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"We have chosen to remain part of the developing world as international scientists, and we have committed to give back to our countries some of what we were able to obtain in the 'North.'"

Science in the Developing World: Building Partnerships for the Future

BY JOSEFINA COLOMA and EVA HARRIS
DIVISION OF INFECTIOUS DISEASES
SCHOOL OF PUBLIC HEALTH
UNIVERSITY OF CALIFORNIA, BERKELEY, AND
SUSTAINABLE SCIENCES INSTITUTE
SAN FRANCISCO, CALIFORNIA
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What might a Costa Rican astronaut, an Ecuadorian molecular immunologist, and an Argentine structural chemist--all of them renowned in their fields--have in common? Well, despite their countries of birth, each of them now lives and works in the United States. We encounter this situation often: experts in different scientific fields who came to the United States or Europe to further their careers and now have little or no contact with their professional counterparts in their countries of origin. We are among them, but we have chosen to remain part of the developing world as international scientists, and we have committed to give back to our countries some of what we were able to obtain in the North. The focus of this article is Latin America, because that is where we have the most experience, but the issues raised are common to most developing countries.

The scientific endeavor in developing countries is very different from scientific research in the first world. Often, due to ever-shrinking economies and national budgets, basic research is not an option. Investigators face tremendous obstacles: limited financial, material, and human resources; scientific isolation; and lack of advanced careers and degrees, institutional support, technical training, research tools, and up-to-date scientific information.

Ironically, this limited access to resources often has a positive outcome in the formation

of a scientist, forcing investigators to be more creative. We can't forget that the most popular verb in some countries is *resolver*, "to resolve." We have learned to improvise and to use common materials and simple tools instead of more sophisticated ones, finding solutions in everyday things and adapting protocols to convert them into low-cost approaches that are useful everywhere (1). Recycling and re-use of laboratory materials, adaptation of equipment, and substitution of reagents are ever-present features in laboratories in developing countries.

The progress of science in the developing world has attained distinct levels in different countries. In Latin America, despite their proximity and similar cultures, individual countries have (or haven't) independently developed their scientific capacity. None of them is classified as a "scientific developed country"; but Cuba and Brazil are considered "scientifically proficient," whereas Argentina, Chile, Mexico, Colombia, Venezuela, Costa Rica, and Bolivia are regarded as "scientifically developing." Sadly, all others are defined as "scientifically lagging countries" (2).

One way to strengthen the scientific base in developing countries is through collaborations and partnerships. Our approach to collaborations with Latin American scientists is such that the main goal is to develop scientific capacity, while performing top-level investigation of local relevance that leads to high-quality publications. We envision it as a bottom-up process; producing gains first at the level of individual scientists and small groups and later expanding to organizations and government agencies.

Through our academic careers and our nonprofit organization, the Sustainable Sciences Institute (SSI), we have embarked on a long-term project, which originated 15 years ago when, through our independent work in several Latin American countries, we realized that the vast resources devoted to basic and applied science in the United States and Europe had little impact on advancing standards of health in the rest of the world. In 1988, one of us (Harris) began a program of molecular biology technology transfer applied to infectious diseases and met the other (Coloma) while presenting this work at a conference in Cuba. Coloma, a native of Ecuador pursuing her Ph.D. at the University of California, Los Angeles, felt the need to do the same in her country. Together, we organized a series of hands-on molecular diagnostics workshops in Ecuador. The program grew, spread to other countries in the region, and gained visibility in the developed world as well through numerous publications and presentations (3). Years later, the work was recognized by a MacArthur Genius Award to Harris, which was used to found SSI in 1998. Peñaranda, with a long career in academia and at the Centers for Disease Control and Prevention in Atlanta, Georgia, joined SSI in 2000 as scientific director.



Eva Harris (left) and Josefina Coloma (right) with SSI's scientific director, Maria Elena Peñaranda.

As part of our program we have taught hands-on workshops focused on diagnosis, epidemiology, and control of infectious diseases to more than 500 public health

researchers and educators in 20 developing countries. We also have helped develop and fund several locally relevant scientific projects and have supplied much-needed equipment, supplies, networking, and technical advice to numerous investigators (4). As a result of these efforts, we have fostered and maintained collaborations and partnerships with several government and academic groups throughout Latin America, and now we are expanding the program into Africa. Because of these and similar efforts, world-class expertise can be found in individuals or small pockets of excellence in the so-called scientifically lagging countries, such as the national virology laboratory in Nicaragua and a university research team in Paraguay.

However, the road has not been easy. Institutions in Latin America are plagued by hierarchical relationships that are very hard to breach. Many young investigators are frustrated in their inability to advance their careers because they and their knowledge of modern concepts and techniques are perceived as threatening to existing power structures. Scarce resources frequently exacerbate political and personal rivalries. It often takes years of working and building trust for true and productive partnerships to develop.

It is evident that the Internet has had a transformative effect by reducing the scientific isolation of scientists in developing countries, by facilitating communication, and by becoming a virtual library. However, subscription prices for scientific publications are still prohibitive for many institutions and scientists. A simple way to increase the knowledge base in these places is to subsidize these subscriptions. There are many other ways one can initiate activities that will catalyze collaborations with the "South." For example, as graduate students, we collected tens of thousands of dollars of equipment and supplies from our universities and local biotechnology companies and channeled them to developing-country laboratories. Graduate students or technicians can volunteer to teach in short workshops or give conferences while traveling in new places. Mentoring of young investigators at the graduate or postgraduate level can be the best means to start a collaboration, but it is essential to support them as they get reestablished in their countries and enter the workforce. Reentry grants and a long-term commitment to provide scientific support are critical elements to encourage scientists to return and remain in their countries.

Lastly, as scientists in the biomedical field, we are convinced that for a sustainable, well-prioritized approach to research, the scientific endeavor needs to serve society and be oriented toward the public good. We strongly believe that building scientific and technical capacity in developing countries will help local scientists define and choose their own development options, acquire indigenous capacity to create human capital and appropriate institutions for development, and, finally, have a more equitable voice in international affairs.

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