

Latin America & Caribbean Islands

There is scope for improvement with the volume and quality of research in this region, but some innovative programmes for study abroad might improve future publications.

ARTICLE COUNT (AC): 2,249
 FRACTIONAL COUNT (FC): 864
 WEIGHTED FRACTIONAL COUNT (WFC): 574

Brazilian economist Antônio Delfim Netto, one of the government officials credited with the country's rapid economic development during the 1970s, famously argued: "One needs to wait for the cake to rise before cutting any slices." That is, a country should not try to redistribute wealth without a preceding phase of vigorous economic growth. If one applies Delfim Netto's maxim to Latin American science, it is clear that the cake has risen — there are almost seven times more papers published by Brazilian scientists in indexed journals, for instance, than 20 years ago, according to the Scimago/SCOPUS database, which started decades before the Nature Index — but this hasn't made it very competitive in the Index. The growth in absolute numbers is still not enough to place countries in Latin America and the Caribbean Islands among the world's leading scientific communities, according to the Nature Index.

Based on the Nature Index's 2014 weighted fractional count (WFC), Brazil produced the region's highest output and is 23rd globally with a 2014 WFC of 237. Behind Brazil, Argentina, Chile and Mexico came in 30th, 32nd and 34th in the global Index. Physical sciences account for 55.4% of the region's WFC.

Brazil puts the most emphasis on scientific research of all countries in the region — spending 1.3% of its GDP on R&D, followed by Mexico at 0.5% of its GDP. Among the four top countries,

Chile provides the least funding for research — about 0.36% of its GDP (which is also by far the lowest of the four in absolute terms, because it also has the lowest GDP) — but its WFC (95) is barely lower than Argentina's (99).

In this region, public funding is much more important than partnerships with the private sector, and scientists rarely become entrepreneurs. Despite this, some government promises for increased support have not been realized. For example, scientometrist Francisco Collazo-Reyes of Mexico's National Polytechnic Institute says, "The winning tickets in the last several presidential campaigns here have several times promised to raise funding to 1% of GDP, but this hasn't materialized so far."

from these areas. Latin American scientists also collaborate often with their neighbours to the north: 28% of Latin American international collaborative work is done with US and Canadian scientists.

Much of Latin America's economic growth in the past couple of decades has been fuelled by Chinese demand for commodities. For example, China imports Brazilian and Argentinean soybeans and Brazilian iron ore. Latin American research centres, however, still seem largely oblivious to the potential of Asian science. Only 4% of international collaborations by scientists from Latin America and the Caribbean Islands include colleagues from East & Southeast Asia.

On average, though, scientists in Latin America and the Caribbean Islands collaborate more often internationally than scientists around the world. In addition, its scientists collaborate significantly with others in North America and Europe. For instance, four researchers from Brazil — plus others from France, Italy, Spain, the United States and Russia — published a 2014 *Nature Biotechnology* article on the sequencing of citrus. The research itself even added to this article's international flavour, since it explored the phylogeny of plants that started to be domesticated thousands of years ago in Southeast Asia. "Advances in citrus genomics should soon allow the identification of the somatic mutations that, with their ancient genetic backgrounds, underlie the

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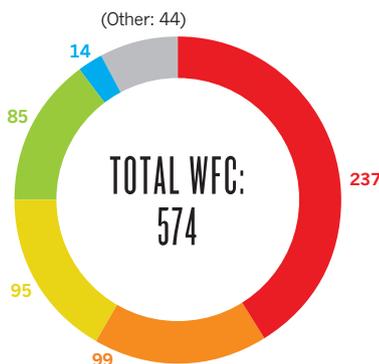
COLLABORATING ON COMMODITIES

The pattern of international collaborations in Latin America resembles that of North America. Both regions lean toward research partners in North & West Europe. In fact, 47% of Latin American and 49% of North American international collaborations involve scientists

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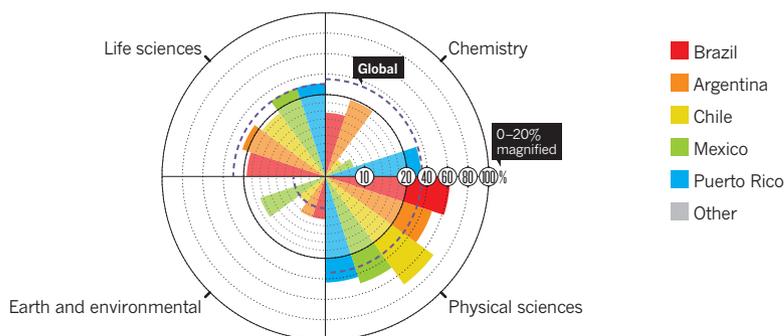
Countries' weighted fractional count (WFC)

Brazil supplied over 40% of the articles in the Index, and Argentina, Chile and Mexico each produced roughly 15%.



Relative subject area distribution

Physical sciences dramatically dominated the publishing, where all of the top five countries focused at least 40% of their output here.*



*Each slice represents the proportion each subject area contributes to a country's overall WFC. Subject areas can overlap, so the total percentage may exceed 100%.

diversity of citrus colour, flavour and aroma in modern cultivars,” the authors concluded.

But citrus is far from the only type of agricultural product that is driving Brazilian science. Indeed, although Brazil grows more than 700,000 hectares of orange trees, it plants more than 10 times that much in sugar cane. In fact, Brazil is the world leader in producing sugarcane ethanol, which has become an attractive alternative fuel for vehicles. In 2014, according to Bloomberg, Brazil’s state-development bank, Banco Nacional de Desenvolvimento Economico e Social, invested US\$843.5 million to increase the productivity of turning sugar cane into ethanol.

SIZE MATTERS

Publicly funded universities that, by North American and European standards, have huge numbers of students and staff, are responsible for most of the research in Latin America and the Caribbean. The two Latin American institutions with the highest WFCs are Brazil’s University of São Paulo (USP), with 100,000 undergraduate and graduate students and 6,000 faculty, and the National Autonomous University of Mexico, with more than 300,000 students and about 37,000 academic staff.

Rogério Mugnaini, a scientometrist at USP, argues that institutions of such size are bound to perform in a relatively irregular way when it comes to publishing research. He says, “They will certainly have a number of groups in a position of international leadership, but also a very long tail of researchers that don’t perform so well.”

As a result, he says, the overall performance of these gargantuan institutions suffers. None of the leading institutions in Latin America is among the top 200 in the world based on the Index’s WFC.

Research strength in Latin America tends to be much more geographically concentrated than in other regions. Brazil, for example, has four institutions in the region’s top 10, and three — USP, São Paulo State University and



This processing factory in Valparaiso, Brazil, turns sugar cane into ethanol for fuel.

the State University of Campinas — are in São Paulo State; the other top-10 institution, the Federal University of Rio de Janeiro, is in the adjacent state of Rio de Janeiro. About half of Brazil’s science output comes from São Paulo, although a 2014 *Nature Genetics* article on the human hookworm’s genome included a Brazilian author from Minas Gerais.

Both Chile and Argentina have two institutions in the regions’ top 10, and the University of Puerto Rico, the sole representative of this US territory, is also among the top 10.

For Chile, says Atilio Bustos-González of the Scimago Research Group at Adolfo Ibáñez University in Viña del Mar, Chile, one of the main challenges is how to increase the output of quality science in research centres outside of Santiago.

REACHING FOR RECRUITMENT

To increase the international relevance of Latin American science, governments are creating programmes to fund scholarships overseas. The most ambitious and controversial so far is Brazil’s Science Without Borders, which

started in 2011. Its initial aim was to send about 100,000 young scholars — mostly undergraduates, plus 15,000 doctoral candidates and 6,500 post-docs — to institutions abroad. President Dilma Rousseff pledged to double that number during her re-election campaign in 2014.

The initiative has been criticized for lax selection criteria and implementation. For example, some undergraduates have been accepted despite having little command of the language of the country to which they were headed, and there are no clear rules to monitor their activities abroad.

The ease with which some students have managed to spend most of their time travelling has led critics to call the initiative “Tourism Without Borders.”

“The focus on undergraduates has attracted a lot of scepticism about the long-term effects of the programme in Brazilian science,” says Mugnaini.

On a more modest scale, the Chilean Ministry of Education has since 2008 awarded Becas Chile (Chile Scholarships) for masters students, doctoral candidates and post-docs.

Those who receive the scholarships sign an agreement to return to Chile after the end of their fellowship. “The first PhDs of Becas Chile are starting to return, and that is bound to generate an increase in the country’s scientific output,” predicts Bustos-González.

The hope is that programmes like Science Without Borders and Becas Chile will give Latin American researchers a chance to interact with scientists from countries with higher WFCs and attract foreign scientists to Latin America.

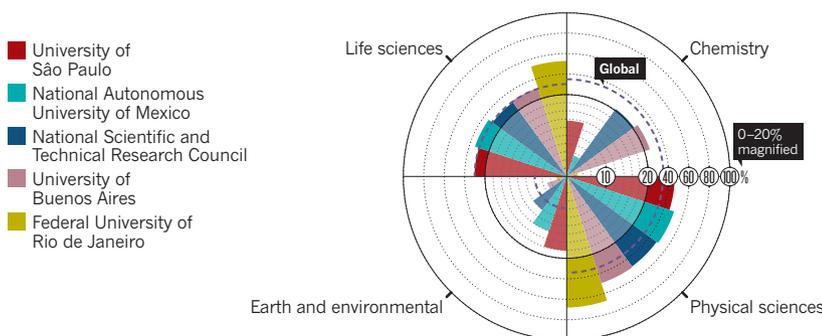
The Brazilian programme, for example, is offering 2,000 fellowships for “special visiting researchers” who are willing to spend at least a month each year in Brazil for a three-year period.

Increasing the cooperation with first-world scientists might improve quality in publications from Latin America & Caribbean Islands. ■

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Top 5 institutions’ relative subject area distribution

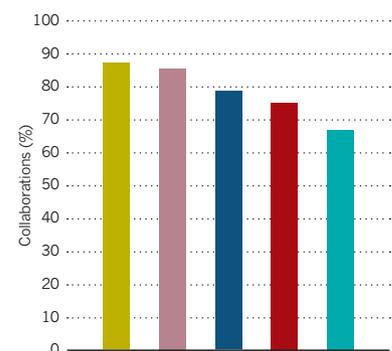
In a region largely focused on physical sciences, the National Autonomous University of Mexico generated more than 40% of its Index articles in the life sciences.*



*Each slice represents the proportion each subject area contributes to an institution’s overall WFC. Subject areas can overlap, so the total percentage may exceed 100%.

Top 5 institutions’ collaborativeness

Four of the top five institutions used international collaborators on more than 70% of their 2014 Index articles.*



*Each bar represents the proportion of an institution’s overall output in the Index (AC) stemming from domestic and international collaborations.