Science will play a key role in realizing *Agenda 2030*

The* 2030 Agenda for Sustainable Development *was adopted on 25 September 2015 at the United Nations Summit on Sustainable Development. This new agenda comprises 17 agreed Sustainable Development Goals which replace the Millennium Development Goals adopted in 2000. What role will science[1] play in realizing Agenda 2030? What are the related challenges and opportunities? The following opinion piece[2] attempts to answer these questions.

There can be no sustainable development without science

Since governments have agreed that *Agenda 2030* should reflect an integrated vision of sustainable development, science cuts across virtually all 17 of the Sustainable Development Goals within this agenda. Provisions related to science are also to be found in the *Declaration*, in many of the targets accompanying the Sustainable Development Goals and in the *Means of Implementation*, including as regards national investment in science, technology and innovation, the promotion of basic science, science education and literacy, and, lastly, in the parts of *Agenda 2030* on monitoring and evaluation.

Science will be critical to meeting the challenge of sustainable development, as it lays the foundations for new approaches, solutions and technologies that enable us to identify, clarify and tackle local and global problems. Science provides answers that are testable and reproducible and, thus, provides the basis for informed decision-making and effective impact assessments. Both in its scope of study and its applications, science spans the understanding of natural processes and the human impact thereon, the organization of social systems, the contribution of science to health and well-being and to better subsistence and livelihood strategies, enabling us to meet the overriding goal of reducing poverty.

Faced with the challenge of climate change, science has already provided some solutions for a secure and sustainable energy supply; yet, there is room for further innovation, such as with regard to the deployment and storage of energy or energy efficiency. This is directly relevant to SDG 7 on affordable and clean energy and to SDG 13 on climate action.

The transition to sustainable development cannot rely solely on engineering or technological sciences, though. The social sciences and humanities play a vital role in the adoption of sustainable lifestyles. They also identify and analyse the underlying reasons behind decisions made at the personal, sectorial and societal levels, as reflected in SDG 12 on responsible consumption and production. They also offer a platform for critical discourse about societal concerns and aspirations and for discussion on the priorities and values that determine political processes, the focus of SDG 16 on peace, justice and strong institutions.

The greater accuracy of weather forecasts is one example of a scientific success story, with current five-day forecasts being about as reliable as 24-hour forecasts four decades ago. There is, nevertheless, still a need for longer forecasts and more regional applications, as well as the dissemination of forecasts of extreme weather events such as heavy rain, flash floods and storm surges, which particularly affect the most underdeveloped countries in Africa and Asia. This need relates to SDG 13 on climate action.

Although infectious diseases have been largely contained in recent decades by vaccination and antibiotics, the world still faces an inevitable rise in pathogenic resistance to antimicrobial drugs (WHO, 2014; NAS, 2013). In addition, new pathogens are emerging or mutating. New methods of treatment based on basic research into the origin of antibiotic resistance and applied research devoted to developing new antibiotics and alternatives are of critical importance to furthering human health and well-being. These issues are relevant to SDG 3 on good health and well-being.

Basic and applied science: two sides of the same coin

Basic science and applied science are two sides of the same coin, being interconnected and interdependent (ICSU, 2004). As Max Planck (1925)put it, 'Knowledge must precede application and the more detailed our knowledge […], the richer and more lasting will be the results we can draw from that knowledge' (ICSU, 2004). Basic research is driven by curiosity about the unknown, rather than being oriented towards any direct practical application. Basic science entails thinking out of the box; it leads to new knowledge and offers new approaches which, in turn, may lead to practical applications. This takes patience and time and, thus, constitutes a long-term investment but basic research is the prerequisite for any scientific breakthrough. In turn, new knowledge can lead to practical scientific applications and big leaps forward for humanity. Basic science and applied science thus complement each other in providing innovative solutions to the challenges humanity faces on the pathway to sustainable development.

1. Science should be understood here in the broader sense of science, technology and innovation (STI), ranging from the natural sciences to technologies, social sciences and the humanities

2. This opinion piece is based on the policy brief entitled *The Crucial Role of Science for Sustainable Development and the Post-2015 Development Agenda: Preliminary Reflection and Comments by the Scientific Advisory Board of the UN Secretary-General.* This policy brief was presented to the high-level session of the United Nations' Economic and Social Council devoted to the sustainable development goals and related processes in New York on 4 July 2014 and has since been updated

There are countless examples of such transformational ideas. In medical history, the discovery of the bacterial origin of diseases allowed for the development of immunization methods, thus saving countless lives. Electricity-based light did not simply evolve from a candle; this transition occurred in steps, through new concepts and sporadic leaps forward. Accelerator-based particle physics is another example of how one invention can have unanticipated beneficial spin-offs: initially developed solely as a tool for basic research, particle accelerators are common nowadays in major medical centres, where they produce X-rays, protons, neutrons or heavy ions for the diagnosis and treatment of diseases such as cancer, thus benefiting millions of patients.

There is, thus, no dichotomy between basic and applied science, nor competition but only opportunities for synergies. These considerations are central to SDG 9 on industry, innovation and infrastructure.

Science, like music, is universal

Science, like music, is universal. It is a language that we can share across cultural and political borders. For example, more than 10 000 physicists from 60 countries work together at the European Laboratory for Particle Physics (CERN) in Switzerland, inspired by the same passion and driven by shared goals. In universities around the world, new graduate and undergraduate programmes are being designed to teach tomorrow's global problem-solvers how to work across disciplines, scales and geographies. Here, science acts as a leverage for research collaboration, science diplomacy and peace, which is also relevant to SDG 16.

Science plays a key educational role. The critical thinking that comes with science education is vital to train the mind to understand the world in which we live, make choices and solve problems. Science literacy supplies the basis for solutions to everyday problems, reducing the likelihood of misunderstandings by furthering a common understanding. Science literacy and capacity-building should be promoted in low- and middle-income countries, particularly in cases where a widespread appreciation of the benefits of science and the resources for science are often lacking. This situation creates dependence on countries that are more scientifically literate and more industrialized. Hence, science has a role to play in the realization of SDG 4 on quality education.

Science is a public good

Public good science not only brings about transformative change on the road to sustainable development. It is also a way of crossing political, cultural and psychological borders and, thus, helps lay the foundation for a sustainable world. Science may further democratic practices when results are freely disseminated and shared, and made accessible to all. For example, the World Wide Web was invented to facilitate the exchange of information among scientists working in the laboratories of the European Organization for Nuclear Research (CERN) in Switzerland. Since then, the Web has radically changed the way in which the world accesses information. CERN being a publicly funded research centre, it preferred to make the Web freely available to everybody, rather than patent its invention.

The need for an integrated approach

For the post-2015 development agenda to be truly transformative, it will be vital to respect the interrelatedness of the development issues addressed by the Sustainable Development Goals. This point was acknowledged by the Open Working Group on the on the Sustainable Development Goals convened by the United Nations' General Assembly during the formal negotiations which led to the formulation of *Agenda 2030*. The artificial division of *Agenda 2030's* goals, based on disciplinary approaches, may be necessary for comprehension, resource mobilization, communication and public awareness-raising. Nevertheless, one cannot insist enough on the complexity and strong interdependence of the three economic, environmental and social dimensions of sustainable development.

To illustrate the strong interrelation between these three dimensions, let us consider the following: nutrition, health, gender equality, education and agriculture are all relevant to several Sustainable Development Goals and all interrelated. It is impossible to be healthy without adequate nutrition. Adequate nutrition, in turn, is closely linked to agriculture as a provider of nutritious food (SDG 2 on zero hunger). Agriculture, however, affects the environment and, thus, biodiversity (the focus on SDGs 14 and 15 on life below water and life on land, respectively); agriculture is estimated to be the main driver of deforestation when mismanaged. Women are at the nexus of health, nutrition and agriculture. In rural areas, they are responsible for the daily production of food and for childcare. Deprived of education and thus of access to knowledge, some women are unfamiliar with the interlinkages portrayed above. Moreover, their cultural background often discriminates against their well-being when they are treated like second-class citizens. Promoting gender equality and empowering rural women will, thus, be of paramount importance to making progress in all the aforementioned areas and to curb unsustainable population growth. Science is well-placed to build bridges permitting such interlinkages, in the context of SDG 5 on gender equality.

Another example of the close interlinkages among agricultural practices, health and environment is the concept of 'one health.' This concept advocates the idea that human and animal health are closely linked. This is demonstrated, for instance, by the fact that viruses originating in animals can spread to humans, as seen in the case of Ebola or influenza (Avian flu, for instance).

Given the interdisciplinary nature of science for sustainable development, the Scientific Advisory Board to the Secretary-General of the United Nations has stressed the importance of intensifying co-operation among the different scientific fields and portraying science clearly and forcefully as a key ingredient in the future success of *Agenda 2030*. Governments should acknowledge the potential of science to federate different knowledge systems, disciplines and findings and its potential to contribute to a strong knowledge base in the pursuit of the Sustainable Development Goals.

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