JORGE A. HUETE-PEREZ, DOUGLAS MASSEY, AND ANTHONY CLAYTON

Supporting Science and Innovation in Central America and the Caribbean

Since 2018, Nicaragua has experienced a deep, multifaceted political crisis that has brought severe restrictions for academic institutions. The government has shuttered universities, canceled permits for collaborating with international institutions, revoked the legal status of the Academy of Sciences of Nicaragua, and displaced researchers. The free exchange of ideas has been sharply curtailed. This dismantling of academic infrastructure has consequences—for Nicaragua's scientific future and for development throughout Central America.

Limitations on academic freedom have directly affected public health and wellbeing in the region. The Ortega administration's seizure of the University of Central America's Managua campus in August 2023 resulted in the closure of its Molecular Biology Center, the country's premier research and training center for biotechnology, which upended key research projects and publications on COVID-19's impact throughout the region. Other Latin American and Caribbean countries are also struggling to maintain scientific research capacity in the face of dysfunctional governance structures that have immiserated their citizens. In Venezuela, for example, the number of families living in extreme poverty rose from around 9% in 2009 to 79% in 2019.

As scientists with extensive experience working in the region and as members of our respective countries' national academies, we have noted how the international community has responded to conflicts that have disrupted science. In Ukraine, for example, leading international institutions have worked together to sustain the country's scientific agenda and its scientific diaspora, creating emergency research grants and temporary academic placements for displaced scientists. Given the out-migration of scientists from Central America and the Caribbean, we have given much thought to how institutions inside and outside the region might work to foster science in the region as a whole. We believe that by closely linking science and technology with development, international institutions can help deliver tangible improvements in living standards while also supporting and promoting science, technology, and innovation (STI).

In developing countries, STI investments can build future innovation capacity while also addressing immediate concerns, such as urban development, energy, transportation, and natural resource management. However, despite widespread recognition that STI investments have multiple benefits, these investments have not been a priority for most governments in Latin America and the Caribbean.

Overall, domestic research and development investment in South America is low by international standards, at 0.6% of gross domestic product (GDP) in 2021. By comparison, countries with a strong science base, such as the United States, Japan, and South Korea, maintain a national R&D intensity of more than 2% of GDP. However, the bigger issue is the uneven contributions to research investments across the region. Brazil alone accounts for over 60% of all the R&D spending in Latin America. And when the three leading countries—Brazil, Argentina, and Mexico—are combined, they account for over 80% of the region's R&D spending.

The other thirty countries in the region share the remaining 20%, meaning that most spend some 0.1–0.2% of their GDP on R&D. This is too low to support significant rates of technological innovation. El Salvador, Guatemala, Nicaragua, Panama, Paraguay, Peru, and Trinidad and Tobago, each invest less than 0.2% of GDP in R&D. This limited support has resulted in a rising gap in economic productivity between the leading and lagging countries in Latin America and the Caribbean.

Despite low rates of investment today, the region has significant opportunities that could be developed in the future. The nations of Central America and the Caribbean are rich in natural resources, possess unique biodiversity, and have significant cultural diversity and local knowledge. Guatemala, the Dominican Republic, and Costa Rica are already actively involved in aspects of environmental research, and Nicaragua, Costa Rica, and Panama are involved in biomedical research. By focusing on these strengths, the region could start to develop locally focused solutions, attract international partnerships, and become an integral research hub in these critical fields. Recognizing and nurturing these opportunities could yet position Central America and the Caribbean as a valuable node for scientific innovation and sustainable development.

We believe one way to make STI investment more attractive is by aligning scientific research efforts with development goals that can be translated into practical societal benefits. For example, investing in digital connectivity is crucial for facilitating knowledge sharing, collaboration, and the implementation of innovative solutions, as highlighted in a recent report on the region by the World Bank. In the health sector, investment in research into tropical diseases, particularly the so-called neglected tropical diseases like Chagas disease, could raise household incomes and living standards for the poorest and most marginalized populations that are susceptible. Adapting successful models from other parts of Latin America—such as Colombia's focus on sustainable resource management and Costa Rica's pioneering strategy for biodiversity—could also help diversify the economies of the region.

More broadly, research could be targeted toward increasing economic growth while also mitigating the alarming effects of climate change. Central America and the Caribbean face frequent and intense storms and extreme weather events. The Dry Corridor, stretching across El Salvador, Guatemala, Honduras, and Nicaragua, suffers from prolonged droughts punctuated by severe rainfalls, exacerbating water scarcity and threatening agricultural productivity. Climate change will worsen these challenges, which already affect millions of people, causing damage to crops and playing a role in migration toward the Global North.

By supporting research into drought-resistant crops and clean energy solutions, STI can contribute to food security, mitigate the impact of climate change on agriculture, and reduce reliance on fossil fuels. Targeted programs that simultaneously address multiple problems, such as increasing economic growth rates while also enhancing climate resilience, can improve people's lives and contribute to the stability of the region.

Similarly, science diplomacy focused on efforts related to the UN Sustainable Development Goals (SDGs) in the region is another promising avenue. By aligning research priorities with SDGs, Central American policymakers can foster international collaboration, help to attract funding and contribute to global knowledge while simultaneously addressing local needs. Aligning national and regional priorities via the SDGs enables collaborations around shared values and outcomes, removing some of the overt political implications of shared work. More generally, engaging around the SDGs empowers countries in Central America and the Caribbean to contribute to and benefit from the global pool of knowledge around the SDGs.

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We have watched as dysfunctional and repressive governments have cost the countries of Central America their academics and researchers**.** This outmigration only serves to isolate these countries and effectively impedes regional collaboration on shared challenges, which is a loss for the global science community. International organizations must articulate an intentional strategy for engagement in the region that supports researchers and local institutions to build and protect capacity for research and collaboration.

Drawing on lessons from Ukraine, researchers and research institutions in Central America and the Caribbean need support from the international scientific community. A critical

component will be engaging with the region's scientific diaspora to overcome the isolation caused by political disruptions and geographic dislocations. Scientific advocacy organizations, groups of scientists, and international organizations such as UNESCO should establish consistent channels of communication with these displaced scientists. Online platforms like listservs and virtual discussion groups, as well as in-person professional workshops, could be used to build community among researchers across the Central American diaspora and within national groups, and could be the foundation for future networking or engagement with the region. Relatedly, universities within the region should be supported to implement programs that connect local students with global issues to prevent brain drain and engage the scientific diaspora through virtual collaborations. These approaches can help retain talent and bolster local research capacities.

US academic institutions can help catalyze a regional scientific revival by developing research collaborations that integrate North American universities, leading Latin American research centers, and Central American institutions. These collaborations should focus on critical domains such as climate change adaptation, sustainable agriculture, and biomedical and infectious disease research, while developing adaptive administrative frameworks that accommodate diverse institutional structures. It will be important for funders to realize that they are building human and physical infrastructure for future collaborations and that supporting fledgling projects is essential.

International funders such as the US Agency for International Development, the Inter-American Development Bank, the European Union, and others could make strategic use of the SDGs, utilizing science diplomacy to forge meaningful research partnerships to address regional challenges. Critical to this approach is creating a robust dialogue between scientists, policymakers, and industry leaders. Science advisory boards within governmental institutions can provide direct research insights, while interdisciplinary policy forums will enable knowledge exchange and comprehensive science communication programs to translate technical research into actionable policy recommendations.

Poverty, war, and dysfunctional government have been part of the Central American and Caribbean region's scientific landscape for decades, causing successive "brain drains" as one generation of skilled workers after another has migrated—and efforts at development have moved in fits and starts. Today, the paradigm of the brain drain is no longer entirely negative; in fact, digital engagement has made diasporas a resource for their home countries. But in order to build on this resource and leverage the other natural and cultural resources of Central America and the Caribbean, outside organizations must be strategic and thoughtful about nurturing intellectual capital and creating pathways for meaningful research to build better lives for people in the region.

Jorge A. Huete-Perez *is a member of the Academy of Sciences of Nicaragua and a professor of biotechnology and science policy with the Science, Technology, and International Affairs Program at the School of Foreign Service, Georgetown University.* ***Douglas Massey*** *is a professor emeritus of Sociology and Public Affairs at The Princeton School of Public and International Affairs.* ***Anthony Clayton*** *is the Professor of Caribbean Sustainable Development at the University of the West Indies.*

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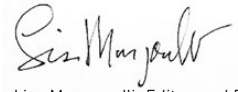

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