

Science in Latin America: towards public policy proposals focused on the development of international scientific cooperation

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Abstract

Governments in Latin America are implementing Science, Technology, and Innovation (STI) policies to foster strategic alliances with international scientific networks, generating exchanges, mobility, and scholarships. The progress of International Scientific Cooperation (ISC) in the region is measured by indicators such as the number of articles, patents, and co-authorship in international research. To improve ISC, policy recommendations include supporting funding flows, knowledge production, collaboration, networking, and linking scientists in diaspora through establishing research agendas at the regional level and fostering science diplomacy.

Introduction

Currently, challenges such as global warming, pandemics, and profound technological changes have become opportunities to foster the development of science and technology. In this sense, governments have advanced towards the generation of modern institutions that allow the development and articulation of capacities. In the case of Latin America, it is evident that science, technology, and innovation (STI) policies have been transformed according to the political-economic reality of the region, where governments have shown greater interest in STI planning and regulations, despite weak financing, fragile institutions and governance, and incipient international scientific collaborations that have characterised the region in recent years. The objective of this policy brief is to review policies and data related to international scientific collaboration (ISC) in Latin America, in order to identify progress in scientific development of the continent and to present public policy recommendations that favor the development of international scientific cooperation in the region.

Public Policy Analysis

In the analysis developed regarding public policies on STI in Latin America, it can be stated that most of the countries focus their STI and international cooperation strategies in the areas of strategic relationship through the participation of researchers in international scientific networks, exchange programs, international mobility, and scholarships to promote the qualification of human talent through masters and doctoral studies. In addition, governments focus their efforts on establishing internationalisation policies that foster collaborative projects in scientific research, technology, innovation, and aim to generate science diplomacy scenarios.

Table 1 addresses the main manifestations of STI policies in Latin America, specifying objectives, scope, and key actors for the development of strategies whose purpose is to promote science and international cooperation in the region.

Table 1. Key aspects of STI policies in Latin America

Country	Objectives and scope of the STI Policy	Actors	Strategies in STI and international cooperation
<p>Chile</p> <p>National Science, Technology, Knowledge, and Innovation Policy</p>	<p>It focuses on four axes of action:</p> <ul style="list-style-type: none"> - Linkage with society to strengthen the social appropriation of Science, Technology, Knowledge, and Innovation. - Future to take advantage of the STI and build new ways of value according to the challenges and needs of the country. - Strengthening of the STI ecosystem, focused on creating routes and spaces of value for the benefit of society. - Institutional capacities, in order to generate an appropriate environment where the best contributions of the country's STI ecosystem emerge. 	<p>Ministry of Science, Technology, Knowledge, and Innovation.</p>	<ul style="list-style-type: none"> - Mobility and creation of international talent networks through actions that allow the return of researchers trained abroad, in addition to attracting international talent. - International projection of national talent through international networks of STI. - Development of international cooperation for the benefit of R+D+i with strategic allies worldwide (Ministerio de Ciencia, Tecnología, Conocimiento e Innovación, 2020).
<p>Brazil</p> <p>National STI Strategy 2016 - 2019</p>	<ul style="list-style-type: none"> - Generate institutional conditions that increase the productivity of innovation. - Reduce regional disparities in production and access to STI. - Provide innovative solutions for productive and social inclusion. - Strengthen the basis for sustainable development. 	<p>Ministry of Science, Technology, and Innovation; National Council for Scientific and Technological Development (CNPq); Coordination for the Improvement of Higher Education Personnel (CAPES).</p>	<ul style="list-style-type: none"> - Promotion, expansion, and internationalization of STI through international exchange and mobility, in order to promote the training of highly qualified human resources. - Promotion of alliances with the most developed countries to strengthen national think tanks to make decisions on investments and international cooperation projects. - Incentives for international mobility programs, and master and doctoral studies (Ministerio de Ciencia, Tecnología, e Innovación, 2016).
<p>Argentina</p>	<p>The purpose is to promote knowledge management</p>	<p>Ministry of Science, Technology and</p>	<ul style="list-style-type: none"> - Strengthening and promotion of international cooperation and

<p>National Science, Technology, and Innovation Plan -2030</p>	<p>for social, productive, inclusive, and sustainable innovation. In this sense, it defines four agendas:</p> <ul style="list-style-type: none"> - Strategic Agendas: Ten national challenges. - Territorial and integrating agendas of STI. - Transversal agendas: General promotion of knowledge, technologies applied to R+D+i, social and human sciences for development. - Institutional change agenda: Human Resources, Knowledge Management, SNCTI Multi-Actor Articulation, Federalization and Internationalisation. 	<p>Productive Innovation.</p>	<p>regional integration around strategic agendas that support scientific research and technological development.</p> <ul style="list-style-type: none"> - Collaboration in strategic areas of research, increasing innovation and development actions that support articulation between the academic, scientific, and productive sectors. - Strengthening the scientific and technological capacities of the country through the development of linkage policies with Argentine researchers, scientists, and technologists residing abroad through the RAICES Program (Ministerio de Ciencia, Tecnología e Innovación Productiva, 2022).
<p>Mexico</p> <p>Special Program for Science Technology and Innovation 2020-2024 (PECiTI).</p>	<ul style="list-style-type: none"> - Train STI communities to face national priority problems with an inclusion approach. - Generate an innovation ecosystem that allows the integration of the country's scientific and technological development actors. - Consolidate the country's scientific, humanistic, and technological capacities to influence strategic national problems. 	<p>National Council of Science and Technology (Conacyt).</p>	<ul style="list-style-type: none"> - Promotion of agreements with international institutions and organizations that facilitate scientific work, technological development, and innovation. - International mobility programs for researchers and postgraduate scholarships for young people abroad. - Participation of the Mexican scientific community in relevant international projects (Consejo Nacional de Ciencia y Tecnología, 2019).
<p>Colombia</p> <p>National STI Policy 2022-2031 (CONPES 4069).</p> <p>2019 International Mission of Wise Men.</p>	<p>There are established seven transversal axes to the strategic focuses of the International Mission of Wise Men:</p> <ul style="list-style-type: none"> - Promote talent and employment in STI. - Improve the generation of knowledge. 	<p>Ministry of Science, Technology, and Innovation.</p>	<ul style="list-style-type: none"> - Implementation of internationalisation policy and agenda with priority issues in science diplomacy. - Promotion of the mobility of researchers and job internships. - Participation of researchers in global scientific collaboration networks.

	<ul style="list-style-type: none"> - Increase the transfer of technology and social appropriation of knowledge. - Promote the use of regional and international potentialities. - Revitalize the National STI System and optimize financing. 		<ul style="list-style-type: none"> - Exchange of experiences through South-South and triangular cooperation. - Development of joint projects in STI and use of the scientific diaspora (Ministerio de Ciencia, Tecnología e Innovación, 2021).
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Source: Own elaboration based on authors

Main indicators for international scientific cooperation

Scientific research can be considered one of the fundamental pillars for analyzing development within a specific context or country. It allows for the examination of the quality of life of its inhabitants, as well as technological, social, political, or economic advances, benefiting not only researchers, but the community in general (Delgado-Bardales, 2021). To evaluate progress in research processes, it is common to revise science and technology indicators based on the number of articles, patents, or projects developed in a specific country or region, such as Latin America.

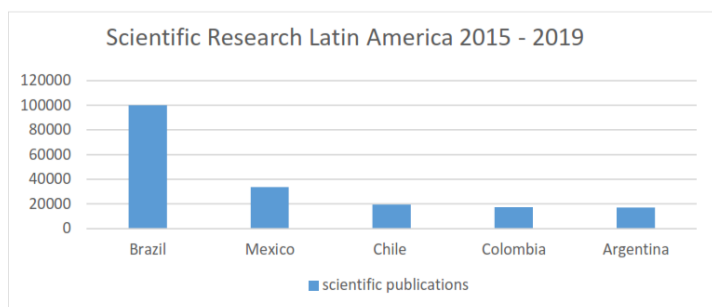
The increase or decrease of these figures depends on the International Scientific Cooperation (ISC). ISC involves different research groups contributing their knowledge and expertise to facilitate the modernization of science, leading to social, political, or economic benefits (González-Huerta & Zavala-Leal, 2022). Among the main indicators of ISC are high-quality and impactful research results, co-authorship in international research, the number of scientific publications and citations, the percentage of international co-publications, official patents, and others (Sebastián, 2019).

In Latin America, it is observed that despite having a low percentage of GDP (between 0.6 and 0.7%) allocated for research funding, only one in five countries invests more than 1%, except for Brazil which exceeds this threshold (UNESCO, 2022). Moreover, various investments have been made in public policies and researcher mobility, which are expected to lead to increased resources for scientific research.

The volume of scientific production can be measured through various indicators, such as the distribution of areas of knowledge, the intensity, and the types and percentages of national and international co-authorship. This takes into account the numbers of documents, articles, and sections of published books, as well as citations. Between 2005 and 2014, Latin America saw a 90% increase in scientific publications, with significant contributions from countries such as Colombia (244%), Ecuador (152%), Peru (134%), and Brazil (118%) (Lemarchand, 2015).

Following this, between 2015 and 2019, scientific production increased by 25% thanks to countries such as Ecuador, the Dominican Republic, Honduras, and Peru (UNESCO, 2022). Additionally, according to Scimago records in 2021, Brazil and Mexico ranked among the top five countries in terms of publications at the Latin American level, with 100085 and 33664 publications, respectively. Chile and Colombia followed with 19638 and 17281 publications, respectively, and Argentina with 17130 publications (Scimago, 2021).

Figura 2. *Number of publications between 2015 - 2019.*



Source: Own elaboration based on Scimago (2021)

The indicators of scientific cooperation or collaboration are considered estimators of the performance of knowledge dissemination and utilization within a science system. In the case of Latin America, there was a positive variation in the participation of European countries such as Portugal and Belgium in the period 2017-2019. Additionally, countries such as Peru and Ecuador were able to establish themselves as countries with greater collaboration, according to OCYT (2021). Lastly, UNESCO (2022) reported an 82% growth in scientific publications and articles between 2011 and 2020, highlighting the growth in countries such as Colombia and Chile. However, the number of research patents only increased by 21% in the region.

Policy recommendations

Considering the situation of international scientific collaboration in terms of policies and indicators in the region, we hereby make the following recommendations for public policy in the region, in order to improve the ISC, taking into account the categories of internationalization of research adapting Van den Besselaar et al. (2012):

Funding flows and knowledge production:

An interesting example of financial support for science and technology projects in the region is the CYTED program, which has an Ibero-American scope and whose objective is to promote scientific cooperation in the region, also linking universities, companies and the third sector, creating thematic networks. This program mainly allows the generation of research projects and the exchange of knowledge among Ibero-American research groups (CYTED, 2023).

Policy actions:

- Funding of international scientific collaboration projects and new knowledge needs to be supported, linking STI to key knowledge areas for the region.
- Patent funding with foreign organizations is required.
- It is recommended to manage joint financing for international mobility programs.
- A key issue is to support the organization of international events in priority areas in the region.
- Countries in the region should establish research agendas at the regional level to direct and focus science, technology and innovation resources.

Collaboration and networking:

An example of success is the case of *Programa Raices* from Argentina, which aims to develop the country's scientific capabilities by connecting with Argentine scientists living abroad. The program not only promotes short stays of Argentine researchers living abroad, but also their return to Argentina and their linkage with scientific careers in their country of origin (Gobierno de Argentina, 2023).

Policy actions:

- The countries in the region need a science diplomacy agenda, in order to advance ISC through regional forums and organizations.
- The linkage and attraction of scientists in diaspora or foreigners who are interested in working with national STI systems is recommended.
- It is necessary to support the development of research networks of scientists, especially with a view to solving the region's challenges.
- It is key to develop transnational science alliances that allow the development of projects.
- It is necessary to generate linkage programs with the scientific and highly qualified diaspora.
- Science, technology and innovation should be established as an area of development within the framework of foreign policy approaches.
- There is a need to create programs for knowledge transfer and promotion of STI produced in the region with other countries in the South.

Training:

An example of a partnership between government and private entities to join efforts to enable high-level training of Colombians abroad is the *Credito Beca Colfuturo 2023* scholarship program. The Ministry of Science, Technology and Innovation of Colombia has contributed more than \$62 billion for the 2023 call for applications, which corresponds to 40% of the total resources available for this call. The remaining 60% is financed by private sector organizations. Selected professionals may receive support of up to US\$50,000 for tuition, insurance, living expenses, and airfare. In addition, they will be able to benefit from more than 120 agreements signed with various international universities that provide complementary scholarships for up to 100% of the tuition (Ministerio de Ciencia, Tecnología e Innovación, 2023).

Policy actions:

-There is a need to continue with high-level training programs abroad, in countries and institutions with developments in priority areas for the region.

-Funding is required for these postdoctoral programs in companies, embassies, laboratories, universities, among other stakeholders.

-It is necessary to support mobility and research stays at the postgraduate level in priority areas for the region.

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