



A FOCUS ON SUSTAINABILITY

# SCIENCE FOR A SUSTAINABLE FUTURE

Education for these children in Banozai, Afghanistan, and hundreds of millions of others worldwide, is essential for a sustainable future. [Photo: Capt. John Severns, U.S. Air Force | Wikimedia Commons]



*How do we live sustainably? At the TWAS General Meeting, speakers sounded a common theme: sustainability requires an understanding that our challenges are interconnected – and that cooperation unlocks solutions.*

 by Edward W. Lempinen

In the common language of policy, journalism and marketing, sustainability often is cast as the answer to a specific challenge: a farming technique, a water conservation plan, technology to reduce air pollution. But the United Nation's Sustainable Development Goals reflect a deeper truth: As population grows, resources decline and the climate warms, sustainability is the only way to assure that healthy human communities can live in balance with a healthy planet.

The 17 goals – SDGs, for short – recognize that everything is connected: water, food and health; education, gender equality and poverty; climate change, biodiversity, governance and economic development. At its General Meeting in Vienna, Austria, TWAS convened an international conversation that explored the many dimensions of the SDGs and what it will take to achieve them by 2030.

The goals “embrace the need for a global transformation that leaves no one behind and gives every person a fair chance of leading a decent life,” said Naledi Pandor, South Africa's Minister of Science and Technology, at the annual Ministerial Session. “The SDGs will only succeed, however, if they are pursued through a deliberate strategy that is targeted at the most vulnerable and poor communities.”

Harald Mahrer, state secretary of Austria's Federal Ministry of Science, Research and Economy, struck a similar note. Under the UN initiative, he said, “every country is asked to contribute to the implementation of the SDGs by asking itself two questions: What can I do to improve the situation in my own country? And what can I do to improve the situation in countries which are not so well off?”

Mahrer and Pandor described specific

initiatives launched by their governments, but they also urged a comprehensive approach across disciplines and borders. It was a theme revisited throughout the 26th TWAS General Meeting, held from 18-21 November at the Austrian Academy of Sciences.

In September 2015, all 193 UN member states adopted Agenda 2030, with the SDGs at the heart of the plan. Comprising 17 goals and 169 related targets, Agenda 2030 may be the single most ambitious effort in history to improve life on Earth.

The TWAS presentations touched many of these themes – food security, urban design and energy, but also education, policy, funding and diplomacy, even the spiritual underpinnings of sustainability. The conclusion: Local work with a holistic orientation – and an emphasis on international cooperation – will be essential for success.

#### **A LEADING ROLE FOR SCIENCE**

Vaughan Turekian, the science adviser to the U.S. Secretary of State, identified several specific roles for scientists: They can identify challenges to sustainable development, conduct research to identify new solutions and build networks to gather data and other evidence needed to evaluate success.

In other presentations, leading researchers focused on specific research initiatives that are supporting progress on Agenda 2030.

**Food security:** Science and technology already have produced powerful new practices and technology to improve food production and nutrition, said TWAS Fellow Moctar Toure, vice president of the Senegalese National Academy of Sciences. But he posed a question:



How can they be rolled out and scaled up to have a global impact?

Quick action is essential, Toure said at a high-level symposium on food security. Despite significant progress in recent decades, about 795 million people worldwide still suffer from undernourishment. If world population approaches 10 billion by 2050, up from 7.4 billion today, that means another 2.6 billion people to feed. Crop production alone will have to rise by 70%, Toure said.

Some of the improved tools are familiar: crop breeding, soil and water management, and food storage. Others will seem futuristic: Real-time satellite monitoring of weather and

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*TWAS Fellow Hans J.A. van Ginkel*

planting conditions. High-powered data analysis to predict food needs and potential disasters. Even robots that can do agricultural work.

But the technology must be used in a way that “draws on ecological principles,” Toure wrote after the TWAS meeting. “The wide consensus is that an agricultural paradigm shift is required.”

**Urban design:** TWAS Fellow Hans J.A. van Ginkel is a social scientist focused on geography of cities. He previously served as undersecretary-general of the United Nations and rector of United Nations University in Tokyo and Utrecht University in the Netherlands. In a TWAS Medal lecture, van Ginkel agreed that the



world must prioritize agriculture while planning for massive urban migration.

Today in the developing world, some 2 billion people live in cities; by 2050, that will grow to 5 billion. The conventional view is that urbanisation is a problem, said van Ginkel.

In fact, he argued, “sustainable development can only be realised with a high degree of urbanisation.” Cities can reduce environmental stress: Wastewater treatment, solid waste management and food distribution are all easier in a city. The real challenges are population growth and wasteful behaviour; inefficient production and consumption styles; and the quality of urban development.

▼ From left: Naledi Pandor, South African minister of science and technology; Harald Mahrer, state secretary of Austria’s Federal Ministry of Science, Research and Economy; Vaughan Turekian, science adviser to the U.S. Secretary of State; TWAS Fellow Hans J.A. van Ginkel, former undersecretary-general of the United Nations; Mirabbos Hojamberdiev, senior researcher, Turin Polytechnic University in Uzbekistan.





▲ Kuala Lumpur, the capital of Malaysia, and its Petronas Twin Towers. [Photo: Zukiman Mohamad/Pexels]

► Asian farmers cultivating tea.

▼ TWAS Fellow Lu Yonglong, co-director of Research Center for Eco-Environmental Sciences at the Chinese Academy of Sciences.



“The challenge will be gigantic in developing countries,” he said.

A key to solving these challenges will be to design and manage rural and urban areas as integrated parts of a unified whole.

**Energy:** Innovation in fields such as chemistry and materials science can have profound applications for sustainable energy, said Mirabbos Hojamberdiev, a senior researcher in the department of natural and mathematic sciences at Turin Polytechnic University in Uzbekistan. Hojamberdiev won the 2015 Attatur-Rahman Prize for growing inorganic crystals that can split hydrogen from water molecules when hit with solar light.

Hydrogen has significant potential as a source of renewable energy. But hydrogen production is a complex, energy-intensive industrial process. Hojamberdiev’s research looks for a more efficient way. His procedure also has potential to purify polluted water.

“The whole system is in its infancy now,” he said. “Today we are working to make the

Sciences at the Chinese Academy of Sciences [CAS], defined the challenge clearly: How to make 17 SDGs and 169 targets measurable and comparable?

He offered a set of priorities: devise metrics for assessing progress; establish monitoring mechanisms to measure everything from water and energy use to human behaviour; enhance infrastructure for evaluating progress, including Earth observation and information technology; and develop standards and instrumentation to standardise and verify data.

### LEADERSHIP FROM POLICYMAKERS

In the quest to achieve Agenda 2030, few partnerships are more important than that between policymakers and scientists.

“Science, policy, politics and governance – those are very difficult to combine,” said TWAS Fellow Elisa Reis, a professor of political sociology at the Federal University of Rio de Janeiro in Brazil. “But unless you combine those four aspects, there won’t be a very



process even more efficient and feasible for scaling-up.”

**The measure of success:** The social sciences will have a crucial role in achieving Agenda 2030 – that was confirmed in a series of lectures in Vienna. Social sciences are critical for assessing human learning, or the psychology of consumption and conservation. They also will be critical in developing the ways to measure progress.

TWAS Fellow Lu Yonglong, co-director of Research Center for Eco-Environmental

big contribution of science in general to the Sustainable Development Goals.”

Mahrer, the state secretary for Austria’s Ministry of Science, Research and Economy, advocated an “ecosocial market economy”. Unlike the social market economic model that prevails in much of Europe, he said, the ecosocial market model seeks a positive impact in three dimensions: ecological, social and economic. It seeks a society that “is sustainable, keeping in mind generations to come.”

Mahrer outlined a number of specific



initiatives undertaken by his country. One, the Austrian Business Partnership Programme, links the private and public sectors in Austria and developing countries with a focus on fields such as energy, food processing and Internet technology.

Since 2004, 148 partnerships have been established, Mahrer reported, with funding of Euro27.4 million. Nearly 4,400 companies and 878,000 individuals have benefitted, and thousands of jobs have been created.

TWAS Fellow Cheng Jin-Pei, representing Chinese Minister of Science and Technology Wan Gang, said policy in his country has been shaped by multiple challenges: a large population, consumption of limited resources, ecological damage and social development that is lagging behind economic growth.

Cheng, director of the Center of Basic Molecular Science at Tsinghua University, said China is seeking answers in innovation driven by fundamental research carried out at a muscular network of national labs, state key labs and major scientific facilities. The results, he said, are evident in such areas as rice-breeding, where breakthrough hybrids set records for productivity, and photoelectric materials that “have laid a solid foundation for commercialization of renewables.”

### EDUCATION: ONE OF THE BEST INVESTMENTS?

In a symposium focused on Austrian science, TWAS Fellow Wolfgang Lutz made a powerful case that policymakers should invest in schools to propel sustainable development.

Every learning experience builds new synapses in the brain, Lutz explained. Improved cognitive skills help people to learn from past experience, change high-risk behaviour and better chart their futures.

Lutz’s research has shown that women with higher levels of education tend to have fewer children. By some analysis, he said, improved global education could reduce global population by more than 1 billion people by 2050. Plus, he has found that education is associated with better health and lower mortality.

Education also is linked to higher personal or household income, he said. Over time, that can drive a nation’s economic and human development.



▲ TWAS Fellow and sociologist Elisa Reis, top; TWAS Fellow and education researcher Wolfgang Lutz.

▼ Students in Samangan, Afghanistan. [Photo: USAID]

### WORKING ACROSS BORDERS

Achieving the goals of Agenda 2030 will require a third critical element: commitment to international cooperation. Research partnerships between developed and developing countries can bring benefits to all sides; for less-affluent countries, scientific partnerships are essential.

“North-South and South-South cooperation is vital to building science, technology and innovation capacity for sustainable development – there are deep reservoirs of talent to be tapped,” said Turekian, the science adviser to the U.S. secretary of state.

These partnerships can extend across sectors – governments, research centres, universities and private enterprise.

For Swedish policymakers, a priority is to support “research of high quality and of relevance to poverty reduction and sustainable development,” said Claire Lyngå, research adviser in the research cooperation unit at the Swedish International Development Cooperation Agency [Sida].

Sida pursues that goal, Lyngå said, through support for capacity-building research in developing countries and for research that





▲ It is essential to remember the needs of poor people even as we protect the environment, said South African legal and human rights activist Albert Louis Sachs. [Photo: Jonathan McIntosh | Wikimedia Commons | CC BY 2.0]



can drive innovation to address poverty and sustainable development.

Elsevier, a global leader in science, health and technology information, is committed to the goal of universal access to research publications in those fields. Michiel Kolman, senior vice president for global academic relations, said that Elsevier's commitment is reflected in Research4Life programme, which

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*Naledi Pandor, South African minister of science*

provides research papers for free or at low cost to institutions in the developing world.

For example, Kolman said, AGORA is the food security arm of Research4Life. It offers 28,000 agricultural books and journals from over 200 publishers to nearly 3,000 registered agricultural institutions. A quarter of the

publications in Research4Life are from Elsevier. “The field of food security research is high-quality and growing fast,” Kolman said, “and at Elsevier, we’ll do everything we can to foster growth in such a critical area of sustainability.”

Pandor, South Africa's science minister, said African countries are increasingly forming African partnerships. But she urged broader collaboration on research that requires “mega-science” facilities such as the Large Hadron Collider in Switzerland or the Square Kilometre Array in South Africa and Australia. These facilities are too big and complex for countries to build on their own, she said.

“Mega-science facilities, by bringing together scientists and experts from all over the world, play a valuable role in building international friendship, improving transnational communication and understanding, and reinforcing solidarity,” Pandor said. “They are an essential element in sustainable growth and development globally.”

#### THE HUMAN SPIRIT OF SUSTAINABILITY

Science, and scientists, also must maintain solidarity with the public, said Albert Louis Sachs, a former South African judge and a leading figure in its break from apartheid. Sachs was the winner of the Tang Foundation's 2014 Tang Prize in Rule of Law.

In a keynote address, he described a case he heard on the South African Constitutional Court: With winter rains coming, poor people living in shacks near Cape Town wanted to move to a site with better drainage. But government housing and sustainable development policies left them no suitable place to go.

The best practice of sustainable development “is not allowing one part of the equation to dominate and crush the other,” Sachs said. “It's finding a way of managing the tensions in a principled manner, that preserves our world and environment, but also looks to the sustainability not only of the Earth and its resources, but of the human beings on the Earth.

“Human sustainability has got to be part of it.” ■

*Cristina Serra and Sean Treacy  
contributed to this report*