article also touched on the Madeira River projects, recognizing both the economic opportunities and the potential environmental impacts. From all of this, it can be inferred that from a Bolivian perspective, there was a widespread sense of mistrust regarding the asymmetrical nature of the relationship between the two nations, and that they were uncertain about the specific strategies required to secure a more favorable deal, while also being responsive to the domestic constituents who opposed the projects due to socio-environmental concerns.

Insights and takeout

Clean and affordable energy, a key Sustainable Development Goal (SDG), is indispensable for fostering economic development and raising living standards, particularly in underdeveloped regions. However, both the demand for and the potential to supply energy can be heterogeneous across regions. The absence of the necessary infrastructure in underdeveloped areas, such as the Amazon, hinders progress and directly impacts the quality of life of local populations. The key question centers on how to achieve optimal outcomes: minimizing environmental, social, and economic costs while maximizing returns for local residents and society as a whole. However, there is no one-size-fits-all solution to that problem, as each region possesses unique characteristics, and the proper identification, utilization and management of local resources is of paramount consideration. In many ways, the case of the Madeira River power plants highlights the complexity and dynamics of such a challenge.

The first insight of interest to theoreticians and practitioners of science diplomacy to be drawn from this case is the deeply interdisciplinary nature of the issues at stake. The simultaneous achievement of energy generation and socio-environmental sustainability involves intricate interactions between different fields of knowledge, including geology, engineering, and social sciences, among others. The sheer complexity of such interactions should be sufficient in itself to illustrate the need for a comprehensive scientific framework to facilitate consensus building, mitigate institutional conflicts, and enhance national and international cooperation.

The case of the Madeira River can be seen as an example where the lack of such a framework led to suboptimal decision making. Data collection, management of technical and scientific information flows, and maintenance of channels for scientific debate were mostly ad hoc, sporadic, uncoordinated, and non-transparent. In some cases, relevant technical assessments were made post-factum, which is far from desirable. In addition, political pressure for swift approval of the initially contested EIA/RIMA studies cast doubt on their validity. This led to institutional uncertainty and irregular enforcement of environmental measures. In addition, court rulings based on technical reports commissioned by third parties further underscored the lack of information management and shifted the decision-making process further toward arbitrary rather than consensus-building procedures.

Although certainly slower at first, formulating a clearer and more solid consultation framework beforehand would have saved stakeholders a lot of time and effort in the long run. Unnecessary impacts on local populations could have been avoided, and even international cooperation with Bolivia could have been advanced, if Brazil had offered a broader and more concise platform based on scientific and technical grounds. This goes to emphasize the potential role of SD in managing techno-scientific knowledge to inform economically viable, socially responsible, and environmentally sustainable policies.

Second, this case is a typical example of what internationalists call a two-level game: the simultaneous interaction between domestic and international negotiations. Although traditionally restricted to the international level, recent literature on SD has been expanding the scope of its concepts, emphasizing its role in supplementing elected officials with scientific expertise at all levels, in what could be more broadly termed Science Advisory. Incorporating this notion, already well-established in the field of International Relations, that the domestic and international levels can sometimes have mutual influences, is a great opportunity for those in the field of SD to expand the use and the understanding of their tools.

In this regard, the field of SD could be enriched by drawing on another notion, one very dear to political scientists and internationalists alike, known as the pluralist view, which frames the outcomes of public policies as the result of competition between different groups with conflicting interests. In this view, governments are fragmented representations of society, with different agencies responding to different groups of constituents. The Madeira River showcases that very clearly, as illustrated by the struggle between Brazilian agencies on the approval of the EIA/RIMA studies, and also by the wavering commitment of the Bolivian government to the construction of new dams in its territory. These inter-bureaucratic struggles show the inherent complexity of policy-making. But, instead of the glaring absence of an integrated scientific framework to assess the complex interactions among social, economic, and environmental systems, the presence of such a framework could have offered technical parameters to help negotiators expand the overlap between their zones of potential agreement. Thus, analyzing both international and domestic dynamics is paramount for skilled diplomats who wish to find effective solutions to problems that require complex political settlements.

Finally, the case demonstrates that science can be strategically used to back up specific interests. While this may sound obvious to policymakers, it may be somewhat disheartening to scientists. Data, methods, and results can be, and usually are, cherry-picked to frame issues in a way that is convenient for interested parties. This is possible not only because of cunning negotiators, but also because skepticism and disagreement are inherent features of scientific inquiry. In this context, the importance of critically evaluating technical-scientific studies is evident, as they are not immune to underlying interests, and even if they aren't technically wrong, they may omit crucial information. The Madeira River case serves as a valuable lesson for students of SD in this regard, as much of the literature emphasizes the universality of science as an asset for consensus building. While this is absolutely true to a certain extent, we shouldn't be carried away by the naive expectation that science will always provide unassailable answers. Thorough evaluation is always necessary to separate the wheat from the chaff. Far from discrediting the potential of scientific cooperation to address global challenges, this means that science diplomats must be aware that knowledge is and always has been a source of power, and that it can sometimes be used to deepen inequalities in asymmetric relationships. Rather, science diplomats should look for opportunities to build scientific cooperation frameworks that aim to mitigate these asymmetries.

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8 Science Diplomacy and Artificial Intelligence

Participating Regions: Latin America, United States, China, European Union

Science for Diplomacy

This is a case of "Science for Diplomacy", as it highlights urgent issues for the development of legal frameworks and international cooperation:

- **Emerging Technologies and Global Governance:** Artificial intelligence (AI) encompasses a range of computational systems that use past observations to predict future outcomes. The pace of development demands international dialogue and joint governance mechanisms.
- **Policy Challenges:** Policymakers must craft legal frameworks that foster innovation while safeguarding citizens against unintended consequences.
- **The Role of Science Diplomats:** Science diplomats are tasked with anticipating the broader implications of technological transformations and equipping decision-makers with critical perspectives.

Executive Summary

The goal of this text is to provide students and practitioners of science diplomacy with a broad overview of the basic definitions and concepts behind artificial intelligence, including its fundamental operational principles and the inherent opportunities and challenges it presents.

This stems from the need to demystify AI and enable policymakers to strategically harness its potential while proactively mitigating associated risks. The text also aims to offer readers a comprehensive overview of how different world regions are currently dealing with the development of legal frameworks for AI regulation.

The text is organized as follows:

- **Section 1** presents a brief introduction to the topic.
- **Section 2** provides a basic notion of what AI is and how it works.
- **Section 3** offers a broad overview of the main opportunities and challenges posed by AI implementation in public and private services, and its impact on decision-making.
- **Section 4** analyzes how four global regions are developing regulatory frameworks to address the challenges and opportunities associated with emerging technologies. Six areas of concern are examined: cybersecurity, data privacy, intellectual property rights, algorithmic bias, political behavior, and ethics.
- **Section 5** offers insights on the role of science diplomats in advancing international cooperation and responsible AI governance.

Keywords: Artificial intelligence; science diplomacy; regulatory frameworks; AI governance.

Introduction

Artificial intelligence (AI) has been having a transformative impact across numerous fields. These include science, the economy, services, politics and even human relations. In science, AI can help researchers understand patterns and accelerate data analysis; in the economy, it can revolutionize industries and enhance productivity; in politics, it can influence decision-making and assist public policies with data-driven insights; and in human relations, it raises important ethical concerns about how we interact with machines and with each other. In addition, AI also offers new ways to address global challenges such as inequality, climate change, food security, and the provision of public goods and services. And there's potential for much more (Gruetzemacher & Whittlestone, 2022; Mont et al., 2020).

Consequently, decision-makers of all levels are increasingly required to understand the applications of AI. However, there are still many misconceptions surrounding AI that can lead, on the one hand, to missed opportunities to improve decision-making, and on the other, to an overestimation of what AI's capabilities are. Hence, there's a pressing need to clarify the uncertainties surrounding AI, and ensure that decision makers have the necessary tools to properly evaluate the use of this technology.

Everyone from policymakers and regulators, to developers, users and consumers, and society at large, is already grappling with significant challenges when it comes to using and integrating AI technologies across these diverse domains. These include, but are not restricted to, cybersecurity, data privacy, intellectual property rights, biased or imprecise information, fake news, political behavior, and ethical concerns of all kinds. At all political levels (local, national, regional and global), policymakers are facing the need to find suitable ways to regulate the use of these technologies. But, in order to tackle these challenges, we first need to understand the basic principles of what AI is and how it works.

What is AI?

There is no single definition of Artificial Intelligence. Despite being a concept that is constantly being reinvented, and particularly hyped recently, it's not really a new one. The idea of artificial intelligence is almost as old as computers themselves, and scientists have been speculating about the similarities between the way computers and the human mind work for decades. In 1950, British leading computer scientist Alan Turing published a seminal paper called "Computing Machinery and Intelligence", in which he developed a philosophical and empirical investigation to answer the question "Can machines think?". He proposed an experiment called "The Imitation Game", which is now regarded as one of the first attempts to determine whether machines can act indistinguishably from humans. The term "Artificial Intelligence" itself, in turn, was coined in 1956 by American computer scientist John McCarthy, who defined it as "the science and engineering of making intelligent machines, especially intelligent computer programs'' (McCarthy, 2007, p.2).

Since then, the general notion of what AI is hasn't changed much. A widespread understanding and somewhat generic definition would be that AI is the use of computer systems to simulate aspects of human intelligence, such as learning, understanding emotions, communicating effectively, being sensitive to specific contexts, and solving problems autonomously. What has certainly changed, however, are the conditions that, in the last decades, have enabled the use of AI to become a reality in many applications. The confluence of five main factors has contributed to the recent upsurge in AI: the increase in available data to train the machines; the increase in computing power arising from advances in nanotransistors; the constant refinement of algorithms[9]; the accumulation of knowledge from previous decades; and the decrease in cost and availability of complementary technologies, such as the Internet (Feijoó et al., 2020). Due to its enormous potential and widespread accessibility, AI has emerged as one of the most rapidly advancing and transformative fields of science.

However, beyond the broad notion that AI is an attempt to simulate human intelligence, there's no consensus on what exactly that means. This is because definitions may vary depending on the type of programming approach, the desired goals, and the techniques employed.

At the macro level, there are currently two major developing (and philosophical) paradigms for what the capabilities of AI should be: general (or strong) AI and narrow (or weak) AI (Bjola, 2020). General AI is seen as the complete simulation of human cognitive capabilities in all their aspects, including the complex interactions between them - it's the kind of machine that would pass Turing's imitation game test as indistinguishable from a human. Although this is the concept of AI most commonly portrayed in science fiction, it's still largely only theoretical now. A narrow AI system, on the other hand, is a computer program that employs a set of mathematical or statistical techniques to perform a single task or very few tasks, such as image recognition or customized recommendations in social media feeds. Most concrete examples of AI applied to the current technological devices and services fit the narrow category.

Other examples of different perspectives and approaches to AI include how developers measure the excellence of AI performance (whether the goal is to mimic typical human behavior, or to achieve a rational optimal result), and the difference between symbolic and connectionist artificial intelligence. These last

[9] "Informally, an algorithm is any well-defined computational procedure that takes some value, or set of values, as input and produces some value, or set of values, as output. An algorithm is thus a sequence of computational steps that transform the input into the output." (Cormen et al., 2009) In other words, algorithms are the set of instructions implemented by developers in the form of code that enable software applications to solve a specific problem or perform a particular task in a systematic and structured manner.

two represent yet another distinction of paradigms in the field of AI. The former relies on predefined rules and decision trees to derive the optimal problem-solving path. In contrast, the latter, also known as neural network-based AI, works by feeding data to the machine, enabling it to learn and discover its own optimal solutions through processes like deep learning and pattern recognition.

So, given the diverse landscape within the field of AI, we find the following two definitions illustrative of what most people these days understand by AI:

"AI refers to the activity by which computers process large volumes of data using highly sophisticated algorithms to simulate human reasoning and/or behavior [employing] any technique that enables computers to mimic human intelligence, [such as] logic, if-then rules, decision trees, and machine learning (including deep learning)" (Bjola, 2020)

"Artificial intelligence (AI) systems are software (and possibly also hardware) systems designed by humans that, given a complex goal, act in the physical or digital dimension by perceiving their environment through data acquisition, interpreting the collected structured or unstructured data, reasoning on the knowledge, or processing the information, derived from this data and deciding the best action(s) to take to achieve the given goal." (European Commission's High-Level Group on AI) (Smuha, 2018)

To simplify, we can condense the parts that make up AI into four fundamental elements: a given goal, input (or data), interpretation (or processing), and output (or action). Thus, AI is a computer system designed to analyze data and optimize decisions to accomplish a certain goal. However, each of these steps can be approached and programmed through a variety of techniques. For example, the dataset can be fed to machines by programmers, or machines can automatically search for new information and constantly update their database. Similarly, the algorithms can either be given by programmers, or the machines themselves can determine the algorithms that best fit the data and constantly improve them as new data is input. This last technique is generally referred to as machine learning. Although not all AI applications are based on machine learning, the use of this technique has become prevalent in many different industries.

So, in a nutshell, AI can be understood as an umbrella term that encompasses many types of computer programs, and because all these techniques are in constant and swift evolution, stricter or narrower definitions can quickly become outdated or meaningless, which, as we'll see, is one of the challenges regulators are facing in the attempts to design coherent legal frameworks.

How does AI work?

As we've seen in the previous section, AI is an umbrella term that designates a broad variety of types of computer programs, each of which works in a specific way. But one general way to illustrate it is this: when trying to achieve a certain goal, every time the AI chooses a course of action that results in an undesirable effect (more distant to the desired goal), it learns to avoid it, and every time it chooses a course of action that results in a desirable effect (closer to the desired goal), it learns to repeat it. In other words, machines learn through a series of iterations and choose the path that will yield the best possible result. In fact, this is not so different from human learning: think of a child burning his or her hand on the fire for the first time, unaware of the consequences of this action, only to associate it with pain and avoid it in the future. But through a sequence of further iterations in different contexts, the child will eventually also associate the proper use of fire with warmth or cooking for nourishment.

Technically, what AI systems essentially do is predict (Feingold, 2023). AI uses past observations to predict future observations through a variety of statistical techniques, enabling machines to perform tasks, make decisions, and solve problems. It feeds on past data to identify patterns, and every time a new observation is included, it predicts in which pattern or patterns that new observation would fit best. This is extremely useful because countless chores can be automated and performed much more effectively. For example, AI systems can find patterns of pixels in an image and, by comparing with the patterns in a database of already labeled objects, identify what objects are in the new image. This is the idea behind applications such as facial recognition, AI art, geospatial referencing and automated medical imaging diagnosis. AI systems can also identify patterns in written texts and predict the most likely next word in a given context, which is the idea behind Natural Language Processors and chatbots that are now widely used in customer services, search engines and translation platforms. In e-commerce, AI is used to identify the consumption patterns of individuals and advertise specific products that are directly relevant to those patterns.

The same basic idea applies to a long list of fields relevant not only to the market, but also to the provision of public goods and services (Mont et al., 2020). In healthcare, AI is used to triage patients, optimizing the distribution of resources and rooms, and predicting the evolution of symptoms. In public security, AI is used to predict the neighborhoods where crime is most likely to happen on a particular day, optimizing police deployment. On the environmental front, AI can help monitor and manage conditions such as air quality, climate, weather forecasting and natural disaster prevention. And the list goes on. But the basic principles are the same: machines are fed with data, make predictions based on the trends they identify, and make suggestions or decisions based on their analysis.

Opportunities and challenges

It's clear by now that, with all these different tools, AI offers incredible opportunities. AI technologies are currently at the forefront of innovation, driving economic development by boosting productivity, enabling automation, broadening the scope of public services and advancing scientific progress. They can also be used strategically by countries to attract foreign investments and generate income through patenting cutting-edge technologies. The integration of AI in public policies and governance offers the promise of vastly improving the speed and

quality of decision-making, with the potential to greatly improve the provision of public services to society. AI technologies might even open new avenues for government transparency, increasing the accountability of public institutions.

However, this technological frontier is not devoid of challenges. Like any other powerful tool, AI can be seen as a double-edged sword (Nature Machine Intelligence, 2022). The application of this kind of technology poses challenges of various natures: economic, legal, political and ethical. Understanding both the opportunities and the risks is of paramount importance to policymakers because the applicability of AI tools also has a series of limitations and weak spots. In other words, policymakers must be aware of the costs associated with AI tools in order to be capable of critically evaluating their implementation. Below, we provide insight into six of these challenges: cybersecurity, user privacy, intellectual property rights, bias, political behavior, and ethical concerns.

One of the first pressing issues is cybersecurity. Because modern companies and governments are becoming ever more dependent on information and communication technologies such as the Internet and cloud computing, they are also becoming more exposed to cyberattacks. Here, AI tools can be seen as a weapon for both prevention or attack. On the defensive side, AI is being used by organizations to protect their digital assets, ensuring confidentiality, integrity and accessibility (Sarker, 2021). Machine learning algorithms can swiftly analyze vast amounts of network traffic and user behavior, allowing for the early detection of anomalies and potential threats. Furthermore, AI systems can enhance the speed and accuracy of incident response by automating routine tasks and even predicting future attacks based on historical data.

However, the dual nature of AI means that it can also be exploited by malicious actors. Adversarial AI, for instance, can create deceptive content and malware that circumvents traditional security measures, making it increasingly difficult to identify and defend against cyber threats. This can lead to data breaches, where sensitive information such as identity and financial data is stolen and potentially misused. These incidents not only jeopardize individual privacy, but can also lead to financial and personal losses and security risks for those affected.

A second issue centers around the collection and use of personal data and its implications for user privacy (Subramanian, 2017). Though not limited to them, social media platforms are the forefront of this discussion. Users may not always be aware that virtually every online interaction they engage in generates valuable data, which service providers often harness for various purposes, including selling bundles and analytics. This practice is sometimes not explicitly disclosed in the terms of use, but even when it is, substantial debate persists about the ethical implications and potential abuses of such practices. A particularly notorious illustration of this issue is the well-known "Cambridge Analytica scandal," when it was revealed that Facebook, one of the largest social media platforms, had allowed unauthorized access and misuse of user data for political and advertising purposes. This gave rise to a broad debate on the responsible processing of personal data and the extent to which the safeguard and use of user privacy should be regulated.

A third challenge revolves around intellectual property rights and plagiarism detection. Generative AI[10] technologies, such as ChatGPT and Dall-E, are becoming increasingly popular as content creation tools. Understandably so: their use has been shown to significantly increase workers productivity (Brynjolfsson, Li, Raymond, 2023). However, in order to formulate new content, AI feeds on previous data, which is often harvested from the tens or hundreds of terabytes on the Internet. Hence, many are worried about the growing inability to distinguish between original creations and AI-generated work. This is reflected in recent claims by professionals such as visual artists, musicians and writers that their styles are being copied and their copyrights are being infringed by these tools.

This issue also leads to questions related to plagiarism in the fields of education and science. Educators, scientists, publishers and developers have recently been involved in a huge debate on whether the use of AI-assisted writing tools constitutes plagiarism (Conroy, 2023). Furthermore, the use of such tools might even be making us change our understanding of what plagiarism means (Dehouche, 2021). Naturally, many service providers, such as Open AI, the company behind ChatGPT, are developing AI-based tools that check for AI-written text, but there is no consensus on their effectiveness.

A fourth highly contentious issue is bias. It's been noted by many observers in applications such as healthcare or candidate selection that AI-based tools sometimes display biased behavior in favor of or against specific characteristics (Gyocha et al., 2023; Nelson, 2019; Roselli, 2019). There are numerous reasons why bias might occur, and it can either be caused by humans or machines. One example is that developers may provide machines with inaccurate mathematical representations of the desired goals. Another is that the algorithms used might not fit the data properly. Yet another is related to the quality and/or appropriateness of the datasets fed to the algorithms: they might be mismatched (when the data used for training doesn't represent the data used in real applications), they might consist of a sample that is unrepresentative of the whole population (this typically happens when users from restricted segments of society generate the datasets that the machines are trained with), and in a more extreme and worrisome case, they might be outright manipulated.

Bias itself is by no means a new problem. Far from being exclusive to AI, it is a common issue in all analytical methodologies, and it's particularly well understood by scholars and statisticians. But because AI technologies are now ubiquitous, the need to address bias is ever more pressing. When decision-making is automated or heavily influenced by AI, undesirable biases can have social impacts, such as perpetuating racial or gender inequalities. On social media, algorithms that reinforce user preferences have been shown to create the so-called echo chambers, isolating users from political perspectives that differ from their own, and even leading to the spread of fake news or imprecise information. As the saying goes, "repeat a lie often enough and it becomes the truth". This can also potentially

[10] Generative AI is "a class of machine learning technologies that can generate new content—such as text, images, music, or video—by analyzing patterns in existing data." (Brynjolfsson, Li, Raymond, 2023).

undermine the overall quality of democratic regimes, political participation and citizenship. Thus, many speculate on the relationship between this self-reinforcing behavior and issues like social polarization and institutional distrust. Central to all these questions is the nexus of responsibility and authority held by those who supply, produce and curate the data that is fed to the machines.

This leads us to a fifth issue worth mentioning, which is the impact AI may have on political behavior and democratic institutions. Drawing on the traditional distinction that political scientists make between politics, policy and polity, it's reasonable to say that the recent rise of AI represents both changes and challenges to these three dimensions. As already mentioned before, AI presents both opportunities and challenges for enhancing the quality of public policies in all stages: agenda setting, policy formulation, decision making, implementation and monitoring (Brandão Campos & Figueiredo, 2022). It's been shown that AI can perform at least four different roles in decision-making processes: assistant, critic, second opinion or consultant. Nonetheless, the quality and effectiveness of AI tools will depend not only on overcoming the challenges mentioned here, but it will also depend on the nature of the decision (the more structured a decision routine, the better it's been shown to fit AI models) and the degree of interactivity between the decision maker and the machine (Bjola, 2020).

In the political realm, the use of AI coupled with other complementary technologies is changing the way policymakers understand and relate to voters (Savaget et al., 2019). This includes, for example, the way they engage with their target audiences. Techniques like sentiment analysis allow government popularity and public opinion to be measured in real time. These and other examples have been widely recognized as a paradigm shift in the communication dynamics between politicians and their constituencies. While this may open up new channels for government responsiveness and accountability, it can also be directly connected to the aforementioned negative effects in terms of individualized content, echo chambers, fake news, and an overall reduction in the quality of democracy.

AI can also have a significant impact on the polity. One concerning issue is transparency. AI, especially when employing technologies like neural networks and machine learning, can autonomously develop algorithms and models that best fit the data. However, because this process involves numerous parameters and layers, these patterns are not always auditable or easily interpretable. While some may argue that the specific inner workings of machines are irrelevant so long as the results are consistently accurate, this runs counter to democratic values where transparency is paramount. In the same vein, a complementary concern is surveillance, since AI tools might give states virtually unlimited capabilities to monitor their citizens, which resonates with fears of democratic backsliding and even totalitarian tendencies.

Finally, the implementation of AI has raised all sorts of ethical and moral considerations. Some of these have been beautifully showcased in works of literature such as "I, Robot", in movies such as "2001: A Space Odyssey", "Terminator", "The Matrix", "Minority Report", or in television series such as "Black Mirror". Because of the metaphysical nature of this debate, not only developers and social scientists, but also philosophers and theologists are deeply invested in it. These ethical dilemmas involve profound questions about determining consciousness, dehumanization in a world increasingly governed by machines and the fear of suppression of fundamental democratic rights (see, for example, John Lennox's "2084").

In the field of AI, these concerns are usually related to the so-called "control problem". Some of the main questions surrounding it are: What will be humanity's relationship with AI? How can we ensure that the goals of machines are always aligned with our own? Will these entities adhere to the same ethical principles that govern human actions? How will machines respond to ethical dilemmas? How can AI be prevented from being used for malicious purposes? Although these questions have so far typically revolved around the still-theoretical strong AI systems, the need to adequately address them is increasingly urgent as weak AI systems are more and more involved in decision-making processes with ethical consequences, such as healthcare and politics. Not to mention the fact that, as technology progresses at a rapid pace, the advent of strong AI systems may not seem so far-fetched anymore.

Comparison of legal frameworks

"As AI systems gain acceptance and become more commonplace, certain critical questions arise: What are the security and legal ramifications of the use of these new technologies? Who can use them, and under what circumstances? What is the safety of these systems? Should their commercialization be regulated? What are the privacy issues associated with the use of these technologies? What are the ethical considerations? Who has responsibility for the large amounts of data that is collected and manipulated by these systems? Could these systems fail? What is the recourse if there is a system failure?" (Subramanian, 2017)

The problems mentioned in the previous section and the questions above are representative of some of the challenges policymakers will have to face when formulating public policies to regulate the use of AI. Individual rights, national economic growth, national security and the relationship between the public and the private sectors are all issues that need to be considered. Policymakers all around the world now face the task of shaping legal frameworks that not only incentivize innovation, but also protect citizens from the unintended consequences and malicious use of AI. Furthermore, these frameworks should be designed to remain relevant even in the face of rapid technological advances. Striking this balance is essential for harnessing the full potential of AI, while safeguarding society's interests, rights, and values, and encouraging economic and social development.

The US, the European Union, China and some countries in Latin America have already taken the first steps towards a regulatory framework. The following cases illustrate policymakers' attempts to create a legal framework that will re-

main up-to-date and effectively address all the emerging issues that will arise as AI grows.

United States

The creation of a regulatory framework for the use of AI in the US is still in its initial stages. It's likely that the first bills to regulate AI at the federal level will prioritize less contentious topics, such as allocating financial resources to AI research and ensuring the safety of AI for children, rather than far-reaching legislation on the matter. Congress has held public hearings and the federal government has organized meetings with top tech executives at the White House. Nevertheless, the introduction of AI legislation at the federal level is pending a better understanding of what AI actually consists of, and how the American government could formulate policies to regulate its use, especially in the light of the risks such technology poses to employment, the spread of misinformation and user security. Meetings between the White House and tech companies began in May 2023, when Vice President Kamala Harris initiated talks with the CEOs of big tech companies, such as Microsoft, Google, OpenAI and Anthropic. While no official outcome resulted from these meetings, shortly after, a group of seven tech companies announced, at the White House, a series of principles to regulate their own use of AI, in the spirit of a self-regulation model.

Nevertheless, some argue that regulation could create a geopolitical risk for the US, since an important part of the country's economic development and wealth is generated by innovative sectors. Experts who advocate for the so-called "don't fall behind" debate argue that regulatory considerations should be taken into consideration when competing with Chinese enterprises, in the interests of safeguarding competitiveness for the American market and research field. Some Congress members endorse a regulatory framework that would invoke open market, open society and democratic principles. This stance directly contradicts the core values of the Chinese Communist Party, which are mostly embodied in China's AI regulatory system.

In this context, government regulation over AI in the US, at the federal level, is mainly carried through the White House Office of Science and Technology Policy (WHOSTP). The goal of this government branch is to formulate a legal structure for an AI Bill of Rights that would guarantee legal protection of citizens. In this aspect, this bill of rights would protect users from risks associated with the adoption of new technologies and automated systems. Among these potential threats, the White House has identified attacks on the democratic system and the infringement of individual privacy rights. According to the US government, when it comes to public policies, the use of AI, algorithms and other emerging technologies are often linked to outcomes that are either ineffective or biased. Moreover, on social media, data collection is often carried out without the explicit consent of users. Thus, the WHOSTP's goals are to ensure that the use of AI does not exacerbate such threats, but rather that automated systems create benefits for users and society.

Recently, the Biden administration has highlighted that the WHOSTP's work on AI has important consequences for the protection of civil rights and democratic values. In this sense, the administration believes that an AI Bill of Rights must be developed based on the experiences of the American public, and on contributions from academics, technologists, activists, politicians and other relevant actors. Hence, the AI Bill of Rights will be formulated together with a handbook ("From Principles to Practice") aimed at incorporating the American government's values on AI into people's or companies' own technological design processes. Although there is still no official definition of what constitutes AI, the WHOSTP principles tend to revolve around the idea of the use of algorithms and automated systems, in general.

According to the US administration's official websites and statements on AI, there are five principles that guide the government's blueprint for AI regulation: 1) Safe and Effective Systems; 2) Algorithmic Discrimination Protections; 3) Data Privacy; 4) Notice and Explanation; 5) Human Alternatives, Consideration, and Fallback. The "Safe and Effective Systems" principle refers to the protection from automated threats. In this sense, systems must undergo "pre-deployment testing", "risk identification" and continuous monitoring to validate that they are secure and effective. Users should also be protected against inappropriate use of data.

The principles of "Algorithmic Discrimination Protections" are closely associated with equity in the use and design of algorithms. Algorithmic discrimination (or bias) occurs when automated systems play a significant role in promoting different treatment that disadvantages individuals based on a series of characteristics: ranging from race and ethnicity to sex (including pregnancy, gender identity, and sexual orientation) or religion, age and other social difference indicators. To this end, AI systems should include safeguards not only by design, but also through independent evaluation and plain language reporting mechanisms. "Data Privacy" is twofold: it means protecting users from abusive data practices through built-in systems and autonomy in how the data generated could be used. In this case, protection should be included in the AI system from the development stage, including the mechanisms to ensure that only data that is strictly necessary for the specific context is collected. To this end, users' choices concerning data collection and use should be respected by developers. As a consequence, any consent requests should be concise, and be understandable in straightforward language.

"Notice and Explanation" is a principle connected to the idea that people should know that an automated system is being used. Developers of such technology must include, in plain language, simple descriptions of how the system works, in addition to the role played by automation, a notice that such systems are in use, the individual or company responsible for the system's development, and further explanations of outcomes that are "clear, timely, and accessible". Finally, the last principle, "Human Alternatives, Consideration and Fallback" is also twofold: users should be able to withdraw, wherever it is more appropri-

ate, and have access to a person who can solve problems that are eventually encountered.

Progress towards a regulatory framework has also been achieved In Congress. Most discussions revolve around the viability of creating an independent agency to oversee AI, create rules to guarantee transparency in the use of AI technology by private companies and maybe even formulate antitrust policies. In May 2023, Sam Altman, the CEO of the San Francisco startup OpenAI, testified before senators. Not only did Altman agree that there should be regulation on the use of AI technology, but he also declared his willingness to work with government authorities to mitigate harmful use of AI technology through regulatory measures. On the one hand, it is important to highlight that many legislators are still calling for more education on the matter, including educating representatives and senators before introducing bills. On the other hand, experts on the subject argue that waiting for Congress to complete the entire legislative process may take too long, considering the speed at which the technology is developing.

At the state level, some analysts say the 2023 legislative session has seen a surge in AI laws, when the number of bills on this topic (proposed or passed) surpassed all previous legislative sessions. As a consequence, 10 states have already included AI regulation as part of larger consumer privacy laws, while many others have established task forces to promote AI education. State-level legislation is often concerned with child protection, medical eye assessments, AI research, and general harm prevention (EPIC, 2023).

In summary, AI regulation in the US is mainly in the discussion phase, rather than at a stage of actual legal development that could impact the sector, we consider only the discussion at the federal level. Privacy, cybersecurity and intellectual property regulation are topics that are already being considered, especially at the state level, but in a very incipient form, usually complementing existing laws. Despite this, the federal government has shown particular concern with issues such as bias and discrimination, the influence of AI tools on political behavior, and ethical and moral considerations. Yet, in all of these instances, only a small number of initiatives have evolved into bills that have been enacted into law. None at the federal level.

European Union

The European Union has been working on AI legislation since at least 2021, when the European Commission presented an AI regulation proposal. The regulation of AI in the EU is part of its "Digital Strategy", which, in turn, is part of Europe's Digital Decade (2021-2030). In the context of regulation, the definition of an "AI system" is of paramount importance to the legal text in question. The European Commission established that this definition should take into account the ever-changing technological changes and market-related issues related to AI, so as to provide legislation that would not fail in terms of legal certainty. As a consequence, according to the Digital Strategy, it was mandatory that

the definition of "AI system" in this framework be "technology-neutral" and "future-proof". Moreover, legal certainty also plays a fundamental role in business, since many European companies –some of the most famous being Heineken and Renault– have protested against a restrictive regulation on AI. These enterprises are fearful of a regulation that would jeopardize not only the continent's competitiveness, but also its technological sovereignty.

Although the AI Act has not come into force yet, its draft has provided a definition for "AI system", which means software developed with one or more of the following techniques and approaches: 1) "machine learning, including supervised, unsupervised, reinforcement learning and deep learning"; 2) "logic- and knowledge-based approaches, including knowledge representation, inductive programming, knowledge bases, inference and deductive engines, reasoning and expert systems; and 3) "statistical approaches, Bayesian estimation, search and optimization methods". These software systems must also be able to produce outputs like content, predictions, recommendations or decisions that impact the environments they interact with, based on a set of human-defined objectives.

The creation of EU standards on AI aims at establishing rules based on a human-centered approach to the matter. Moreover, according to EU official web pages on the topic, the goal is to enact far-reaching legislation that encompasses ethical standards, while also supporting the creation of jobs and enhancing performance of existing ones. Geopolitically, the installation of an AI that is "made in Europe" is also a characteristic that should be present in the EU's regulation. Finally, the EU also expects to legislate on the issue in such a way that could inspire or influence other regions and countries.

In this vein, the principles that guide the EU regulation are: "safety, transparency, traceability, non-discrimination and environmentally friendly use". As a consequence, AI systems must be overseen by people, rather than by automation. Furthermore, one of the key aspects of this new regulation is the classification of AI systems into different categories according to the risk they pose to their users. In this mechanism, different risk levels will imply different regulation and different intensity of regulation. The draft AI Act establishes four risk categories into which a given AI system could be classified: "unacceptable risk", "high risk", "generative AI", and "limited risk". These risks are further explained below, according to the legal text of this European Act.

Unacceptable risk AI systems are those that are considered a threat to their users, whether they are human beings or not, and, because of that, should be prohibited. Such unacceptable risk could be related to cognitive behavioral manipulation of individuals or particularly vulnerable social groups, social scoring, or real-time and remote biometric identification systems. However, the use of AI systems within this risk category could be considered acceptable if they are used to prosecute serious crimes, once court approval has been obtained.

High-risk technologies are those where the use of AI represents a threat to citizens' fundamental rights or safety. Automatic categorization into this sec-

ond risk class occurs when the product falls under the EU's product safety legislation, for example, "toys, aviation, cars and medical services". However, EU regulation on AI also includes in this category AI systems that can be classified into the following areas: "biometric identification, management of critical infrastructure, education, employment management, access to essential private services and public services, law enforcement, border control, and, finally, assistance in legal interpretation and application of the law". High-risk AI systems must comply with regulations that stipulate stringent testing, "comprehensive documentation of data quality", and the establishment of an accountability framework outlining human oversight. Examples of such systems, according to EU web information, include autonomous vehicles, medical devices, and machinery integral to critical infrastructure.

When it comes to the generative AI category, one representative example is ChatGPT. This sort of technology is required to comply with transparency requirements, such as assuring that AI-generated content is publicly informed as such, or developing software that prevent machines from generating illegal content. Publishing summaries of copyrighted data used for training also falls into this category. The last category, limited risk, is subject to less restrictive regulation. For these AI systems, the draft AI Act sets out transparency rules that must be respected, while users must be able to decide whether they want to continue to use them or not. Video games, spam filters and deepfake video or audio content fall under this category.

Once the AI Act comes into effect, penalties for non-compliance or the presentation of false documentation may be applied. Indeed, according to its text, fines can reach up to €30 million or 6% of global turnover. Moreover, the next step towards AI regulation would be the establishment of a European Artificial Intelligence Board, composed of representatives from EU member states. Its responsibilities would not only be to oversee the implementation of the regulation, but also to provide guidance to national governments on the matter.

In sum, the EU AI legal framework encompasses norms on cybersecurity, privacy, intellectual property, bias and social discrimination, political behavior, and ethical concerns. However, it does not do so in a direct way. The risk classification system takes into account all those elements, but on a case-by-case basis. For example, user privacy rules may be more or less strict depending on the risks entailed by the use and design of a specific technology - they do not stem from the EU legislator's concern for privacy in itself.

China

Alongside the EU, China is also spearheading the development of AI regulatory frameworks. The country's efforts encompass measures establishing rules for algorithms —the most common aspect of AI on the internet— as well as new regulations on artificially generated images and chatbots - the most famous example being ChatGPT.

A Chinese law regulating generative AI came into effect on August 15, 2023. This law (The Cyberspace Administration of China's (CAC) Generative AI Measures) is a milestone when it comes to legislation on generative AI, even when taking into account such regulations worldwide. The 2023 law imposes restrictions on companies offering this kind of service, both in terms of the training data used and the outputs produced. The new rules also aim to balance development and innovation with the security and governance of systems. Finally, the new law prohibits AI from generating content, in various forms, if it poses a threat to national sovereignty or to the Chinese socialist system. Nevertheless, numerous provisions only refer to generative AI systems with public-facing functionalities.

Before this law was passed, the Chinese government had already found ways to indirectly regulate AI. Beijing utilized antitrust and data security norms to legally regulate the use of emerging technologies. In 2022, the country issued the Algorithm Recommendation Regulation, aimed at establishing a set of rules for the use of algorithm recommendation technologies by Chinese online service providers. This legal text also prohibits unlawful price discrimination and safeguards the rights of workers whose schedules are based on algorithmic functions. Moreover, in January 2023, the Deep Synthesis Regulation came into force, establishing rules related to algorithm registration obligations.

Just as the US fears that AI regulation could put the country in a delicate position vis-à-vis China, Beijing is channeling significant effort into avoiding new rules that could jeopardize the technology sector in the country. This segment of the economy has already faced serious challenges due to American semiconductor export controls on Chinese companies. However, in contrast to the free market approach, which prevails in the US, Beijing welcomes a more active role for the state in regulating challenges intrinsically related to the use of emerging technologies. Moreover, spearheading AI regulation may position China as a global leader in the field, rendering the country more influential in the development of international standards.

These regulations offer valuable insights for international policymakers. Chinese regulators are progressively enhancing their administrative expertise and regulatory capabilities by introducing a series of more specific AI regulations. Reusable regulatory instruments, such as the algorithm registry, serve as regulatory support systems that can facilitate the development of subsequent regulations, which proves especially beneficial as China readies itself to formulate a comprehensive national AI legislation in the coming years (Sheehan, 2023).

Similar to the case of the US and the EU, Chinese AI regulation takes into account concerns related to the areas of cybersecurity, privacy, intellectual property, bias and discrimination, political behavior and ethical and moral considerations. Many of the norms established by recent legislation aim to impede political threats to the country's political system, while also guaranteeing favorable market conditions for the innovation sector of the Chinese economy and

a reasonable degree of protection for Chinese nationals when using technologies that involve any sort of artificial intelligence in their design.

Latin America

In Latin America, as well as in any other part of the developing world, AI regulation is of crucial importance, to the extent that dominance over emerging technologies could be a great opportunity for national development. In this context, legislation should not fall behind. Notwithstanding, in Latin America, regulatory and institutional approaches are beginning to emerge, independently, in various countries, rather than being part of a coherent regional strategy. Therefore, Latin American countries present varying levels of engagement with regard to regulating AI and other emerging technologies. According to a 2023 report by the Latin American Artificial Intelligence Index (ILIA) (CENIA, 2023), the general landscape of the AI sector in Latin America is characterized, among others, by the following elements:

- Insufficient connectivity: only 70% of the population, on average, have access to the internet. Moreover, there is a significant difference between internet access and data download rates in more urbanized areas when compared to rural regions of each individual country.
- Data availability, capacity and governance: this area is highly heterogeneous among Latin American countries. In this context, multilateral discussions are needed in order to promote equity in the region.
- Lack of education and job conversion programs: only three countries have established educational programs related to AI, and only Brazil has included AI in its education system. Thus, the automation of labor could pose a serious threat to the region in terms of employment.

According to ILIA (CENIA, 2023), in terms of "vision and institutionalization", Chile, Argentina and Peru are the countries with the highest scores, meaning that these three countries have developed the most comprehensive AI strategy in the region. A fundamental aspect when it comes to "vision and institutionalization" is the gap between these three countries and the countries at the bottom of the ranking, as the latter present almost nonexistent levels of interaction between AI stakeholders, exposing the absence of a national vision on AI and the lack of civil society participation in the building of such a vision.

Regarding the issue of regulation, the ILIA report (2023) used three main indicators to measure the level of development of the national debate on AI: the existence of specific regulation, the existence of AI-related regulations, and number of tentative regulation initiatives. Brazil and Colombia scored the highest in this category, followed by Chile and Peru. However, only Brazil and Chile currently have bills being debated in their legislatures. According to this report, Latin American countries can be divided into three groups: Peru, Colombia, Brazil and Chile represent the first group, where a more developed regulation framework can be found. Argentina, Mexico, Uruguay and Costa Rica are in the second group, characterized by an ongoing regulatory process. Finally, Ecuador, Panama and Paraguay are in the third group, where there is no specific regulation, although there might be laws on data protection and cybersecurity.

Whether Latin America finds a way to regulate AI at the regional level, or independently at the national level, ILIA (CENIA, 2023) points out a few challenges and points that require attention. Among them, we highlight:

- Absolute necessity to invest in connectivity, without the dependence on the Global North.
- Absolute necessity for regional cooperation, highlighting multicultural collaboration. Diversity in Latin America allows the region to develop AI systems that reflect the unique characteristics and address the specific challenges of each country.
- Prioritize and urgently develop regulation in critical areas: among the most important areas of AI regulation, the report emphasizes data protection, transparency, and multilateral governance.
- The establishment of accountability rules aimed at private enterprises: not only is this important to protect people's rights and freedoms, but it is also fundamental for ensuring a greater level of independence from economic and political forces from the Global North.

According to experts, regulation in Latin America has focused primarily on the negative impact of AI, especially on the threat to job opportunities. Moreover, failure to pay attention to the various opportunities presented by the use of AI by the public sector, including generative AI, hinders a common regional diagnosis that would address shared challenges. For example, generative AI has been widely used by public agencies in the region: from the formulation of an AI regulatory bill in Costa Rica with the help of ChatGPT, to the use of ChatGPT by judges in various rulings in Colombia, Bolivia, Mexico and Peru (Tech Policy Press, 2023).

Multilaterally, the AI for Sustainable Development in Latin America (AISDLA) stands out. The initiative was organized by the Economic Commission for Latin America and the Caribbean (ECLAC) and held in Santiago, Chile, in August 2023. The organization of the event was supported by the European Union through the EU-Latin America and the Caribbean Digital Alliance. The event was also dedicated to a debate on a regional vision on the benefits and threats of AI. However, to date there has been no international agreement on a common definition of AI or other emerging technologies.

In terms of North-South relations, there is a tendency in the developing world to draw heavily on European and North American experiences for reference on emerging issues. This has been recently illustrated by the EU's support in the organization of ECLAC's AISDLA event. At the same time, the developed world has vested interests, both commercial and political, in exporting its own views

on such topics, which could be interpreted as a soft power strategy. Indeed, the EU regulatory project has set itself the goal of being influential worldwide. In this context, Latin American countries —as well as other regions from the Global South— must take into account individual experiences and national idiosyncrasies when developing their own AI regulation, whether at the regional, national or subnational levels. This is especially true in light of the findings of the ILIA report (CENIA, 2023), which indicates that Latin American countries are seriously lagging behind the developed world in the realm of regulation. This difference could lead to a regulatory rush in the region, which could benefit from previous experiences in the Global North, due to the need to quickly implement legislative measures to regulate this ever-changing sector.

Insights and takeouts

The role of AI in diplomacy can be seen from numerous perspectives. From a policy viewpoint, the opportunities and challenges presented by the use of AI-assisted tools are no different for foreign policy than other public policies in general. Thanks to the computing power to process large amounts of data, AI can be used as a tool to increase the speed and quality of decision-making. Concrete implementations have so far been mostly limited to administrative expedients such as consular services, where AI provides huge gains in productivity of highly structured procedures such as passport expedition or consular information services (Bjola, 2020). However, many diplomats are still skeptical or unsure about how best to implement AI-assisted tools in more context-sensitive situations.

Nevertheless, there are numerous promising ways in which AI can change the practice of diplomacy. For example, it can be used to model and predict the most likely outcomes of complex negotiations, such as multilateral trade agreements, or it could be used for instant translation, enhancing the quality of international face-to-face dialogues (Buch et al., 2022). The strategic incorporation of scientific expertise into negotiations, including technologies such as AI, for enhancing results has been referred to by some as “science in diplomacy” (Oliveira, 2021). But, despite the potential for positive impact, decision-makers also need to be aware of the limitations and drawbacks of such technologies, as already mentioned in the previous sections.

Another aspect of the relationship between AI and diplomacy is that states are increasingly showing signs of competition rather than cooperation between their national systems of innovation (Feijóo, 2020). Very few initiatives aim at developing a more internationally integrated approach. This is happening, of course, because AI technologies can offer states significant advantages over their peers. This is true for the economy, where AI can enhance the position of states in global markets and value chains, and it’s also particularly true in military applications, where states see the opportunity to leverage their relative capabilities and their ability to project power through the use of advanced technologies. By contrast, efforts to converge states in a more cooperative framework for a regime of global governance of frontier technologies such as AI has been referred to as “technology diplomacy”. This involves opening up opportunities for cooperation in the field of AI, including regulatory experience, the implementation of AI-driven tools in public policy, and the sharing of expertise on national innovation strategies.

Given the highly complex landscape presented, it’s easy to see that science diplomats must engage in a wide range of activities in order to enhance international cooperation on the use of AI technologies. Overall, science diplomats must be capable of anticipating the repercussions of fast technological transformations and provide decision makers with insights on how to shape national and global policies, so that they can optimize advantages and mitigate adverse outcomes (Colgazier, 2018).

In this sense, science diplomats need to be informed enough to address all relevant aspects of the use of such technologies. A truly interdisciplinary encounter is thus required, one that allows for dialogue between the innovation and tech fields, the social sciences and policy makers. In addition, science diplomats need to be able to make use of a variety of tools such as “policy making, public diplomacy, bilateral and multilateral engagement, actions through international and treaty organizations, conventions and partnerships, grant-making and information-gathering and analysis” (Kļaviņš, 2021) in order to develop consensus on the rules and objectives for collaborative projects (Montgomery, Colglazier, 2022).

Furthermore, AI and other related technologies are highly complex scientific endeavors, and properly understanding their applications is not trivial. As ubiquitous as they are nowadays, there is still widespread misunderstanding of what AI is, how it works, and what it can and cannot do. Hence, it’s natural that misinformed policymakers may be led to underestimate or overestimate its impact. However, because science diplomats are positioned in between domestic and international scientific communities and policymakers, they can play a crucial role in bridging this gap with valuable assessments and advice (Montgomery & Colglazier, 2022). Educating and breaking misconceptions is the first step toward informing strategic and evidence-based decision-making. Thus, science diplomats can also become science communicators and facilitate the dialogue between developers and policymakers from diverse policy areas, including but not restricted to foreign policy.

Finally, both domestically and internationally, science diplomats must assist regulators in establishing comprehensive legal frameworks that can both allow innovation to thrive while also protecting individuals from the risks entailed. This is a complex task that involves informing both developers and policymakers about each other’s positions. It’s crucial that developers become fully aware of concepts such as political legitimacy, accountability, transparency, responsiveness, individual rights, and their importance to political institutions, so as to further incorporate them into AI designs.

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9 Closing the Gap Between Intention and Action: Behaviorally-Aligned Strategies for Effective Plastic Reduction

Participating Countries: Argentina, Brazil, Canada, Jamaica

Executive Summary

This document offers an overview of existing or potential policies aimed at mitigating plastic pollution in four nations across the Americas—Argentina, Brazil, Canada, and Jamaica. It also explores how a behavioral framework can be applied to analyze and formulate effective policies for addressing plastic pollution. Policy efforts can sometimes fall short of their intended outcomes, creating what's known as an intention-action gap—a disparity between policy objectives and the day-to-day behavior of stakeholders.

This brief underlines recommendations that are aligned with behavioral principles to minimize the impact of plastic waste and pollution. The primary objective of this policy brief is to provide policymakers with insights into behaviorally-informed policy perspectives for tackling plastic pollution in their respective countries.

Given the multifaceted nature of plastic pollution, addressing this challenge requires a combination of science diplomacy approaches and behaviorally-informed strategies. The integration of behavioral science into policymaking is critical, as policies inherently drive behavioral changes. It is clear that the effectiveness of policies is highly dependent on the context, which shapes individual and collective behavior. Therefore, an ecosystem-level institutional approach, rather than a sole focus on individual behavior change, is essential to address human psychological biases.

This case study is based on a project by IAI STeP fellows: Awasthi et al (2023). Closing the IntentionAction Gap: Behaviorally-Aligned Strategies for Effective Plastic Pollution Reduction. Journal of Science Policy & Governance, 22. *https://doi.org/10.38126/JSPG220202*

Keywords: Plastic pollution; public policies; EAST framework; science diplomacy; behavioral science; ecosystem change; microplastics; ocean pollution.

Science for Diplomacy

This is a case of "Science for Diplomacy", as it focuses on urgent international policy challenges where science—particularly behavioral science—can support more effective and cooperative solutions:

- **From Policy to Behavior:** While over 120 countries have implemented bans or taxes on single-use plastics, these measures alone are insufficient. Behavioral science offers critical insights to bridge the intention-action gap in policy implementation.
- **Science-Informed Policymaking:** Policymakers face the challenge of integrating behavioral knowledge into regulatory frameworks to drive sustainable change in production and consumption.
- **Capacity Building for Sustainable Change:** Strengthening governments' internal capacity to systematically incorporate behavioral insights into public policy is key to long-term impact on plastic pollution.
- **Ecosystem-Level Thinking:** Understanding that policy effectiveness is shaped by institutional and social context—not just individual behavior—underscores the need for systemic design approaches.

Introduction

Plastic has revolutionized our lives, offering convenience in diverse areas such as food safety, technology, and medicine. However, it's also become one of the most significant environmental challenges of the 21st century, causing severe harm to ecosystems, food chains, and human well-being. The negative impacts extend to livelihoods, affecting industries like tourism and fisheries, leading to substantial economic costs (UNEP 2021a).

The Organization for Economic Cooperation and Development (OECD 2022) found that the world is producing twice as much plastic waste compared to two decades ago, with only 9% effectively recycled. The vast majority of plastic waste is mismanaged, ending up as uncollected litter, in landfills, or incinerated. Most poorly managed plastic waste seeps into the natural environment, ultimately reaching our rivers and oceans. This has led to numerous international, regional, national, and local policies and laws aimed at curbing plastic pollution, with over 550 such policies in existence (Karasik et al. 2022).

While over 120 countries have implemented bans or taxes on single-use plastics, these measures alone are insufficient to tackle the plastic pollution problem. These regulations mainly target items like plastic bags, which represent a small proportion of the plastic waste, and are more effective at reducing litter than overall plastic consumption (OECD 2022).

To address this global issue, the UN Environment Assembly unanimously endorsed an historic resolution called "End Plastic Pollution: Towards an internationally legally binding instrument." This resolution calls on the Intergovernmental Negotiating Committee (INC) to complete an international legal framework by 2024, focusing on the full life cycle of plastics and sustainable consumption.

The complexity of plastic pollution as a global problem requires extensive science diplomacy approaches and behaviorally-informed strategies. Integrating behavioral science into policymaking is vital, recognizing that policies inherently drive behavioral changes. It's evident that the effectiveness of policies is highly dependent on the context that shapes individual or collective behavior. Therefore, rather than focusing solely on individual behavior change, an ecosystem-level institutional approach is critical to addressing human psychological biases.

In the Americas, various countries are taking measures to combat plastic pollution through bans, taxes, and regulations. The Latin American and Caribbean (LAC) region produces a significant portion of global plastic waste (UNEP 2018; 2021), and many countries in the Americas are striving to reduce the use of single-use plastics.

This policy brief employs the EAST framework to analyze policies on plastic in four target countries —Argentina, Brazil, Canada, and Jamaica. The EAST framework (Easy, Attractive, Social, and Timely) focuses on four key factors that influence behavioral change in individuals. These factors, when incorporated into policies or campaigns, are more likely to encourage individuals to adopt and maintain new behaviors. These four selected countries provide an opportunity to develop behaviorally-aligned science diplomacy solutions to regional issues, given their representation across the Americas.

In these countries, early-career researchers participating in the Inter-American Institute for Global Change Research (IAI) STeP Fellowship Program have reviewed plastic pollution policies and regulations, recognizing that understanding stakeholders' processes and challenges is essential to effective policy compliance.

Argentina

Argentina currently lacks a national law specifically targeting plastic pollution. While some cities, such as Buenos Aires, have banned single-use plastics like straws and plastic bags, the country has yet to establish a comprehensive legal framework for addressing this environmental challenge. However, there are promising developments on the horizon.

In October 2021, the Ministry of Environment and Sustainable Development introduced a significant legislative proposal known as the "Law of Packaging with Social Inclusion." This proposed law places a strong emphasis on Extended Producer Responsibility (EPR) throughout the entire lifecycle of plastic products, spanning design, production, distribution, consumption, and disposal.

This proposal was passed by the Chamber of Deputies, with the backing of the Natural Resources and Budget commissions. Unfortunately, it did not progress to the Senate due to the year-end legislative turnover. In addition, disagreements among political parties on certain aspects of the bill brought the policy cycle to a halt. As a result, the bill will have to be reintroduced for further deliberation.

A key feature of this proposed law is the introduction of an environmental tax on companies involved in packaging production. Those companies that employ recycled materials or alternative, less contaminating materials will be subject to lower taxes than those relying primarily on plastic. The revenues from this tax are intended for the creation of recycling systems that promote social inclusion. This includes support for recyclers, often referred to as "Cartoneros," and cooperatives involved in collecting, reusing, and transforming packaging materials before final disposal.

Around 200,000 recyclers across different municipalities in Argentina currently work under challenging conditions and without labor rights. The introduction of this environmental tax is expected to improve their working conditions

and dignify their essential work. However, there are opposing viewpoints, with some political parties and large companies expressing concerns that the tax will drive up product prices, particularly essential items such as medicines.

Brazil

Brazil is yet to adopt a national law directly targeting plastic pollution and banning single-use plastics. However, there have been some notable actions at the local level.

While certain cities and states in Brazil have implemented regulations to restrict or ban specific types of single-use plastics, the country as a whole lacks comprehensive legislation on the matter. For instance, the state of Espírito Santo initially banned plastic bags, but later reversed the decision. In contrast, the island state district of Fernando de Noronha stands as the first in the country to enforce a total ban on the import, distribution, and use of single-use plastic packaging and containers.

In a groundbreaking development in October 2022, the Federal Supreme Court unanimously upheld a law initiated by the municipality of Marília in the state of São Paulo. This law mandates the use of biodegradable bags and sacks instead of traditional plastic ones. This landmark decision is poised to set a precedent for local governments across the country to enact similar regulations.

At the federal level, the Brazilian Chamber of Deputies has seen the introduction of several national draft legislations addressing the issue of single-use plastics. The very first bill, presented twenty-five years ago as PL 3.750/1997, included elements like extended producer responsibility, a tax on producers (excluding recycled materials), and awareness-raising measures aimed at combating plastic pollution in rivers.

Over the years, a number of lawmakers have introduced additional draft laws related to single-use plastics. These proposals have accumulated in the National Congress, although none of them have yet been passed. An extensive array of sixty-five draft bills has been merged into the draft PL 612/2007, which primarily focused on biodegradable plastic bags.

However, the EAST framework analysis here primarily centers on draft law PL 10.504/2018, which represents a more comprehensive proposal to establish a national program for banning single-use plastics by 2030.

Canada

In Canada, the federal government has taken a significant step in addressing plastic pollution by designating plastics as “toxic” under the Canadian Environmental Protection Act. This move has paved the way for regulations that aim at eliminating single-use plastic items through a ban on their sale, import, and production, with the ambitious goal of achieving zero plastic waste by 2030. While this marks progress, it’s important to note that the ban encompasses only a limited range of products, and some restrictions won’t take effect until 2025. Regrettably, the six product categories subject to the ban constitute just a small fraction, approximately 3%, of the total plastic waste generated annually (Environment and Climate Change Canada, 2023).

Implementing this ban is projected to incur an estimated cost of CAD 1.3 billion over the next decade, and it is expected to have adverse economic repercussions on local employment. Additionally, it’s worth mentioning that there are non-monetized ecological consequences as a result of the selected items ban, particularly affecting wildlife and their habitats. Furthermore, owing to the lack of readily available alternatives, certain items, such as plastic cup lids, remain permissible, which, coupled with the banning of some compostable plastic products, make the policy somewhat confusing for producers.

Jamaica

Jamaica’s legislation stands out for its clarity and user-friendliness. Its drafting process was thoughtfully conducted by a government-appointed working group, which engaged in numerous consultations with a wide range of stakeholders before its enactment. Nevertheless, there’s a marked shortfall in enforcement, likely stemming from a lack of adequate human, financial, and institutional resources, including a robust municipal waste management system.

Delving into the appeal of this Jamaican legislation, it’s evident that it faces some challenges in this regard. While the broader public and other stakeholders acknowledge the importance of curbing plastic usage and waste, the ban was introduced in an environment where the convenience, affordability, and ubiquity of plastic, particularly in the form of shopping and carrier bags, had become the norm. Unlike some policies that offer tangible incentives to the public, this legislation relies on citizens cultivating their personal sense of environmental stewardship to achieve compliance.

Furthermore, it doesn’t necessarily appeal to the financial interests of consumers and the private sector. The adoption of alternative paper-based and reusable products in the food industry has been marred by issues such as high costs and problems like heat transfer and leakage due to the subpar quality of the materials used. To protect their profits, businesses and restaurants have found legal means to circumvent the use of paper-based containers and avoid prosecution by increasing the import and use of plastic-based food containers, which, ironically, were not initially addressed in the ban. This strategy has led, albeit unintentionally, to replacing one form of plastic waste with another. At present, alternative products are used in the formal retail market, including major supermarkets, but some retail and wholesale businesses still provide plastic bags with purchases. Recent assessments suggest that these plastic shopping bags may have been illicitly imported or are being locally manufactured (NEPA, 2022).

Notably, the social dimension is a strong suit of this Jamaican legislation. Recognizing the need for public buy-in and social acceptance, an educational campaign and a well-crafted communication plan accompanied the legislation's implementation. Information about the ban was disseminated through traditional and social media, leveraging Jamaica's Vision 2030 Development Plan and the 2018-2021 Medium-Term Socio-Economic Policy Framework. A "Beating Plastic Pollution Campaign" was launched to raise public awareness about the detrimental impact of plastics on the environment. It sought to promote environmental stewardship and influence behavioral change by encouraging a shift from disposable to reusable items. The campaign adopted the "6Rs" approach: Reduce, Reuse, Refuse, Rethink, Repair, and Recycle (GoJ, 2018).

Moreover, recent government reports have recognized that the magnitude of plastic waste pollution cannot be adequately addressed through a voluntary system. They have signaled that a Deposit Refund Scheme (DRS) will be enacted into law by the end of the 2022 financial year (Spence, 2022b).

From a timing perspective, the Jamaican legislation is appropriately aligned with the prevailing needs. Jamaica's previous approach to tackling plastic pollution had been somewhat sporadic, marked by intermittent recycling projects and localized beach clean-ups conducted by state agencies and environmental NGOs. Consequently, the introduction of this legislation concerning single-use plastic came at a fitting time and was warmly received by the public. The legislation's three-phase process aimed to gradually guide consumers, producers, and businesses toward full compliance with the policy by 2021.

Environmental impacts and political challenges

The four countries examined each have unique political, economic, social, and cultural contexts, and their characteristics vary significantly – encompassing geographic location, language, size, and economic development, among other facets. Despite these differences, they all share a common challenge: grappling with the persistent menace of plastic waste, its leakage into the natural environment, and the knock-on consequences for economic sectors, health, and the livelihoods of their respective populations. For instance, Brazil contributes a staggering 325,000 tons of plastic waste to the ocean annually from land-based sources such as open dump sites (Oceana, 2020). Similar challenges are evident in Jamaica, Argentina, and Canada.

This ubiquity of plastic pollution can be attributed to unfavorable waste management conditions, including inadequate plastic waste infrastructure, ineffectual enforcement mechanisms, and insufficient investment in low-cost and readily accessible alternative materials. Additionally, the existing policies have largely failed to address microplastics or plastic particles. The powerful plastics industry and market pressures often thwart discussions, the passage of laws, and even the effective implementation of public policies. Over the decades, Brazil has introduced numerous draft laws on plastic bags and single-use plastics, yet none have successfully navigated the path to approval. Similarly, in Canada, plastic producers have responded to the nationwide plastic policy by filing two lawsuits aimed at blocking the implementation of the single-use plastic ban.

Policymakers find themselves at a juncture where they need to consider fresh strategies to promote collaborations between the public and private sectors, as well as innovative approaches to sustainable production and consumption. Brazil, for example, has recently issued two decrees on social inclusion and the valorization of waste pickers in the framework of reverse logistics. This term denotes the management and control of the flow of goods and materials from consumption at retail stores back to their initial point of production. Embracing reverse logistics can mitigate environmental impact while augmenting the value of returned products. These decrees bear similarities to Argentina's "Law of Packaging with Social Inclusion," and both offer insights and lessons that can be valuable for the broader Latin American and Caribbean (LAC) region. Nonetheless, before these plastic policies can be effectively implemented, policymakers should explore ways to extend producer responsibility throughout the entire production-to-disposal chain, and involve the private sector in addressing this issue by holding them accountable for sustainable management and environmental protection.

In the fight against plastic pollution, this gap plays a pivotal role in determining the success of policies. Despite comprehensive policy frameworks and the involvement of numerous well-intentioned stakeholders, the actual implementation of these policies frequently falls short. There are several key elements to bridging the gap between intentions and behavior and addressing the intention-action gap in plastics policy. These include establishing clear and achievable goals, breaking down overarching objectives into smaller, more attainable milestones, and ensuring that accountability mechanisms are in place to support these measures.

Policy takeouts

In the case of Argentina, the bill encountered significant challenges due to misinformation circulating among the population. Uncertainty prevailed regarding who would foot the tax bill fueled rumors about consumers' ability to shoulder this burden. Consequently, acceptance of the policy became an uphill battle. Following an EAST analysis, it becomes evident that a policy must embrace the "Attraction" aspect in order to achieve compliance. In simpler terms, if a policy inflicts harm without delivering benefits to the population, it's likely to face resistance. To secure public acceptance, the government should launch campaigns to explain the true implications of the policy, dispelling misinformation. This should be complemented by robust scientific evidence and comprehensive studies on plastic bans, clearly delineating the beneficiaries and payers, as observed in the aforementioned case.

Canada's approach to banning plastics by employing the term "toxic" underscores the necessity for meticulous categorization and specificity when formulating policies governing plastic compounds. The vast array of polymer types and uses calls for greater precision. Without it, legal circumvention becomes more accessible through the pursuit of lawsuits that delegate the authority to ministers to determine the banned status of each type of plastic. Such ambiguity significantly undermines the effectiveness of policies. Therefore, the classification of plastic categories and specifications needs to be carried out in cooperation with experts in order to avoid misinterpretation and circumvention.

Jamaica's experience with plastic prohibition provides valuable insights into the dynamics of plastics in society. The ease and speed of plastic production and circulation have created an environment ripe for smuggling and clandestine manufacturing. Furthermore, the population's strong attachment to plastics necessitates a gradual transition, creating a gap between supply and demand that could be exploited by manufacturers of illegal products. To ensure policy effectiveness, the government must take proactive measures, developing surveillance strategies both within the country and at its borders, with the guidance of security experts and national institutions. This approach will enable the population to gradually phase out plastic use without exposing themselves to potentially hazardous smuggled products.

A policy designed with behavioral insights in mind offers advantages throughout the entire policy process cycle, spanning from formulation to implementation and evaluation. When implemented, behavioral solutions have proved to be cost-effective in terms of public funds, as they can be incorporated into an ongoing policymaking or implementation process. They can also reduce the long-term expenses associated with policy failures during implementation and real-world change (Thaler and Sunstein, 2009).

In the absence of nationwide policies, it becomes challenging to bring nations to the negotiating table to forge consensus and create multilateral binding policies that address the issue while considering the concerns and preferences of all stakeholders in their respective countries. Given the transnational nature of this issue, which calls for multilateral cooperation and consensus, countries must collaborate to develop transboundary solutions and share best practices, technology, and resources to effectively manage plastic waste.

Science diplomacy presents a promising approach to unifying all these elements and should be considered by governments to build consensus and facilitate solution-oriented collaboration among countries grappling with the same challenges, such as plastic pollution. In essence, behaviorally-informed public policies rely not on a single strategy isolated in political, economic, social, cultural, or infrastructural silos, but on a range of multi-scale strategies and combined approaches. This policy brief provides a comprehensive overview and commentary on the behavioral constraints within existing policies and draft legislations aimed at combating plastic pollution. Strengthening the government's internal capacity to consistently integrate behavioral insights into public policy is crucial for driving sustainable societal change and action against plastic pollution, at both the ecosystem and individual levels.

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10

Belmont Forum – IAI and the Transdisciplinary Approach

Participating Countries:
Argentina, Brazil, Canada, Mexico, United States

Executive Summary

The Belmont Forum and the Inter-American Institute for Global Change Research are collaborating to create a joint action to foster transdisciplinary (TD) approaches: workshops to engage researchers from Latin America to discuss TD. The first workshop received positive feedback and was considered a success by participants, organizers, facilitators, and case study presenters. It effectively achieved its objectives of deepening the understanding of transdisciplinary approaches, both for those already involved in TD projects and for those interested in starting them.

It emphasized the importance of sharing insights from diverse TD settings, leading to two significant outcomes. The first outcome is common threads and insights, which means that the workshop enabled common threads in TD practice to be identified. Scientists, policymakers, and practitioners seeking to engage in TD endeavors should take note of these shared experiences. This recognition allows for a more informed and holistic approach to TD projects.

The second outcome relates to guidance for future TD workshops. The workshop results provided specific recommendations that can shape and enhance future training activities, making them more effective in building capacity for TD approaches. These experiences from the Americas may serve as a valuable starting point for driving global sustainability transformations.

The current challenges posed by global environmental change (GEC) emphasize the need for an urgent shift in knowledge production towards more collaborative perspectives. This means engaging a wider range of stakeholders and fostering interdisciplinary collaboration.
Finally, the text encourages the organization of more events focused on building capacities in TD approaches, underlining the growing importance of TD in addressing complex global challenges and highlighting the role of such workshops in equipping individuals and groups with the skills and knowledge needed to drive meaningful sustainability transformations.

Keywords: Transdisciplinary; collective learning; training; collaborative science; participation; diversity and inclusion; knowledge co-production.

Science for Diplomacy

In the context of the Belmont Forum, the main approach is "Science for Diplomacy", as it emphasizes:

- **Democratization of Knowledge:** Transdisciplinary (TD) approaches foster more equitable power dynamics and inclusiveness in the knowledge production process.
- **Stakeholder Engagement:** Researchers engaging with real-world problems build meaningful connections with stakeholders, gaining perspectives beyond traditional scientific domains.
- **Alignment with Global South Thought:** TD resonates with emerging frameworks from the Global South, including "lifeways," "nature's contributions to people," and "cognitive justice."
- **Institutional Collaboration:** The joint efforts led by the Belmont Forum and the IAI demonstrate how TD can connect scientific research and public policy in innovative, inclusive ways.

Introduction

The Belmont Forum is a partnership of funding organizations, international science councils, and regional consortia committed to the "advancement of international transdisciplinary research", while "providing knowledge for understanding, mitigating and adapting to global environmental change" (Belmont Forum, s.n.). Established in 2009 by major funders of environmental change research and international science councils, it strives to enhance sustainability science. Serving as an international platform, it draws together members from five continents, collectively financing environmental change research with a shared vision of advancing the United Nations Sustainable Development Goals. Acknowledging the value of international collaboration, the Belmont Forum's actions are guided by the objective of supporting international transdisciplinary research to provide knowledge for understanding, mitigating, and adapting to global environmental change. The Forum champions multinational and transdisciplinary collaborative research, drawing from the natural, social, and human sciences disciplines, engaging stakeholders in the co-creation of knowledge to promote sustainability.

The Sustainability Research and Innovation (SRI) Congress, a collaborative effort between the Belmont Forum and Future Earth, stands as the world's largest gathering for the global sustainability community. This platform brings together experts from diverse sectors of society to collaboratively generate knowledge and move towards a more sustainable and inclusive world. Therefore, the SRI also serves as a hub for building networks of skilled TD scientists and practitioners who are dedicated to addressing the complex, transnational issues arising from GEC. In recent decades, extensive efforts have been made to apply the TD approach to intricate socio-environmental problems, resulting in a substantial body of literature (Lawrence et al. 2022).

The profound impact of human activities on the Earth's ecosystems has led scientists to propose the advent of a new geological epoch known as the Anthropocene, commencing with the rapid industrialization of human societies (Mahli 2017). The Anthropocene calls for a collective reevaluation of solutions to GEC, including issues like biodiversity loss and climate change. It calls for new pathways through the co-production of knowledge (Jasanoff 2004; 2021). In essence, co-production refers to collaborative methods of knowledge production that incorporate the perspectives of those affected by the issues that science seeks to address (Turhout et al. 2020). TD provides a framework capable of grasping the complexity of GEC issues in the Anthropocene. By encompassing diverse academic disciplines, from the natural and social sciences to local and indigenous knowledge, TD can connect general scientific knowledge to specific issues and develop practices that foster the common good (Hirsch-Hadorn et al. 2007; Dieleman 2017).

The outcomes of such research are locally relevant, solution-oriented, and enable teams to provide knowledge that is highly beneficial for local communities, social actors, stakeholders on the ground, and policymakers, thus facilitating transformative change (Becerra-Fernandez and Sabherwal 2014). TD can promote democracy and equitable power dynamics in knowledge production and improve the interaction between science, policy, and society, ultimately contributing to a sustainable and just future. A notable shift in TD scholarship has been the reconceptualization of TD as a way of life

Science Diplomacy in action: the Transdisciplinary Approach 101 workshop

The Belmont Forum and the IAI created the Transdisciplinary Approach 101 workshop. The initiative was organized and hosted by the Science Technology and Policy Fellows (STeP). Transdisciplinarity (TD) is an innovative research approach that transcends traditional interdisciplinary boundaries. With the goal of delving into the TD approach and its potential to advance sustainability goals, the Belmont Forum and the Inter-American Institute for Global Change Research (IAI) facilitated the "Transdisciplinarity 101" online workshop during the Sustainability, Research, and Innovation (SRI) Congress, both in Pretoria, South Africa, and virtually from June 20-24, 2022.

The workshop consisted of two sessions with approximately 100 participants, all of whom were part of the SRI event. This conference, which serves as the world's preeminent gathering for transdisciplinary research, brought together more than 2,000 global leaders from academia, civil society, government, and the private sector, all committed to catalyzing transformations toward sustainability. The core objective of the workshop was to create a conducive environment for participants to share their insights and experiences related to transdisciplinary research, using the Americas as a launching pad for transdisciplinary approaches on a global scale, as mandated by the IAI.

In the introductory session, a seasoned TD team consisting of Lily House Peters, Gabriela Alonso, and Marshalee Valentine explained the key concepts of TD approaches, emphasizing their differences from other collaborative research models and advocating for a reevaluation of power dynamics in knowledge co-production. Following recent shifts in TD literature, they underscored the importance of recognizing dominant power structures and embracing TD as a way of life.

The ensuing discussion divide participants into breakout rooms with options for both Spanish and English speakers to exchange perspectives and experiences related to conducting TD research. These conversations were guided by two central questions: "Whose knowledge about the project counts, to whom, and under what conditions?" and "What challenges and opportunities do you see in decentralizing research and sharing power in collaborations?" To facilitate collective reflection on these questions, jamboards were employed to gather ideas and comments from participants, culminating in a plenary session.

Following these discussions, the speakers shared their experiences and lessons learned in applying TD, covering aspects like team organization, engagement with a wide range of social actors and stakeholders, and the transition from science to policy and, ultimately, to action through effective communication strategies. They provided concrete examples from their involvement in a project in Central America. The second session delved deeper into best practices and lessons learned in applying TD to research in diverse geographic contexts. Three TD teams presented insights from projects carried out in the North American Arctic, Africa, and the Caribbean (see Case Studies below). These case studies adhered to a template provided by the IAI and Belmont Forum organizing team, detailing their geographic location, project duration, collaboration stories, teamwork dynamics, contentious issues, and the outcomes produced.

These case studies shed light on the "process of forming TD teams, engaging with stakeholders, and bringing research to inform action." The presentations were followed by a moderated discussion with the audience, connecting the case studies to the participants' own experiences. These conversations were guided by jamboards and centered on questions like, "Can you identify practices that enhance equitable collaborations in TD?" and "What are the common sources of conflict/controversy in TD?" The session concluded with a Q&A in a plenary session and a final wrap-up summarizing the entire workshop experience. Following the SRI workshop, the lecturers, case study presenters, and organizers met to evaluate the outcomes, identify crosscutting issues, and devise recommendations for best practices in applying TD approaches and for future TD training activities.

Workshop case studies

Jamaican Women in Coffee (JAWiC)

JAWiC is an NGO whose mission is to unite women within the coffee industry, acknowledge their invaluable contributions, and promote a sustainable and equitable future, particularly for farmers in Jamaica's Blue Mountain and High Mountain regions. JAWiC has successfully executed three significant projects to date: 1) Pilot Survey, 2) "Strengthening the capacity of women coffee farmers in Jamaica through Training: Phase 1," and 3) "Strengthening the capacity of women coffee farmers in Jamaica through Training: Phase 2." These initiatives aim to tackle key industry challenges, including gender inequality in resource distribution, declining coffee quality and quantity, and reduced livelihoods for small-scale farmers due to insufficient income.

All three projects share the common objective of empowering women in Jamaica's coffee industry through strategies such as enhancing their participation in policy decisions, providing direct support for agricultural inputs, facilitating access to international markets, and offering training in marketing, business management, coffee production, sustainable farming practices, and climate change adaptation. The JAWiC team boasts a diverse group of experts, including farmers, processors, marketers, researchers, quality management professionals, coffee importers, geologists, sustainability and climate change experts, and IT specialists. This collaboration of different disciplines proved crucial in defining JAWiC's vision and strategic goals, transcending the conventional approach of addressing one issue at a time without collective teamwork.

By employing a transdisciplinary approach, JAWiC effectively identified and addressed systemic issues within the coffee industry, including climate change, resource constraints for implementing best practices, knowledge gaps in coffee production, the lack of connections between farmers and buyers, and the absence of structured community leadership. Noteworthy collaborations emerged, such as research and IT experts designing a pilot survey tool that laid the foundation for Projects 2 and 3, and quality specialists working with soil and disease management experts to create farmer-friendly training materials.

These long-term collaborations built a network empowering women in the coffee industry, establishing JAWiC as a central hub for Jamaican women in coffee. The collection of data on women in the coffee sector was groundbreaking, providing crucial insights into their most pressing needs and setting benchmarks for quantifiable results. These baselines are now integral to all subsequent processes, fostering a strong network among women in the Jamaican coffee industry and ensuring their continued engagement in the project. One specific challenge JAWiC encountered in its early stages was securing funding for the initial baseline database, as no previous in-depth research had been conducted.

JAWiC's project outputs include capacity-building programs for climate-smart coffee production, organic farming, pest and disease management, and soil and water management. Additionally, they produced a video to share the experiences of women in the coffee industry, an icon-based Farmers' Diary for recording farming activities, workshop content summaries, and established collaborative relationships with the Canadian Funding Agency and the Jamaica Agricultural Commodity Regulatory Authority.

From Nunavik to Iceland: Climate, humans, and culture across time throughout the coastal (sub) Arctic North Atlantic (NICH-Arctic)

NICH-Arctic is a transdisciplinary project exploring culture-environment interactions in response to climate change in the subarctic North Atlantic. Supported by the Belmont Forum, this four-year project brings together researchers from various natural and human science disciplines to examine the subarctic climate in four North Atlantic regions: Nunavik, Labrador, Greenland, and Iceland. NICH-Arctic focuses on three key areas: the natural variability of sea ice, climate, and vegetation; the adaptation of local populations to their environment; and the cultural representations and perceptions of natural environments by both local and extra-regional populations. Targeted impacts of the project encompass database management, integrated documentation, resilience assessment, knowledge dissemination, and workshops involving researchers and local community members.

The NICH-Arctic project focuses on archaeology and climatology. A noteworthy initiative is the Qajartalik project, led by the Avataq Cultural Institute in Quebec, Canada. Avataq, a non-profit organization, is seeking UNESCO recognition for the unique Qajartalik site, home to ancient petroglyphs carved by Dorset peoples. By integrating data on climate, human occupation, land, and marine environments in the Kangiqsujuaq region, the project aims to explore potential links between climate change and cultural transitions in Nunavik.

One of the project's notable outcomes is the "face to face for the climate" interactive workshop, which engages high school students in discussions on climate change and past climate documentation methods. The project successfully reached a significant number of students in a short period. Challenges encountered in applying a transdisciplinary approach included navigating different expectations and the vast time scales involved in various studies. Collaborating stakeholders had to grapple with biases stemming from their respective expertise and discrepancies in the time frames in which they operated.

The Future Resilience for African Cities and Lands (FRACTAL)

This project is a transdisciplinary research group focusing on resilience in African cities and lands, particularly in southern Africa. The project's goal was to advance scientific understanding of regional climate responses to human activities and collaborate with decision-makers to integrate this knowledge into climate-sensitive decisions at a city-regional scale. FRACTAL fostered strong cooperation between researchers, city government officials, and key decision-makers across eight southern African cities, including Blantyre, Cape Town, Durban, Gaborone, Harare, Lusaka, Maputo, and Windhoek.

FRACTAL used a wide range of methods, such as field trips, games, roleplays, city-to-city learning and knowledge exchanges, climate risk narratives, and visioning processes. Learning Labs facilitated city learning processes, while an "Embedded Researcher" approach enabled early career researchers to bridge the gap between universities and local governments. The project yielded several outputs, including academic publications, communication products, reports, policy briefs, and governance recommendations. Notably, FRACTAL had an impact on city of Harare, leading to the creation of a Climate Desk responsible for coordinating environmental and climate-related issues.

In summary, these workshops identified common challenges and opportunities in transdisciplinary practice. Some of the overarching themes included the importance of including local perspectives and addressing power imbalances in knowledge production. Sources of controversy related to conflicting stakeholder agendas, leading to divergent expectations and potential conflict. Collaborative practices encompassed deep listening, language awareness, art, and joint learning experiences. While funding constraints remained a challenge, the growing interest in actionable research and transdisciplinarity held promise for future projects.

Policy takeouts

The cooperative efforts led by the Belmont Forum and the IAI showcase the importance of TD approaches when integrating research and public policy, especially in tackling empirical problems focused on global environmental change. The workshop advocated for the importance of TD research and international collaboration to create knowledge not only for understanding, but also for mitigating and adapting to global environmental change. Initiatives such as the "Transdisciplinary Approach 101 workshop" are important for fostering science diplomacy, with a special emphasis in delivering science advice to public policy practitioners.

Takeaways from the workshop were derived from the experiences and insights shared by the attendees who engaged with the theoretical framework of Transdisciplinary (TD) practices and studied specific case examples, emphasizing the diversity of actors involved in global environmental change. Consequently, the recommendations presented below stem from this collective empirical knowledge. The case refers to the results obtained through the online training workshop on transdisciplinary approaches (TD) at the Sustainability, Research and Innovation Congress (SRI) in 2022, organized by the Belmont Forum and the Inter-American Institute for Research on Global Change (IAI).

The initial critical lesson is that Transdisciplinary (TD) approaches have the potential to foster democracy and more equitable power dynamics in the knowledge production process. They can also enhance the interaction between science, politics, and society to promote sustainability and equity in the future. Furthermore, by addressing real-world issues, researchers form strong connections with the stakeholders they collaborate with. This leads to new perspectives and ways of addressing non-scientific viewpoints. In addition, the workshops revealed recurring themes in participants' discussions. The first of these concerns the question, "Whose knowledge is valued?" Workshop participants broadly concurred that TD research and practice should actively integrate the viewpoints of local populations who directly experience the outcomes and impacts of activities. However, it is often Western and academic knowledge that receives more attention, leading to power imbalances in projects and collaborations. These imbalances are evident in TD experiences, both for workshop participants and case study presenters.

The primary challenges identified by workshop participants revolve around the differing expectations and goals among those involved in case study projects. Often, there is little alignment between the objectives of funders and researchers. To address this, transparent communication is considered essential. It requires a willingness to listen and to ensure that all voices are heard, especially those of marginalized groups. In addition, financial constraints were repeatedly cited as a challenge in TD projects, including budget distribution inequities among partners, budget planning difficulties due to unexpected TD complexities, and the challenge of finding sustainable long-term funding solu-

tions, given the considerable time and effort that must be put into stakeholder engagement.

The workshop also provided several valuable insights for improving TD collaborations, including deep and attentive listening to all stakeholders, focusing on language and the meaning of words, discussing decolonial and socially legitimate approaches, employing art to grasp the human aspects of environmental change, and promoting joint learning experiences. The text concludes with recommendations for applying a TD approach to projects, underlining the significance of the knowledge gained from the participants' collaborative efforts during the workshop. These recommendations include identifying conflicting priorities at the project's outset, enhancing communication, transparency, and participation, acknowledging local time frames, addressing underlying power imbalances, introducing additional methodologies, and continuing to build capacities.

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Pulp Mills in Fray Bentos: Argentina–Uruguay Conflict over Transboundary Water Management

Participating Countries: Argentina and Uruguay

Science in Diplomacy

In the context of the disputes between Argentina and Uruguay over the pulp mills in the Uruguay River basin, this is a case of "Science in Diplomacy", because:

- **Science as a Language and Arena of Dispute:** Science served both as a tool of cooperation and as a source of contention, shaping technical and legal discussions throughout the conflict.
- **Transboundary Waters as Contested Commons:** Shared water resources can be both a source of conflict and a platform for cooperation—this case exemplifies how environmental concerns and state interests can collide.
- **Scientific Advisory under Pressure:** The role of science advisors became essential in informing negotiation and litigation, though political divergence limited consensus.

Executive Summary

Since 2006, when the Uruguayan government approved the construction of two pulp mills in the town of Fray Bentos, on the Uruguayan side of the Uruguay River, social and political turmoil has grown in the area. The two mills, which are owned by foreign enterprises, represented significant investment opportunities for the Uruguayan economy. Nevertheless, they could also, potentially, generate environmental and health damage to the population of Gualeguaychú, on the other bank of the river, in Argentinian territory. The issue was first raised by the environmental movement, created on the Argentinian side, but was later taken into account by both government authorities. Several instances of dispute settlement were involved, from direct bilateral negotiation to judicial proceedings involving the International Court of Justice (ICJ) and MERCOSUR.

Moreover, science played an important role in all the dispute settlement stages. However, political disagreement prevailed when it came to accepting the judicial solutions to the case. In order to provide a more detailed description of the events that led to this controversy, this case study is structured as follows:

- A historical and legal context is presented, focusing on the origins of the conflict.
- The emergence of the social movement in Gualeguaychú, Argentina, and its roadblock strategy is analyzed.
- The dispute settlement process is described, with an emphasis on how the case was discussed across different institutional arenas.
- Finally, the role of science in the dispute is reviewed, along with key lessons for the science-policy interface.

Keywords: Pulp mills; transboundary water management; dispute settlement; science advisory.

Introduction

Historically, the La Plata Basin has been a major geopolitical factor in the Southern Cone. Control over navigation routes and its resources, including water use, has been a driving force of conflict in the region, leading to wars such as the Platine War (1851-1852) or the Paraguayan War (1864-1870). Indeed, transboundary waters are a source of conflict and dispute at both inter-state and sub-national levels around the world, although they can also be the basis for cooperation (Espínola and Ribeiro, 2020). In the latter sense, a series of treaties have established the legal framework for cooperation around Plata Basin's water resources and their use and management: the Plata Basin Treaty (1969), the Plata River Treaty (1973), the Uruguay River Treaty (1975) —also known as the Uruguay River Statute— and the Tripartite Agreement (1979), among others. This legal framework encompasses rules on navigation, port facilities, pollution, law enforcement and several other relevant water management related subjects. Against this backdrop, the operation of two foreign pulp mills in Uruguay, on the banks of the Uruguay River, led to a controversy encompassing the opposing interests of the two companies, the government in Montevideo, Argentina, and the civil society in both countries. The main issue revolved around the environmental impact such activity would have on the region's water resources, in addition to allegations of violations of international environmental laws and joint river management laws.

The Uruguay River Basin makes up a significant part of the La Plata Basin, covering an area of approximately 365,00 square kilometers in the south-eastern part of South America, in the Southern Cone. It is surrounded by Brazil, Uruguay and Argentina. Its main watercourse is the Uruguay River, which forms the border between Uruguay and Argentina for much of its length, before merging with the Paraná River. The source of the conflict is precisely the section of the river that borders Uruguay to the east and Argentina to the west and south, as polluting activities in Fray Bentos (Uruguay) are expected to cause environmental and public health damage in the Argentinian city of Gualeguaychú.

In terms of the governance of the La Plata Basin, the Intergovernmental Coordinating Committee of the La Plata Basin Countries (CIC) stands out as a result of the legal development in the regulation of this basin. Its work focuses on guaranteeing respect for the principles recognized in the main treaties governing the basin, such as cooperation and communication in all relevant matters, sustainable development and the rational use of water. In parallel, the Administrative Commission of the Uruguay River (CARU, in Spanish) is a specific committee dedicated to the governance of the Uruguay River Basin. CARU was a particularly important negotiating forum for the conflict analyzed in this case study, both because of its mediation capacity and its specialization in the Uruguay River Basin.

The conflict originated in 2003, when the Uruguayan government authorized the Spanish company Empresa Nacional de Celulosa de España (ENCE) to build a pulp mill in Fray Bentos. The reason for the diplomatic and social disagreement was the potential environmental impact these enterprises could have not only to the Uruguay River's water resources as a whole, but especially to the population of the Argentinian city of Gualeguaychú, on the opposite bank of the river. Two years later, the authorization for a second mill in Fray Bentos, led by the Finnish company OyMetsä-Botnia AB (Botnia), aimed at producing 1 million tons of pulp per year –twice as much as the ENCE mill– increased diplomatic tensions in the region. The approval for the construction of the pulp mills on the banks of the Uruguay River was also the cause of the social turmoil which later became the symbol of the controversy, both in political talks and in the media.

In terms of environmental damage, paper production is a highly polluting and water-intensive industrial process. From the outset, environmentalists and civil society representatives warned the population of Gualeguaychú about changes in the smell and color of the water as well as the presence of toxic substances in its composition as effects caused by Botnia's pulp mill. Moreover, the chemical process for bleaching sheet paper makes it even more potentially dangerous to the environment. This is especially if when elemental chlorine is used in the process, despite technological advances that have reduced such pollution. The "elemental chlorine free" (ECF) technique uses chlorine dioxide for bleaching wood pulp and is gradually becoming an increasingly popular industrial practices. The "elemental chlorine free" (ECF) technique uses chlorine dioxide for the bleaching of wood pulp and is gradually becoming more popular among industrial practices of the field. A more comprehensive —and even more effective— method is the "totally chlorine free" (TCF) technique, which does not require any chlorine compounds to bleach wood pulp. However, the development of these methods is still slower in developing countries such as Argentina and Uruguay – and was even slower in the first decade of 21st century.

According to a 2006 World Bank report, both pulp mills in Uruguay used ECF bleaching methods, in line with European Union regulations and best practices to control and prevent environmental damage. Although European companies in the sector have already begun to use the TCF technique, this method was not used for their Latin American operations. Despite this legal background supporting the operation of the ENCE and Botnia mills, environmental activists were not fully confident in the ECF method. In fact, NGOs have pointed to environmental damage related to the mill's.

Civil society reaction and "*modus operandi*"

The dispute was centered on two main issues. First, the Argentinian government raised a legal and diplomatic dispute over the legitimacy of the approval of the two pulp mills, including whether or not Montevideo respected international law on the management of the river's water resources. Second, the road-

blocks also represented a source of conflict. Uruguayan authorities pointed out that the movement was initially supported by the local government of Gualeguaychú, while Buenos Aires took no action to demobilize the protesters. The process of resolving the dispute involved three main spheres of negotiation: 1) initial bilateral negotiations; 2) the case in MERCOSUR; and 3) the case in the International Court of Justice (ICJ).

Initially, bilateral negotiations were held in the realm of CARU, but later both countries abandoned diplomatic means of dispute settlement and resorted to judicial bodies. The abandonment of CARU as a negotiation forum was possible because the Commission is not a judicial body. On the contrary, its role is mainly to mediate and facilitate negotiations. Moreover, during this first phase of the negotiations, Uruguay also invoked the Organization of American States (OAS) in an attempt to compel the organization to facilitate the talks, especially due to the roadblocks, which, according to Montevideo, were clear violations of the OAS rules on freedom of movement. However, the OAS did not get involved, arguing that in order to mediate a given conflict, both sides must request the organization's intervention (Piscitello, Andrés, 2007).

When Argentina and Uruguay began bilateral negotiations under the CARU in 2003, Uruguay refused to respond to Argentina's request for information on the pulp mills case, immediately breaking off the talks. Nevertheless, high-level meetings were held at the beginning of 2004, in which the Uruguayan authorities provided the information previously requested by the Argentinian government. Another result of these meetings was the creation of a Bilateral High-Level Technical Group (GTAN) to monitor the pulp mills' operations and provide more scientific information on their impacts. Uruguay decided to provide the information previously requested and agreed to the creation of such a technical group, with the expectation of finally closing the case. The GTAN was established as a technical body, although under the supervision of the foreign ministries of both sides. From the beginning, however, disagreements arose over the data collection methods and the actual goals of this technical group. In this context, there was no agreement on a joint final report, leading each side to present its own individual report. Although judicialization in this scenario became an even more likely means of dispute resolution, another series of bilateral negotiations delayed such a solution (Piscitello, Andrés, 2007).

In 2006, the Argentinian president and his Uruguayan counterpart agreed to a new bilateral meeting to discuss the issue. On the one hand, the Argentinian leader convinced the Uruguayan authorities to present a joint request to the two pulp mills to postpone the construction and operation of their operations. At the same time, both presidents would ask the environmental movement to lift the roadblocks, a top priority for Montevideo. To compensate for the lack of a joint final report on the GTAN, another bilateral technical commission was formed, composed of six national and international experts in the field. This time, the goal was to produce a report within 45 days that would describe the environmental impact that the mills would have on the river and the population on both sides of the river. More importantly, this joint report would also be the basis for a future summit meeting tasked with ending the dispute. Despite these achievements, the negotiations failed because BOTNIA did not accept a postponement of its operations for more than ten days, a period that was too short for the Argentinian authorities to consider it a good-will gesture (Piscitello, Andrés, 2007).

Although ENCE did move its construction site, as mentioned above, the summit never took place due to BOTNIA's determined resistance to postpone its activities for more than 10 days. As a result, both countries finally resorted to legal action. While the Argentinian side saw the issue as a legal dispute over traditional international law (the 1975 treaty), Uruguay considered the roadblocks a violation of MERCOSUR's integration norms. Thus, while Argentina preferred the International Court of Justice (ICJ), Uruguay preferred to take the case to the MERCOSUR dispute settlement system.

In this context, an analysis of the dispute settlement process in MERCOSUR is appropriate to further understand the case. The case was submitted to MERCOSUR at the same time as it was submitted to the ICJ, although it was resolved much more quickly in this regional judicial mechanism. An "ad hoc" Arbitral Tribunal was established in 2006 following a formal complaint from Uruguay. The latter claimed that the Argentinian government's inaction with respect to the roadblocks was a clear violation of integration norms, since it hindered the right of movement of goods, services, people and tourists. Meanwhile, the Argentinian defense focused on the idea of a conflict of rights, among other technical and formal arguments. This government recognized that the roadblock may have affected the right to free movement of goods. However, Buenos Aires did not act against the roadblocks to ensure the right to freedom of expression, assembly and protest. In the face of this opposition, Buenos Aires argued that the Argentinian authorities should above all respect the environmental movement's right to protest, since human rights related to political and civil liberties are given a higher hierarchy by national law (Piscitello, Andrés, 2007).

The Arbitral Tribunal ruled in favor of Uruguay. Not only did it consider the roadblocks an objective restriction on the transit of goods and services, one of the pillars of MERCOSUR, but it also ruled that the Argentinian government should have prevented the roadblocks from being set up or maintained, even though they were performed by individuals rather than official authorities. Argentina accepted the result of the "ad hoc" court and did not appeal to the Mercosur Permanent Review Tribunal. Nevertheless, the country did not make much effort to demobilize the social movement, especially since the case was still being discussed under ICJ jurisdiction.

In May 2006, Argentina took the matter to the International Court of Justice (ICJ) in The Hague. The lawsuit accused Uruguay of violating bilateral agreements related to the shared use of the river. The Argentinian claim focused on the Uruguay River Treaty of 1975 norms that created the obligation to inform

potentially dangerous activities when those activities could affect the common use of the river. The accord also established that the parties should not allow activities that would jeopardize the environmental quality of the water potentially. Pragmatically, what the Argentinian government was requesting was a halt of the construction works of the pulp mills (Escrihuela, 2019).

Although Uruguay preferred to deal with the issue through the MERCOSUR dispute settlement mechanism, it accepted the legitimacy of the ICJ, not only because it presented a legal defense before the court, but also because it asked the court to force Argentina to repress the blockaders -which the ICJ did not do. Uruguay's defense centered on evidence that the approval of the two pulp mills did not violate the 1975 Treaty and that its Ministry of Housing, Land Planning and Environment (DINAMA) had taken all appropriate measures to ensure that there would be no environmental impact on the Uruguay Basin. Against this background, the Court ruled in 2010 that there was no evidence of contamination related to the pulp mills' activities.

The ICJ ruled that Uruguay had violated some procedural obligations regarding notification, but did not find that the mills caused significant pollution. In addition, the court ordered both countries to monitor the environmental impact of the mills. The ICJ ruling had two practical consequences. First, it recognized that there was no legal impediment to the construction or operation of the Botnia mill. Second, the roadblock was dismantled after four years of mobilization. In addition, the fact that 11 out of 14 judges sided with Uruguay and that the left-wing Mujica administration had taken office in Uruguay only a month earlier opened the door to new rounds of diplomatic talks. The new political landscape was a milestone in Argentina-Uruguay relations, given the ideological identification of the two governments. In this context, political negotiations on sensitive issues were conducted in a more cooperative environment.

In the realm of the ICJ judgment, both sides used scientific knowledge to interpret data on the case to support their claims. Indeed, most of the discussions before the ICJ were based on technical analysis of water quality and other pollution-related topics, in addition to a debate over the most appropriate methods for measuring environmental impact. In this context, science advisory played an important role in the controversy, since technical knowledge was used as a source of legitimacy for each side's claims. Indeed, the data collection methods and their interpretation were vigorously contested by the other side as part of the judicial dispute. This scientific controversy was possible because the Uruguay River Treaty of 1975 stipulates that studies related to water quality must be presented and shared with all parties before any party authorizes a construction site to begin operations. Notwithstanding this, the Uruguayan government had received the environmental impact study from the interested companies, but according to the Argentinian authorities, nothing was shared.

Following the ICJ ruling, the governments of Argentina and Uruguay embarked on negotiations that resulted in an agreement for the joint monitoring of the

Uruguay River under the responsibility of CARU. To this end, the Technical Commission was created in 2012 and more than 60 rounds of measurements have been carried out. This advisory committee, composed of four scientists (two from each country), would visit the pulp mill still in operation - Botnia's - up to 12 times a year to ensure that the mill does not contaminate the water resources of the Uruguay River. Since 2017, the studies have covered all 500 kilometers of the river, which makes up the border between the two countries. (PETHERICK, 2010).

Initially, however, the debate over water quality caused disagreement between the scientific communities of the two countries, as well as between the environmental and scientific authorities on both sides, despite high-level political talks. Uruguay's Ministry of Housing, Land Planning and Environment (DINAMA) declared that there were no signs of pollution in the river. But inland water specialists from Argentina, led by researchers from the University of Buenos Aires, strongly disagreed. Using methods developed by the University of La Plata, the research team found that the Uruguayan authorities' findings were unreliable because they had not sampled enough sites. In addition, the researchers stated that DINAMA did not take into account variations during different seasons: in summer, the water in the river ebbs and the flow of the river is influenced by sea water, which can change the concentration of pollutants. Another point of scientific controversy is related to the presence of Eucalyptus globulus wood fibers and nonylphenol contaminants from detergent breakdown in the water. Although Argentinian research indicates high levels of these materials, DINAMA data indicates that contamination was even lower in the areas affected by the factory than in some other areas where samples were collected (PETHERICK, 2010).

Overtime, less conflict between the two side's scientific community has been noticed. The 2016 report on the quality of water is a symbolic example of the commission's work. On the occasion, the report analyzed more than 30 different stretches of the river to study the quality of water, and identified four areas in which the data did not correspond to the ideal parameters. These parameters concern oil and metal concentration in the water, water temperature and other forms of measuring pollution. It is important to highlight as well that most of the studies were conducted with the assistance of Canadian laboratories, in Canada, though some of the analyses were carried out in Argentina or Uruguay due to conservation issues.

Another signal of broader cooperation in the period following the ICJ decision is the common intention of the two sides of the controversy to create a binational laboratory whose goal would be to study the quality of the water resources of the Uruguay River. The agreement for its creation was signed in 2016, after the transition from the Mujica to the Vázquez administration. The idea of the laboratory represents an important step in the political rapprochement between the two countries. The goal is for the new laboratory's studies to cover not only the area affected by Botnia's pulp mill, but also the entire Uruguay River basin.

In 2019, the architectural project to build the laboratory's facilities in Fray Bentos was selected and construction is currently underway. The laboratory is also an example of South-South cooperation in science and innovation diplomacy, as it is expected to produce high quality science and research and save up to 50% of the cost of sending water samples to Canadian research centers.

Conclusions and public policies takeouts

The causes of conflicts over transboundary waters are manifold. For example, they may be related to disputes over water use or access to resources in times of scarcity (Espínola and Ribeiro, 2020). In the case analyzed by this study, however, pollution was the driving force behind the controversy. Even if transboundary waters represent a unique opportunity for integration, cooperation may not be symmetrical. In fact, international relations in the realm of water management are influenced by the location of states along the river: if they are located upstream in the river basin, they can gain political control over the negotiations due to this geographical advantage (Espínola and Ribeiro, 2020). This was the case for Uruguay's cellulose industry project.

International diplomatic dispute resolution bodies were not effective in finding a common ground between the two sides. Negotiations in CARU easily broke down and the OAS did not get involved. Conversely, actors have resorted to several fora —OAS, MERCOSUR, ICJ– and although judicial decisions were respected, there is still political resentment when it comes to this case. Nonetheless, the countries involved in the controversy have channeled a great deal of effort into negotiations, even if they were not fruitful. The explanation for this is probably the historical scenario of cooperation that has developed between the two neighboring countries. As a result, relations between Argentina and Uruguay were seriously affected, especially in the years immediately following the ICJ decision, but they gradually returned to normal, especially after the ICJ decision and the election of like-minded presidents in both countries.

Furthermore, internally, in Argentina, the conflict gave a new status to environmental issues. Escrihuela (2019) points out that no other environmental issue had previously received such extensive coverage by Argentinians. The author also argues that the controversy is closely linked to a new form of political engagement within the country's civil society when it comes to environmental and sustainability issues. Although the first Kirchner administration did not place environmental issues high on the country's political agenda, the case inspired legal activity at all levels of government. In fact, the 2007 Law for the Protection of Indigenous Forests and the 2010 Glacier Law were passed amidst the controversy.

Against this background, the case of the pulp mills highlights that science was the language in which the controversy was carried out: science was a tool for cooperation, but also a source of controversy. The bilateral technical commissions that were established —like the GTAN— were conceptualized to be a neutral environment where scientists could find a common ground for providing information to support political negotiations. However, science did not guarantee consensus. On the contrary, there were technical disagreements over data collection methods and data interpretation. Furthermore, it is important to highlight that environmental social movements did not fully trust the data presented by the Uruguayan authorities and the pulp mill companies.

Under these circumstances, it is possible to conclude that science has been present throughout the negotiation process, and that it has continued to be an essential part of the controversy once the case reached the courts. However, science alone was not sufficient to mitigate the conflict or resolve the issue. Although science was a common language between the two actors during the political and legal discussions, and although technical knowledge was key to legitimizing each side's position, scientific advice contributed more to escalating the conflict than to finding common ground between the two sides. This situation changed only after a high-level political and ideological alignment between Argentina and Uruguay, at a time when the ICJ and the MERCOSUR "ad hoc" court had already delivered their verdicts.

In this new political scenario, the advisory committee set up by the two countries gradually evolved into a more cooperative environment. This phenomenon is probably the result of a common ground created by the fact that both sides' experts, acting indirectly as representatives of their countries, had scientific knowledge as a standard. There was still a political interest behind the results: as the 2016 report shows, if pollution had increased over the years, the conflict could have resurfaced. Nevertheless, the binational laboratory, which makes pollution measurements more independent of foreign research centers, is a clear signal of cooperation between the two neighboring countries.

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12

Coal Power Plant and Alumina Production in Jamaica: The Role of Science Diplomacy in Environmental Negotiations

Participating Country: Jamaica

Science in Diplomacy

In the context of disputes related to coal-based energy in Jamaica, this is a case of "Science in Diplomacy", because:

- **Bridging Science and Policy:** Science diplomacy acted as a bridge between the scientific community and policymakers, providing evidence-based knowledge, technical expertise, and informed options for decision-making at both national and international levels.
- **Civil Society and Academia in Action:** The coal-fired power plant controversy in Jamaica highlights the pivotal influence of civil society organizations and academic actors in shaping environmental and energy-related negotiations.
- **Raising Awareness Through Research:** The Red Dirt Report and its funding were instrumental in raising public and institutional awareness of the environmental and social costs of bauxite mining and alumina refining.
- **Shifting Power Dynamics:** Science advisory mechanisms helped shift the negotiation focus from purely commercial concerns to environmental considerations, redefining the negotiation space.

Executive Summary

This case study explores the relationship between Science Diplomacy (SD) and multilateral negotiations, with a specific case study focusing on aluminum production in Jamaica. It highlights the often indirect yet pivotal role of SD in shaping the outcomes of negotiations concerning energy and environmental issues. Although the concept of SD is not always directly at the negotiation table, SD practices act as a bridge between the scientific community and policymakers.

The case study analyzes the influence of SD on negotiations related to alumina production in Jamaica, specifically the sale of the Alpart alumina refinery in 2016. It demonstrates how SD diverted the negotiations from purely political and commercial considerations to technical discussions about environmental impacts. The crisis initially centered on a coal-fired power plant and eventually extended to bauxite extraction, revealing the critical role of affordable energy in aluminum refining.

Methodologically, the research design follows the traditional guidelines of a descriptive case study, employing concepts extracted from both negotiation theory and science diplomacy. The leverage and interests of key actors, including JISCO (Jiuquan Iron and Steel Company), the Jamaican government, and the Jamaica Environment Trust (JET), are examined.

Ultimately, the study underscores the influence of SD practices on the negotiations, shifting the focus toward environmental concerns and highlighting the importance of informed decision-making in international negotiations. JET played a pivotal role in exposing environmental hazards and influencing the redefinition of power dynamics. This case thus exemplifies how SD can reshape negotiations and foster sustainable solutions to complex global challenges.

Keywords: Science diplomacy; international negotiations; multilateral negotiations; foreign policy; science advisory.

Introduction

In our interconnected world, global challenges demand global solutions. Environmental issues, that transcend borders and impact every corner of the globe, are a prime example of this. In the pursuit of effective solutions, the realms of science and diplomacy converge in what is known as Science Diplomacy (SD). This case study explores the complex connection between science diplomacy and multilateral negotiations on energy issues through a case study of the aluminum production in Jamaica, shedding light on its sometimes indirect, yet vital, influence on the final outcome of negotiations.

Science diplomacy plays a significant role in multilateral negotiations, even when scientists are not directly seated at the negotiation table. It serves as a bridge between the scientific community and policymakers, providing evidence-based insights, solutions, and technical expertise to inform decision-makers. By facilitating the exchange of scientific knowledge, collaborative research, and cooperation on global challenges such as climate change, public health, and sustainable development, science diplomacy enhances the credibility and effectiveness of multilateral negotiations. It fosters trust, encourages

Potential environmental impacts

The extraction of bauxite requires considerable water usage, drawing from local water resources. This practice has the potential to stress aquatic ecosystems and disrupt hydrological cycles. Watercourses become avenues for sediment transport, altering natural flow patterns and affecting aquatic life. The result is a chain reaction that extends beyond the mining sites, impacting downstream ecosystems and communities that depend on these water sources (Hyslop & Nesbeth, 2012). In the context of the Alpart deal, the water-intensive nature of bauxite mining and the alumina refining process required rigorous monitoring of water use and discharge. The ecological implications of the deal hinged on the adequacy of mitigation measures to prevent water resource depletion and pollution (London Mining Network, 2022).

A modern coal-fired power plant can release approximately 762 kilograms of CO2 per megawatt-hour of electricity generated, with the 1,000 MW plant projected to emit around 6.7 million tons of CO2 annually. This emission level exceeds more than half of Jamaica's 2025 target under the 2015 Paris Agreement. Coal-fired power plants also emit various pollutants including mercury, lead, arsenic, sulfur dioxide, dust, and soot, impacting both public health and the environment. The opposition considered the proposed coal plant to be short-sighted, posing dangers to local residents, suggesting that the immediate advantages would be outweighed by long-term losses (EJATLAS, 2023; JET, 2023).

The ecological implications of bauxite mining also extend to soil degradation. The removal of vegetation exposes the soil to the erosive forces of wind and water, leading to soil loss and reduced fertility. What were once lush, biodiverse landscapes are transformed into barren wastelands – a stark reminder of the ecological toll of aluminum production. The loss of biodiversity from deforestation can have cascading effects throughout the ecosystem, affecting everything from soil health to water quality. The intricate connections between different species create a delicate balance that, when disrupted, can lead to ecological degradation.(JET, 2023; London Mining Network, 2022).

The case of Jamaica

Bauxite is the main mineral used for producing aluminum. In Jamaica, ALCOA, the world's foremost aluminum producer, has been mining bauxite since 1963. These efforts have propelled Jamaica to become the world's sixth largest supplier of bauxite, just behind Australia, Guinea, Brazil, China and India. In 2016, as the ink dried on the historic deal to sell the Alpart alumina refinery, a counter-narrative emerged in Jamaica that echoed the country's commitment to environmental protection and sustainable development (London Mining Network, 2022).

The bauxite industry, often referred to as "red dirt," has been a significant presence in Jamaica since the 1950s. In the 1960s, Jamaica rose to prominence as the world's leading bauxite producer, reaping substantial economic benefits. However, this prosperity came at considerable cost to the environment and local communities. The expansion of the bauxite industry led to deforestation, water pollution, displacement of communities, destruction of agricultural land, and a significant decline in air and water quality. These negative impacts took a toll on the health and well-being of Jamaicans (London Mining Network, 2022).

In July 2016, it was reported that a Russian mining company had entered into an agreement to sell its Alpart alumina refinery in Jamaica to China's Jinquan Iron and Steel Company (JISCO) for USD 300 million (CGTN, 2018). The deal also included a commitment from JISCO to rehabilitate and expand the refinery, converting it into a 500,000-ton-per-year aluminum smelter. These agreements were signed in Beijing, following discussions involving senior mining and energy officials from Jamaica, Rusal, JISCO, and the Development Bank of China. The Development Bank of China expressed its willingness to invest up to USD 2 billion over several years into the project. The lack of affordable energy has been a major obstacle for Jamaica in realizing its goal of fully converting bauxite into metal. The Alpart refinery had been inactive for seven years due to a sluggish alumina market after 2008 (EJATLAS, 2023).

In 2017, the Jamaican government established the Cockpit Country Protected Area (CCPA). However, the CCPA was notably smaller than what the Cockpit Country Stakeholders Group (CCSG) had advocated for, and excluded critical areas such as Special Mining Lease (SML) 173 from protection. This decision led to renewed opposition and heightened environmental concerns. The cumula-

tive environmental and social challenges associated with the bauxite-alumina industry in Jamaica have prompted calls for action. At the forefront of these efforts is the Jamaica Environmental Trust (JET), which conducted the 2020 Red Dirt Study. This comprehensive study sheds light on the significant social costs that Jamaican society is bearing as a result of the industry's operations, and calls into question its long-term sustainability (London Mining Network, 2022).

Opposition to a proposed coal-fired power plant arose, raising questions about the environmental impact and long-term sustainability of such a project. Activists in Jamaica have rallied behind the findings of the Red Dirt Study, calling for the re-designation of Cockpit Country, an immediate halt to mining activities in the area, a moratorium on further bauxite mining permits throughout Jamaica, and the development of an exit plan for the industry. The relevance of this study is further underscored by its connection to concerns surrounding the sale of the Alpart alumina refinery to China's Jinquan Iron and Steel Company (JISCO), underscoring the broader implications of bauxite and alumina operations in Jamaica.

At the heart of this opposition was the #SayNOtoCoalJA initiative, led by the Jamaica Environment Trust (JET), which combined the voices of over 21,000 people united against coal-fired energy (EJATLAS, 2023). The Jamaica Environment Trust (JET) is a non-governmental organization (NGO) that was established in 1991 with the primary mission of promoting environmental conservation and sustainable development in Jamaica (EJATLAS, 2023). This situation involves a dispute concerning a coal-fired power plant. Simultaneously, it has the potential to evolve into a dispute over the extraction of bauxite. A surplus of affordable energy is an essential component of the aluminum refining process, and the lack of this resource in Jamaica has impeded the nation's efforts to transform its bauxite resources into the final metal product through all stages of production.

The Jamaica Environment Trust (JET), a prominent environmental advocacy group, recognized the implications of the coal-fired power plant proposal. In response, they launched the #SayNOtoCoalJA initiative—a grassroots campaign aimed at raising awareness, mobilizing public opinion, and pressuring policymakers to reconsider the energy choice for the nation's future (JET, 2023). The proposal for a coal-fired power plant in Jamaica marked a departure from the nation's previous focus on renewable energy sources like wind, solar, and hydropower. The appeal of coal lay in its potential to provide cheap and abundant energy. However, it came at an alarming environmental cost due to its significant greenhouse gas emissions, contribution to air pollution, and detrimental effects on local ecosystems (Hyslop & Nesbeth, 2012).

The #SayNOtoCoalJA campaign leveraged social media, public rallies, community engagement, and petitions to build momentum. The #SayNOtoCoalJA campaign highlighted several pressing concerns, including (i) air pollution: coal-fired power plants are notorious for emitting harmful pollutants that contribute to poor air quality and health problems like respiratory diseases; (ii) climate change: burning coal releases large amounts of greenhouse gases, exacerbating global climate change and its far-reaching impacts; (iii) ecosystem damage: coal extraction and transportation of coal can harm local ecosystems, disrupting habitats and polluting bodies of water; (iv) long-term economic consequences: while coal may appear cheap in the short term, its environmental impact can lead to long-term economic burdens associated with health care costs and environmental rehabilitation (JET, 2023).

The #SayNOtoCoalJA initiative garnered significant public support. Over 21,000 people signed the petition opposing the coal-fired power plant, a testament to the strength of public feelings against the project. The campaign also succeeded in drawing attention to the potential environmental consequences of the coal plant and stimulating public discourse on the nation's energy choices (JET, 2023).

The Negotiation involving Jinquan Iron and Steel Company (JISCO) and other political actors

While the core business of Jinquan Iron and Steel Company (JISCO) was iron and steel, the acquisition of the Alpart alumina refinery was driven by a strategic move into the aluminum market. With the refinery, JISCO aimed to secure a key raw material, alumina, for its aluminum production. This was in line with its economic interest in diversifying its industrial portfolio. In this regard, access to Jamaica's bauxite deposits, a key ingredient in alumina production, was JISCO's primary interest in the negotiations. The company's economic interest lay in ensuring a stable supply chain for raw materials, thereby reducing its vulnerability to market fluctuations and resource shortages (CGTN, 2018; Tingling, 2016).

JISCO's interest in acquiring Alpart extended beyond economics. The deal facilitated the company's expansion into international markets, increasing its global presence and influence. In other words, JISCO could count on the support of the Chinese government, as its commercial interest aligned with the political interest in projecting China's economic strength and strategic reach. China's political interest aligned with JISCO's goal of securing vital resources for its industries. The acquisition of the Alpart alumina refinery provided China with a reliable source of alumina to support its ambitious industrial growth and economic development (London Mining Network, 2022).

China's drive to secure bauxite reserves in Jamaica also reflects its approach to mitigating resource vulnerability. With the world's largest population and a rapidly growing economy, China faces a constant need for raw materials to fuel its industries. By diversifying its bauxite sources through investments in different regions, China aims to reduce the risk of supply disruptions and maintain stable economic growth. Therefore, JISCO used the Chinese government's interests as leverage in its negotiations to acquire the Alpart alumina refinery (CGTN, 2018; Tingling, 2016).

JISCO's leverage with Jamaican government officials in the negotiations was increasingly strong. The Jamaican government's primary interest was in promoting economic growth and job creation. The Alpart deal, by sustaining and potentially expanding the alumina industry, could stimulate economic activity and contribute to national development. At the heart of Jamaica's push to attract Chinese involvement in its aluminum sector is a quest for economic diversification and growth. Historically reliant on traditional sectors such as agriculture and tourism, Jamaica has recognized the potential of the aluminum industry to inject new life into its economy. By attracting China's expertise and investment, Jamaica seeks to expand its industrial base, create jobs, and unlock new avenues of economic progress.

The negotiations were heavily influenced by the interests and influence of a civilian organization called the Jamaica Environment Trust (JET). JET's primary interest was to educate the public about the environmental and health hazards associated with coal-fired power plants. It sought to dispel misconceptions about coal as a cheap energy source by highlighting the hidden costs of pollution and climate change. It had great leverage because civil society mistrusted Chinese interests in Jamaica and the environmental impacts at stake. By channeling the voices of concerned citizens, JET aimed to create a groundswell of opposition. The campaign's social media presence and petitions allowed individuals to easily voice their concerns and show solidarity against the coal plant proposal. (JET, 2023)

The Red Dirt Report, spearheaded by the Jamaica Environment Trust (JET), is a critical document that sheds light on the multifaceted challenges posed by the bauxite-alumina industry in Jamaica. It plays a pivotal role in educating the public about the environmental and health hazards associated with coal-fired power plants and, by extension, the broader environmental concerns linked to bauxite mining and processing. By providing scientific evidence and communicating its findings to society, this report goes beyond dispelling popular misconceptions about coal as a seemingly cheap source of energy, and delves into the hidden costs of pollution and climate change, strengthening the public coalition for sustainable development.

Funding is vital for such a comprehensive and impactful report. The support of organizations such as the Grodzins Fund and Jamaica Conservation Partners (JCP) underscores the importance placed on addressing these pressing issues. Their financial backing allowed the Jamaica Environment Trust (JET) to collaborate with experts in various fields and provide them with the resources needed to research and compile each chapter of the report. They also collaborated with long-standing partners, the Environmental Law Alliance Worldwide (ELAW), further enhancing the depth and reach of the report. However, the effort faced additional challenges due to the COVID-19 pandemic, making financial support even more critical to overcome these unforeseen obstacles.

The Red Dirt Report, and the funding it has received, are essential components in raising awareness about the environmental and social costs associated with bauxite mining and alumina processing in Jamaica, challenging the landscape of the negotiations. Power dynamics can be challenged by changing the information available and, therefore, the coalitions of support and costs of each actors' choices. The Red Dirt Report provided valuable information and evidence that supported the #SayNOtoCoalJA campaign's efforts to encourage policymakers to prioritize cleaner and more sustainable energy alternatives over coal.

Insights and takeouts

Recent literature has broadened the scope of SD away from strictly international negotiations, emphasizing that it should not be seen as a substitution of elected officials for trained scientists, both because there are concerns that politics could interfere with academic freedom and that science could become politically instrumentalized, especially by the most powerful players. Rather, researchers have focused on the science advisory aspect of SD, which is aimed at potentially enhancing the quality of decision making by offering "evidence-informed options to the policy process at the domestic and international levels" (López-Vergès et al., 2021), either in the presence or absence of a legal or institutionalized framework for SD (Gittens et al., 2021).

In light of the above, this report serves as a cornerstone for informed decision-making and advocacy within the framework of science diplomacy. It aims to mitigate the negative impacts of these industries and ensure the well-being of communities and their environment. In addition to setting the stage for dialogue between civil society and government, it also marks the possible actions of science diplomacy involving private actors.

The case of the proposed coal-fired power plant in Jamaica exemplifies the significant impact that civil society organizations and scientists can have in shaping environmental and energy negotiations. The #SayNOtoCoalJA initiative, led by the Jamaica Environment Trust (JET), demonstrated the power of public outcry and grassroots movements to influence policymakers to prioritize cleaner and more sustainable energy alternatives.

Civil society organizations like JET played a critical role in channeling public concern and rallying a groundswell of opposition to the coal plant proposal. Through social media campaigns, petitions, and public forums, they effectively engaged the Jamaican people and raised awareness of the hidden environmental and health costs associated with coal-fired power generation.

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13

The Sustainability Side Letter in the EU–Mercosur Agreement

Participating Countries:
Brazil, Argentina, Paraguay, Uruguay, Venezuela, Bolivia

Executive Summary

This case study delves into the negotiations on the trade pillar of the EU–Mercosur Interim Agreement, with a focus on environmental considerations. The breach of confidentiality in environmental discussions underscored the discrepancies between the parties and stimulated a broader discourse on the role of science diplomacy in negotiations.

The EU's intervention emphasized environmental priorities, reframing the negotiations and highlighting the importance of technical and scientific cooperation.

Despite the significance of trade for sustainable development, challenges such as the Amazon wildfires disrupted negotiations and highlighted the intricate balance between economic and environmental interests.

This study highlights the evolving nature of international diplomacy and stresses the imperative need to integrate science into negotiations in order to effectively address emerging challenges.

Keywords: European Union; Mercosur; negotiations; confidentiality.

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Science for Diplomacy

In the context of the additional letter attached to the EU–Mercosur trade agreement, "Science for Diplomacy" is the most fitting typology for the following reasons:

- **Enabling Environmental Collaboration:** It underscores the need for EU–Mercosur cooperation to meet international environmental commitments. Science for Diplomacy plays a vital role in fostering this collaboration and ensuring both blocs work together on implementing global standards.
- **Integrating Scientific and Technical Commitments:** The letter includes provisions related to climate change and forest management, illustrating how diplomacy can incorporate scientific expertise into environmental policy design and execution.
- **Strengthening Implementation Mechanisms:** Science-informed diplomacy supports the technical cooperation needed to effectively apply environmental norms and address implementation gaps.
- **Balancing Asymmetrical Interests:** The negotiation process exemplifies how diplomacy can mediate between differing interests of the EU and Mercosur countries to craft mutually beneficial environmental commitments.

Introduction

After twenty years of intermittent rounds of negotiations, the agreement in principle between Mercosur and the European Union (EU) was signed on June 28, 2019. This represents the trade pillar of a broader agreement known as the Association Agreement, which also includes two other pillars: political dialogue and cooperation. Both were concluded in 2018, but their contents were not made available for public scrutiny, and only the agreement in principle, concluded in 2019, had its text made public. The sudden announcement of this agreement raised expectations about how environmental issues would be addressed, as there had already been criticism from environmental movements about the potential impacts of increased trade on the environment, particularly in relation to deforestation. The "Trade and Sustainable Development" chapter was touted by negotiators as a significant step forward in this area and a solution to concerns about the trade-sustainability dichotomy. However, the text was heavily criticized by environmentalists on both sides of the Atlantic and sparked pressure for changes to the text and to European trade policy as a whole.

The European Parliament also issued a report on October 7, 2020, announcing that the agreement could not be ratified if it remained as it was. The mismatch between expectations and the published text reflects the impact of the delay in concluding the negotiations. Contemporary concerns about environmental issues have changed dramatically in European societies over the past twenty years, particularly the sense of urgency about climate change. The pressure for more effective environmental protection measures affects the supranational bodies of the EU, urging them to impose stricter measures on their trading partners through agreements negotiated by the bloc.

The conclusion of negotiations with Mercosur intensified a long-standing debate about two ways to link environmental commitments to free trade agreements: the US sanctions-based approach and the EU promotional approach. The promotional approach reinforces the obligation of parties to fulfill commitments made in previous international agreements, such as the Paris Agreement. The EU also encourages its partners to comply with obligations related to domestic legislation and normative clauses included in trade agreements. The latter aspect is particularly important for the EU as it has become a "normative power" (Manners, 2002), i.e. an international actor capable of actively shaping international trade regimes and extending its own regulatory framework to other regions through trade agreements.

While the European Commission advocates the continuation of the promotional approach to promote sustainable trade practices, the European Parliament, environmentalists, and part of the academic community advocate stronger environmental chapters in trade agreements negotiated by the bloc. There is, however, no scientific evidence on which approach is more effective in compelling countries to fulfill the commitments established in trade agreements (Bronckers; Gruni: 2021), but the urgency of the environmental issue has led public opinion to favor tougher measures.

In addition, European protectionist sectors opposed to the agreement are trying to turn environmental regulations into trade barriers. In light of this scenario, in February 2023, the European Commission drafted an addendum ("side letter") as a proposed annex to the agreement to delve deeper into the issues covered in the original agreement's Trade and Sustainable Development chapter. The side letter is the EU's attempt to overcome the impasse caused by the environmental issue in the ratification of the agreement in principle, allowing the issue to be discussed in parallel between the parties without interfering with the already agreed content.

This case study will analyze this specific negotiation and the potential tensions between the interests of those involved. Differences in expectations between the parties on the environmental issue became apparent in March 2023 when the confidentiality of the letter was breached, and the first reactions from governments and civil society emerged. While environmental movements like Climate Alliance and members of the European Parliament criticized the lack of instruments to ensure monitoring and compliance with the goals of the Paris Agreement, Mercosur countries argued that the demands to reduce deforestation were unrealistic. The Brazilian government, the main target of the conditions proposed in the text, expressed concerns about the possibility of sanctions, although the side letter did not directly mention penalties. Thus, a new phase of discussions between the blocs has opened, the outcome of which could further jeopardize the ratification process on the European side. Since it is a mixed agreement, ratification will have to take place in the supranational bodies of the European Union and in the national parliaments of the member countries, which in turn have veto rights.

Historical Context

AAlthough it was not the main focus of the negotiations between Mercosur and the European Union (EU), the environmental issue has been present since the beginning of the dialogues. The text of the EC-Mercosur Interregional Framework Cooperation Agreement, signed in 1995, makes several references to environmental protection and has an article dedicated to the subject (Article 18 - Cooperation in the Field of the Environment). The Framework Agreement was aspirational in nature and only indicated future cooperation actions, but it is noteworthy for its emphasis on the environment. This concern was influenced by the guidelines of the Maastricht Treaty, signed in February 1992, which established the pillars of the supranational institutions as they are known today. The treaty also broadened the EU's objectives to include "sustainable growth" as one of its goals.

The use of the word "growth" was criticized by scientists, and the Rio Declaration on Environment and Development (June 1992) adopted the term "sustainable development", increasing pressure for adjustments to European standards. The Treaty of Amsterdam (October 1997) and the Treaty of Nice (February 2000) made sustainable economic progress one of the main objectives of the EU, but it was not until the Treaty of Lisbon (December 2007) that a more comprehensive view of the issue was included, referring to the sustainable development of Europe and the planet (Kenig-Witkowska, 2017). In parallel with the growing awareness of the issue, the Common Foreign and Security Policy, established by the Maastricht Treaty, sought to increasingly link environmental commitments to trade policies and agreements with the rest of the world. Returning to the discussion of the negotiations with Mercosur, another important document to trace the relevance of the issue in the negotiations was offered by the European Commission on September 17, 1999. Called the "Negotiating Directives," the text stipulates that "environmental protection and ecological balance will be taken into consideration in the implementation of various aspects of economic cooperation between the parties" (Ghiotto; Echaide, 1999).

These principles guided the discussions of the 1st Summit of the European Union and Latin America and the Caribbean held in Rio de Janeiro in 1999, where trade agreements were also discussed. The creation of the Bi-Regional Negotiating Committee (CNB), responsible for future trade liberalization and the consolidation of Mercosur as the main Latin American interlocutor, also represented a step forward in the relationship between the blocs. The main outcome of the 1st Summit was the signing of the Rio de Janeiro Declaration, a document that established guidelines for future cooperation between the two regions. According to the text, the parties made the commitment to "prevent and reverse environmental degradation, mainly resulting from excessive industrial concentration and inadequate consumption patterns, as well as from deforestation and soil erosion, ozone layer depletion, and the increasing greenhouse effect that threatens the global climate" (Folha, 1999).

In April 2000, the first CNB meeting took place and the main objectives of the negotiations were defined, including environmental protection, indicating the consolidation of the issue on the negotiating agenda. Between 2001 and 2004, the technical meetings of the CNB were held in a promising sequence, hinting at a satisfactory conclusion of the agreement. However, over the fifteen meetings held during this period, disagreements turned into impasses: the offers presented by the European Union did not include products of interest to the South Americans, and vice versa. In addition to the problems inherent in the dynamics of the negotiations, the CNB also had to deal with internal factors in the countries of the bloc and the influence of international events. For example, at the fifth CNB meeting in July 2001, Argentina was facing a severe economic crisis and threatening to leave Mercosur; and at the tenth meeting in June 2003, the CNB was awaiting the conclusion of the first stages of the reform of the European Union's Common Agricultural Policy (CAP), which would begin the following month.

Amid this turbulence, negotiations were suspended in October 2004 and did not resume until 2005, when an attempt was made to restart the agreement through a ministerial meeting in Luxembourg. According to Araújo (2018), the meeting "reiterated the importance of restarting negotiations through political momentum to overcome differences." Also in 2005, new meetings took place between the blocs' coordinators, and finally, in 2006, a meeting of the Mercosur-European Union Business Forum was held in Buenos Aires. During this event, the decoupling of the negotiations from the Doha Round agreement was discussed, but no concrete results were produced. This indecision significantly increased skepticism about the viability of the agreement, a situation that was exacerbated by the onset of the global financial crisis in 2008.

In this new context, EU foreign policy returned to bilateralism, prioritizing narrower agreements with emerging powers such as India, Russia, China, and Brazil. The Strategic Partnership between Brazil and the European Union was signed in 2008, although it did not have a multilateral focus. The Partnership did, however, provide for the resumption of negotiations with Mercosur. While the bi-regional dialogues were at a standstill, in 2009 the European Parliament published a report entitled "EU Strategy for Relations with Latin America", which added the Millennium Development Goals to the cooperation agenda for future bi-regional meetings. These guidelines shaped the EU's international action with its trading partners at the United Nations Summit on the Millennium Development Goals in September 2010. From then on, the environment became a central issue for the EU and would influence all aspects of its external relations. Also in 2010, negotiations with Mercosur were resumed under the auspices of the Brazilian president and the European Commission president.

The impetus for negotiations was renewed, but elections in Brazil, Argentina and France between 2010 and 2012 prevented the blocs from exchanging proposals to finalize the agreement. Only rounds of negotiations on rules continued during this period, and there was an expectation that proposals would be exchanged at the end of 2013, but this did not happen, leading to a period of stalemate between 2013 and 2015. Only in May 2016 did the parties exchange tariff proposals, but the results were unsatisfactory and the agreement remained suspended. It was only in 2017 that the talks were reactivated. Also in that year, the Subcommittee on Trade and Sustainable Development was created, responsible for drafting the chapter on the subject in the final proposal of the agreement. According to Aprile (2021), the formation of the subcommittee represented the centrality of the environment in the EU's trade agenda.

The Chapter on Trade and Sustainable Development of the Agreement

As discussed in the previous section, sustainable development gradually became part of European institutions and norms throughout the 1990s and 2000s, influencing the Common Foreign and Security Policy and trade policy. An important event in the consolidation of the sustainable agenda in the EU's

foreign trade was the publication in 2006 of the European Commission's document "A Global Europe", which provided guidance for including the theme in future agreements. The first Economic Partnership Agreement to include a chapter on Trade and Sustainable Development was signed with CARIFORUM in 2008. With regard to free trade agreements, the first to include a chapter on the subject was signed with the Republic of Korea in 2010.

According to Adinolfi (2020), the EU is increasingly aligning itself with the broader context of the 2030 Agenda, using its trade policy to promote sustainable development values and promote European exports in international markets. The text of the commercial part of the Association Agreement with Mercosur reproduced this pattern and mentions in its first article the commitment of the parties to various international regimes: Agenda 21, the Rio Declaration on Environment and Development, the Johannesburg Declaration on Sustainable Development of 2002 and the Johannesburg Plan of Implementation on Sustainable Development, the Ministerial Declaration of the United Nations Economic and Social Council (ECOSOC) on creating a national and international environment for full employment and decent work for all, the Declaration on Social Justice for a Fair Globalization of the International Labor Organization (ILO) of 2008, and the Final Document of the United Nations Conference on Sustainable Development of 2012, also known as Rio+20, entitled "The Future We Want". Finally, the article mentions the document "Transforming Our World: The 2030 Agenda for Sustainable Development" from 2015, which established the 17 Sustainable Development Goals (SDGs) and their 169 targets.

Regarding the SDGs, the text emphasizes (although without providing details) that the parties must work together to ensure that trade relations contribute to achieving the goals. Article 6, entitled "Trade and Climate Change", mentions the United Nations Framework Convention on Climate Change, invoking the parties' commitment to reducing greenhouse gas emissions. On this point, Ghiotto and Echaide (2020) comment that its inclusion was considered a victory by European negotiators by making compliance with the Paris Agreement a condition of the agreement. Despite the initial enthusiasm, criticism soon emerged from environmentalists involved in the issue: the environmental clauses do not obligate the parties to comply with them, and the text does not provide for sanctions. Another recurring criticism among environmentalists and representatives of the Green Group in the European Parliament was the little or no attention given by negotiators to environmental impact assessments. The first study of this kind was conducted by the University of Manchester in 2003 at the request of the European Commission and published in 2009. However, the greatest disappointment came with the study released by the London School of Economics in 2020. Commissioned in 2017 by the European Commission, the report was completed after the conclusion of negotiations in 2019, raising questions about the Commission's and other European institutions' responsibility to adopt environmental impact studies as the primary guide for the bloc's trade relations.

This episode represented the failure to use science in diplomacy, that is, the use of specialized knowledge and scientific advice in international affairs. However, the discontent caused by this failure expanded the debate on the use of science diplomacy in the negotiation of free trade agreements and opens up space to influence other dialogues, even within the framework of the agreement between Mercosur and the European Union. Complaints about the environmental aspect of the chapter on Trade and Sustainable Development were limited to stakeholders involved in the issue until the announcement of the conclusion of the negotiations. The issue gained prominence and entered the agenda of European civil societies from August 19, 2019, a date known as the "Day of Fire" due to a series of fires orchestrated by farmers in the northern region of Brazil, especially in the state of Pará. The wildfires increased by 300% on that day alone, and later the smoke reached the city of São Paulo, in the southwest of the country, more than 2,604 km away from the main focus of the fires.

The controversial statements made by the then Brazilian president and the lack of action to combat the problem had a negative impact on European public opinion and greatly influenced opposition to the agreement with Mercosur. According to a survey conducted by the NGO Rainforest Foundation Norway in 2021, 75% of respondents in 12 European countries began to oppose the ratification of the agreement following the news of the dramatic increase in Amazon fires in 2019 (Ayuso, 2022). In the same year, the "Stop EU-Mercosur" coalition also emerged, an initiative against the agreement that brings together 400 civil society entities in Europe and South America. Furthermore, a study conducted by Skill, Passero, and Francisco (2021) demonstrated the immense international repercussion of the fires on social media through hashtags such as #PrayForAmazonas, #ActForTheAmazon, and #AmazonFire, generating an unprecedented global mobilization around the issue.

The Negotiation of the Side Letter

The impact of the Amazon fires was devastating for the international image of the Bolsonaro government in Brazil, and pressure from environmental groups was directed at the Mercosur-EU agreement, with the intention of making it a tool for compliance with environmental standards. Advocates of the "sanctions-based" approach gained ground in discussions on trade agreements within the European Union and began to receive support from public opinion.

Therefore, in March 2022, the European Commission announced that it had presented a proposal for a side letter with more environmental commitments to Mercosur by the end of that year. Europeans also awaited the outcome of the Brazilian elections to resume the dialogue on the ratification of the agreement, which had been stalled after the crisis with the Bolsonaro government. In March 2023, the side letter was leaked against the will of the European negotiators, and the public had access to its contents.

The preamble of the text mentions more environmental commitments than the chapter on Trade and Sustainable Development of the agreement, citing the United Nations Declaration of Human Rights, the United Nations Declaration on the Rights of Indigenous Peoples, the Convention on Biological Diversity (CBD), the Convention on the Conservation of Migratory Species of Wild Animals, the Kunming-Montreal Global Framework for Biodiversity, the Convention on International Trade in Endangered Species of Wild Fauna and Flora, the Ramsar Convention on Wetlands of International Importance, the Montreal Protocol on Substances that Deplete the Ozone Layer, the United Nations Convention to Combat Desertification and Mitigate the Effects of Drought, and the Global Forest Goals.

Next, the document refers to the need for efforts to achieve SDG 15.2 on the sustainable management of all types of forests and halting deforestation, as well as mentioning that the agreement could contribute to a sustainable recovery after the COVID-19 pandemic. Since the trade pillar of the agreement was concluded before the pandemic (in June 2019), the European Commission included this point recognizing the conjunctural changes caused by the health crisis.

Two points concerning the Paris Agreement deserve attention and demonstrate an attempt to strengthen the commitment to sustainability: the text emphasizes the need for regular information exchange between the parties on the progress made in meeting the targets and establishes additional commitments for the implementation of Nationally Determined Contributions (NDCs). The side letter proposes progressive NDC targets and stipulates that the parties cannot reduce them, especially with regard to existing deforestation goals until the date of the political agreement between Mercosur and the European Union. In other words, the letter reduces the flexibility provided by the NDCs for developing countries to plan and implement the targets according to their capacities and needs.

The content of the letter prompted reactions from Mercosur governments, particularly the new Brazilian government, and from environmental movements dissatisfied with the laxity of a document that should theoretically force Mercosur countries to comply with the Paris Agreement targets. The Lula government in Brazil described the letter as a "threat" and said it wasn't right to impose "punishments on any country that does not comply with the Paris Agreement when they (Europeans) didn't comply either". Meanwhile, while the Fernandez government in Argentina stated that the letter's content was "excessively focused on the environment, without recognizing the three dimensions of sustainability: environmental, economic and social".

Mercosur sent a counter-proposal on September 13, 2023, and its content is still confidential. The text is said to be preliminary, and a more detailed version is expected by the end of the year. According to the press, the lack of consensus within Mercosur prevented a stronger response, as Argentina and Brazil intend to negotiate for more restrictions on government procurement. Therefore, the Mercosur text only refers to "greater space for public policies."

Given the statements of Mercosur leaders and the foreign policy conducted by Brazil during the Lula government, it is presumed that the final response from the South American bloc will include the topic of sustainable development, which was only tangentially discussed in the European letter. Mercosur will likely emphasize the inequality between the blocs to reaffirm the need for investments to achieve the targets. The most interesting point for this discussion in the present work is precisely the opening of a new negotiation based on the exchange of side letters, which will lead to more discussions and could further delay the ratification of the trade pillar.

Figure 19: *Brazil's Environment minister seeks to resume EU-Mercosur agreement*

It is interesting to note that the controversy surrounding the environmental issue is a recent phenomenon and did not pose difficulties for the negotiators over more than twenty years of negotiations. The obstacles have always revolved around tariffs and phytosanitary barriers. The Mercosur countries are signatories to the same environmental regimes as Europeans, and Brazil, in particular, has robust legislation on the subject. The hurdles lie in the implementation of laws and the lack of resources to do so, as is the case with most developing countries. The European Union's side letter made the environmental issue central to the conclusion of the trade pillar of the agreement.

Insights and takeouts

Gradually, science diplomacy has become an important tool for trade negotiations to support the positions of the parties involved. The European Union is at the forefront of this process, but when negotiating with other regions and seeking the primacy of its sanitary, phytosanitary, and environmental criteria as a common basis for dialogue, it encourages other actors to use science diplomacy as a counter-argument.

In general, free trade agreements with the EU aim to harmonize the partners' standards with European regulations. Regulatory harmonization has the advantage of providing access to the European market and raising the safety

standards of other countries. However, on the other hand, if a criterion is not met by one of the parties, it can become an insurmountable trade barrier.

The agreements of the World Trade Organization (WTO) have a widely used loophole to raise trade barriers: although the WTO emphasizes that SPS (Sanitary and Phytosanitary) measures should not create additional barriers, it allows the use of stricter regulations as long as they have scientific justifications (Kareem et al, 2018). Several disputes between developed and developing countries have arisen over this clause and have been referred to the WTO's settlement procedure.

Studies indicate that SPS measures are crucial in determining market access conditions and may have a distorting effect on trade (Murina; Nicita, 2014). Furthermore, compliance with SPS measures is expensive and requires technical expertise and infrastructure. The EU's SPS measures are particularly demanding, one example being the criteria for the use of pesticides that are higher than the globally acceptable benchmark.

Another point that sparks discussions is environmental impact reports. In the case of Mercosur, there is already comprehensive domestic legislation on the subject, and the countries are bound by major international regimes. The new discussion around the side letter will focus on the need for more environmental regulations and/or the enforcement of existing regulations.

This scenario offers an opportunity for the incorporation of science diplomacy and requires a twofold effort by governments: to empower diplomats who can discuss technical details at international negotiation tables and bureaucrats who can understand the intricacies and diplomatic language. Although this is already happening to some extent, there is a need to increase the number of policymakers trained in science diplomacy.

Policy lessons and recommendations: science diplomacy has enormous potential to support trade negotiations and the environmental issues that underlie them. With the growing centrality of the issue, it is essential for the parties involved in the negotiations to base their decisions on scientific grounds. At the same time, agreements between developed and developing countries need to be balanced, and SPS and environmental standards should not be used as additional barriers, as recommended by the WTO.

The main policy lessons from the analysis are:

1. The side letter negotiations will require the parties involved to determine whether additional legislation is needed for Mercosur to meet its environmental commitments or the enforcement of existing standards. The second alternative (enforcement) is likely to be advocated by Mercosur, and scientific assessments may point out what is needed to implement these measures, as well as the time and resources required to put them into practice.

2. Technical-scientific cooperation is essential for the blocs to achieve their environmental goals. The cooperation pillar of the agreement between the blocs was concluded in 2018 without discussion with civil societies and the scientific community. Since cooperation and trade topics were separated to facilitate the negotiation process, there is a need to realign the commitments made and the requirements of the side letter.

3. More environmental impact studies should be conducted by both blocs, taking into account aspects that were left out of previous publications, such as indigenous populations and other South American ecosystems (such as Argentina's Chaco region, also vulnerable to deforestation). Additionally, the impact of a no-deal scenario should also be assessed, as the lack of employment prospects and the reprimarization of Mercosur economies have led to the expansion of the agricultural frontier regardless. Illegal mining is also a symptom of this. Many analysts argue that the agreement could create economic growth prospects and curb the deindustrialization of the region.

4. The adaptation of Mercosur countries (if the agreement is ratified) to the SPS criteria of the European Union will require scientific expertise and cooperation, something already provided for in another part of the agreement that has not been disclosed to the public. There is an urgent need to gather this information, engage with civil society, and rethink sustainability in the light of international cooperation.

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14 Environmental Justice Along the Lithium Supply Chain: A Role for Science Diplomacy in the Americas

Participating Countries: Argentina, Bolivia, Chile

Executive Summary

South America and Australia are the primary producers of exported lithium, with the United States not fully tapping into its lithium reserves. China, South Korea, and Japan import the bulk of lithium for battery production, while Europe and North America account for a significant share (~40%) of electric vehicles on their roads.

The costs and benefits associated with lithium mining are intricately linked to the various steps in the supply chain. South America bears the brunt of the environmental and health-related consequences of lithium mining and production, while North America reaps the rewards from EV sales and use.

Some South American communities bear the negative environmental and health impacts of lithium mining, while others benefit financially from the process. This generates a global imbalance in environmental justice.

The United States recognizes EVs as a key element for a sustainable future but often overlooks the full life cycle of its components. Addressing these disparities through science diplomacy between North and South America could minimize total costs, optimize shared advantages, and support more equitable benefit distribution across the region.

This study underscores how science diplomacy can:

- Strengthen international cooperation
- Establish sustainability standards for mining operations
- Trace the origin of lithium
- Promote fairer benefit-sharing in the Americas

Keywords: Science diplomacy; lithium; mining; sustainability; electric vehicles; Americas; water.

Science in Diplomacy

This is a case of "Science in Diplomacy", as it reveals how integrating science into diplomacy can help address environmental and social asymmetries in global supply chains:

- **Unequal Distribution of Costs and Benefits:** Lithium extraction imposes significant environmental and health costs on South American communities, while North America and other regions benefit from the growing electric vehicle (EV) market.
- **Scientific Cooperation as a Tool for Equity:** Collaborative international science can help establish sustainability standards and trace lithium origins, promoting environmental justice.
- **Science for Sustainable Policy Design:** Embedding scientific knowledge in diplomatic efforts offers support for climate action while ensuring a more equitable distribution of benefits across the Americas.

Introduction

The challenge of mitigating climate change by reducing the consumption of fossil fuels is particularly urgent in the transportation sector, where electric vehicles (EVs) are being hailed as a comprehensive solution for addressing climate change. In the United States, the transition to EVs is particularly prominent because the transportation sector stands as the main contributor to greenhouse gas emissions. However, EVs rely on batteries that are dependent on rare minerals, specifically lithium. The demand for EVs powered by lithium-ion batteries has surged in affluent nations, including the US.

The high demand for EVs and their lithium-ion batteries is exerting significant pressure and creating economic opportunities for extracting lithium salts from brines located in a region known as the "Lithium Triangle" (LT), situated in the central Andes of South America. This region encompasses the Atacama Desert and is also home to indigenous communities and unique ecosystems. Transnational corporations are increasingly operating in this delicate region, spanning Chile, Bolivia, and Argentina, in a context marked by rudimentary environmental policies and safeguards for extraction in these countries.

The adoption of electric vehicles (EVs) in North America has the potential to bring benefits to South America, including climate change mitigation and economic growth opportunities driven by increased demand for South American lithium. However, the current environmental and social consequences of lithium mining disproportionately affect the Global South due to mining activities, while the Global North benefits from the shift to electric vehicles over traditional internal combustion engine vehicles. There are limited regulations in place governing these companies, and a conspicuous absence of individuals with scientific or indigenous expertise involved in policy-making related to mining in the LT.

The current state of the EV battery supply chain creates an opportunity for science diplomacy, which involves supporting foreign policy on issues where science and technology play a crucial role. Science diplomacy encompasses intergovernmental communications and policies related to climate change, biodiversity, shared natural resources, and cross-border ecosystems, as well as their effects on communities, health, and economic prospects.

Given the growing demand for lithium, there is a pressing need for international policy development and science diplomacy across the entire supply chain. Supply chain policies, such as certifications that highlight environmentally and socially sustainable practices within the supply chain, have been well-established in sectors like agriculture and forestry, where they have effectively reduced deforestation linked to commodity production. However, these best practices are not yet well established in the mining sector, including the lithium supply chain. Incorporating scientific evidence into the policy-making process can help assess and develop better policies by identifying the impacts of lithium mining.

Collaborative international scientific research can play a crucial role in establishing sustainability standards for mining operations and devising procedures to trace the origin of lithium salts. Science diplomacy can mitigate the costs of lithium mining and enable a more equitable distribution of benefits as the demand for EV batteries continues to grow. Precedents set by policies and diplomatic agreements in other sectors can provide guidance for achieving socially and environmentally sustainable outcomes at various stages of the lithium supply chain, benefiting both northern and southern countries. Leveraging these lessons and existing international collaborations can lay the groundwork for achieving equitable distribution of health, economic benefits, and climate impacts throughout the lithium supply chain in the Americas.

Potential Environmental Impacts

Lithium extraction imposes costs on local communities in the form of environmental degradation. Notably, the competition for water resources in lithium mining regions is so intense that it could jeopardize the livelihoods of nearby populations, including marginalized indigenous communities (Romero et al. 2012). In fact, lithium mining leads to water scarcity not only in the immediate vicinity of mining areas but also in adjacent regions (Liu and Agusdinata 2020).

However, there could also be substantial benefits for local communities, contingent on effective local management of the lithium industry. These benefits manifest themselves primarily through indirect job creation and the allocation of royalties and taxes. For instance, in Argentina, the lithium industry employs 37,794 people in the mining sector, with recent job increases (9.8% from November 2021 to November 2022). In Chile, revenues generated by the lithium industry rank among the highest for Chilean export commodities (Cochilco 2020). These benefits can reach workers through wages, the government via royalties, and neighboring communities indirectly through increased overall economic activity. It's worth noting, however, that while mining companies benefit from the revenue, not all of these firms are South American-owned. The extraction of lithium by foreign-owned companies results in the export of profits from South America (see Espina 2022; Ibarra 2022; Reuters 2023).

The current state of lithium mining leads to water scarcity and environmental degradation, resulting in a reduced quality of life, including health impacts due to a lack of clean water. Some of the most affected groups are indigenous communities living near the LT, who may not fully benefit from the potential climate change mitigation afforded by EV use if they are compelled to relocate due to mining activities encroaching on their land or reducing their access to water. Meanwhile, US residents directly experience benefits such as cleaner air due to reduced EV emissions and reduced noise pollution resulting from quieter power sources in EVs, both of which contribute to improved health outcomes (Khreis et al. 2023).

The transition from internal combustion engine vehicles (ICEVs) to electric vehicles (EVs) can bring significant benefits to areas that embrace EVs. For instance, EVs emit less heat than ICEVs, thereby reducing the intensity and prevalence of heat islands in urban areas (Li et al. 2015). One of the most widely discussed and apparent benefits is the lower carbon emissions associated with EVs, depending on the specific power sources used to charge them. Even if power plants powering EVs rely on coal, gas, or other less environmentally friendly fuels, EVs still contribute to emissions reductions due to their higher overall efficiency compared to ICEVs (Requia et al. 2017). In addition to these advantages, EVs can offer a range of local benefits, including reductions in local pollutants and noise pollution (Noel et al. 2018).

Moreover, the benefits generated by the mining industry may not be evenly distributed among the three LT countries. For example, the 2021 Infrastructure Investment and Jobs Act in the United States encourages trade with the nation's commercial partners, offering advantages to Argentina and Chile. However, it's important to note that the US market is not the only option available. In fact, Bolivia has established a partnership with a Chinese company, which could potentially open up Chinese markets for Bolivian lithium.

Chile policy background

Lithium has been a central focus on Chile's political agenda for the past decade. In 1979, it was designated as a non-concessional resource of national significance, and its extraction and trade were reserved for the state. Under this arrangement, the state could grant companies the right to extract lithium through special lithium operation contracts or administrative concession licenses (Cochilco 2009). For many years, Chile has exclusively granted extraction privileges to two companies: the Chilean giant SQM (Sociedad Química y Minera), one of the world's leading lithium producers, and the US-based firm Rockwood Lithium/Albemarle. In June 2023, the Chilean government introduced a new National Lithium Plan, creating opportunities for national stakeholder involvement, lithium exploration, salt flat and lithium research, and establishing a state-owned lithium company that can also collaborate with other enterprises (Gobierno de Chile 2023).

By negotiating contracts, the Chilean government is able to increase lithium production in the country while redistributing the proceeds of exploitation among companies, the state and local communities. Furthermore, public policies related to research, development, innovation and value addition in the lithium supply chain have been actively promoted. These policies include commitments from companies to make direct financial contributions to support plans and programs designed to fulfill these objectives (Poveda 2020). However, these policies have not fully achieved their stated objectives of fostering economic growth and equitable redistribution.

Recent discussions in Chile over the receipt, or lack thereof, of royalties from lithium extraction highlight political concerns about matching resource redistribution with the aforementioned goals. There are significant environmental and social concerns associated with lithium extraction, including the increasing scarcity of water resources, the presence of indigenous communities, and the sensitivity and fragility of the Salar de Atacama ecosystem. Extraction impacts flora, soil, biodiversity, and climate, and many of these effects are costly or irreversible. One of the most complex issues linked to lithium extraction is its impact on the hydrogeological balance of wetlands, alluvial mud, lagoons, and other water sources (Lunde Seefeldt 2022). The government's newfound interest in stakeholder engagement and research could potentially address these concerns, especially if scientific and indigenous knowledge is actively sought and integrated into the policies and actions stemming from the new strategy.

In Chile, there are no comprehensive studies on the fragility of the ecosystem in the Lithium Triangle (LT) or the sustainability of lithium extraction. Nonetheless, mining is heavily regulated as a sector in Chile. The Environmental Evaluation Service (Servicio de Evaluación Ambiental or SEA) is responsible for conducting environmental impact assessments prior to the start of any mining project in the country. The process is akin to the requirements of the US National Environmental Protection Act for environmental impact assessments (EIS) (Public Law 91–190, 1970). However, the guidance documents provided do not establish clear guidelines or thresholds for sustainability. In the US, both EIS and SEA guidance require water resource assessments, but even if adverse effects are identified, mining can still be authorized if mitigation measures are put in place and the overall benefits of the project are deemed to outweigh the costs. Disagreements persist between mining companies and regulators in Chile over the extent and actual environmental impacts of lithium mining in the region (Houmann 2019), despite scientific evidence of significant negative impacts over the past two decades (Liu et al. 2019).

Argentina policy background

Argentina lacks a coherent and well-defined public lithium extraction policy. Responsibilities for resources are shared at the national, state, and provincial levels, resulting in a highly intricate policymaking landscape (see López Steinmetz & Bing Fong, 2019). Policies at the provincial level exhibit significant variation. In provinces like Salta and Catamarca, there is a pro-mining stance, where the state primarily acts as a facilitator for private companies (Fornillo 2015a, p. 75). Conversely, the province of Jujuy takes a more proactive approach to maximizing the benefits derived from resource extraction. In 2011, Jujuy declared lithium a strategic mineral, emphasizing revenue generation through value-added processes and the creation of local employment opportunities (Barandiarán 2019). With the goal of achieving sustainable growth and socio-economic development, the provincial government and the Universidad Nacional de Jujuy are involved in various research and development initiatives in collaboration with the Argentinian National Scientific and Technical Research Council (CONICET) and other national public universities.

In Argentina, the Regional Lithium Committee is tasked with coordinating efforts among provinces and the national government with respect to research, production, and trade in the lithium sector. The Ministry of Science and Technology of Argentina has been invited to participate in the committee. However, as of April 2023, no clear documentation outlines the specific measures or thresholds that the committee will focus on, nor does it provide information on its current status.

Global North and Global South cooperation

Policies originating in the Global North can have consequences that extend to the Global South. In the context of lithium mining, substantial government incentives and investments in vehicle electrification have led to a rapid surge in demand for battery components, including lithium. Recent federal legislation in the United States, notably the Infrastructure Investment and Jobs Act, encourages the adoption of electric vehicles through tax credits, funding for research and development, and the establishment of a publicly-funded national EV charging network (Public Law 117-58, 2021). Automakers have aligned themselves with these new policies, announcing their intentions to transition US manufacturing and sales to predominantly or substantially electric vehicles by 2035 (IEA 2022). However, the raw materials essential for EV components, particularly lithium for batteries, are not being produced in the US at a scale anywhere near sufficient to meet the projected demand.

Due to limited domestic access, the US relies on products manufactured with imported lithium. The pace at which the country can increase its domestic lithium supply will depend on policy decisions and technological advances. However, establishing new mining operations is a time-consuming process, particularly for a mineral like lithium where there is only one existing facility as a reference point. In the broader context of the US mining sector, obtaining the necessary Mine Plan approvals takes an average of two years and, in some cases, up to 11 years, not including the time needed for plan development and establishment of operations after approval (GAO 2016). While domestic lithium mines are in development in the US, the precise timeline for their operation and lithium production remains unclear (CRS 2022).

Countries with free trade agreements with the United States, such as Chile and Australia (the largest lithium producer outside of South America), are in a favorable position (USTR 2023). However, in the absence of a FTA with the US, both Argentina and Bolivia would encounter additional obstacles when participating in the lithium market in response to the demand from EVs sold in the United States. This situation would likely lead to an increase in EV prices for US consumers, either because manufacturers source minerals from Australia, a country with higher labor costs and stricter labor regulations, to meet the requirements, or because manufacturers fail to meet the criteria for government subsidies.

Private sector standards have also emerged to encourage the adoption of "good" practices by producers, offering incentives rather than relying on sanctions like market exclusion mechanisms. These standards often come in the form of certification schemes designed to accredit products and services that adhere to specific production standards aimed at safeguarding the environment and promoting social welfare in their places of origin (Blackman and Rivera 2011). Evaluations of these certification schemes have yielded mixed evidence regarding their effectiveness in reducing environmental and social impacts. Whether and how these sector-specific policies and standards, whether based on sanctions or incentives, can be effectively applied to enhance sustainability and equity in emerging commodity supply chains like lithium remains an open question.

Insights and takeouts

Governments can develop guidelines and regulations based on existing studies that examine the environmental impacts of mining. For example, a 2019 study by Liu et al. examined evidence of environmental degradation in areas surrounding lithium mining activities. The study used five environmental indicators measured using satellite imagery: Normalized Difference Vegetation Index, Daytime Land Surface Temperature, Soil Moisture Index, Nighttime Land Surface Temperature, and Net Evapotranspiration. The reported values from this research could serve as a foundation for establishing methods, standards, or thresholds for monitoring potential environmental damage. However, additional studies using locally collected data, such as water quality and quantity near mining areas, are essential.

Science plays a crucial role in advancing our understanding and knowledge base, which can then be harnessed by policymakers and regulators to establish sustainable practices for sourcing lithium. This knowledge has a dual application —it can inform domestic policy development and also serve as a foundation for science diplomacy in the context of the global lithium supply chain. Science diplomacy entails international collaboration and the exchange of recommendations between countries with established environmental impact policies, such as the United States, and countries that are in the process of shaping their policies, such as Argentina. This collaborative effort not only aids in policy formulation grounded in scientific evidence but also fosters robust bilateral relationships geared towards achieving economic objectives and environmental safeguards at various stages of the supply chain. Figure 3 illustrates the interconnectedness between the supply chain steps highlighted in Figure 1, where South America predominantly focuses on lithium extraction, ultimately leading to the availability of electric vehicles (EVs) in North America. This two-way linkage presents opportunities for science diplomacy throughout the supply chain.

Stakeholders along the supply chain can reach consensus on setting standards and criteria, often guided by interdisciplinary sciences, to distinguish socially and environmentally responsible lithium extraction operations from those that fall short. Subsequently, stakeholders, including policymakers and upstream industry players within the supply chain, can formulate and apply rigorous methodologies, guided by geochemical science, to trace the provenance of lithium used in EV batteries and ensure that it is sourced from responsible operations.

Once standards and thresholds are established, various approaches can be employed to meet environmental impact goals. Mitigating damage during the mining process is one avenue, while another involves replenishing resources after overexploitation. Experts from the Inter-American Development Bank suggest the possibility of rejuvenating water resources during and after mining operations that consume substantial amounts of water. Such corrective actions are aligned with the principles outlined in the IRMA Standards under the "Planning and Managing for Positive Legacies" category (IRMA 2022).

The geochemical sciences can contribute significantly to devising procedures that enhance the transparency and accessibility of tracing lithium in EV batteries. Desaulty et al. (2022) introduced an innovative geochemical methodology based on analytical fingerprints of lithium isotopes present in raw and processed materials. This approach aids in identifying the source (i.e., mine site or refining plant) of ores and products through quantifiable material characteristics. While lithium extraction and purification processes typically obscure its geological origin, geochemical techniques can distinguish between lithium salts derived from ores with similar origins but potentially varying environmental or social impacts due to different extraction methods.

The implementation of a lithium certification system has the potential to stimulate the development of a responsible, sustainable, and secure supply of raw materials for batteries. Such a system would ensure the protection of human rights and environmental conservation throughout the supply chain. The establishment of lithium certification is of critical significance, particularly in light of the political drive to re-industrialize battery production in Europe and the United States, with a focus on sustainable battery manufacturing initiatives. Certification policies align with the overarching goals of Northern policies, which emphasize the protection of people and the environment, and could be more effectively assessed and fulfilled through certification measures.

Integrating science into diplomatic efforts can offer valuable support for global efforts aimed at mitigating climate change and promoting equitable distribution of benefits along supply chains to enhance local economies and well-being. The development of robust methodologies for evaluating the hydrological consequences of lithium mining will be pivotal for incorporating scientific insights into regulations governing the lithium supply chain. Recent research indicates that a framework that integrates remotely sensed and ground-based climate data, physical hydrological assessments, and specific residence time measurements may provide a more suitable approach for comprehending the intricate hydrological system of brines in the Atacama region and estimating environmental impacts (Moran 2022).

Furthermore, some studies have identified a negative correlation between lithium mining and flamingo populations in the Chilean Andes, potentially due to water scarcity resulting from lithium extraction (Gutiérrez et al. 2022; Marconi et al. 2022). Additional research is imperative to comprehend how lithium mining impacts biodiversity in the Lithium Triangle. Scientists can play a significant role in better estimating the population dynamics of fauna in this region, a necessity not only for charismatic species like the flamingo, but for the entire wildlife ecosystem that depends on it.

Various stakeholders in the lithium extraction sector, including governments, local and international research institutions, and local communities, have a significant role to play in addressing the challenges involved. State actors within the Lithium Triangle (LT) can serve as intermediaries, facilitating communication between international scientists and local stakeholders. Given the substantial national investment in lithium activities in the LT, state-led efforts to enhance international collaboration are crucial for establishing sustainability guidelines and traceability mechanisms. Scientists and organizations engaged in these initiatives will require access to reliable data and field sites to ensure credible research outcomes. Federal governments can play a pivotal role in granting research permits and facilitating connections between researchers and local parties affected by the lithium industry. Strengthening diplomatic ties will benefit stakeholders in both northern and southern regions and promote research aimed at addressing global challenges in the lithium supply chain.

Socially responsible lithium mining calls for the involvement of stakeholders, particularly local and indigenous communities, who bear the brunt of the adverse effects of lithium mining. Engaging local communities in formulating standards can potentially lead to stricter sustainability guidelines. Since these communities directly experience the costs of resource exploitation, their perspectives on the potential negative consequences of lithium extraction carry significant weight. Stakeholders who fail to engage with local communities risk overlooking the less tangible consequences of mining activities and may even face opposition from these communities.

Effective communication between diverse stakeholders has been incorporated into certification processes like IRMA, which involve interdisciplinary collaboration among various parties to establish standards and assess compliance. Committee members include NGOs, mining and mining exploration/development firms, original equipment manufacturers (OEMs), labor groups, and local communities.

The policy lessons and recommendations that emerge from our analysis suggest a role for science in diplomacy to foster a more sustainable and equitable lithium supply chain. Governments, private companies, scientists, and local communities can collaborate across borders to formulate achievable common objectives and standards, particularly with respect to sustainability throughout the lithium supply chain for electric vehicle (EV) batteries. The following summary encapsulates the policy lessons:

Employ concepts and methodologies developed in sustainability science to assess the environmental and social performance of economic activities, defining thresholds and establishing standards to distinguish sustainable from unsustainable mining operations.

Use geochemical methods to trace the origin of lithium used in electric vehicle battery production, to verify that the lithium has been sourced sustainably.

Multilateral opportunities and collaborations are fundamental to addressing these pressing issues in the context of international lithium trade. South American countries in the LT are disproportionately bearing the direct costs of the EV transition, while North America stands as one of the primary beneficiaries. Scientific evidence can play a crucial role in addressing these challenges within the global lithium trade landscape.

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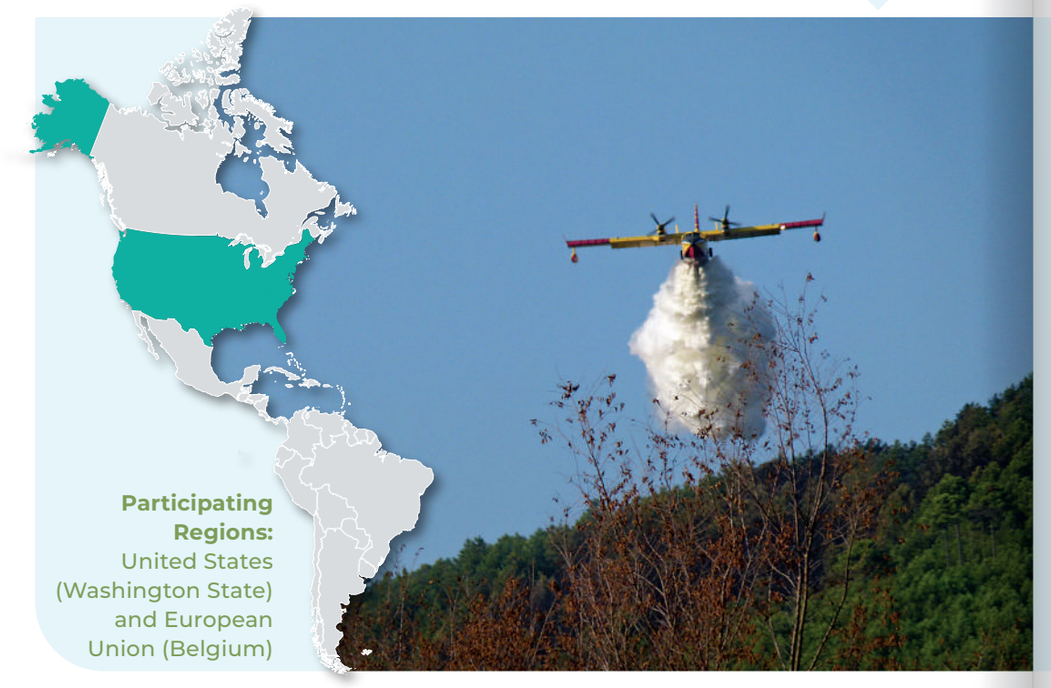
15

Comparing Pesticide Regulations: What Can Belgium (EU) and Washington State (US) Learn from Each Other?



Participating Regions: United States (Washington State) and European Union (Belgium)

Science in Diplomacy

This case represents "Science in Diplomacy", as it explores how international collaboration and evidence-based policymaking can advance sustainable agriculture and improve regulatory frameworks:

- **International Collaboration:** Science diplomacy fosters collaboration between countries to exchange best practices in pesticide regulation and advance global standards.
- **Scientific Data Sharing:** It enables the transatlantic exchange of scientific evidence on the impacts of pesticide use, improving risk assessments and regulatory alignment.
- **Joint Solution Development:** Through science diplomacy, regions can co-develop innovative and sustainable approaches to reduce pesticide use and mitigate environmental and health impacts.

Executive Summary

Global pesticide usage has nearly doubled since 1990, with the worldwide market projected to reach USD 130 billion by the end of 2023. This surge in the use of pesticides, or plant protection products (PPPs), has played a vital role in boosting crop yields to meet the food demands of our rapidly growing global population.

However, as early as the 1960s, concerns emerged about the potential non-specific environmental impacts of PPPs, leading to growing resistance and calls for more sustainable agricultural practices. In response, governmental and intergovernmental bodies have prioritized PPP use in policy debates.

This policy analysis compares regulatory systems governing PPPs in the United States and the European Union, focusing on two case studies—Washington State and Belgium. By exploring the complexities and nuances of each regulatory context, the study reveals common challenges and opportunities for improvement. It further analyzes what both regions can learn from each other to enhance their approaches to pesticide governance.

The study also proposes the creation of an intergovernmental framework for sharing scientific evidence on PPPs, aiming to foster transatlantic cooperation. A case study on pesticide use in potato production offers concrete examples of regulatory similarities and differences, including reduction targets and implementation tools.

By combining open-source policy analysis with interviews, the study provides actionable insights for policymakers addressing global food security while protecting human and environmental health through informed PPP regulation.

Keywords: International science diplomacy; science policy; sustainability; agriculture; pesticides.

Introduction

To promote sustainable food systems and agricultural practices, governmental and intergovernmental organizations have placed a strong emphasis on these areas. The United Nations has set Sustainable Development Goal (SDG) 2, focused on achieving Zero Hunger, and SDG 12, aimed at promoting Sustainable Production and Consumption. The European Union has made the Farm to Fork strategy a central element of its European Green Deal, while the United States has introduced the Agricultural Innovation Agenda (AIA) (FAO 2021; European Commission 2020; USDA 2020).

A topic of significant debate in discussions about sustainable agriculture is the use of plant protection products (PPPs), commonly known as pesticides. These chemical formulations contain active substances that protect plants and crops from pests, diseases, weeds, and other agricultural threats in practices related to farming, forestry, and gardening. While PPPs have played a crucial role in maintaining crop yields, there is growing concern regarding their impact on human health and the environment (Popp, Pető, and Nagy 2012, 243–55). The use of PPPs can result in unintended exposures and corresponding adverse consequences for non-target organisms and environments. Additionally, their use can lead to the development of resistance among the pests and pathogens targeted by these pesticides, requiring higher dosages and the rotation or combination of different pesticides to achieve the same crop yields (Hawkins et al. 2018, 135–55).

With the global population steadily increasing, the agricultural sector has been under pressure to increase crop yields to ensure an adequate food supply, a fundamental aspect of food security. The Green Revolution, which began in the mid-20th century and introduced advances in controlled irrigation, mechanization, synthetic pesticides, synthetic fertilizers, and plant breeding, has significantly boosted agricultural productivity. This period saw a shift towards larger farms, specialization, and automation, particularly in the Western world. The widespread adoption of monocultures has increased agricultural efficiency, but it has also raised the risk and severity of pest and disease outbreaks, as well as soil degradation (Oerke 2005, 31–43). Without appropriate measures, this trend could pose a threat to the food security goals of the agricultural sector.

Despite mounting evidence showing the feasibility and necessity of reducing pesticides, the use of PPPs by farmers has steadily increased over the past six decades in the European Union, the United States, and China (Deguine et al. 2021). Several studies have demonstrated that significant reductions in pesticide use are achievable in conventional arable farming without negatively impacting yields or profitability, provided that proper farming practices are implemented (Lechenet et al. 2017). Overall, farmers' reluctance to adopt alternative crop protection strategies may stem from a lack of education, outreach, decision support tools, and incentives provided by federal and local governments to facilitate this transition. It's crucial to recognize that the use of PPPs also carries implications for human health, as prolonged exposure through inhalation, ingestion, and dermal contact can cause a range of adverse effects.

Growing attention has been paid to the potential neurological, immunological, endocrinological, and carcinogenic effects of pesticides, as well as their impact on vulnerable groups such as children and pregnant women (Mokarizadeh et al. 2015, 258-278). In this analysis, we explore the regulatory framework for PPPs in the context of potato production in both the EU and the US. The central concerns in the sustainability debate surrounding PPPs include (1) ensuring food security and income generation for farmers, and (2) protecting humans and the environment from harmful chemicals and their residues.

Pesticide regulation

Pesticide regulation in the United States had its roots in 1947, when the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) was enacted (Bosso 1988, 4-5). The initial purpose of FIFRA was to establish standards for the labeling and registration of pesticides. Subsequent milestones in pesticide regulation involved two amendments to the Federal Food, Drug, and Cosmetic Act (FFDCA), the Pesticides Control Amendment (PCA) in 1954 and the Food Additives Amendment (FAA) in 1958 (Nownes 1991, 3-5). These amendments introduced the concept of "Generally Recognized As Safe" (GRAS), a term used by the Food and Drug Administration (FDA) to indicate that a chemical or substance added to a food is considered safe by experts.

Public perceptions of pesticides and their effects on human and ecosystem health experienced a transformation with the publication of Rachel Carson's "Silent Spring" in 1962 and scientific studies highlighting the adverse effects caused by pesticides (Nownes 1991, 4-5). During the 1960s, there were multiple attempts to reform FIFRA, including proposals to shift FIFRA's authority from the United States Department of Agriculture (USDA) to the Food and Drug Administration (FDA), to enhance public access to pesticide registration data, and to mandate improved interagency collaboration. Unfortunately, none of these proposals garnered sufficient support to pass in Congress. Nevertheless, a 1964 amendment to FIFRA authorized the suspension of pesticide registrations found to pose risks to human health (Osteen and Fernandez-Cornejo 2013, 1020).

The pivotal regulatory changes to FIFRA occurred in 1972, coinciding with the creation of the Environmental Protection Agency (EPA). These changes were prompted by concerns about the short- and long-term toxicity of pesticides. In 1972, an amendment known as the Federal Environmental Pesticides Control Act (FEPCA) required the EPA to register and "reregister" older pesticides according to newly established scientific standards. Manufacturers were required to furnish data demonstrating "no unreasonable adverse effects" on human health or the environment, making this information publicly available

after successful registration (Osteen and Fernandez-Cornejo 2013, 1020). These changes led to the banning of DDT and chemically similar compounds and standardized data collection for risk assessment. Pesticide manufacturers assumed responsibility for data collection and safety testing of other pesticide products. After testing, the EPA was mandated by law to decide on the continued marketing of pesticides through the "reregistration" process (Wayland and Fenner-Crisp 2016, 5).

Subsequent modifications to the registration process took place in 1978 (P.L. 95-396), 1988 (P.L. 100-532), and 1996 (P.L. 104-170). These amendments introduced fees and streamlined registration procedures to supplement appropriations and defray costs associated with reregistration and tolerance reassessment. More recent changes to FIFRA were enacted through the Pesticide Registration Improvement Extension Acts, including PRIA 1-4, which aimed to further streamline the registration process. These acts have been periodically renewed every five years since 2004, with the latest PRIA 4 being signed into law in 2019. The amendments to the pesticide registration process have refined it over the years by introducing fees to support pesticide registration, exemptions, and fee waivers to benefit smaller farmers and stimulate competition. Furthermore, funds are renewed every five years to cover healthcare costs stemming from pesticide-related injuries and to fund educational programs aimed at reducing exposure to toxic pesticides (EPA 2022).

The Food Quality Protection Act of 1996 (FQPA) made significant changes to both FIFRA and FFDCA, enhancing consumer protection by establishing pesticide residue limits for raw and processed foods and requiring confirmation that exposure to chemicals does not endanger consumers. FQPA also mandated periodic reviews of all registered pesticides every 15 years through a registration review process.

Today, the Pesticide Environmental Stewardship Program (PESP) takes center stage in encouraging reduced pesticide use and maintaining a monitoring system for alternative solutions. Established in 1994, PESP awards grants totaling USD 50,000 to EPA regional offices to promote Integrated Pest Management (IPM) practices, with regional specialists overseeing data collection and program management. PESP is part of the EPA's PestWise program, a consortium comprising four EPA environmental stewardship programs, including PESP, which strives to safeguard human and ecosystem health through innovative IPM practices and educational initiatives (US EPA, Office of Pesticide Programs 2010).

Beyond these programs, legislation has been proposed to reduce pesticide use and close loopholes that permit unregistered or expired pesticides to continue to be used. The Senate introduced the Protecting America's Children from Toxic Pesticides Act (PACTPA) to address these concerns and ban pesticides like paraquat, parathion, and paraffin oils, which are already banned in major agricultural hubs. While the PACTPA has faced challenges in making significant progress in recent years, the EPA remains committed to reassessing pesticides when necessary, while also introducing new policies to track pesticides with off-target effects, although these policies have not yet been enacted into law (117th Congress). At the federal level, pesticide regulation is primarily the responsibility of the EPA, but its enforcement has largely become the purview of individual states (Janasie 2019, 4). Since 1975, each state has been authorized to enact its own pesticide regulations, provided they meet or exceed federal regulations. State regulatory authority over pesticides is enforced through a combination of FIFRA and state pesticide laws, with states even able to require the registration of pesticides exempted under FIFRA. Section 24(c) of FIFRA enables states to add uses to particular pesticides under special circumstances. The extent of pesticide regulation varies from state to state, with some states, such as California, imposing stricter restrictions on specific pesticides, while others, like New York, prohibit the aerosol application of phorate or paraquat (Donley 2019, 6-8).

Although individual states have made substantial strides in reducing the use of harmful pesticides, the national process for eliminating approved pesticides remains sluggish. Consequently, older hazardous pesticides, such as paraquat, which can be lethal if ingested and have severe lasting effects through skin or eye contact, remain on the market. Additionally, there has been an uptick in the use of pesticides containing multiple active ingredients, but policies and research addressing their impact on human and ecosystem health are still lacking (Schulz 2021, 3).

In 1997, the state legislature mandated that all state agencies with pest control responsibilities adhere to the principles of IPM (Regular Session Fifty-Fifth Legislature 1997). Seattle and Olympia have implemented legislation that goes a step further in reducing pesticide use. In 1999, Seattle initiated a pesticide reduction strategy aimed at phasing out the use of hazardous herbicides and pesticides, targeting a 30% overall reduction in pesticide use (City of Seattle 1999). In 2005, the Olympia City Council passed a resolution to reduce and eventually eliminate the city's purchase and use of pesticides (Resolution M-1621 2005).

In February 2012, the potato commissions of Washington, Idaho, and Oregon established the Northwest Potato Research Consortium (NPRC), fostering collaborative research efforts with an annual budget of over USD 1.5 million. The NPRC is committed to investigating various aspects of potato production, including the development of IPM methods for effective control of potato pests and pathogens (Schreiber et al. 2019). The tri-state initiative comprises scientists from respected institutions such as Oregon State University, Washington State University, the University of Idaho, and private research entities. The NPRC releases periodic IPM guidance for farmers in the Pacific Northwest to assist them in implementing cost-effective pest management strategies.

Another research initiative geared towards reducing pesticide use is administered by the Washington State Commission on Pesticide Registration (WSCPR). Established in 1995, the WSCPR aims to address the high cost of obtaining and

maintaining EPA pesticide registration while providing Washington farmers with access to safe and effective pest control products. Since 1999, the WSCPR has expanded its scope, engaging in projects not related to pesticide registration, including biological and mechanical pest control methods (Washington State Division of Agriculture, n.d.). The WSCPR actively supports studies and activities aimed at reducing pesticide use, facilitating IPM research, and implementing pesticide resistance programs in the state, with support ranging from USD 2,500 to USD 35,000 (Washington State Commission on Pesticide Registration 2022).

Defining the Regulatory Framework for PPPs in the European Union: A Comprehensive Overview

Within the European Union (EU), a comprehensive and dynamic regulatory system has evolved over decades to mitigate the risks associated with Plant Protection Products (PPPs). The early Council Directives of the 1970s, such as Directive 76/895/EEC and Directive 79/117/EEC, began to lay the foundation for pesticide residue limits and control of the use of PPPs containing certain active substances, such as DDT (European Commission 2003). The most significant milestone, Directive 91/414/EEC of 1991, aimed to harmonize the risk assessment and approval process for PPPs across European Member States. This Directive initiated a comprehensive safety review of all active substances used in PPP in the EU, which at the time totaled about 1,000 (Directive 91/414/EEC 1991). Directives 79/117/EEC and 91/414/EEC were subsequently repealed in 2009 and replaced by Regulation 1107/2009, which is recognized as one of the world's strictest pesticide regulations (Robinson et al. 2020). Regulation 1107/2009 requires that PPPs can only enter the market if they adhere to defined protection objectives, ensuring a high level of safety for both humans and the environment.

The EU shifts the burden of proof to the PPP industry to demonstrate that active substances have minimal harmful or unacceptable effects on human or animal health (e.g., mutagenicity, carcinogenicity, reproductive toxicity, or endocrine disruption) and the environment. A dual system is in place, with the European Food Safety Authority (EFSA) responsible for evaluating active substances used in PPPs, while Member States assess and authorize products containing these active substances and adjuvants (such as surfactants or oils) at the national level (European Commission 2009). In addition to restricting the market access of unsafe active substances, the EU also regulates the maximum legal levels of PPP residues in food and feed through Regulation 396/2005/EEC, consolidating earlier Directives like 76/895/EEC (fruit and vegetables), 86/362/EEC (cereals), and Regulation 2377/90/EEC (veterinary medicinal products) (Council Regulation (EEC) 396/2005/EEC 2005, Council Directive 76/895/EEC 1976, Council Directive 86/362/EEC 1986, Council Regulation (EEC) 2377/90 1990). Official checks on PPP residues in food of plant and animal origin are carried out regularly, and these residues must not exceed the set Maximum Residue Levels (MRLs), determined on the basis of good agricultural practices and the necessary exposure levels to protect consumers (EFSA 2018). Besides individual MRLs for each active ingredient, EFSA also considers the potential harmful effects arising from cumulative exposure to multiple active ingredients, even if each falls within the acceptable limit, a phenomenon known as the "cocktail effect."

If pest control is necessary, sustainable biological, physical, and non-chemical methods that offer effective pest control are preferred over chemical methods. These methods involve targeted applications, reduced doses, less frequent applications, and anti-resistance strategies to maintain PPP effectiveness. However, a 2020 review conducted by the European Commission found that most Member States had failed to effectively promote the sustainable use of pesticides and had not met the requirements specified in the Directive and their National Action Plans (European Commission 2020). Consequently, in 2022, the European Commission proposed a new regulation that establishes legally binding targets for the EU and its Member States to reduce the use and risks of chemical pesticides by 50% by 2030. This reduction is essential to align with the goals set by the European Green Deal, Farm to Fork, and Biodiversity Strategies, all aimed at safeguarding human health and ecosystem well-being.

Belgium: EU case study on the legislative framework of potato PPPs

Belgium boasts the distinction of being the world's largest exporter of prepared or preserved potatoes. The potato sector stands as a robust pillar of Belgian agriculture, delivering a remarkable potato yield of 40 tons per hectare in 2020, cultivated across approximately 100,000 hectares of land (FAOSTAT 2022). Since 2014, all Belgian potato growers have been obligated to implement Integrated Pest Management (IPM) practices, courtesy of Directive 2009/128/EEC (Council Directive 2009/128/EC 2009). However, the precise implementation of these IPM guidelines displays minor variations between the Flemish, Walloon, and Brussels Capital Regions (European Commission 2014).

For the purposes of this analysis, we refer to the Flemish guidelines. In the Flemish region, growers must adhere to a meticulously detailed list of IPM practices tailored to each major cropping system (Ministry of Agriculture and Fisheries 2021). These practices are divided into three classes. Class 1 measures are obligatory and must be fully implemented, including measures like planting certified disease-resistant varieties, engaging in monitoring programs, employing validated low-drift spraying equipment, and returning surplus PPPs to an approved producer.

Furthermore, each grower is required to register with an accredited certification and inspection body that conducts farm inspections every three years to ensure compliance with the pertinent IPM guidelines. Class 2 measures, while not mandatory, still require partial implementation and include strategies such as the use of catch and cover crops for disease control and removing diseased plants. Class 3 measures are site-specific practices that can be used in specific

circumstances or locations, such as breaking up non-draining layers of soil or using false seed beds and precision irrigation in areas with specific conditions (e.g., heavy clay soils, arid regions, or plots with exceptional weed pressure).

Belgium's commitment to promoting sustainable agricultural practices is underscored by the presence of government-funded research centers dedicated to major crops or their systems. In the case of potato cultivation, the Proefcentrum Aardappelteelt (Potato Cultivation Research Center or PCA) shoulders this responsibility. The PCA supports potato growers by providing official lists of disease-resistant varieties, tailor-made management programs for specific pests and pathogens, and, notably, operates a warning model for potato growers.

The warning model integrates climate data, field monitoring, and various sources of information to identify high-risk periods for potential outbreaks of major potato pests and pathogens (PCA 2018). Based on these insights, the PCA issues alerts to registered potato growers, allowing them to apply crop protection products when necessary, deviating from fixed schedules as stipulated by IPM principles (PCA 2022).

Furthermore, the PCA is engaged in continuous efforts to develop more sustainable crop protection strategies. It has formulated herbicide, fungicide, and insecticide programs that refrain from using active ingredients classified as candidates for substitution at the EU level, while maintaining sufficient diversity to manage resistance effectively. Additionally, the PCA consistently tests innovative biostimulants, biopesticides, and other products that have the potential to reduce reliance on conventional pesticides, thereby advancing the cause of sustainable agriculture.

Pesticide use in Latin America: Comparison to the US and the EU

The ever-present need for increased agricultural production has led to a growing reliance on pesticides. However, the United States faces a complex regulatory scenario influenced by differences between individual states and their agricultural practices. To navigate this terrain effectively, policy changes must address both the federal and state levels. In light of these complexities, a practical approach might be to focus on federal-level changes in the registration process and the collection of scientific data, while relying on the state level to enforce regulations for specific pesticides and their applicability to cropping systems. There are numerous avenues for pesticide regulation within the purview of the EPA. The US Department of Agriculture (USDA) could play a more significant role in assisting with enforcement, as each state implements FIFRA enforcement based on its specific needs. Additionally, the upcoming Farm Bill, which is reauthorized every five years, has the potential to provide a comprehensive approach to pesticide regulation through its various titles. Furthermore, raising awareness about the harmful effects of pesticides and proper handling practices can be an effective strategy, especially considering the multitude of pesticides and their varying degrees of toxicity.

In the European Union, a crucial initial step towards pesticide regulation involves reinforcing existing legislation aimed at reducing pesticide usage. Many EU Member States have fallen short of the pesticide reduction targets outlined in Directive 2009/128/EEC. To address this issue, the EU Commission may contemplate initiating legal action through an infringement procedure, which, if unheeded, could lead to financial penalties imposed by the European Court of Justice for non-compliance. Failure to adhere to this Directive casts doubt on the feasibility of enacting more stringent legislation. Consequently, the European Commission's proposed legislation on sustainable pesticide use, seen as an ambitious step towards reducing pesticide usage and its associated risks, should provide the necessary mechanisms and incentives to achieve these new targets.

The proposed binding reduction targets, while ambitious, still offer Member States flexibility to implement measures according to their specific contexts. Additionally, complementary policy measures are need, such as incentives for the use of pesticide alternatives, funding for research and development of alternative strategies and products, and other preventive and curative interventions. However, opposition has emerged from various Member States and lobbying organizations, especially in light of the war in Ukraine and its potential impact on food security. This resistance has resulted in several amendments to the proposed regulation, reducing its scope and ambition and raising concerns among experts about its impact on biodiversity, a cornerstone of agricultural production.

The transition to reducing pesticide use is predominantly funded by the new Common Agricultural Policy (CAP), which was adopted in 2021 and took effect on January 1 of this year. However, the budget and funding mechanisms are not aligned with the proposed regulations aimed at reducing pesticide use. This raises questions about whether the proposed regulations can provide the necessary incentives to aid Member States in their transition towards reduced pesticide use. As a result, there is a compelling need to integrate and align agricultural and related policymaking processes in order to achieve cross-cutting goals more efficiently and cost-effectively..

Like in the United States and Europe, countries in Latin America use pesticides extensively in their agricultural activities to boost crop yields and protect them from pests and diseases. However, the data needed to assess pesticide exposure is scarce, and the subsequent regulation of pesticide use varies widely across the region's vast agricultural landscape. Some countries have strict regulations in place, while others have weaker enforcement and monitoring systems. Overall, in Latin America, the majority of regulatory decisions regarding pesticides focus on hazards instead of risks. The Andean countries (Bolivia, Colombia, Ecuador, Peru and Venezuela) are an exception since they adhere to the Andean Manual as a regulatory framework to assess risks from the agricultural use of pesticides (Casallanovo et al. 2021, 901-904). In recent years, there has been a growing concern about the health and environmental impacts of

pesticide use in the region, leading to calls for tighter regulations and greater transparency in the use of the chemicals. Compared to the US and the EU, countries in Latin America generally have less stringent regulations on pesticide use and may use pesticides that have been banned or restricted in these other regions, raising concerns about food safety and public health. Potential solutions that have been proposed include harmonizing risk assessment schemes with other regions such as the US and the EU, enhancing data sharing within Latin America and with other regions and characterizing pesticide use in each country (Casallanovo et al. 2021, 901-904).

Insights and takeouts:

To foster collaborative efforts between the United States and the European Union on pesticide regulation, strengthening platforms for sharing pesticide-related data and scientific evidence is a fundamental first step. Given the nature of the data collected on the impact of individual pesticides on human and ecosystem health, coordinated data collection and assessment could save time and resources. Initiatives like the Pacific Northwest Pesticide Risk Assessment Center in the US exemplify such coordination, tapping into the resources and expertise of experts from major research institutions. It not only fosters information exchange among researchers but also facilitates interaction between researchers and farmers. EU Member States could establish similar initiatives at national or international level, leveraging the intellectual capital of their major academic research centers.

The article advocates the establishment of a platform for sharing "pesticide-related data and scientific evidence" between the European Union (EU) and the United States, with the aim of bolstering bilateral relations and enhancing policy development while saving time and resources. However, such a platform should not be confined to EU-US cooperation. Several other nations, including Brazil and Argentina, possess valuable knowledge and research institutions in this area. In a world where environmental concerns and climate change are increasingly paramount, exchanging studies and sustainable alternatives to pesticides from major commodity-exporting nations can foster economic and political ties.

At a higher institutional level, enhancing coordination and cooperation at an intergovernmental level could yield benefits for both the US and the EU. Such collaboration could provide valuable insights and best practices to regions and countries with less stringent pesticide regulations, thereby reducing the competitive advantage and leakage effects in terms of pesticide use in agriculture. Existing intergovernmental cooperation between the Food and Agriculture Organization of the United Nations (FAO) and the World Health Organization (WHO) through joint meetings on pesticide residues and pesticide management could serve as a model for the US and the EU. Furthermore, the EU's consolidation of pesticide legislation could inspire a simplified approach in the US, where multiple federal and state entities currently oversee pesticide regulation, leading to fragmented authority and challenges in accessing concise information. Standardized reporting systems for pesticide use by both large- and small-scale farmers could improve transparency and data collection in the US.

The United States and the European Union (EU) share common objectives in their quest to improve human and ecosystem health while providing for their growing populations. Collaborative efforts between these regions can yield valuable insights and promote a unified approach to pesticide use. The importance of educational programs aimed at training individuals in pesticide handling and safety measures to minimize health risks is evident for both farmers and the general public in these regions. However, effective implementation requires sufficient funding for all involved stakeholders, not just farmers. By embracing these measures, the US and the EU can not only facilitate the transition to reduced pesticide use, but also contribute to similar goals in other regions and countries across the globe.

A notable deficiency in the United States is the absence of an institution dedicated to promoting Integrated Pest Management (IPM) among producers, similar to the Potato Cultivation Research Center in Belgium. This void presents a significant problem, because even when research into alternatives to traditional pesticides (PPP) is conducted, these innovations remain inaccessible and unfamiliar to the general public. This reiterates the central thesis of the article, highlighting that farmers' reluctance to adopt alternative crop protection strategies is a consequence of information scarcity. Consequently, when formulating policies regarding pesticide usage and substitution, a multifaceted approach must encompass education and dissemination mechanisms, in addition to research and financial support, to reshape the preferences and perspectives of both growers and consumers.

The collaborative efforts of early-career researchers from the US and the EU in this transatlantic science diplomacy endeavor exemplify the benefits of working together towards common goals. The outcomes of this analysis underscore the potential of science diplomacy to foster sustainable solutions in the global shift towards more sustainable agriculture and a prosperous future for all. While the overarching objective should be to gradually reduce pesticide use, overly rigid enforcement may lead to non-compliance. Policymakers must therefore consider their nation's specific context and implement measures to ensure long-term adherence to policies.

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Overcoming Plastic Pollution: Challenges for Brazilian Policy and Global Governance Opportunities

Participating Country: Brazil

Executive Summary

This policy position paper examines the historical development and diverse uses of various types of plastics, with a specific focus on polyethylene, a widely used plastic.

It emphasizes the significant increase in plastic consumption and its negative consequences, including environmental pollution, threats to biodiversity, climate change, damage to the oceans, economic instability, and risks to human health.

The paper also discusses plastic-related legislation being considered by the Brazilian government, highlighting the need for effective policies that are aligned with global efforts to address plastic pollution and transition to a circular economy.

It presents a comprehensive policy roadmap that integrates established methods, promising strategies, the goals of the United Nations Ocean Decade, and concerns voiced by UN Member States as they work toward a binding legal agreement by 2024, as seen in the Plastic Pollution INC1 process. Furthermore, the paper suggests using ocean knowledge and scientific insights to inform decision-making for various audiences, including lawmakers and waste handlers. It also outlines the benefits of transitioning to a new plastic economy, which includes addressing global challenges and reducing local social disparities related to pollution, climate change, and biodiversity loss.

Throughout the document, there is a strong emphasis on science diplomacy and stakeholder engagement as crucial elements in resolving the growing plastic pollution crisis and achieving the transformation toward a circular plastics economy.

Keywords: Public policies; solid waste; single-use plastics; microplastics; plastics circular economy; environmental, social and governance; international collaboration.

Science in Diplomacy

This is a case of "Science in Diplomacy", highlighting the role of scientific knowledge and multistakeholder engagement in developing more effective national policies aligned with global environmental governance:

- **Informing Policy through Science:** Science diplomacy provides a channel to integrate ocean knowledge, scientific data, and global best practices into plastic pollution policy design.
- **Bridging Global and Local Action:** The paper demonstrates how Brazilian legislation—while still fragmented—can benefit from science-based international cooperation to align with the global push for a binding treaty on plastic pollution.
- **Stakeholder Participation:** Science diplomacy supports broader stakeholder engagement, from local waste managers to international negotiators, fostering inclusive and evidence-informed governance.

Introduction

The emergence of plastics, hailed as a revolutionary creation, has now morphed into the world's most pressing global environmental conundrum. This milestone spurred a flurry of innovations in synthetic plastics production, which gained particular prominence during World War II (1939-1945), when synthetic plastics derived from fossil fuels, primarily petroleum, answered the clarion call of the era. Among these breakthroughs the birth of polyethylene in 1933 stood out, followed by the introduction of expanded polystyrene and polyethylene terephthalate (PET), both in 1941. The post-war landscape underwent a significant transformation as surplus petroleum resources and production capacity transitioned to the mass consumer market, ushering in an era where plastics began to infiltrate numerous facets of daily life. While recognizing the need to regulate the use and life cycle of all plastics, this policy paper focuses primarily on polyethylene, a ubiquitous component of our everyday items.

Renowned for their convenience and affordability, plastics have woven themselves into the fabric of modern life, spanning a wide spectrum of applications from packaging, household goods, cosmetics, transportation, technology, medical devices and children's toys to construction and more. However, a growing awareness of the detrimental impact of plastics on biodiversity, climate, human health and the planet's well-being now reveals a vexing paradox. Global plastic production, for example, contributes a staggering 1.96 gigatons of carbon dioxide annually to greenhouse gas emissions. In the United States alone, the healthcare costs stemming from diseases and disabilities associated with plastic-related chemicals rose to more than USD 920 billion in 2015 (Landrigan et al. 2023).

Plastic pollution has become so ingrained in our daily lives that it has influenced our very language. The term "Plasticene" has emerged to describe the overwhelming prevalence of plastic pollution in contemporary life, although it has yet to earn the distinction of being a geological epoch (Haram et al. 2020; Rangel-Buitrago et al. 2022). In parallel, the expressions "plastic pandemic" and "plastic tsunami" have been coined, drawing a striking parallel to the COVID-19 pandemic, underscoring the magnitude and gravity of the plastic predicament (Subramanian 2022). Single-use plastic products and disposable plastic packaging, while convenient, cast an ominous shadow as they pose a substantial and persistent threat to our environment.

When plastics are subjected to the recycling process, their polymer integrity diminishes, rendering them unsuitable for the production of identical, high-quality items. Consequently, recycled plastics are typically repurposed into secondary products of lower quality. Furthermore, recycled plastics often face a one-way journey, as their diminishing quality prevents subsequent recycling. The design of plastic items has a significant impact on their recyclability, with certain types presenting formidable obstacles to the recycling process and impeding the transition towards a circular economy for plastics. Examples of these recalcitrant plastics encompass laminated packaging, thin plastic films, expanded polystyrene foam, commonly known as Styrofoam, and items composed of various plastic polymers. It is estimated that a mere 21% of plastics found in short-lived products can be recycled in an economically viable manner, thereby providing scant incentives for collecting and recycling such items (UNEP 2023). Consequently, non-recyclable plastics frequently end up polluting the environment.

These complexities of plastic recycling have compounded the struggle to strike a balance between plastic production and recycling. The repercussions of this failure are cumulative. Global plastic production rates have risen relentlessly, doubling between 2000 and 2019, while a paltry sub-10% of the world's plastic waste has undergone recycling (OECD 2022). This ushers in a detrimental feedback loop, with climate change exacerbating the consequences of plastic pollution, and vice versa. For example, during intense rainfall, plastics can impede proper water drainage, increasing the risk of flooding. Furthermore, the disposal of plastics through incineration and landfills releases a slew of greenhouse gases, including carbon dioxide, methane, and other pollutants.

The convergence of scientific evidence and international cooperation around the issue of plastics culminated in a historic global consensus at the fifth United Nations Environment Assembly in March 2022, where all 193 UN member states took a landmark decision to put an end to plastic pollution. The scientific consensus is unequivocal: plastic pollution represents a grave problem with profound implications for both human and planetary well-being. Ignoring the plastic crisis is not an option we can afford. Furthermore, the transition to a renewed plastics economy promises substantial economic advantages, paving the way for new business opportunities, particularly for those agile enough to adapt and embrace change (UNEP 2023).

A global movement has gained momentum, with the objective of mitigating the detrimental effects of plastics and curbing the proliferation of plastic waste in our oceans. To this end, more than 120 countries have introduced bans or levies on single-use plastics, encompassing items like plastic bags, utensils, straws, beverage containers, and food packaging. In a groundbreaking step, Bangladesh took the lead in 2002 by becoming the world's first nation to enact a ban on plastic bags, setting a pioneering example for others to emulate. Nevertheless, in terms of substantive policy action, Europe has been at the vanguard. Since 2021, the European Union has enforced a ban on specific single-use plastic items within Member States' markets and has actively combated the ten most common single-use plastic items found on European beaches. This comprehensive list includes plastic food containers, beverage cups, packaging, wrappers, cigarette butts, cotton swabs, utensils, plates, straws, and balloon sticks.

Potential Environmental Impacts

The growing issue of plastic waste, if not properly managed and disposed of, will invariably seep into the natural environment. Driven by the forces of wind, water runoff and other contributing factors, this waste eventually finds its way into the oceans. The oceans, which profoundly influence global weather patterns, play a pivotal role in absorbing approximately 30% of carbon dioxide emissions and are the source of at least 50% of the Earth's oxygen, thanks to their photosynthetic biodiversity. Their significance isn't confined to environmental health alone; they also play a crucial role in facilitating global trade and transportation. In 2010, the global trade in ocean-based goods and services accounted for roughly 2.5% of the global GDP, with projections suggesting it could double in size by 2030 (OECD 2016). However, the detrimental effects of plastic pollution on ocean health jeopardize all the benefits we derive from these vast bodies of water.

Once plastics find their way into the ocean, the currents can transport them over long distances, ultimately culminating in the formation of large accumulations of plastic waste, commonly referred to as "garbage patches," located within the oceanic gyres and settled on the seabed. The process of plastic degradation in the ocean, driven by environmental factors like UV light, heat, and wave action, breaks down plastics into tiny particles, categorized as microplastics and even smaller nanoplastics. Microplastics are defined as "synthetic solid particles or polymeric matrices, with regular or irregular shape and with size ranging from 1 µm to 5 mm, of either primary or secondary manufacturing origin, which are insoluble in water" (Frias and Nash 2019). Primary microplastics are intentionally produced minute plastic particles that are incorporated into a variety of consumer goods, including cosmetics, personal care products, cleaning agents, and synthetic textile fibers. In contrast, secondary microplastics originate from the unintended fragmentation of larger plastic items. Nanoplastics are tinier still, typically falling within the size range of 1 to 1000 nm, and they result from the fragmentation of larger plastic items or unintentional production during the manufacturing processes of plastic goods (Gigault et al. 2018).

Both microplastics and nanoplastics can serve as habitats for microbial communities, giving rise to what is known as a plastisphere. Within this plastisphere, several pathogens have been discovered, including Vibrio spp., Aeromonas salmonicida, and Arcobacter spp., which are common culprits in aquatic animal diseases in aquaculture. These pathogens pose a significant threat to food security, as they can cause substantial losses in commercially farmed aquatic species (Amaral-Zettler et al. 2020; Cholewinska et al. 2022; Marathe et al. 2022). The presence of Vibrio spp. in floating microplastics raises concerns as it is associated with the emergence of antimicrobial resistance, which accelerates the spread of drug-resistant microbial populations, particularly during the summer months when they proliferate in response to elevated water temperatures (Amaral-Zettler et al. 2020). Moreover, while many Vibrio spp. strains are harmless to humans, certain variants can cause disease in both wildlife and humans. Furthermore, the release of microplastics into rivers by wastewater treatment systems is another potential source of human infection. For instance, downstream from sewage treatment plants, microplastics have been found to harbor higher concentrations of the Campylobacteraceae family, a pathogen responsible for gastrointestinal illness in humans (McCormick et al. 2014).

The case of Brazil

Brazil occupies a pivotal position on the global stage as both a major producer and consumer of plastic. Unfortunately, this translates into an annual discharge of over 325,000 metric tons of plastic into the ocean, culminating in beaches littered with plastic debris stretching from the northern to the southern shores (Zamora et al. 2020; Oceana 2022). When it comes to materials generated by industry and the volume of material recovered, Brazil has a meager recovery rate of 3% for dry waste, of which all types of plastic constitute 16.8% of urban solid waste. It's worth noting that Brazil has yet to implement a comprehensive ban on single-use plastics, although several municipalities have introduced local regulations on plastic bags and straws.

In addition to the pressing issue of plastic pollution, Brazil has embarked on a series of policies and programs dealing with solid waste. The National Solid Waste Policy, or PNRS, a monumental legislative milestone (Law 12,305/2010), sets the fundamental framework for waste management in the country. It took 19 years of deliberation and discourse to culminate in the enactment of this comprehensive legislation, which defines the core principles, goals, instruments, and guidelines for integrated and responsible waste management, as well as the obligations of waste producers and the government.

However, the implementation of the PNRS is progressing at a sluggish pace, underscoring the challenges Brazil faces in waste management, particularly in cases where there is insufficient political will to reach viable solutions. For instance, Article 54 of the Law mandated the closure of dumpsites by August 2, 2014. Paradoxically, in the same year, 489 new dumpsites sprung up, apparently linked to a major global sporting event held in the country—the FIFA World Cup. In 2018, a total of 1,037 dumpsites were reported to the Federal Government, but only thirty-one of them had an environmental operating license, highlighting the widespread lack of authorization by local authorities (Faroni-Perez 2020). Furthermore, the process of closing these dumpsites and uncontrolled landfills was postponed by Law 14.026/2020, allowing some municipalities the option to extend the deadline until 2024. These unfavorable waste management circumstances and decisions have likely contributed to the escalation of plastic pollution and its unchecked release into the environment.

In addition, more than a decade later, a program to integrate reverse logistics into the circular economy was approved (Decree 10.936/2022) and, more recently, another decree (Decree 11.413/2023) was issued to implement it. Reverse logistics and recycling are key pillars in the pursuit of a circular economy, guar-

anteeing the efficient reuse and return of goods and materials to industries and production processes. This approach advocates resource efficiency, waste reduction and reduced reliance on landfills, along with reduced extraction of virgin materials, all while keeping materials within the economic cycle. Enhancing the stability and profitability of plastics recycling has the potential to slash pollution by an estimated 20%. This can be achieved by increasing the proportion of economically recyclable plastics from the current 21% to an ambitious 50% by 2040 (UNEP 2023).

Over the 1997-2021 period, the Brazilian Chamber of Deputies dealt with a plethora of proposals related to plastic bags, seventy in total. Notably, a significant portion of them, thirty-one to be exact, have emerged since 2018. Among these proposals, sixty-five have found a home in draft bill PL No. 612/2007. This particular piece of legislation prescribes guidelines for the use of biodegradable plastic bags for packaging products and goods in commercial establishments nationwide. Various other bills have sought to either ban or restrict the use and sale of plastics, each with varying degrees of restriction and affecting different products and raw materials. While these drafts have the potential to curb plastic consumption, none of them, as of yet, involve changes in the production or marketing of non-recyclable or minimally recyclable plastics. This includes items like laminated snack bags and blister packs, despite their well-documented adverse impacts on society and the environment.

In 2018 and 2021, the term “single-use plastics” appeared in seven pieces of draft legislation. Notably, two of these drafts were christened “National Day to Combat” and “Awareness Against Plastic Use and Plastic Pollution.” Among these legislative efforts, PL No. 10,504/2018 stands out as the most comprehensive. This proposal aims to establish the National Program for the Ban of Single-Use Plastics by 2030, offering a promising path forward. By steering the market towards reusable and refillable products in lieu of single-use plastics, it has the potential to bolster the business case for the reuse market. This strategic pivot, coupled with effective measures like eliminating unnecessary and non-recycled plastics, promoting reuse, and adopting innovative delivery alternatives, promises to achieve a substantial 30% reduction in plastic pollution by 2040 (UNEP 2023).

The term “microplastics” has appeared in eleven pieces of draft legislation since 2015. A debate on this issue kicked off in 2016 but subsequently encountered roadblocks, with none of these bills having been enacted thus far. The deliberate inclusion of microplastics in the manufacture of personal care products and cosmetics has faced considerable scrutiny, with suggestions to ban such products (MMA 2019; UNEP 2023). Everyday items like toothpaste, exfoliants, nail polish, and shower gel can contain up to 90% primary microplastics in their composition, becoming a source of environmental contamination when discarded and released into nature (UNEP 2015; IUCN 2017). Enacting a ban on the intentional inclusion of microplastics in products can help curtail further contamination and mitigate existing pollution, which poses an environmental liability. Brazil can take a pivotal step toward banning the deliberate use of microplastics in personal care items by fostering cooperative engagement with the business sector to facilitate policy acceptance and implementation.

Brazilian National Law No. 9,605/1988, which addresses criminal and administrative penalties linked to activities detrimental to the environment, is unequivocal in its definition of environmental crime. Article 54 categorizes it as “causing pollution of any nature at levels that result or may result in harm to human health, or that causes the death of animals or significant destruction of plants.” Plastic pollution may fall within the scope of this definition. Moreover, Article 72 outlines administrative sanctions for environmental violations, including fines, seizure of assets, and suspension of activities. These measures, together with Articles 74 and 75, which lay the foundations for imposing fines for damage caused, set the minimum and maximum financial penalties and provide a legal framework to address plastic pollution in the context of environmental compliance and the safeguarding of human and ecological well-being, as required by Article 225 of the Federal Constitution..

While recent policies mark essential strides towards more sustainable waste management, the journey to reducing single-use plastics and curtailing plastic seepage into the oceans will require sustained political commitment and intensive efforts. Brazilian legislators and decision-makers must position the nation as a proactive contributor to the global fight against plastic pollution. In the coming years, Brazil’s federal government is poised to assume a leadership role in global environmental and social endeavors, with a governance scope extending from the Amazon Forest to the Blue Amazon.

The term “Blue Amazon”, coined by the Brazilian Navy, refers to Brazil’s exclusive economic zone and continental platform, underscoring its biodiversity and significance. The Blue Amazon contributes substantially, accounting for nearly 20% of the country’s GDP, employing approximately one million artisanal fishermen, and hosting the world’s second largest mangrove forest—a valuable carbon storage asset—all of which face the looming threat of plastic pollution (Faroni-Perez 2023).

Several initiatives are already in motion, including Brazil’s active involvement in the United Nations Clean Seas campaign, the launch of the National Plan to Combat Marine Litter in 2019, and the introduction of financial incentives by the Brazilian Ministry of Science, Technology, and Innovation in 2022, aimed at promoting science and technology. However, it’s imperative to expedite these actions and implement effective policies commensurate with the scale and nature of the plastic pollution challenge. Given Brazil’s status as one of the world’s leading plastic producers and consumers, a robust commitment from both political leadership and stakeholders is paramount to developing innovative solutions.

Plastic pollution poses a grave threat to the oceans, which are fundamental to humanity’s sustenance, oxygen supply, livelihoods, and overall well-being.

A systematic approach is imperative in the transition from a linear to a circular plastic economy. This encompasses the rigorous enforcement of existing laws and the formulation of common policies. Notably, the development and enactment of policies to ban intentionally manufactured microplastics, regulate single-use plastics and establish a circular economy serve as a strategic roadmap, bolstering Brazil's national resolve to combat plastic pollution.

Science Diplomacy best practices to overcoming plastic pollution

Plastic pollution transcends borders, extending its adverse effects to marine areas beyond national territories, often referred to as the high seas. To effectively address this global threat, a unified approach involving science diplomacy and the active participation of stakeholders is imperative. Collaboration among governments, non-governmental organizations, and the private sector is essential for crafting sustainable solutions to combat plastic pollution. Recently, the United Nations reached a milestone on the international stage with the High Seas Treaty—a pioneering global agreement that extends protection to the vast two-thirds of the ocean outside of state jurisdiction. This treaty not only signifies a monumental step in shielding the high seas from pollution, but also encompasses measures to combat overfishing and habitat degradation, while fostering opportunities for scientific cooperation (Nature 2023).

Drawing inspiration from the lessons learned during the COVID-19 pandemic, where science diplomacy practices, governmental and corporate agreements, international organization efforts, and technology sharing expedited vaccine development, it is evident that such cooperative mechanisms hold the potential to address shared crises. The same principles that facilitated the rapid development of COVID-19 vaccines can be harnessed to address the complexities of the "Plasticene" or "Plastic Pandemic," a challenge as multifaceted and as daunting as the pandemic.

In 2022, the United Nations Environment Assembly (UNEA) took a historic step by adopting a resolution that acknowledges the need for a comprehensive, globally coordinated approach to tackle plastic pollution. At the same time, efforts are underway to establish a global treaty on plastic pollution, with the aim of finalizing an international legally binding instrument (ILBI) on plastic pollution by the close of 2024. This agreement is poised to promote international collaboration and coordination to reduce plastic pollution and its far-reaching impacts. It spans the entire plastic lifecycle, encompassing production, design, and disposal. The treaty will lay the groundwork for nations to set targets and take concrete actions to curtail single-use plastic production and consumption, improve waste management, and augment research and monitoring of plastic pollution.

The inaugural Intergovernmental Negotiating Committee (INC) convened in Punta del Este, Uruguay, featuring representatives and stakeholder groups from 160 countries. Brazil actively participated in INC-1 and emphasized the importance of developing ambitious implementation strategies commensurate with the proposed obligations and measures. The Brazilian delegation underscored the necessity of outlining the scope, objectives, and implementation methods for the forthcoming ILBI, while advocating for a balance between socio-economic and environmental considerations (IISD 2022). The impending treaty, slated to be finalized next year, poses a considerable challenge. It hinges on swift action and international collaboration to secure consensus. A five-year delay in the effort to combat plastic pollution would result in escalating costs and an additional eighty million metric tons of plastic pollution by 2040 (UNEP 2023).

Insights and takeouts:

Depending on the specific scope, priorities, and requirements of businesses, several attainable goals and accountable steps can be taken. These actions could include formulating corporate policies aimed at reducing or eliminating the use of single-use plastics, developing innovative technologies and initiatives for the removal of plastics and microplastics from water bodies, supporting inventive programs centered around alternative materials, allocating resources for collaborative awareness-raising campaigns involving governmental and non-governmental organizations, and fostering projects dedicated to the restoration and preservation of marine biodiversity and ecosystems.

The International Organization for Standardization (ISO), a non-governmental global organization boasting a membership of 167 national standards bodies, plays a pivotal role in the world's economic landscape and international trade. It continually shapes and disseminates standards that undergo review every five years. A noteworthy illustration of ISO's commitment to sustainability is its endorsement of the London Declaration in 2021, in which 165 countries pledged to align international standards with climate change objectives, a significant accord given the interconnectedness of the climate and ocean crises, both profoundly influenced by plastic pollution.

ISO has also established a Sustainable Finance Technical Committee to develop new standards that harmonize global financial systems with sustainability imperatives. This initiative underpins the legitimacy, reliability, and scalability of sustainable financial endeavors. It steers financial institutions toward the more comprehensive integration of Environmental, Social, and Governance (ESG) considerations into their investment and financial practices while guarding against "sustainability washing." This deceptive practice, also known as greenwashing, relies on vague or misleading claims to present products or practices as more sustainable than they actually are, a ploy that misleads investors and consumers. It is a devious strategy that undermines genuine sustainability initiatives and can mislead stakeholders, fostering the perception that sustainability is a marketing gimmick rather than a genuine commitment to environmental responsibility.

The International Organization for Standardization (ISO) is encouraged to collaborate with key bodies like the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) and the Scientific Committee of the UN Decade of the Ocean. Such partnerships would ensure the adoption of best practices in ESG standardization, with a specific emphasis on promoting ocean health and sustainability. These efforts are of great significance, as they form the bedrock of human well-being and economic sustainability..

The potential synergy between International Standards and national laws and the global agreement on plastic pollution is of paramount importance. ESG considerations present a remarkable avenue for realizing the Sustainable Development Goals (SDGs), the seventeen universal objectives that the United Nations adopted in 2015, encompassing the three dimensions of sustainable development: economic, social, and environmental. These goals are organized into five pillars: people, prosperity, planet, peace, and partnership.

Private sector financial investments aimed at eradicating plastic pollution align with multiple SDGs and the five pillars and hold substantial potential for mitigating liabilities, risks, and legal disputes stemming from the damage wrought by ocean plastic pollution. Moreover, standardizing and implementing ESG practices could position private institutions as pioneers in reversing the decline of ocean health during the United Nations Decade of Ocean Science for Sustainable Development and the United Nations Decade of Ecosystem Restoration (2021-2030). Therefore, the organizations responsible for shaping these standards should intensify their focus on this promising opportunity to incorporate ocean-related goals aligned with the challenges and objectives of the UN Ocean Decade.

For instance, more than 80% of globally traded goods pass through coastal ports and are transported by sea, and the proportion is even higher for most developing nations. These activities entail pollution and greenhouse gas emissions that impact on marine ecosystems, biodiversity, and the manifold benefits conferred by the ocean. Additionally, microplastics can enter a ship's engine cooling system, damaging pumps, filters, and other components. Plastic debris can also become entangled in a ship's propellers or intakes, causing damage and potentially incapacitating the engine. Nearly all corporations, directly or indirectly, maintain a connection to the ocean through their business operations and can commit to ESG principles to enhance the ocean's sustainability and well-being.

The ESG document provides explicit tools under Dimension E (Environment) to address factors such as land use, air quality, climate, freshwater resources, pollution, biodiversity and ecosystem services. However, it does not explicitly encompass the ocean sustainability agenda. As such, there is a compelling case for the ABNT to consider the inclusion of ocean-related targets in the PR 2030 during its review process. Such an addition could set a notable example of the corporate sector's proactive stance in combating the cycle of deteriorating ocean sustainability, driven primarily by plastic pollution.

In the context of Brazil's development status, enforcing policies presents unique challenges, especially when they rely on public compliance. The state often struggles to effectively monitor and enforce these policies due to its limited reach. A clear example of this challenge is the law aimed at closing landfills, which faced considerable difficulties in implementation, leading to the introduction of a law postponing its enforcement for a decade. This highlights the consequences of rigid policies in a vast nation like Brazil. Therefore, when crafting prohibitive policies in Brazil, practicality and public compliance are essential considerations. Equally critical is the government's ability to enforce these policies. In cases where alignment is lacking, a pragmatic approach may involve setting achievable goals and introducing flexibility into the implementation timeline.

Plastic products are an integral part of daily life but pose environmental problems when used for aesthetic purposes in cosmetics and personal care products, resulting in microplastics entering sewage systems and contaminating water. Prohibition policies could effectively reduce plastic use if governments collaborate with the corporate sector to ensure practicality and compliance. The global implications of plastic pollution, affecting biodiversity, climate change, and nations worldwide, call for international cooperation to achieve sustainable solutions. Incentives for collaboration exist, given the common interest in reducing plastic consumption. This cooperation can take the form of joint actions and agreements, while incorporating sustainable principles into international organizations such as the International Organization for Standardization (ISO) and the World Trade Organization (WTO).

Microplastics are also of concern to the private sector due to their potential to disrupt shipping and global trade. To encourage corporate cooperation, governments and international organizations should disseminate science-based information about the issue of plastics through accessible platforms or programs, such as those provided by the Inter-American Institute for Global Change Research (IAI). The challenge of the "action-intention gap" requires policies that engage and mobilize society as a whole, including the government, the private sector, and the public, to align their commitments and efforts. This cooperation can be achieved through various approaches, including restraining demand, designing for circularity, enhancing recycling, closing leakage pathways, cleaning up, raising awareness, offering incentives, and ensuring transparency.

The Brazilian National Standards Organization (ABNT) made a significant move in the direction of sustainability by publishing an ESG Recommended Practice (ABNT/PR 2030) in 2022. This document reflects a growing trend towards sustainable development and offers valuable guidance for measuring and reporting environmental, social, and governance (ESG) data. Its impact extends to the corporate realm, where it assists companies in bolstering their sustainability performance, fostering transparency and accountability, and meeting the increasing demands from investors, consumers, and various stakeholders.

Furthermore, while ABNT/PR 2030 incorporates the dimension of biodiversity and ecosystem services, it lacks the necessary set of indicators and metrics to fully realize its potential. In Brazil, the Brazilian Platform on Biodiversity and Ecosystem Services (BPBES) plays a pivotal role in gathering and translating scientific knowledge into language comprehensible to policymakers in both the public and private sectors. By engaging in a strategic partnership with BPBES, ABNT can leverage substantial expertise in the field of environment-ocean interfaces, thereby enhancing the scientific foundation of PR 2030 during its subsequent phases.

To further strengthen their efforts, both ABNT and ISO stand to gain from establishing partnerships with the Science, Technology, Policy (STeP) Fellowship Program offered by the Inter-American Institute for Global Change Research (IAI). STeP is a cutting-edge program that facilitates the provision of expert scientific advice to decision-makers for the development of climate-responsive public policies. It also nurtures future leaders in Latin America and the Caribbean, imparting hands-on learning, professional development, and mentorship, enabling these fellows to bridge the gap between science and policy. Such partnerships, combining international networking with workplace cooperation, provide opportunities to share resources and integrate diverse knowledge and expertise across sectors and nations.

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17 Sustainable Juruti by ALCOA: Lessons from a Multi-Stakeholder Governance Model

Executive Summary

Sustainable Juruti is a multi-stakeholder model of governance of ALCOA's Juruti bauxite extraction site in Pará, Brazil. It was developed in partnership with Fundação Getulio Vargas (FGV) and the Brazilian Fund for Biodiversity (Funbio), and first implemented in September 2008.

Its main goal is to offer an institutional framework for horizontal cooperation between the company, the government, and civil society. Independent review was carried out by USP's Center for International Negotiations Studies (CAENI) and Columbia University's School of International and Public Affairs (SIPA), with a particular focus on the Sustainable Juruti Council (CONJUS), a democratic public space with broad stakeholder representation.

The review concluded that, in spite of the model's comprehensive design and partial success, it presented important flaws, including:

- Uncertain and/or irregular distribution of responsibilities among stakeholders
- Wide variation in stakeholder interests and expectations

Based on the findings of CAENI and SIPA, and cross-referencing the literature on Corporate Social Responsibility (CSR), this case presents valuable insights for students and practitioners of Science and Innovation Diplomacy (S&ID). It showcases the complexity of interacting with stakeholders with highly uneven capabilities, and highlights governance issues related to institutional design, overlapping mandates, expectation misalignment, and the importance of communication—challenges that are central to science and innovation diplomacy in practice.

Keywords: Multi-stakeholder governance; corporate social responsibility; science and innovation diplomacy; sustainability.

Science in Diplomacy

This is a case of "Science in Diplomacy", as it offers valuable insights into how scientific and innovation diplomacy can help design, analyze, and navigate multi-stakeholder governance models:

- **Cross-Sectoral Engagement:** Sustainable Juruti exemplifies a governance model that attempts to foster horizontal cooperation between business, government, and civil society in a decentralized and resource-sensitive region.
- **Institutional Design Challenges:** The case highlights recurring issues in multi-stakeholder frameworks, such as unclear distribution of responsibilities and misalignment of stakeholder expectations—key issues for S&ID practitioners to address.
- **Corporate Social Responsibility and Innovation Diplomacy:** The intersection between CSR literature and innovation diplomacy practices opens opportunities to rethink collaborative models in resource-intensive regions.

Introduction

Mining is one of Brazil's most important economic activities, and the country is a leading exporter of mineral ores. According to a 2022 report by the Brazilian Ministry of Mines and Energy (BRASIL, 2022), the mining sector accounted for 2.4% of the country's GDP in 2019 (excluding oil and gas). Specifically, Brazil is home to some of the largest bauxite reserves in the world, estimated at 2,700,000 kilotons, or 8.4% of total global reserves. In 2021, Brazil processed 33,365 kilotons of bauxite, making it one of the top producers, alongside countries such as Australia, China and Guinea.

Most of the extraction of bauxite in Brazil takes place in the Amazon rainforest, in the states of Para and Rondonia. However, like many other extractive activities in the region and elsewhere, the mining industry has been surrounded by a long history of social and environmental conflicts, which over time prompted stakeholders to pressure companies to align more closely to sustainable development practices (Prno & Scott Slocombe, 2012). This included engaging in broader governance structures based on relational approaches with local communities in order to mitigate the negative impacts of mining activities (Gavidia, 2015). One such example is the Juruti Sustentável (Sustainable Juruti) initiative, a tripartite governance structure implemented by multinational mining company ALCOA, which aimed to align its bauxite extraction complex in Juruti, Para, with a sustainable development agenda for the region (Monzoni et al., 2008).

The municipality of Juruti, on the western border of the State of Para, sits on the banks of the Amazon River, and on one of the largest bauxite mines in the world, with an estimated reserve of around 700 million metric tons (Alcoa Brasil, 2023). ALCOA began bauxite extraction in Juruti in 2009, and currently produces around 7.5 million tons of bauxite per year. Facilities also include a port terminal that can receive ships of up to 85,000 tons, a series of processing, storage and residue facilities, and a rail network with 81 wagons that connects the mines to the port. Before the extraction of bauxite began, Juruti's economy was based on fishing, subsistence farming, and small-scale commerce and services. Currently, the mine employs around 570 workers directly and 2700 indirectly. According to government statistics, Juruti was estimated to have 35,350 residents in 2009, and saw significant population growth after the installation of the plant: in 2022, Juruti's population had increased to 50,881 residents, of which around 60% lived in rural areas, and according to Alcoa Brasil, these were divided into 176 communities.

Sustainable Juruti was developed in partnership with Fundação Getulio Vargas (FGV) and Fundo Brasileiro para Biodiversidade (Funbio), and first implemented by ALCOA September 2008 as a multi-stakeholder governance model for the Juruti site, with the overall objective of providing an institutional framework for horizontal cooperation between the company, the government and civil society. It came as a result of ALCOA's willingness to adopt the principles of corporate social responsibility in its operations at Juruti, in the face of community opposition.

Independent monitoring and evaluation is regarded as a crucial component of the model, so in 2009, at the request of ALCOA, the University of São Paulo's (USP) Centro de Estudos das Negociações Internacionais (CAENI) and Columbia University's School of International and Public Affairs (SIPA) teamed up to provide with an assessment of the design, initial implementation and future prospects of the multi-stakeholder processes, with a particular focus on the Conselho Juruti Sustentável - Sustainable Juruti Council (CONJUS), designed as a democratic public space with broad stakeholder representation (Bartolini et al., 2010). The study concluded that, despite the model's comprehensive design and partial success, it presented some important flaws that were mainly due to a) uncertain and/or irregular distribution of responsibilities among stakeholders; b) wide variation between stakeholders' interests and expectations.

Other independent evaluations have since been conducted, such as Borba (2012), Gavidia (2015), Gavidia & Kemp (2017), and Portela (2017), providing further insight into the implementation of Sustainable Juruti. Meanwhile, studies such as Pereira et al. (2022) Cornejo et al. (2010), Hoelscher & Rustad (2019), Shrivastava & Vidhi (2020), and Wood Jr. & Morais (2021) have provided insight into similar models implemented by other mining companies and/or at other sites.

Based on the study conducted by CAENI and SIPA, updated by cross-referencing with the aforementioned literature, we present some of these insights in the next sections because we believe they can be valuable for students and practitioners of Science and Innovation Diplomacy (S&ID). Although not explicitly a case of S&ID, they showcase the development and implementation of a multi-stakeholder governance model focused on achieving high standards of social and environmental development, which is often the goal of S&ID initiatives.

As S&ID grows both as a concept and a practice, more and more actors are becoming involved in interconnected networks of national, international and transnational initiatives. As a result, the complexity of the required governance models is also increasing (Sánchez, 2018). However, S&ID had only recently become a fully developed literature, so a lot can be learned from older, more established literatures. Thus, we take Sustainable Juruti as a case study of a multistakeholder model of governance informed by the literature on Corporate Social Responsibility (CSR). We hope to draw lessons from such an initiative because it faces many of the same challenges that those in the area of S&ID will eventually face when planning formal and informal governance structures, such as institutional design, overlapping mandates, stakeholder expectations, among others.

CSR in the mining sector

The Sustainable Juruti model of multi-stakeholder governance is a direct corollary of the growth of international Corporate Social Responsibility (CSR) principles and standards that have transformed the relationship between companies and society in recent decades. Beyond legal obligations, companies today are often interested in protecting their reputation, mitigating risk and enhancing real and perceived value to investors and stakeholders by actively managing the socio-environmental impacts arising from their activities. These principles are an evolution of philanthropic models previously adopted by companies, such as the company town model, which are now considered paternalistic.

Extractive industries, such as mining, have long been associated with adverse social, environmental, political and economic impacts, particularly affecting local communities (Hoelscher & Rustad, 2019). Areas subject to mining are prone to undergo critical social conflicts because of real or perceived damage to social and environmental tissues, unfulfilled expectations of economic development and revenue sharing, land dispossession, unsatisfactory or inadequate working conditions, and even slave labor (Bansal et al., 2023). Sometimes, these conflicts end up overlapping with pre-existing power dynamics in the region, as has often been the case in the Amazon.

All of this can lead to fierce societal opposition to mining projects, with communities engaging in organized or semi-organized disruptive activities, such as strikes, protests, riots, or even formal complaints and legal actions, ultimately tainting a company's reputation or hampering operations. Consequently, mining companies have been progressively engaging in a spectrum of CSR practices, from purely environmental conservation to more complex shared governance models, to ensure the long-term viability of their projects. Also, the emergence of sustainable development as a top priority in global political and corporate agendas has brought about new perspectives and demands over socio-environmental governance, which in turn has led mining companies to seek ways of legitimizing their operations vis-à-vis societal actors.

One of the most important elements within the framework of CSR practices has been termed "social license to operate" (SLO), which is understood as the need to respond to social expectations beyond mere legal compliance, specifically regarding the effects of mining on local communities (Prno & Scott Slocombe, 2012).

"A social license to operate is earned by a company acquiring free, prior and informed consent from indigenous peoples, and local communities. It is acquired through mutual agreements giving the communities leverage to negotiate conditions with the companies, and serves as the means by which the community monitors the practices of the mining company. While mining companies are increasingly expected to gain a social license to start operations or to continue accessing resources in existing projects, this is an ideal process that is not often realized in practice but rather serves as a means for a company to mitigate social and environmental risks once it is already operating in a community" (Bartolini et al., 2010, p. 13).

While all segments of society can be involved in the environmental governance structure of mining activities (such as the government, the media, consumers and society in general), the concept of SLO is mainly based around the idea of local communities as key arbiters, and focuses on practices that might enable them to play active roles in the governance structure of the project. Within this framework, companies are expected to receive constant feedback and approval from societal actors, which can grant or refuse it at any time, according to their expectations regarding the impacts of the mining activities in question, in what can be described as a relational approach (Gavidia, 2015).

Failure to obtain an SLO is now considered one of the major risks in the mining industry, therefore companies are highly incentivized by investors and stakeholders to seek it (Pereira et al., 2022). Thus, most scholars agree that, in order to secure an SLO, companies must implement practices such as early and continuous communication with local communities and other stakeholders, "transparent disclosure of information, development of conflict resolution mechanisms, and culturally appropriate decision-making" (Prno & Scott Slocombe, 2012, p. 347).

However, although obtaining an SLO and other CSR practices are important for building mutually beneficial relationships between businesses and societies, they can sometimes be insufficiently effective in achieving the desired goals and may even exacerbate pre-existing conflicts (Hoelscher & Rustad, 2019). For example, companies often fail to engage in genuine dialogue with local communities and tend to one-sidedly impose their own view of what is "sustainable" or "fair". The success of these initiatives will then depend on many design, implementation and monitoring choices.

Sustainable Juruti: a multi-stakeholder governance model

Sustainable Juruti is a component of ALCOA's CSR strategy at its bauxite site in Juruti. When installation began in 2006, ALCOA faced fierce community opposition and sought the assistance of the Center for Sustainability Studies at the leading business school Fundação Getúlio Vargas (FGV) and the Fundo Brasileiro para Biodiversidade (Funbio) to develop a governance strategy that could address socio-environmental sustainability concerns and establish an SLO. It's worth noting that the legal process for licensing mining operations in Brazil is formally restricted to a set of permits that assess only environmental impacts, so the development of such a governance model is not bound by law, but is instead informed by the ideas of CSR and SLO discussed previously.

FGV and Funbio started by surveying local communities in 2006 and concluded that there were high community expectations regarding ALCOA's operations, such as the provision of public services and goods that are typically the

responsibility of local governments. FGV and Funbio outlined a final version of the model in 2008 (Monzoni et al., 2008). Sustainable Juruti was designed around four premises: effective and broad participation of society in the formulation of a sustainable development agenda; a territorial approach, recognizing the impacts both within and outside the municipality of Juruti; dialogue with global, regional and local contexts; incorporation of sustainable development values into ALCOA and its practices.

Sustainable Juruti's overall design consists of three main pillars: a) the Conselho Juruti Sustentável - Sustainable Juruti Council (CONJUS); b) sustainable development indicators; and c) the Fundo Juruti Sustentável - Sustainable Juruti Fund (FUNJUS). The interaction between these three pillars is intended to result in a local sustainable development agenda, as seen in Figure 1. In 2016, CONJUS merged with FUNJUS and formed the Instituto Juruti Sustentável - Sustainable Juruti Institute (IJUS), although they still exist within IJUS with their original attributions. Today, the official status of IJUS is a Civil Society Organization of Public Interest (OSCIP).

Sustainable Juruti Council (CONJUS): CONJUS is regarded as the central component of the model. It functions as a democratic public space, and has tripartite representation: business, local government, and civil society organizations. It aims to operate as a forum where stakeholders can engage in long-term dialogue and planning. In 2009, CONJUS had over 40 formal members, including tripartite representatives and alternates, although there is no information available on the current size of the membership. CONJUS' organization chart of 2022-2024 was composed of 8 civil society organizations (such as trade unions and human rights NGOs), three companies, and three government/public bodies, including a federal university, plus an alternate for each one of them. CONJUS also has eight technical chambers, each of which is responsible for assessing the needs and priorities of different areas such as health, education, security, etc.

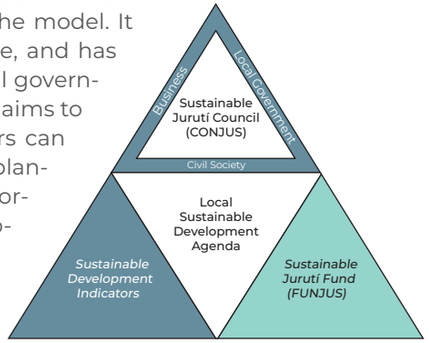

Figure 20: *Sustainable Juruti three-prong model (Bartolini et al., 2010)*

Sustainable development indicators: in order to inform CONJUS, identify priority areas and monitor progress, Sustainable Juruti outlined a plan to establish a set of social, environmental and economic indicators. These were to be developed alongside local and regional actors through research and engagement of local stakeholders, including sectoral representatives and government authorities. After a long series of public hearings and workshops, FGV published two documents reporting a set of more than 150 indicators, the latest being in 2011 (Morzoni et al., 2011). However, these indicators were not intended to assess the performance of CONJUS as a governance model, but rather the social, economic and environmental performance of the municipality of Juruti.

Sustainable Juruti Fund (FUNJUS): FUNJUS is the financial mechanism of Sustainable Juruti, dedicated to the supervision of activities and asset management. Its purpose is to provide financial and material support to initiatives as conceived by CONJUS. At first, the management of the fund was shared between ALCOA, members of the executive board of CONJUS, and Funbio, although now Funbio is no longer a partner, and its activities are overseen by members of civil society associations, public authorities and ALCOA. ALCOA has been the main funder of FUNJUS since its inception.

CONJUS as a multi-stakeholder public space

EIn 2009 and 2010, a group of researchers from USP's CAENI and Columbia's SIPA set out to conduct an independent review of ALCOA Brazil's system for multi-stakeholder dialogue and collaboration in Juruti, with particular focus on the institutional structure of the local council (CONJUS). The goal was to provide ALCOA with critical feedback on the Council's institutional design, implementation and effectiveness (Bartolini et al., 2010). While the study provides a thorough evaluation of a wide variety of aspects, three main findings are of particular relevance to us: a) the uncertain and irregular distribution of responsibilities among stakeholders; b) the wide variation in expectations, interests and attitudes among stakeholders; c) the asymmetric relationship among stakeholders.

First, a major design flaw identified was that CONJUS overlaps with many pre-existing government councils and their mandates in areas such as education, health, and rural development. These councils are managed by the mayor's office and governed by municipal law, whereas CONJUS does not have the legal status of a municipal council. In general, CONJUS is seen by the municipal government as duplicating many existing government structures. Although there is contradictory evidence on the effects of overlapping mandates in public policies and governance structures (Nolte, 2018), in the case of CONJUS, this overlap has created challenges in the planning and execution of public policies. Ultimately, it also raises a question of legitimacy, as it blurs the line between business and government, given that these two spheres are not equally accountable or responsive to society.

One notable example was Agenda Positiva. In 2007, before Sustainable Juruti had been established, societal pressure, especially from social movements that opposed the mine, led ALCOA to partner with the local government in a cooperation framework called Agenda Positiva, in which ALCOA allocated 50 million reais to projects such as the Juruti Community Hospital, a cultural center, new public school classrooms, and road expansions. This can be seen as ALCOA's response to the high expectations of the local communities regarding the role that the company would have in improving the quality of public services that are typically, but poorly, provided by the municipality. However, the costs of

maintaining these projects are not compatible with the financial constraints of the municipal government, so most of them have proved to be unsustainable in the long run. This trend continued to exist after the implementation of Sustainable Juruti, and it highlights the fact that there's a lack of clearly defined roles for CONJUS within the official institutional framework for the provision of public goods and services, which in turn can lead to poor planning or inefficient implementation of public policies.

CONJUS's relationship with the municipal government is marked by an irregular distribution of responsibilities. Juruti and its region have experienced an increase in population and economic activity, raising the demand for the provision of services and infrastructure. Indeed, both ALCOA and the municipal government have vested interests in providing these services and receiving credit for social welfare activities: ALCOA is interested in presenting these actions to shareholders and enhancing the company's local reputation in order to secure an SLO, while the municipal government is interested in pleasing its constituency.

Thus, these overlapping mandates may have shifted the relationship between the municipal government and CONJUS from a cooperative one to a competitive one. Different studies have noted that the municipal government does not consider CONJUS as a legitimate decision-making locus (Bartolini et al., 2010, Borba, 2012). "Among the executive power representatives of the Prefeitura [the municipal government], the main understanding and expectation is that CONJUS is and should remain only a consultative forum, directing the diverse social demands to other institutions to execute and fund" (Bartolini et al., 2010, p. 37).

This dynamic is said to have blurred the boundaries between ALCOA's and the government's responsibilities to the community. However, ALCOA's interest in CONJUS is that it reduces transaction costs of negotiating with local stakeholders, smoothing the path for obtaining and securing an SLO. Although CONJUS is supposed to provide a formalized forum for both the government and ALCOA to discuss, negotiate, and distribute these demands and responsibilities, this clash reveals "the underlying differences in interests that guide both government and corporate actors, while at the same time underscoring the need for a well-defined partnership in providing sustainable solutions to Juruti's challenges." (Bartolini et al., 2010, p. 26)

This leads to the second finding. Although most reviews agree that the tripartite constitution of CONJUS has indeed provided a forum for discussion, debate, exposition and sharing of information, each of the three sectors represented in CONJUS has completely different expectations and interests regarding the council. We highlight two aspects in dispute: the objectives and purpose of CONJUS, and the extent and nature of the dialogue with local stakeholders.

Stakeholders' perceptions of the role of CONJUS vary considerably, ranging from a space for information sharing, a forum for discussion, a consultative body, a lobbying organization, to an institution with the capacity to act independently in order to solve the problems identified in its statutes. Formally, ALCOA recognizes it as a "consultative body [that] will observe the activities being promoted for the sustainable development of Juruti, whether by companies or public authorities, including Alcoa's own mining" (Bartolini et al., 2010, p. 36). As already mentioned, both studies that evaluated the political relationship between CONJUS and the municipal government agree that the public authorities do not consider CONJUS a legitimate decision-making locus, mainly because local stakeholders see it as an extension of ALCOA (Bartolini et al., 2010; Borba, 2012). They are particularly concerned with how CONJUS duplicates already existing government structures and could be a competitor to the municipality in defining and implementing public policies.

However, interviews have shown that some members of CONJUS often expect the council to have the authority, plus technical and financial capabilities, to independently execute initiatives and projects. On the one hand, this could be understood as the consequence of the lack of a clear definition of the purpose of the council. On the other hand, it could also be a corollary of the increased representation that civil society organizations have been experiencing through CONJUS, which are eager to voice their grievances and to implement changes, but are unaware or poorly informed about the scope and mandate of the council.

One of the principles of CONJUS is the broad participation of societal agents. However, CONJUS faces a trade-off between representation and decision-making ability. The more members, the more widespread their views, attitudes, and interests, which makes consensus-building very unlikely. CAENI and SIPA have identified that CONJUS members have at least two different incentives: "(1) members who are committed to CONJUS as a means for funding development projects and the work of [their own] community organizations, and (2) members who are committed to the success of the institutional arrangement as a forum for discussion" (Bartolini et al., 2010, p. 33). These varying attitudes hinder the capacity to formulate a unified vision and agreement among CONJUS members on its goals and mission. Ultimately, this leads to the perception that CONJUS is "just dialogues", but has no enforcement power.

The extent and the nature of the dialogue between ALCOA and local stakeholders has also been highlighted as a cause of contention. There's a general perception among civil society that ALCOA's willingness to engage with local communities has diminished over time, once operations began, leading to frustration and dissatisfaction among some members.

In fact, and finally, the community-company relationship is marked by a huge asymmetry between these stakeholders. Juruti communities have often been subject to "historical poor governance, limited access to information, poor education opportunities, and unfulfilled political rights." (Gavidia, 2015, p. 196), so there's a sense that community-company negotiations tend to heavily favor ALCOA.

The depth and quality of communication between the parties are usually a cause for complaint. The CAENI and SIPA study has found that, despite input

from surveys and discussions with local stakeholders, the involvement of the municipal government and local civil society in actually shaping the model's design appears to be minimal. This was further corroborated by Gavidia and Kemp (2017), who argued that instead of a true relational dialogue, company-community communication was often narrow and top-down. According to them, "[...] local people had an insufficient understanding about topics that are relevant for community decision-making processes. This included access to basic information about mining activities, social and environmental impacts, negotiation of compensation, and the rights and responsibilities of the company and the community." (Gavidia e Kemp, 2017, p. 85). This stems from the asymmetrical company-community relationship, as the local community is much more dependent and relies much more on dialogue with ALCOA for information than the other way around.

Insights and takeouts:

Governance is at the forefront of the most recent discussions on the institutional structuring of S&ID (Da Silva et al., 2021). New governance regimes are being designed and redesigned to address the more complex, geographically decentralized network of interactions between a wide variety of stakeholders, including governments, industry, academia, societies and local communities. Thus, as S&ID grows both as a concept and a practice, more and more actors are becoming involved in interconnected webs of national, international and transnational initiatives, and as a result the complexity required to implement efficient governance models is also increasing (Sánchez, 2018).

S&ID diplomats might experience challenges in designing and working with multi-stakeholder governance in either of these two situations: 1) governance arrangements designed to coordinate different S&ID systems; 2) governance arrangements designed to coordinate the provision of other services and public goods and which include S&ID diplomats or other knowledge-based bodies among their stakeholders.

The case of Sustainable Juruti is valuable to students of S&ID because it illustrates a complex multi-stakeholder governance model with goals to achieve a socio-environmentally sustainable agenda. Although this model wasn't informed by concepts pertaining specifically to the S&ID literature, there are many lessons to be learned from the older, more established literature on Corporate Social Responsibility, which has been devising and experimenting with concrete implementations of multi-stakeholder governance models in a variety of settings for quite some time.

Sustainable Juruti showcases a complex web of interactions among stakeholders with very different capabilities in three major groups: business, government, and civil society. Variation also occurs within each of these three groups in a spectrum of levels of organization, interests, attitudes, and expectations. Here's a summary of the main takeaways that the analysis of Sustainable Juruti can provide to students of S&ID.

1. An organization is fundamentally defined by its function (Olson, 1971), so having clear goals and purposes is crucial. A clear distribution of responsibilities among stakeholders is also a prerequisite for expectations to converge as much as possible. There's contradictory evidence on the effects of overlapping mandates: they might reinforce or hinder public policy, so thorough case-by-case consideration is required. In the case of CONJUS, the overlap between the Council and local government structures was found to produce suboptimal public policy implementation. This might be a paramount concern when devising governance models where multi-level government agencies and private actors will interact and are most likely to overlap.
2. There's a trade-off between inclusivity and consensus building: the more members, the more difficult it is to reach consensus. A higher number of members also increases fixed and transaction costs, such as the time and effort required to coordinate audiences and organize demands. In some cases, such as Sustainable Juruti, this may be a structural feature that renders the organization unable to assume a decision-making role. Thus, the breadth and reach of an organization must match its purpose, whether it is advisory or executive. This must be defined beforehand with a clear set of rules on how participants are to engage in the governance structure and what they should expect from it.
3. Meaningful communication among stakeholders is paramount. However, differences in educational levels, proficiency in technical-scientific knowledge, and diverse cultural backgrounds among stakeholders can make communication very difficult or inefficient. This is particularly the case when the stakeholders include vulnerable populations and where information asymmetry can be perceived as a mechanism of power dynamics, as has been the case in Sustainable Juruti. Here, the concept of Social License to Operate can offer some inspiration: it's important to validate models with more vulnerable stakeholders, which may sometimes imply engaging in activities such as information translation and adaptation, including science communication, to ensure that stakeholders fully understand their circumstances and options.
4. Governance models should consider whether their actions and projects are sustainable in the long run. Otherwise, stakeholders might feel frustrated, tricked, or perceive the structure as a set of empty promises. It's also important to consider how the delivery of public goods will be jointly managed by stakeholders in the long term. In the case of Sustainable Juruti, Agenda Positiva proved unsustainable because the municipal government could not afford to maintain the public goods provided by ALCOA. In another example, FGV has only published the Sustainable Development Indicators twice, in 2009 and 2011, even though they are considered a major pillar of Sustainable Juruti. Because of the amount of effort required for such in-depth research, the continuity of this project is only viable with the long-term involvement of a major institution such as FGV. This suggests that designing an appropriate governance model is as important as ensuring that the expectations around it and the partnerships need to implement it will also be fulfilled in the long run.

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Conclusion

After delving into the case studies, the importance of integrating academic research, public policies, and the use of science diplomacy becomes evident, especially in specific contexts of Latin America. This convergence not only makes it possible to address common challenges, but also to qualify and enhance the outcomes of public policies through the application of science. Science emerges as an invaluable tool in the panorama of public policies by mobilizing human, scientific, technological, and financial resources to address problems that directly impact citizenship, while adhering to legal and ethical principles. Collaboration between scientists and policymakers is crucial to ensure that public policies are evidence-based and geared towards effectively addressing the problems faced by society.

The cases highlight that scientists and policymakers usually operate within different logics, with the latter being tied to the concreteness of the social world, where solutions are required quickly, and new problems are constantly coming up. Scientists, on the other hand, seek answers within a methodological rigor that requires time, peer discussions, and numerous revisions. Furthermore, the answer is not always correct and often requires adjustment. Notwithstanding, science can play an essential role in empowering, qualifying, and steering the public debate by providing a multidimensional understanding of the issues at hand. As public participation in decision-making increases, it is crucial that decision-makers, whether government officials, public servants, or members of organized civil society, are properly trained and informed to work together.

The convergence of academia and public policy can serve a dual purpose: enhancing decision-making and ensuring that public participation is more than a formality. Thus, it is essential to share scientific data and information, allowing for effective communication between different actors, to fuel informed and well-founded discussions. Furthermore, all domains of public policy, including foreign policy, require continuous monitoring and evaluation to ensure their legitimacy and effectiveness. The alignment between science, technology, and innovation agendas with international objectives demonstrates that science can play a key role in shaping and implementing global public policies.

Within the case studies analyzed, a variety of common challenges are found in public policies across different countries in Latin America and the Caribbean. Some of these include: designing coherent and effective governance structures, engaging and articulating stakeholders, arbitrating conflicting interests among stakeholders, involving civil society in decision-making, designing mechanisms for border conflict resolution, managing natural resources properly, dealing with technological disparities and other asymmetries, harmonizing divergent legal frameworks, among others. All of them highlight the need for sustainable alliances between different sectors and the importance of effective monitoring systems to achieve the Sustainable Development Goals (SDGs).

Whether for civil servants, government officials, or community leaders, it is paramount to connect decision makers with different actors, including epistemic communities in the academy. This can be achieved through various means, such as organizing seminars, engaging with experts, disseminating data, and drawing comparisons with field experiences, among other possibilities (Enap, 2018). This is because there are numerous perspectives through which a social issue can be perceived. Consequently, understanding the problem should take into account a range of stakeholders capable of contributing to the development of solutions (Enap, 2018). (highlight the ability to connect “the right people”)

From a development perspective, the analysis of the selected cases highlights the role of diasporas in emerging economies. Countries such as Colombia, Chile and Honduras have sought to articulate their scientific diasporas in projects and programs to harness human and technical resources for the advancement of science, technology and innovation. In addition, South-South cooperation has been emphasized as an important tool for addressing global problems through scientific guidance. There is also a focus on the importance of teaching science diplomacy in university programs in a positive and contextualized way, with recommended topics including international relations theory, foreign policy, and the history of science.

However, there are still challenges in consolidating these strategies as effective in achieving their objectives in the field of science, technology, and innovation. Thus, the case studies analyzed here provide a real panorama of the use of science, technology, diplomatic cooperation, and innovation, as well as the difficulties in Latin America and the Caribbean. By addressing various issues and offering insights into public policies, regulations, and international cooperation, they can be an important tool to inform the decision-makers ultimately tasked with addressing complex challenges.

The advancement of Science and Innovation Diplomacy in Latin America and the Caribbean requires strengthening the capacities of key stakeholders and strategically institutionalizing initiatives. The efficacy of actions to achieve these goals hinges on a strategic view of Science and Innovation Diplomacy, which involves mapping domestic capabilities and needs alongside an international assessment of potential opportunities. This means identifying key actors and issues pertinent to the endeavor. With this objective in mind, this booklet, along with the discussion and the case studies, provides a concise guide for policymakers on crafting strategies for science and innovation diplomacy.

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