



## Science, technology and innovation for sustainable development\*

Science, technology and innovation are essential drivers of sustainable and inclusive development. It is therefore crucial that science, technology and innovation initiatives address all aspects of sustainable development — economic, social and environmental — and their interrelationships, since technological choices can have negative impacts on the social and environmental dimensions of sustainable development. It is equally important that knowledge systems be constructed broadly to include the cultural, social and institutional dimensions in which they operate.

The role of government in building science, technology and innovation capabilities is fundamental, including in stimulating the development of systems that will foster the acquisition, development and dissemination of knowledge at the national level. This includes the promotion of education, research, development and technological dissemination, as well as the design and implementation of nationally appropriate industrial policies. Moreover, the international community should review the extent to which the international trade and investment regimes can guarantee adequate policy space for national Governments in this area. In particular, the limitations imposed by the World Trade Organization Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS Agreement) and the Agreement on Trade-Related Investment Measures

(TRIMS) should be recognized, especially the restrictions on the use of policy instruments such as domestic content, export performance and standards for government procurement that have been widely used by developed countries and successful industrializers in the developing world.

The current system of promoting research and development, including associated intellectual property rights, leads to underinvestment in social priorities and restricts access to the benefits of innovation. Alternative modalities for supporting and financing global research and innovation merit serious consideration. Knowledge, research and technologies that have a direct bearing on the fulfilment of basic human needs and on small rural producers and that tackle environmental challenges, in particular those relating to climate change, should be freely accessible to all as global public goods. A major challenge for science, technology and innovation for sustainable development will be climate change adaptation, especially in the most vulnerable communities and countries. To this end, emphasis should be placed on the creation of an improved knowledge base for the understanding of climate change dynamics and of the technologies and innovations needed to respond to them.

### 1. Introduction

Science, technology and innovation play a critical role in achieving sustainable development goals, including with respect to enhancing productivity and inducing a dynamic transformation of the economy, increasing growth rates and the number of decent jobs while reducing fossil-based energy consumption, developing essential drugs and improving health/medical care, achieving food security through sustainable agricultural methods and raising agricultural productivity, reducing the drudgery and improving the safety of housework, and increasing the safety of reproduction. Advancing a nation's capacity in science, technology and innovation and its effective application in economic

activities are essential factors for expanding peoples' capabilities and achieving sustainable development. At the same time, science, technology and innovation form part of global and national capabilities to address the economic, social and environmental dimensions of development and their interactions.

While science, technology and innovation are essential in finding answers to the sustainability crisis that the world is currently facing, there is a need to look at the broader context and take into account both the cultural and historical dimensions in which science, technology and innovation operate. Under this framework, it is crucial to recognize that although the world is confronting common crises, there are differences within and between coun-

\* Excerpt from Committee for Development Policy, Report on the eighteenth session, See Official Records of the Economic and Social Council, 2013, Supplement No. 13 (E/2013/33)

tries; hence, knowledge systems should be constructed broadly to include the diverse historical, cultural, social and institutional features of countries.

In this regard, the contributions of science, technology and innovation to a new sustainable development paradigm require a deep understanding of the relation among the three pillars of sustainable development, acknowledging that environmental degradation harms economic development and human well-being, especially for the poor and vulnerable groups in society. Social and economic sciences must contribute as much as natural and technical sciences to an approach where improved quality of life and sustainable patterns of consumption and production can be reconciled with reduced environmental degradation, poverty and inequalities, and the promotion of peace and security.

Similarly, it is imperative to understand that there are technological choices that can have negative impacts (externalities) on the social and environmental dimensions of sustainable development. They also have important distributional consequences besides generating “winners” and “losers” owing to the introduction of new production processes and labour-saving technologies. Important distributional implications emerge particularly owing to decisions about which types of knowledge and innovations are promoted and developed and which types are neglected and forgotten. Thus, it remains important to be clear about the fact that the choices we face are societal choices, not scientific or technical ones. Understanding this approach, science, technology and innovation for sustainable development offers immense opportunities to connect science with society, culture and traditional knowledge.

## **2. Science, technology and innovation: meeting basic human needs and environmental challenges**

The science, technology and innovation capabilities of a nation are basic, yet crucial, factors not only for sustained economic growth, but also for a nation’s ability to provide its citizens with quality education, good health care and safe food and to mitigate the negative impacts of climate change and natural disasters.

Since the adoption of the Millennium Development Goals in 2000, there have been renewed efforts to use science, technology and innovation, nationally and globally, for the development of vaccines and improved medical treatments for tropical diseases and other diseases that plague the developing world, as well as for global pandemics such as HIV/AIDS<sup>1</sup>. Technological innovation has played an equally critical role in the management of safe freshwater resources and in addressing concerns about water scarcity in agricultural production by small farmers. International research institutions, supported by public funds, have

been active in agricultural innovation in developing countries in the past, leading to the green revolution of the 1960s and 1970s. National Governments expanded roads, irrigation systems and electrical power supply to support farmers to adopt the new technology. International lending was also prioritized for agricultural development<sup>2</sup>. More recently, an innovative system, known as the rice intensification system, has been successfully tested in 40 countries<sup>3</sup>. Nonetheless, these efforts remain limited. Moreover, in many instances, access to technology and innovation remains restricted in view of the proprietary nature of intellectual rights.

Geography matters in climate change, and some regions will be more affected than others. The economic, social and environmental consequences will also vary, depending on levels of development in general and on individual, local and national preparedness to mitigate and adapt to the impact of climate change.

A major challenge for science, technology and innovation in climate change is to support mitigation and adaptation. While much attention has been paid to mitigation, particularly because greenhouse gas emissions are largely generated in the more technologically advanced countries, little or no attention has been paid to the promotion and development of science, technology and innovation for adaptation. Most of the adaptation technologies currently available reflect informal or spontaneous processes, such as indigenous or traditional knowledge-based technologies used to cope with flooding and irrigation systems developed and updated to make more efficient use of scarce water. Adaptation measures are likely to be more amenable to small-scale interventions and thus more adaptable to local conditions and institutions. However, adaptation measures are likely to be more accessible to richer countries, communities and individuals, which are not necessarily the most vulnerable.

## **Science, technology and innovation as global public goods**

The above-mentioned considerations reinforce the need to view certain technologies, particularly those that contribute to meeting basic human needs and environmental challenges, as global public goods that deserve to be supported by a system of incentives to make them accessible to all. The development and dissemination of these technologies should be a global priority. However, both confront major obstacles.

First, with respect to development, markets have not been efficient in providing these goods and services in the right quantity and quality in a timely manner. The current system of financing research and development depends largely on granting exclusive intellectual property rights as an incentive for private investment

<sup>1</sup> See Official Records of the Economic and Social Council, 2009, Supplement No. 13 (E/2009/33).

<sup>2</sup> The green revolution has been criticized based on the technology it promoted, which involves intensive use of fertilizers, chemical pesticides and water; these have negative environmental impacts.

<sup>3</sup> Rice has been the single most important staple of the poor, particularly in Asia and parts of Africa.

in the generation of technology and innovation. This leads to underinvestment in innovations for social priorities, notably to meet basic human needs and environmental sustainability. Therefore, alternative mechanisms for financing innovation are needed, such as prizes and public funds (including public funds to buy technologies that would then be made freely accessible), and deserve further consideration.

Second, with respect to dissemination, technologies receiving patent protection are often less accessible owing to monopoly pricing, which makes them more costly. However, a defining aspect of global public goods is that they should be non-exclusive; once the knowledge or technologies are created in these crucial areas, no one should be excluded from the access to them. The question is how to secure sustainable funding to provide them. Because of their non-exclusive nature, research and development in such technologies has long been underfunded, in particular with respect to those needed by poor people living in low-income countries.

### **3. Building science, technology and innovation capabilities for sustained growth: the role of Government**

Development is, in essence, a process of capacity-building. Developing countries confront many obstacles in building a robust and entrepreneurially dynamic private sector; however, they also have some advantages. They can draw on the knowledge accumulated elsewhere, obviating the need to devote significant resources to research and development. Developing countries use a given technology only after it becomes an industrial standard, which also implies that they can adapt these existing mature technologies. This is known as the “latecomer effect”<sup>4</sup>. However, latecomers also need to acquire new or emerging technologies, which are often associated with dynamic markets. Emerging technological paradigms can serve as a window of opportunity for latecomers because they are not necessarily locked into the “old” or “mature” technological paradigm and thus are able to make best use of new opportunities in the emerging or new industries.

However, developing countries often go through technological learning and capability development before reaching the stage where they can fully benefit from the latecomer effects. Public and/or private entities need to build a stock of knowledge in the form of human and physical capital, identify the technologies and industries in which the country or firm has the larger growth potential and channel the resources into them, while acknowledging the risks of failing to plan.

Governments thus have a fundamental role to play in building science, technology and innovation capabilities, including in stimulating the development of systems that foster the acqui-

sition and dissemination of knowledge, as well as in designing and implementing industrial policies. Evidence suggests that the level of expenditure on research and development is key to building up innovation capacities. Meanwhile, a country’s institutions, educational system and quality of education are significant factors in achieving the transition from the low-income to the middle-income level. In this regard, it should be noted that tertiary education and retraining and facilitating the mobility of researchers are necessary to enhance the transfer of technology among different sectors of the economy and the application of such technology in business activities.

Moreover, building technological capacities requires Government support. When private capacity is non-existent or weak, the public sector as a whole needs to lead the design and implementation of a new industry or a new technology, with a combination of horizontal interventions at the macroeconomic level. As the capacity of the private sector advances, the direct involvement of the national Government may become less prominent, its policies are likely to be more targeted to specific industries or technologies, and the nature of public and private cooperation takes the form of partnership. Ultimately, the private sector may become fairly independent from the public sector in technological development, with the latter providing the former with economic incentives, including exclusive property rights for a certain period, to encourage its efforts. Nonetheless, it should be recognized that even in developed countries, Governments continue to conduct and sponsor a significant amount of research and technological development, and not only in defence-related matters.

### **4. Importance of policy space for science, technology and innovation**

A pertinent question is whether the current international trade and investment regimes guarantee enough policy space for the Governments of developing countries to promote national science, technology and innovation capabilities.

Among the relevant multilateral, regional and bilateral agreements, the TRIPS and TRIMs Agreements should both be mentioned. The TRIPS Agreement establishes minimum standards for domestic intellectual property protection with which signatory countries (excluding least developed countries) are required to comply. This has significant implications for permissible science, technology and innovation policies at the national level. In this regard, certain measures that developed countries used in the course of their industrialization, namely, discrimination against foreign patent application, or exclusion of such industries as chemicals and pharmaceuticals, are no longer available. However, the TRIPS Agreement contains several “flexibilities” that can be used by developing countries in designing their own intellectual property rights system. Meanwhile, the TRIMs Agreement prohibits practices such as local content requirements manufacturing requirements, export performance, trade balancing

<sup>4</sup> Alexander Gerschenkron, *Economic Backwardness in Historical Perspective* (Cambridge, Massachusetts, Belknap Press of Harvard University, 1962).

requirements and technology transfer requirements. Simply put, these measures significantly limit policy space for Governments in developing countries. Beyond this issue, there is the question of whether the TRIPS rules are the right intellectual property rights model for developing countries and what implications they bring in terms of access to knowledge and technology.

There is a need for a global dialogue on the reform of international trade and investment regimes. In particular, intellectual property right systems need to evolve from a focus on protection to one that fosters dissemination. Stringent protection of intellectual property rights, particularly patents, can be a serious deterrent in countries' efforts to achieve sustainable development in general and to pursue appropriate industrial policies to that effect. In this regard, the international community should also consider several policy issues, including a broad research exemption for experimental users and judicial power to require non-exclusive licensing in the spirit of public interest. Moreover, there is a need to install a minimum safeguard of public interests by ensuring transparency in licensing and allowing wider use of non-exclusive licensing, particularly in the patenting of results of publicly funded research.