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NEWSLETTER

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The challenges of COVID-19

The South's role in the global pandemic

KFAS

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▲ Top: Hayat Sindi, the Senior Advisor to His Excellency Bandar M.H. Hajjar, President of the Islamic Development Bank (IsDB). Above: Africa faces numerous pandemic-related challenges. (Photo: KB Mpofu-ILO)

Cover picture: A woman in Harare, Zimbabwe, distributes detergent and hand-sanitising gel to protect against COVID-19. (Photo: KB Mpofu-ILO)

▼ TWAS issued a statement urging the inclusion of developing countries everywhere in efforts to control COVID-19. (Photo: WHO/Kisimir)

EDITORIAL

A HEALTH CRISIS IS TRANSFORMING THE WORLD

▲ Romain Murenzi, TWAS Executive Director

If there ever was a clear and consequential example of a global challenge, one that has the potential to directly influence the daily lives of everyone in the world, it is COVID-19.

Think of it this way: This pandemic has the potential to influence everyone's life, if not through direct danger of infection, then through the various ways society is reshaping itself to contain the disease. The pandemic and its economic ripple-effects are ever-present and immediate. Meanwhile, the response must also be global. To meet the challenge to contain and hopefully cure this disease, scientific institutions and the world's governments must collaborate, share knowledge, and commit resources to these goals.

And the developing world has a large part to play in this global effort. The virus can gain a foundation from which to spread anywhere, North or South. So we must work together now.

But we also must continue to work together in the future, to ensure that we are not caught flat footed a second time should another such pandemic emerge. This means that the developing world needs scientific expertise, medical infrastructure, and willing cooperation from other nations everywhere, from both developing and developed countries.

Therefore, in this edition of the TWAS Newsletter, we are highlighting perspectives on the pandemic from developing world scientists; our partners, our Fellows, and our Young Affiliates. In our lead feature, we tap into the expertise of Hayat Sindi, the Senior Advisor to His Excellency Bandar M.H. Hajjar, President of the Islamic Development Bank (IsDB). She reminds us that the lessons from COVID-19 must be made a permanent part of our scientific practices when it comes to collaboration, changes to work practices, and investment.

TWAS also released a powerful statement calling for stronger international collaboration, joint-action across the globe by leading scientists, efforts to improve healthcare systems in the global South, and an exchange of best practices in responding to COVID-19 from governments and science academies that have found success. We believe these priorities, at the heart of the Academy's mission to advance science and scientific institutions in the developing world, are too important to be forgotten.

The statement (found on Page 20) details these unignorable needs. It also urges a holistic approach to science, including human, animal and environmental health. We additionally call for an emphasis on science capacity, because developing nations everywhere need workers and experts that can manage medical and epidemiological data to inform policy advice. Further, we note that the Academy has demonstrated the effectiveness of South-South cooperation, with hundreds of PhDs among developing world scientists now to its credit.

Some day, the pandemic will be seen not only as a crisis, but as a historical event that transformed the way the world works. It is up to scientists, their allies, and indeed everyone with a stake in the future to make sure that this transformation is positive. With a spirit of science that is open, collaborative and humane, we can all take part in making that promise a reality.

Romain Murenzi,
TWAS Executive Director

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IN THE NEWS

Plastic pollution may worsen antibiotic resistance

Each year, millions of tonnes of plastic enter our oceans. Many of the negative effects of all this plastic are well known: it poisons fish, entangles sea turtles, and has been implicated in the deaths of sperm whales.

New research raises yet another concern: marine plastics may be spreading antibiotic resistance. A recent study found that almost all of the marine plastics studied harbored antibiotic-resistant bacteria.

Hakai Magazine:
www.bit.do/PlasticSpread

Madagascar's mysterious cats identified

Madagascar's elusive "forest cats" are twice the size of house cats and have a voracious appetite for the island's native birds, snakes, rodents, and lemurs. But cats didn't evolve on the island, and the history of these felines has long been a mystery.

Now, researchers have revealed the cats' origin story: They descend from domestic felines that hopped off Arabian trading ships perhaps more than 1000 years ago. The new paper may offer a first step toward limiting the toll these relentless hunters take on the island's rich biodiversity.

Science Magazine:
www.bit.do/MadagascarCats

Robots deployed in coronavirus fight

Robotics are being used to sanitise hospitals, some of which use ultraviolet to clean, in a bid to minimise health workers' exposure to the coronavirus.

In China, ground zero of the viral outbreak, robots are being used in hospitals to deliver food and medication and take patients' temperatures. Drones are deployed to transport supplies, spray disinfectants and do thermal imaging. Police officers were also recently issued smart helmets with facial recognition technology and an infrared camera that automatically detects body temperature.

SciDev.Net:
www.bit.do/COVIDrobots

Block on GM rice has costs

Stifling international regulations have been blamed for delaying the approval of a food that could have helped save millions of lives this century. The claim is made in a new investigation of the controversy surrounding the development of Golden Rice by a team of international scientists.

Golden Rice is a form of normal white rice that has been genetically modified to provide vitamin A to counter blindness and other diseases in children in the developing world. It was developed two decades ago but is still struggling to gain approval in most nations.

The Guardian:
www.bit.do/GMblock

Attacks on scholars worldwide raise concern

Attacks on higher-education communities have become a troubling global phenomenon that shows no sign of abating, according to a report. The annual analysis — compiled by Scholars at Risk, an international advocacy network based at New York University — tracks incidents that violate the academic freedom or human rights of scholars or students. This year's report documented 324 verified attacks in 56 countries from September 2018 to the end of August 2019.

Nature:
www.bit.do/AttacksScholars

Q&A HAYAT SINDI: CREATIVE MINDS DON'T KNOW BARRIERS

by **Cristina Serra**

Investing in education, research and innovative ideas should become the norm after COVID-19, urged Hayat Sindi, the G20 Global Ambassador for the Health and Development Partnership.

Each crisis reveals new paths to development, and COVID-19 is no exception. After the initial confusion and emergency measures, countries worldwide began reorganizing their social systems, education structures and everyday lives. While this unexpected pandemic was unfolding, the international community agreed on the importance of sharing scientific knowledge and working together to achieve common benefits. Now Open Science, innovation and interdisciplinary collaborations are rapidly becoming key factors that will influence global decisions.

Hayat Sindi, a Saudi Arabian medical scientist, is an influential voice from the Arab world whose opinions are internationally valued. She was the first Saudi woman to be accepted at Cambridge University where she earned a PhD from Newnham College (2001) and was a visiting scholar at Harvard University. Through the years, she gained international recognition: in 2012, she was appointed by UNESCO Director General as a UNESCO Goodwill Ambassador, and in 2013 she was invited to serve in Saudi Arabia's Consultative Council. Today, she is Senior Advisor to His Excellency Bandar M.H. Hajjar, President of the Islamic Development Bank (IsDB), and the Global Ambassador for the Health and Development Partnership with the G20.

In this interview with TWAS staff writer Cristina Serra, Sindi offers her view on how to get the most out of the COVID-19 emergency. (The interview has been slightly edited for clarity).

We are living in unprecedented times due to the COVID-19 pandemic, which has taken many by surprise. After months of efforts, and with signs of improvement, there are still many questions with no answer. Is there a particular lesson we should learn from this experience?

● Nations worldwide had different priorities before COVID-19. Now the whole world is realizing that we need innovation, science and technology in order to survive. Now, more so than in

▶ Doctors discuss a COVID-19 patient in the intensive care unit of Eugenio Espejo Hospital in Ecuador. (Photo: Paul Salazar-World Bank)

the past, policymakers, governments and institutions are changing their priorities, rethinking how they can use creativity, science and technology to allow conversations, e-learning and all the other activities we need to carry out from home. Certainly, now more than ever we need innovation in every aspect of our lives: scientific, financial, social innovation. But, in parallel, we need to invest more in science and technology.

In the COVID-19 era the concept of Open Science has become central to many institutions, including UNESCO. Is Open Science a tool that could reinforce, or even create scientific cooperation at the global level?

● Absolutely! We all have different skills and cope with different situations in different ways, but we are all facing the same future. Therefore, we must realize that we can learn from each other, transfer knowledge and collaborate. Along with Open Science, we also need to consider Open Innovation, these concepts are similar, in that they both assume broad and active engagement and participation in the innovation process. Therefore, we need to couple Open Science and Open Innovation to catalyse actionable knowledge in service of the Sustainable Development

Goals (SDGs), with particular focus on the Least Developed Countries (LDCs).

Could you provide an example?

● At IsDB, we have established an amazing Transform Fund, and we have a category that looks to sponsor any innovative ideas that fall under capacity building. Through the lens of capacity building, in different countries, we look at educational systems, health, food security, renewable energy, water, infrastructure and industries. Through IsDB's partnership with TWAS, we also have a programme to help member countries build their capacity in research, expertise and training. At the moment we are working with two major labs from two different countries to join their workforces. We have identified two African research groups, from Nigeria and Benin, that work on the same topic, water and hygiene, and we are supporting and promoting their collaboration. Their labs have different capacities and resources, but from their collaboration we see there is technology transfer. Collaboration can influence and impact several areas — involving women, young entrepreneurs, professors, and cross any type of barrier, nationality, status and experience. They are now building something for local common benefits. Open Science has tremendous power: it encourages multidisciplinary and social innovation. In order for both Open Science and Open Innovation to be a beneficial tool, we need to have joint programmes between G20 countries and LDCs, to improve collaborative capacity building. Therefore, we must enhance the preconditions for Open Science and Open Innovation. This can be done through support for SDG4, which includes literacy and lifelong learning, as well as SDG9, which includes infrastructure for internet connectivity and access to digital networks. We should also ensure open access to existing scientific and technological information, and flexible intellectual property rules that do not discourage users from contributing to projects and that allow fair use of their services.

Where in particular does COVID-19 call for transnational cooperation?

● As you said, regarding this virus there are still many questions with no

◀ An Afghan volunteer health worker distributes free face masks in downtown Kabul, Afghanistan. (Photo: Jawad Jalali-Asian Development Bank)

> Collaboration can influence several areas — involving women, young entrepreneurs, professors, and cross any type of barrier, nationality, status and experience.
>
> *Hayat Sindi*

answer. To address this pandemic, we need to produce knowledge in immunisation, pharmacology, engineering, synthesis chemistry, physics, maths and drug design if we want to achieve clinical and health goals. All of that is a huge opportunity for Open Science and collaborative work. With TWAS, we are working in this direction. We have launched two joint programmes: one is a technology transfer grant aimed at receiving innovative proposals to tackle challenges posed by COVID-19; the other is a postdoctoral fellowship programme for building skills in sustainable science, based on attaining the 17 SDGs. Both these initiatives are targeted at promising young researchers from IsDB Member Countries, including from the 21 IsDB Least Developed Member Countries (LDMCs).

Do you spot any potential barriers — political instability, lack of access to computational resources, lack of skills and capacities — that could prevent some countries, especially from the global South, to benefit from the opportunities disclosed by Open Science?

● I think that nothing can stop us, if we give priority to innovative ideas, empower young entrepreneurs and offer them our support so that they can come up with new ideas. Every year, I receive a number of amazing ideas and scientific proposals from all over the world (more than 5,000 from the developing world). This shows that in terms of creativity and innovation, smart, creative minds have no barriers. It does not matter if you live in a country with poor resources. Developing countries are dynamic. They want to establish partnerships, see their neighbours, have trade, build health and education. At the global level, as COVID-19 is teaching us, there should be no more barriers. We are all affected by this virus, in all areas of the world.

But funding is always of the essence. Without funds there is no innovation.

● At IsDB, as I said, we have established a Transform Fund worth USD500 million that we are using to give seed money to help great ideas flourish. The Fund was launched in 2018 to fuel new ideas and the

scaling up of innovations, to help entrepreneurs, start-ups, small and medium-sized enterprises (SMEs) and institutions that need initial funding and growth capital. This year, through the third call since its inception, the Fund will financially support projects that help curb the spread of COVID-19, minimising the socio-economic impact of the pandemic.

We asked applicants to come up with ideas on diagnostics such as low-cost rapid tests and screening methods, scaling up, and prevention. We also requested ideas on the application of advanced technology such as Internet of Things, Big Data, blockchain and Artificial Intelligence, and on capacity building interventions targeted at improving the operations of health care providers in epidemiology and infection control.

We received several amazing ideas from all over the world. We received proposals from last year's winners, who came up with ideas that changed their previous inventions, adapting quickly to COVID-19, according to three Rs principles: "Respond, Restore, Restart". It's amazing to see how people are thinking and challenging their existing ideas.

You are an advocate of women in science. Do you think that COVID-19 will promote a more prominent presence of women on the scientific stage?

● Yes, I'm absolutely positive about this. Women have a different approach to science. They are concrete, with a strong sense for operation and for finding solutions in the caregiving sector. I recently did a small survey among my scientist friends. I asked, if they had a robot or a smart AI device, what they would use it for? The answers were interesting. The majority of men said they would use it for fieldwork in war zones, in place of soldiers. Women said they would use it to test for Ebola. Both want to save lives, but women were directed towards direct healthcare.

Through the UN SDGs, we offer women amazing opportunities to be engineers, scientists and chemists; to get out of their comfort zone and have a wider purpose, to express their creativity. We should allow women to explore their capacities and become experts in their fields. Of course, we want to walk hand in hand with men. We need both genders. Men and women complement each other.

Big Data, Open Access, connectivity: in general, how far are the developing countries from full participation in these opportunities?

● What I am currently witnessing is that many international companies are providing developing countries with data and open access to information. And international agencies are acknowledging the importance of Open Science because of the situation I mentioned before. We are all affected by events, we cannot avoid the domino effect, and if we experience the same situation, we need to have the same resources to face it.

> "I see lots of energy in young people. They are educated, they want to make a difference in their lives."
>
> *Hayat Sindi*

I see lots of energy in young people. They are educated, they want to make a difference in their lives and through the IsDB scholarship programme that

▶ Healthcare workers at Thailand's Bamrasnaradura Infectious Disease Institute. (Photo: U.N. Women)

▲ The General Hospital of the South of Quito, of the Ecuadorian Social Security Institute, implemented s triage area in a parking lot. (Photo: Paul Salazar-World Bank)

has been running over the past few years (sponsoring more than 16,000 students). We can see how the big companies now want to cooperate with IsDB.

COVID-19 has not had as much of an impact on the Arab countries as it did on the rest of the world. Did you notice any major changes, different attitudes in the society, in the way people plan for their future, that could be attributed to COVID-19?

● I do not have the view of COVID-19's full impact, but I can say that observing the Middle East, China, Europe, Italy and France, we have learned from them, taking quick action to contain the spread, with a sound front line focused on screening and testing, and in practicing social distancing. In Saudi Arabia, where I am, we experienced a very good and intense response, as we were asked to stay home. We have been provided with applications to get groceries and medication. We have been encouraged to undertake screening, and we have managed to isolate people. People themselves, from all parts of society, have answered in a very responsible way.

Hence we may say there is an optimistic feeling?

● Yes, even in the month of Ramadan (from 20 April to 23 May). It was not easy for us not to be able to go to the mosque and pray together, but we understood the health risks, so we stayed at home, enjoyed the family, and asked the Creator for help. We understood that public health and security are more important than our personal needs. We all know we are close to the end of the tunnel, and keep thinking about the future, invest in the future, in research, in providing the youth with the devices they need to continue their education. Education never stops. Now more than ever. ◘

COVID-19 IN AFRICA

TWAS Fellows who are experts in contagious diseases say Africa's pandemic-related challenges include coordination, capacity and public hygiene.

by **Sean Treacy**

The novel coronavirus has drawn the world's attention, causing alarm as countries scramble to prepare for the new pandemic, and save as many lives as they can.

In Africa, resources for science and health management are often scarce and populations are simultaneously fighting other dangerous diseases. African countries face challenges both familiar and unique, say two TWAS Fellows on the continent with lengthy experience in infectious disease control.

Shabir Madhi, a 2018 TWAS Fellow in South Africa, runs a research unit investigating COVID-19 and is currently surveilling the progress of the disease in high-density regions of his country. The former director of the National Institute for Communicable Disease in the country, he is continuing to provide advice to South African health ministries. Vincent Titanji, a 2004 TWAS Fellow in Cameroon is an expert in infectious diseases and the former vice-chancellor and coordinator of the biotechnology unit at University of Buea in Cameroon. He also provides science advice to his government and is a member of a team drafting a statement from the Cameroon Academy of Sciences on the pandemic for his country.

VULNERABLE POPULATIONS

Madhi said the challenges they face are serious and many, and he gave several examples. Testing for the coronavirus began only with the private sector, which provides care for 15-20% of the population. The remaining majority of the population has little access to testing, and people generally live close together, making social distancing difficult and making it less likely the lockdown will be able to interrupt the spread of the virus.

Perhaps the most alarming circumstance in South Africa is that, while its elderly population is small, with only 2-to-3% of its citizens over 65, there are a very large number of immunocompromised citizens because of the prevalence of HIV and tuberculosis.

"The big unknown in South Africa is how individuals with HIV and TB are going to be affected," said Madhi. "The population of South Africa is 58 million, of whom 7 million are infected with HIV, and right now we don't know what the impact of infection would be on HIV-infected individuals."

Even when on antiretroviral therapy, Madhi noted, HIV patients are generally about 40% more likely to die of seasonal influenza than the general population, and it follows logically that they may be especially vulnerable to COVID-19 as well.

"We've got data from other pathogens as well, even with the presence of antiretrovirals people living with HIV still have high susceptible morbidity and mortality for other infectious causes," he added. "That certainly is a big concern."

A QUESTION OF PREPAREDNESS, AND OF CLEAN WATER

Titanji noted that because of the recent Ebola epidemic that struck other countries in Cameroon's region in 2014, local people were already fairly psychologically primed for the social distancing measures that will be necessary to contain COVID-19 cases.

"Already, to fight Ebola there was this education that people should avoid touching corpses and people who are infected, so this idea of isolation was already there in the population. So people, they are prepared,"

▼ Health workers deal with the COVID-19 pandemic in Madagascar. (Photo: Henitsoa Rafalia-World Bank)

Titanji said. "Also circulation of information has improved as the technology has improved."

Yet Cameroon faces serious challenges that other nations share. In many towns, the water supply is tainted by pollution, and so washing one's hands to prevent a coronavirus infection could lead to getting a completely different kind of infection.

"It's no secret that potable water supply is a challenge," said Titanji. "There are cities in which water is rationed. In the countryside, where people get their water from springs and wells, that may be less of a challenge. But again the population in the countryside is not so dense. It's not the same problem as in the cities."

A lack of clean water for handwashing is an issue facing many other developing nations. South Africa faces this dilemma too, Madhi said. Water is non-potable in much of the country, and the price to buy that amount of water from shops for handwashing is unrealistic for most people. Meanwhile, people also need food and other supplies.

"In absence of social support, which would mean people being provided food parcels almost on a daily basis, the reality for most people in these kinds of countries is that they live from hand to mouth," Madhi said.

▲ Top: Shabir Madhi, a 2018 TWAS Fellow in South Africa. Above: Vincent Titanji, a 2004 TWAS Fellow in Cameroon.

> In absence of social support, which would mean people being provided food parcels almost on a daily basis, the reality for most people in these kinds of countries is that they live from hand to mouth.
>
> *TWAS Fellow Shabir Madhi*

CHALLENGES IN CAPACITY AND EDUCATION

Titanji observed that the reaction in Cameroon needs better structuring as well. "The way the Cameroonian health system is organized, it's organized around public hospitals and health centres," he said. "The question of capacity, that is how many beds, how many isolation units do we have … I think would be a major challege."

International organizations play an important role in providing assistance in the crisis. Cameroon, Titanji said, is currently working closely with the World Health Organization, for example. And help is needed in particular in education, which Titanji called "one of the pillars of controlling and coping with epidemics like this one."

Madhi noted that it's important for international organizations to keep improving the technology and science capacity in these countries, which he thinks TWAS can play an important role in. Scientists from countries that have experienced the outbreak, and those bracing for the worst of it still, should work together to identify the most important research questions to contain the virus worldwide.

"Fostering those sorts of community sharing practices would be highly useful," Madhi said. "Networking individuals, sharing expertise, and sharing methods for example; those would be useful initiatives." ◘

NEVER LOWERING THE GUARD

Viruses and parasites can teach us much, and TWAS Affiliates say that scientists must keep working even when no pandemics affect the world.

by **Cristina Serra**

The coronavirus pandemic has left us with many unanswered questions. But many other viruses in the humans' history still resist our efforts to understand their behaviour. Some are highly infectious while others can be controlled easily by the immune system. Some are endemic, while others show fluctuations, playing havoc before disappearing with no clear reason.

Good examples are Dengue and Zika. The first is a constant presence in many countries causing almost 400 million infections per year, while Zika caused large outbreaks in 2015-16 then, all of a sudden, its infections started to decline. Why? Scientists do not know.

"Viruses are not living organisms in a strict sense. But when they hijack a cell's machinery they almost come to life. Some call them parasites, others claim they are just a bunch of proteins. Scientifically, they are interesting because they help scientists understand how cells work," says João Trindade Marques, a Brazilian virologist and a TWAS Young Affiliate (2013-2017), now an Alumnus.

Marques earned his PhD from the Federal University of Minas Gerais (2002) in Brazil, working on the characterization of wild poxviruses, DNA viruses that include the virus that causes smallpox, which was eradicated in 1980. Viruses from the same poxvirus family still intrigue scientists, since they are quite common and infect farm animals like cows.

This is why the world can't just respond to diseases like this when an emergency is currently happening, say Marques and another TWAS Young Affiliate. Research on infectious diseases and, in general, research on human immune responses to pathogens has to be ongoing at all times.

As Marques explains, all viruses manipulate their host and their evolutionary success is granted only when they interact with the host without killing it. In doing so, they ease further dissemination in the environment. This is why understanding their behaviour, especially in epidemic-free times, is very important.

VIRUSES CAN TEACH US

After working as a postdoc at the Cleveland Clinic (Ohio, US) and at Northwestern University (Illinois, US) Marques returned to Brazil, where he is now a professor in the department of biochemistry and immunology at the Federal University of Minas Gerais. In 2013, he was elected a TWAS Young Affiliate, which he saw as a great opportunity to ease collaborations across countries through contacts with TWAS scientists.

Today he studies human infections like Dengue and Zika, caused by mosquito borne viruses. He is investigating the immune responses in insect vectors such as the mosquito *Aedes aegypti*, which transmits the viruses to humans but do not fall ill.

Dengue plagues more than 100 countries in the world, causing 100 million severe infections and 22,000 deaths per year. Zika infections are particularly dangerous to pregnant women, and no vaccine is currently available, and it is still a

▲ A seller and customer wear masks during the COVID-19 pandemic in Kenya. (Photo: Sambrian Mbaabu-World Bank)

▼ Below: Josephine Ngunjiri, a 2017 TWAS Young Affiliate from Kenya. Bottom: João Trindade Marques, a Brazilian virologist and a TWAS Alumnus.

> Female genital schistosomiasis is a major source of social stigma in women, because it causes (partial or total) inability to conceive.
>
> *TWAS Affiliate Josephine Ngunjiri*

mystery why the virus disappears for years after sudden epidemics.

"We are trying to understand how mosquitoes can control Dengue and Zika viruses without dying. We have created mutant insects that fall ill and die from the infection and are elucidating the biochemical mechanisms behind antiviral resistance in mosquitoes," he explained.

FROM A DIFFERENT PERSPECTIVE

Many scientists think there could be a link between some recent pandemics and climate change, because with the increase in global temperature, many species are changing their habitats.

"Infection trends are rapidly mutating and even high altitude places are now susceptible to infectious diseases that were once confined to planes, where temperature once were higher: this is a matter of public health concern," explains Josephine Ngunjiri, a 2017 TWAS Young Affiliate from Kenya with a PhD in tropical and infectious diseases from the University of Nairobi.

Ngunjiri, currently a lecturer in biological sciences at the University of Embu, Kenya, specialises in applied parasitology and infectious diseases. Her qualifications put her in contact also with coronavirus research, as she is now collaborating with the Institute for Health Metrics and Evaluation to monitor the effect of social distancing measures enacted by Kenya's government on the burden of disease.

Ngunjiri's main interest, however, is in parasitic infections and their socio-economic impact, especially on children and women. She is studying schistosomiasis, a neglected tropical disease caused by flatworms called schistosomes, which is endemic in 74 resource-poor nations.

The parasites enter the human body through the skin once in contact with contaminated water, she explained, often invading the genital tract to form granulomas in the uterus, tubes, and ovaries causing infertility.

"Female genital schistosomiasis is a major source of social stigma in women, because it causes (partial or total) inability to conceive," Ngunjiri added. Once the husband finds out his spouse is not able to conceive, he rejects her or forces her in polygamous relationships getting married again.

Another focus of Ngunjiri's research is the impact of tungiasis on children aged 5-14. Tungiasis is a skin infestation caused by the female sand flea (*Tunga penetrans*) that embeds itself in the host's skin. School drop-outs caused by this infection is a major problem in endemic areas of Kenya, which adds to social stigma too.

In addition, the scientist recently started a collaboration with Kenya's department of neglected diseases, under its Ministry of Health, on schistosomiasis research projects to ensure the objectives are aligned, and to orient policy makers' decisions to control health disparities across the country. ◘

Read more:
www.twas.org/node/15035/

JOINT STRATEGIES DRIVE PROSPERITY

Scientific advice and science diplomacy initiatives may help solve global challenges, experts at an Islamic Development Bank-TWAS event suggest.

by **Cristina Serra**

The world is facing many urgent problems including pandemics, climate change and water availability. Why, then, should we worry about the fate of roughly 30,000 species at risk of extinction for whom the International Union for Conservation of Nature urges protection?

Not everybody knows that the extinction of living species, meaningless as it may appear, could trigger a ripple effect and alter the global food chain with an impact on world biodiversity.

"Wildlife is often something you watch on television. But the air we breathe, the water we drink and the food we eat all ultimately rely on biodiversity. Without bees to pollinate there would be no fruit or nuts," said Abdul Hamid Zakri, the former science adviser to the Prime Minister of Malaysia and one of the distinguished speakers at an Islamic Development Bank (IsDB)-TWAS workshop.

The workshop was organized as part of a new TWAS-IsDB high-level Science Diplomacy initiative, following an agreement endorsed by IsDB and TWAS in July 2018 aimed at advancing scientific research and capacity building activities in the IsDB member countries.

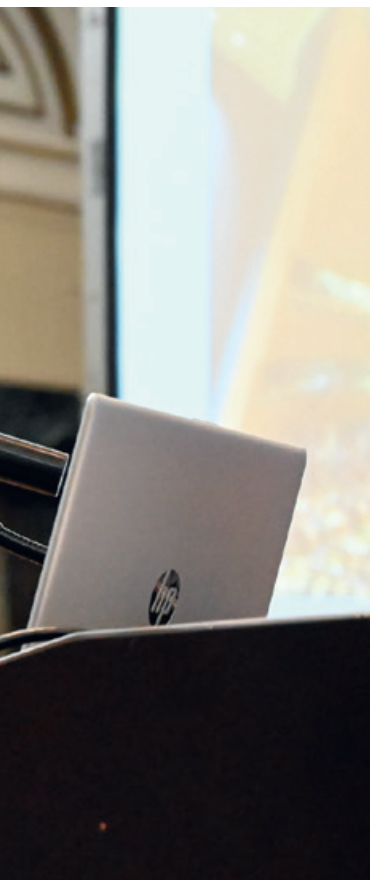
The event was held in Jeddah, Kingdom of Saudi Arabia, from 16 to 18 December 2019, with more than 25 high-level participants, including ministers of science, policymakers, scientists from IsDB member states and others.

Among the attendees were His Excellency the IsDB President, Bandar M.H. Hajjar; Hayat Sindi, Senior Advisor to the IsDB president; TWAS President Professor Mohamed Hassan from Sudan; and TWAS Executive Director Romain Murenzi from Rwanda, to name a few.

"The partnership with TWAS and the participation in the science diplomacy workshops will act as a driving force for IsDB, making its impact among member countries even more relevant," Hayat Sindi said, praising the initiative.

▼ TWAS Fellow Abdul Hamid Zakri, former science adviser to the Prime Minister of Malaysia, speaks at the event.

▲ His Excellency the IsDB President, Bandar M.H. Hajjar.



Hajjar, president of IsDB mentioned the achievements obtained by South Korea, Myanmar, Singapore and Rwanda through science diplomacy initiatives and high standards for quality of education. "Many other problems such as climate change cannot be solved by individual countries: they need cooperation," he urged.

A shared observation was that the new challenges we face at the global level and the changes in today's mass dynamics call for different approaches and strategies. Greater connectivity among peoples and nations could be both a problem and a solution.

"Science and technology are evolving rapidly and intertwine with economics and development," said Vaughan Turekian, the executive director of the Policy and Global Affairs Division at the US National Academies of Science, Engineering and Medicine. "Today, one of the key roles of science diplomacy is to fuel science interactions as a basis for addressing key global challenges ... In this respect, initiatives such as the one from IsDB and TWAS are pivotal in paving new avenues for the future."

In his keynote address, Murenzi reviewed the role that TWAS has played since its inception, in 1983, in bringing together the countries of the South via programmes designed to build scientific capacity and promote South-South collaboration in science. This, he said, can be considered as a prime example of science diplomacy.

And just because of its international and border-crossing capacity, science diplomacy and the scientific language can reach beyond political differences and help build confidence and understanding. Science, said Lassina Zerbo, the executive secretary of the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO), from Burkina Faso, brings countries together to address cross-border challenges, but science has to be ready for when the political moment is ripe.

In line with some of the U.N. Sustainable Development Goals, the workshop opened the door to the debate about food security. Moctar Toure, TWAS's vice president for Africa and a former executive secretary of the Special Programme for African Agricultural Research (SPAAR), hosted by the World Bank, focused on hidden hunger, a condition whereby people's caloric intake is adequate but lacks essential nutrients.

"IsDB and TWAS ... through their science diplomacy programmes could help devise a long-term agricultural model and help governments to refine their pro-poor economic and social policies," Toure said.

Chaudhary Fawad Hussain, the minister of science and technology from Pakistan, said digitalization will provide data from different sectors, which will enable the IsDB member countries to make good policies and control their economies.

> "Today, one of the key roles of science diplomacy is to fuel science interactions as a basis for addressing key global challenges ..."
>
> *Vaughan Turekian*

The workshop's conclusion went to Mohamed H.A. Hassan, TWAS's current president, who served 26 years as the Academy's executive director. Hassan, who received one of seven Science Forum South Africa Science Diplomacy Awards in 2016 for his unceasing efforts to foster international cooperation and friendship, noted that countries with no academy of science may see the value in establishing one, and suggested creating a virtual platform where the value of research and development, and of science and technology could be explained. ◘

BIG DATA TRAINING: A MUST

To exploit the potential of Big Data, partnerships must include young researchers and students – experts at an international forum in South Africa say.

by **Cristina Serra**

Huge amount of random, non-organized data – or big data – are produced at a fast pace every day by every sector of our complex world. They have an intrinsic value that needs to be disclosed. And skills to process big data can make the difference between developed and developing countries.

Finance, marketing, agriculture and healthcare: there is virtually no field untouched. Africa and the Global South in general need to move quickly ahead on the road to "datafication" – the transformation of aspects of life into data, and of these data into new information. But the South must also explore the profound consequences of this revolution, in terms of both its challenges and its opportunities.

"In the Global South, the potential of big data and analytics is great. Data is everywhere, all around us. This serves like a gold mine that has to be explored for meaningful knowledge discovery, which can uplift the South economically, socially, academically and in virtually all spheres," said Bolanle Ojokoh, an associate professor in the department of information systems of the Federal University of Technology in Akure, Nigeria. She is also a TWAS Young Affiliate.

Ojokoh, who is an executive board member of the TWAS Young Affiliates Network (TYAN), was among the participants at an international panel titled: "Big Data and Data Analytics for the Global South". The panel was organized by TWAS at the annual international forum - Science Forum South Africa (SFSA), which took place at the CSIR International Convention Centre in December 2019.

Other participants in the TWAS panel were: Victoria Nembaware, project coordinator at Sickle Africa Data Coordinating Center (SADaCC) of the University of Cape Town (UCT), South Africa; Anne Namuli, a software engineer with HiveOnline Aps limited; and Ina Smith, planning manager at the Academy of Science of South Africa (ASSAf).

TWAS has been taking part in global discussions on big data for several years, offering its voice in the international fora. In 2015, the International Council for Science (ICSU); the InterAcademy Partnership (IAP); the

◀ Bolanle Ojokoh, executive board member of the TWAS Young Affiliates Network (TYAN).

> Big data is an emerging field that we cannot ignore, due to the exponential growth in data creation and analytics.
>
> *Vittorio Venturi*

▲ Vittorio Venturi, scientific coordinator at ICGEB, Trieste (left) and Roseanne Diab, the current director of GenderInSITE.

International Social Science Council (ISSC); and TWAS developed an accord, "Open Data in a Big Data World", including a list of 12 principles to guide open access to big data.

Key technologies like machine learning, data mining and management are essential for big data analytics, noted Ojokoh. "But we need to solve some challenges posed by data growth: recruiting and retaining big data analytics, integrating disparate data sources, security, data validation, organizational resistance and governance." This is why, she pointed out, education on data science should start at the high school level.

"Big data is an emerging field that we cannot ignore, due to the exponential growth in data creation and analytics, and the need for interpretation of the data to allow useful and effective decision-making," observed TWAS panel attendee Vittorio Venturi, who is the scientific coordinator at the International Centre for Genetic Engineering and Biotechnology (ICGEB), headquartered in Trieste.

Victoria Precious Nembaware, Sickle Data Coordinating Center, UCT, addressed the use of big data on sickle cell disease (SCD), one of the most prevalent genetic conditions in sub-Saharan Africa. SCD has received little attention for research, she observed, however there is considerable data from health and research facilities in different African countries.

"To accelerate research on SCD in Africa, SADaCC as part of the SickleInAfrica consortium is supporting a multi-national registry," Nembaware said. Then she explained that to maximise the impact of big data being collected in the registry, SickleInAfrica is also supporting infrastructure development, training in big data analytics, and tackling ethical, legal and social implications associated with the SCD registry and big data.

Nembaware, who is passionate about mentoring of the next generation of African health researchers, has conducted numerous mobile health (mHealth) projects including development of the mGenAfrica project. "With my colleagues, we have developed a mobile phone app (mGenAfrica) in collaboration with various stakeholders, aimed primarily at promoting uptake of careers in genomics and related fields through facilitating engagement between researchers and high school learners."

TWAS's session was unique because it was targeted at a young audience, predominantly postgraduate students. Roseanne Diab, the former executive officer of ASSAf and the current director of GenderInSITE, a UNESCO programme unit hosted by TWAS, chaired the round table.

"It was encouraging to have an auditorium filled to capacity, excellent speakers and an audience eager to learn more about big data in the African context," said Diab, who is also active in the Organisation of Women Scientists for the Developing World and serves on the Gender Advisory Panel to TWAS.

"Work in these areas and sensitizing young researchers towards the great potential that these new tools offer can result in new employment opportunities as well as innovation in general," she concluded. ◘

Read more:
www.twas.org/node/14962/

FRESH FORCES FOR GLOBAL CHALLENGES

We should support young scientists for they may drive strategic changes at global level, experts at a COMSATS/TWAS workshop in Turkey say.

by **Cristina Serra**

Sooner or later, global challenges like energy supply, biodiversity protection and climate change will need concrete actions, rather than simple good will. Unfortunately, the achievement of these and other Sustainable Development Goals (SDGs) still appears far out of reach.

Is it because of a communication gap among decision makers, politicians, the research community and environmentalists? Or because of misinformation and distrust towards science? Whatever the reason, young scientists could make the difference and be a powerful resource to implement the sustainable goals if they receive adequate training, experts at a workshop in Turkey suggested.

"Challenges like climate change, health, education and workforce redundancy in the wake of the 4th Industrial Revolution need a collective response at all levels. This is not possible without effective partnerships and due involvement of international organisations," said Junaid Zaidi, the executive director of the high-level Commission on Science and Technology for countries of the South (COMSATS).

Zaidi, the founder rector of the COMSATS Institute of Information Technology (CIIT), Pakistan's first exclusive institute of information technology, offered his welcome address at the workshop "Sustainability, SDGs and Global Challenges" organized in Gebze, Turkey (3-5 December 2019), by COMSATS and TWAS.

The workshop was generously sponsored by the Swedish International Development Cooperation Agency (Sida) and hosted by TUBITAK, the Turkish Scientific and Technological Research Foundation that offered the venue. The goal of the event, which had 25 young scientists from S&T lagging countries in the audience, was to raise awareness about the U.N. SDGs, and to build scientific capacity and visionary perspective among young scientists and researchers in the Least Developed Countries (LDCs)

The workshop also provided the opportunity to celebrate Islamabad-based COMSATS' Centre for Climate and Sustainability (CCCS), a virtual and physical network of centres collecting 14 COMSATS member countries and centres of excellence.

▼ Participants at the COMSATS/TWAS workshop during a discussion.

"SDGs have been at the core of COMSATS' activities," recalled Zaidi. " We strongly believe that our collaboration with TWAS over the years has been immensely beneficial, and look forward to enhanced future collaboration in the areas of mutual interest."

Among the participants in the event were Orkun Hasekioğlu, the executive vice president at TUBITAK, who is responsible for research institutions and international relations; and Opha Pauline Dube, an associate professor in the Department of Environmental Science at the University of Botswana (UB), and a global leader in environmental change.

"We have entered a new epoch, the Anthropocene, where humans are a geological-magnitude force for planet Earth," observed Dube, who is also the founder and chair of the Botswana Global Environmental Change Committee at UB and a co-author in several Intergovernmental Panel on Climate Change (IPCC) assessment reports.

> We have the ability to make significant transformations for the better, and should not waste our chance.
>
> *Opha Pauline Dube, University of Botswana*

And humans, Dube noted, are triggering a dramatically fast rate of change in population growth, urbanization, and resource exploitation. Dams, for example, were built to benefit agriculture and economies – and this was true for a while. But in the long run they affect moisture availability, increase salinity of rivers and offer breeding grounds to malaria vectors. However, as she concluded, we have the ability to make significant transformations for the better, and should not waste our chance.

Humans are not the only species on the planet but they are certainly the most problematic, pointed out Boudjéma Samraoui, professor of biology at Badji Mokhtar University in Annaba, Algeria. Demographic problems, habitat fragmentation and alien species invading new habitats not in accordance with their needs may trigger epidemics and emerging diseases, or lead to sudden disappearances of species that are critical in the global food chain.

"No one is safe in front of this threat, and if we don't become aware of how quickly we are causing this biological annihilation – 100 times faster than in the past – we might get out of bed, one day, and find that we are the stars of the 6th mass extinction," Samraoui warned.

No doubt that scientifically and technologically lagging countries are more exposed than others to fast-paced changes. As Max Paoli, TWAS's programme coordinator observed, epidemics, poor food quality, lack of sanitation and education affect populations that tend to crowd in metropolitan areas, facing exponential growth trends, and problems.

"All is connected and our current unsustainable development may only exacerbate the situation. It's time that researchers - and particularly young researchers - raise their voice within their communities, universities and local institutions, to promote better sustainable plans," Paoli urged.

During presentations and breakout sessions the participants could engage with each other and come up with new ideas and strategies. This is how the workshop laid the ground for more active involvement of scientists in their home countries.

As Rebecca Nekaka, an assistant lecturer at Busitema University Faculty of Health Sciences in Uganda said: "Here we heard about the role of education for sustainable development, and I am very motivated to take what I have learned in my own career."

For Atunga Nyachieo, a senior research scientist and chief of research at the Institute of Primate Research in Kenya, the event taught him about the essential role of biodiversity conservation. "Climate change," he said "leads to loss of biodiversity, and without biodiversity there is no life." ■

Read more: www.twas.org/node/14886/

Statement on COVID-19

International collaboration in combating the pandemic is key, says the TWAS Council, and mitigating the disease's impacts depends on joint efforts inclusive of developing countries.

TWAS endorses the global call from UNESCO and from its close partner organization, the InterAcademy Partnership (IAP), recognizing the essential need for the global research community to act collectively and for open science to control the spread of the virus. TWAS also emphasizes that efforts to use scientific research to contain the virus must be inclusive of countries in the developing world, with an eye toward strengthening capacity for scientific research in the least-developed countries.

The rapid spread of the novel coronavirus and its resulting condition, COVID-19, has caught much of the world off-guard. The tragedy has yet to fully play out, but it is already clear that the crisis is thoroughly global in nature and that science is on the front lines in the fight against the virus. This includes medical professionals attempting to heal the sick at risk to their own health, public health officials tracking the virus and vigilantly urging such measures as social distancing to mitigate its spread, and researchers now engaged in the development of diagnostics, treatments and vaccines.

All of these will be especially important in the developing world, where resources are scarce, scientific infrastructure remains underdeveloped, and health care services are under-resourced. Science is needed in these countries, where many millions are vulnerable to the virus. Africa alone has an estimated 25.7 million citizens living with HIV as of 2018, who as immunocompromised persons could be highly threatened by the virus. Tuberculosis patients, of which there are millions in both Africa and South Asia, are also a high-risk population.

In fact, there are numerous issues common to the developing world that could worsen the impact of the virus. How can people without access to clean water be expected to wash their hands? How can people living in overcrowded, urban living situations expect to effectively practice social distancing? How will preventative measures impact developing nations that are most vulnerable to the effects of climate change or the economic consequences of a quarantine? These alarming and major challenges confront us today, and they will remain when the pandemic has ended unless the global community takes action.

So TWAS, as a leading organization for the development of science capacity in the developing world, not only endorses IAP's statement but holds that developing countries and especially the Least Developed Countries must receive strong support from the global health and scientific communities. We call for international collaboration, especially South-South collaboration between developing countries, both during the COVID-19 pandemic and in its aftermath, to provide developing nations with expertise and scientific knowledge to respond to this crisis and guard against similar future events.

In doing so, this call places emphasis on three key points:

1. There needs to be joint action by leading scientists, universities and research institutions worldwide to find appropriate cures for and vaccines against the virus.

This global pandemic is an "all hands on deck" moment. It will require the best minds in the scientific fields of contagious disease from every corner of the globe, working together with important international organizations such as the WHO, UNESCO research centres and Chairs to offer up their advice and services and bring the novel coronavirus under control.

Scientists, universities and research institutions in developing countries have specific experience and expertise in mitigating outbreaks of infectious diseases because of the prevalence of neglected tropical diseases in their home countries. They can provide valuable insights and indispensable contributions that must not be overlooked. So it is important that these international efforts include scientists from sub-Saharan Africa, from Latin America, from the Caribbean, from the Arab Region and from Central, South, and Southeast Asia. People all over the world will be deeply impacted by this pandemic, and institutions from all over the world must play a part in finding solutions.

2. There must be joint action by governments and the private sector to strengthen the health care systems in developing countries, especially in Africa, Latin America and the Caribbean, through South-South and North-South cooperation.

Science capacity is critical. There must be international collaboration to strengthen the health care systems in countries with poor facilities, including the development of well-equipped hospitals, and well-qualified doctors and nurses. Developing countries also need workers and experts who can collect and interpret epidemiological data, and provide policy advice based on those interpretations. And these researchers are needed everywhere, because a future outbreak could start anywhere in the world before it spirals out of control. Furthermore, developed countries must be aware of the risks to their own populations and health systems if the pandemic is not halted in developing countries.

Photo: KB Mpofu-ILO

Photo: KB Mpofu-ILO

TWAS, in its 37 years as an institution, has shown that South-South cooperation can work, having facilitated the PhD education of hundreds of scientists from the developing world. North-South cooperation also continues to be an important source of expertise for the developing world's next generation of scientists. Countries with strong institutions for science must not only continue this work, but take action to accelerate scientific research capacity in countries that have the least resources for research. By strengthening science capacity across all fields, basic and applied, countries can develop the institutional strength they need to support repeated generations of new scientists who can address whatever critical need arises.

3. National governments and Academies of Science in countries that have successfully responded to COVID-19 should exchange best practices in controlling the disease.

Numerous countries — notably including China, Republic of Korea, Japan and Singapore — have at the moment successfully brought COVID-19 under some measure of control. Meanwhile other countries that are currently battling the spread of the disease will likewise develop unique experience, and thus expertise, on the nature of the pandemic.

Information about which measures worked, which measures didn't, and which may have had adverse effects is expected to be freely available to countries that are just now beginning to fight the disease and implement quarantine measures. To date, some countries, like China, have actively shared valuable experiences and provided necessary support to many countries. We call upon more research institutions and policymakers in countries that are successful against COVID-19 to share best practices with countries still fighting the pandemic, and to include developing countries in opportunities to both acquire and share these "lessons learned". To facilitate this constructive spirit of sharing, openness and full transparency, the international scientific community should;

- continue to ensure that the tremendous power of science to shape the future of humanity is enshrined in 'scientific literacy' for

all humankind through reducing the knowledge gap, shared values and the spirit of 'Open Science'

- mobilize the policy makers, civil society and private sector and patent holders to further collaborate with scientists to share scientific information to meet societal needs through equal opportunities, and preserve our planet;
- embrace the principles of solidarity and knowledge sharing as aptly shown in the coronavirus pandemic.

Furthermore, to help control such diseases, the international community should also consider adopting a more holistic approach to human, animal and environmental health. There is a need to support more monitoring of potential emerging pathogens, especially in developing countries; to reduce the risk of such pathogens spilling over from wild animals by phasing out 'wet markets', and discouraging the exploitation of 'bushmeat'; and to continually collaborate to implement proven measures that would prevent any such outbreak from reaching epidemic or pandemic proportions.

The nature of pandemics means they can begin and gain a foothold in any country from where they would spread throughout the world. So, for the sake of all countries, no single nation can be excluded from this urgent and critical need for international collaboration.

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In conclusion, this pandemic highlights an important truth: In today's world, we are all connected, and thus we must all protect one another. It is more important than ever to view the benefits of science as a global common good and as human right available to all. Science isn't just a tool for discovery, but a means to help people, our lives, our families and our societies, as portrayed in the ongoing work of UNESCO towards an international Recommendation on Open Science. Through cooperation, mutual support, and a spirit of sharing and openness, we can prevail in containing COVID-19 together and build a world that is better prepared for such crises in the future.

With the endorsement of the members of the TWAS Council:

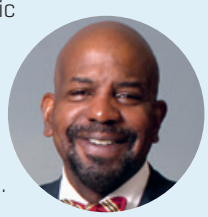
This statement was released by TWAS on 9 April, 2020, in response to the novel coronavirus pandemic. Statements from UNESCO and the InterAcademy Partnership (IAP), endorsed by TWAS as part of this statement, can be found online:
UNESCO: www.bit.do/UNESCOcovid
IAP: www.bit.do/IAPcovid

PEOPLE, PLACES & EVENTS

LAURENCIN NAMED UNESCO WINNER

Cato Laurencin, a professor of chemical and biomolecular engineering, materials science and engineering, and biomedical engineering at the University of Connecticut, has been awarded the prestigious 2019 UNESCO-Equatorial Guinea International Prize for Research in the Life Sciences.

The prize, in its 5th edition, rewards outstanding scientific research projects in the life sciences that have led to an improvement in the quality of human life.



Laurencin received the prize on 9 February, at the meeting of the African Union in Addis Ababa, Ethiopia. Laurencin, a 2006 TWAS Fellow, is the Albert and Wilda Van Dusen Distinguished Endowed Professor of orthopaedic surgery, and the chief executive officer of the Connecticut Convergence Institute for Translation in Regenerative Engineering.

His name is inseparable from the field of stem cell science, nanotechnology and biomaterials, and regenerative engineering, where he pioneered important innovations.

He has been named to America's Top Doctors for over 15 years, and in the last years he has received prestigious honours and awards for the contributions he gave to the advancement of science. Among them: the National Medal of Technology and Innovation from President Barack Obama; the Simon Ramo Founders award from the National Academy of Engineering; and the Walsh McDermott Medal from the National Academy of Medicine.

SUSANA ARRECHEA WINS ELSEVIER AWARD

Susana Arrechea, a 2017 TWAS research Grant winner and an affiliated professor with the School of Chemical Engineering, University of San Carlos, Guatemala, is among the winners of a 2020 OWSD-Elsevier Foundation Award.

Arrechea earned a PhD in nanoscience and nanotechnology (cum laude) from the University of Castilla-La Mancha, Spain, then she worked on renewable energy at the University of California-Berkeley, as a visiting researcher. Later she moved to the Center for Biotechnology Studies of the University of Valle de Guatemala.

Her research focuses on new industrial and environmental applications of nanoparticles, nanotubes, and graphene, with the aim to come up with more sustainable building materials, in water treatment, in solar devices and other solutions for renewable energy. She is giving an important contribution to science in Guatemala, with projects that cover improving solar electrification, connectivity, and digital and STEM literacy in schools in rural Guatemala.

In 2018, the magazine Estrategia y Negocios named Arrechea one of the 50 Defiant Woman in Central America.

FLOR PUJOL LECTURING ON COVID-19

Venezuelan virologist **Flor Pujol**, a 1997 and 1999 TWAS Research Grant recipient, explains some basic features of the Coronavirus in a very exhaustive and simple You Tube video. During the COVID-19 pandemic Pujol, who is a professor at the Venezuelan Institute for Scientific Research (IVIC) and head of the molecular virology laboratory, has engaged in several education and communication initiatives, to make sure that the right messages are delivered to the population.

Pujol is a regional leader on molecular epidemiology and evolution of hepatitis viruses, with unique studies on viruses infecting Amerindians from Venezuela.

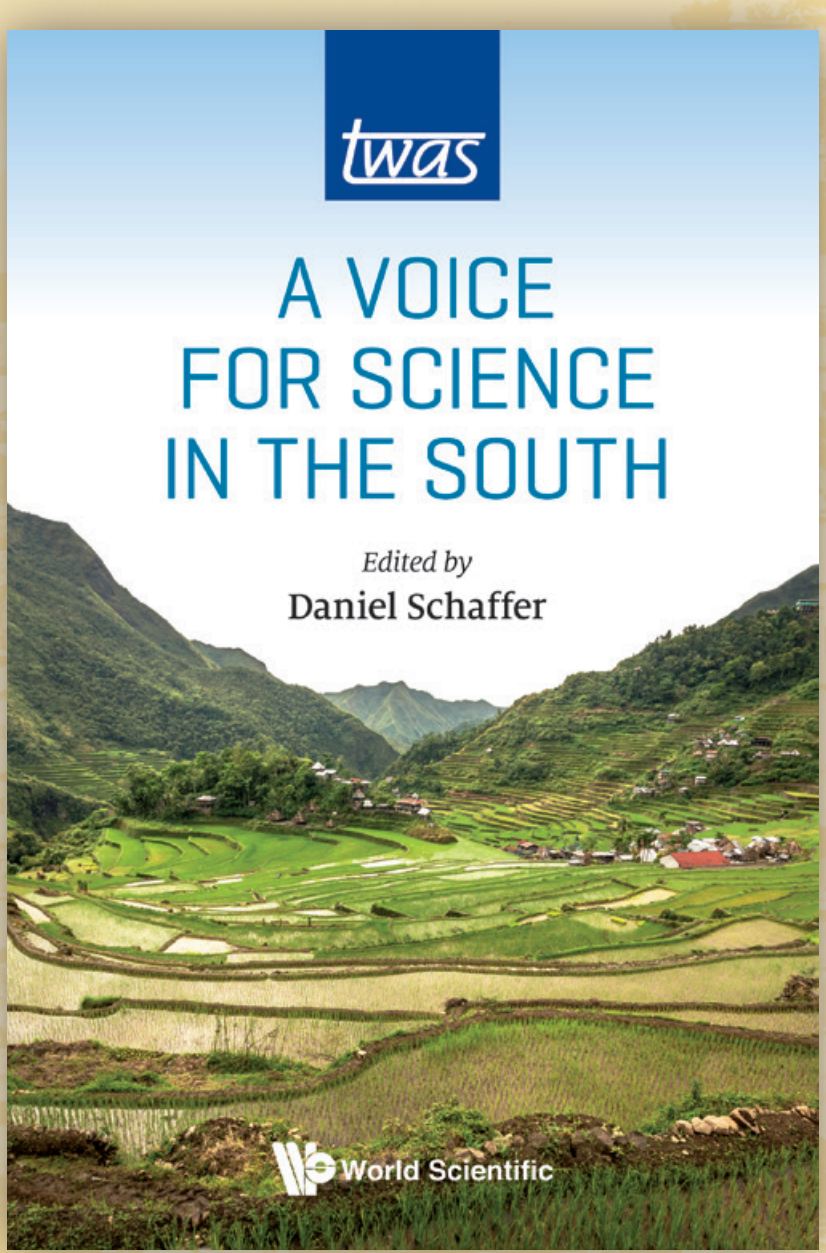
She was also involved in the first report of HIV-2 circulation in Venezuela, and the molecular description of a devastating epidemic of HIV-1 in Venezuela. A fellow of the Venezuelan Academia de Ciencias Físicas, Matemáticas y Naturales, and of the Latin American Academy of Sciences, she has also collaborated in the study of genetic diversity and molecular virology of dengue virus and gastroenteritis viruses.

BE A CONTRIBUTOR

Do you have news for People, Places & Events?

Please send an email to Cristina Serra (cserra@twas.org) with a brief explanation, link to more details, photos with credits and contact information.

In 11 inspiring essays, **TWAS leaders** detail the **Academy's triumphs and challenges** in advancing science for the developing world.



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United Nations Educational, Scientific and Cultural Organization

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The World Academy of Sciences for the advancement of science in developing countries – TWAS – works to support sustainable prosperity through research, education, policy and diplomacy.

TWAS was founded in 1983 by a distinguished group of scientists from the developing world, under the leadership of Abdus Salam, the Pakistani physicist and Nobel laureate. Today, TWAS has almost 1,300 elected Fellows from more than 100 countries; 14 of them are Nobel laureates. It is based in Trieste, Italy, on the campus of the **Abdus Salam International Centre for Theoretical Physics (ICTP)**.

Through more than three decades, the Academy's mission has remained consistent:

- Recognize, support and promote excellence in scientific research in the developing world;
- Respond to the needs of young scientists in countries that are lagging in science and technology;
- Promote South-South and South-North cooperation in science, technology and innovation;
- Encourage scientific and engineering research and sharing of experiences in solving major problems facing developing countries.

TWAS and its partners offer more than 460 fellowships per year to scientists in the developing world for PhD studies and post-doctoral research. TWAS prizes and awards are among the most prestigious given for scientific work in the developing world. The Academy distributes nearly USD1 million in research grants every year to individual scientists and research groups. It supports visiting scientists and provides funding for regional and international science meetings.

TWAS hosts and works in association with two allied organizations on the ICTP campus:

The Organization for Women in Science for the Developing World (OWSD). At its founding in 1989, OWSD was the first international forum uniting women scientists from the developing and developed worlds. Today, OWSD has more than 9,000 members. Their objective is to strengthen the role of women in the development process and promote their representation in scientific and technological leadership.

The InterAcademy Partnership (IAP) represents more than 140 national and regional science and medical academies worldwide. IAP provides high-quality analysis and advice on science, health and development to national and international policymakers and the public; supports programmes on scientific capacity-building, education and communication; leads efforts to expand international science cooperation; and promotes the involvement of women and young scientists in all its activities.

TWAS receives core funding from the Italian Ministry of Foreign Affairs and International Cooperation, and key programmatic funding from the Swedish International Development Cooperation Agency (Sida). It is a programme unit of UNESCO.

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