

Chapter 2

The Role of Science, Technology and Innovation Policies and Instruments for a Paradigm Shift Towards Sustainable Development

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Abstract There is an increased recognition that Science, Technology and Innovation (STI) can spur inclusive and sustainable development in multiple ways. For STI to be a driver for sustainable development it is important that Development Agendas are people-centered, creating an enabling environment for the power of STI to be a harness for development. This implies that countries and regions have to develop, implement and monitor their national and regional STI policies and programs that promote knowledge production, dissemination and utilization as well as the development and appropriation of technologies that spur innovation not only at large production facilities but also at grassroots level, involving small and medium enterprises (SMEs), as part of a broader development agenda. These frameworks require that special attention is given to human capital development, a fundamental block of any sustainable development agenda, and to governance mechanisms that promote broader participation in decision making in STI related issues, in particular promoting the participation of vulnerable groups such women, youth, Small Islands Developing States (SIDS) and indigenous people. This paper argues that STI policies need to be transversal, cross-cutting policies that support and build the structural pillars for sustainable development and through dialogue, engage the wide range of development stakeholders. It also explores the ways UNESCO intervenes in this strategic area for development through the design, planning, formulation, monitoring and evaluation of national and regional STI strategies and policies (including reforms), as well as thorough building the national and regional capacities in science and in public policy development, and the development of national, regional and global fora on STI and development.

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2.1 Introduction

In today's highly interconnected world, human beings, as part of the biosphere, are considered the major force impacting our planet; therefore, the human species is facing a crucial transition period. In this uncertain stage of human history, vulnerabilities and risks are high but also are opportunities for socio-ecological changes and transformations. What is important is that global sustainability becomes the foundation of our interconnected and interdependent global economic, social and environmental systems.

The reality, however, is that we still promote a model of development based on the premises that development is a process of structural changes that will imply a series of historic steps that developing countries have to follow in order to move from a traditional society to a more modern one in order to reach the present levels of mass consumption of developed countries. This model assumes that industrialization is the main driver of growth, and consequently the degree of development is essentially measured by levels of production and consumption, using indicators such as Gross Domestic Product (GDP) and per capita income, ignoring other relevant information such as social equity, life expectancy at birth, redistribution of wealth, access to educational and health systems, absence of violence, environmental sustainability and other indicators that measure better the improvement of living conditions and welfare of all.

It is in this context that concepts such as *Knowledge Economy*, defined as an economy where “the generation and the exploitation of knowledge have come to play the predominant part in the creation of wealth” (DTI 1998), gained root and became the paradigm of most of the interventions in the field of Science, Technology and Innovation (STI).

However it is clear that with the financial, energy, food and environmental crisis that the world, as a whole, is facing nowadays, a paradigm shift will have to occur, in particular in economies that are extremely vulnerable to global trends and issues such as the economies of the Least Developed Countries (LDC) and Small Islands Developing States (SIDS), in particular in Africa.

It is high time to acknowledge that integrating environmental, educational and social issues into economic decisions is vital to humanity. It is time to reaffirm that economic and financial crisis cannot be solved without deeply transforming the way we consume, we produce, and we interact with our planet.

Clearly, part of the problem rests in the fragmented and restricted analysis on which we base our decisions, in the predatory nature of the globalization process occurring today, and in the fact that local problems need more and more global solutions.

In order to address the causes of the present crisis it is important to look at knowledge in a different way, not only as a driver for the economy but as the main driver for the empowerment of the people in the different societies. The concept of *Knowledge Societies*, defined as societies that have a culture of science and use knowledge to act, is therefore a better one to use when discussing STI and

development, but unfortunately is still only part of the discourse and rarely integrated and used in the design of policies, programs and interventions. It is needed that alternative models for development are discussed and that they integrate concepts, such as the one on sustainable societies, concepts that supports the paradigm shift from a knowledge economy to knowledge societies.

These alternative concepts of development defend that we should think in the diversity of sustainable societies, with economic and technological options that are differentiated, that are geared towards a harmonious development of the people and their relationship with the natural world, clarifying the boundaries of a new ethical behavior in the relationship between nations and its people, and placing the common good in the front of development interventions.

In itself this implies that more than one development model is needed, and that nations and regions should choose models that are interlinked and interdependent and that reflect visions of the world that are locally relevant and culturally appropriate.

In that sense we are talking about development models that are people-centered and inclusive; models based on local realities that take advantage of local knowledge and innovation capacities; models that start from the country's potential to solve both local and global issues and that strives to create a culture of ingenuity, science and technology. Models that capture the complexity of our development challenges and the dynamics of the natural environment we live in. It implies that we have to embrace the values, behaviors and lifestyles required for a sustainable future and in that process strengthen two critical drivers for development: ethics and empowerment. It is about building up conviction and commitment to pursue a better development path; it is about using diversity to sustain growth.

The concept of sustainable development has experienced an extraordinary rise over the past two decades and now pervades the agendas of governments, international organizations and corporations as well as the mission of educational and research programs worldwide. Although there are some earlier antecedents, these ideas had their formal appearance with the Brundtland Report, *Our Common Future* (1987) and the results of the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the International Council for Science (ICSU) World Conference on Science (1999). At the same time a list of important and influential documents were published, showing the relevance of sustainable development within the global agenda (Clark and Dickson 2003; Kates et al. 2001; NRC 1999; Parris and Kates 2003; UNCED 1992) conforming the bases for the organization of a new research and innovation paradigm.

As mentioned in the State of the Planet Declaration (Planet Under Pressure 2012): “The defining challenge of our age is to safeguard Earth’s natural processes to ensure the well-being of civilization while eradicating poverty, reducing conflict over resources, and supporting human and ecosystem health.”

This is a clear challenge to science and engineering. For it requires building scientific and technical skills and to develop the social support to apply them (Brito 2005).

The international scientific community has an important role to play in finding alternative solutions to the development challenges of today. This has implications, it means that the scientific endeavour will have to integrate the different disciplines and move from interdisciplinary to transdisciplinary, to build the knowledge needed for finding more sustainable paths for the future.

It is interesting to see that sustainability science, as a new paradigm, has been applied more and more in the last decade and those large programs such as Future Earth are taking roots in the scientific community and growing. However, when we look at the distribution of research projects that have sustainability science at the core we realize that the African Continent is lagging behind, once again (Bettencourt and Kaur 2011).

Therefore, if we want a planet that will continue to develop and strive towards improved living conditions for all its citizens, sustainable economic growth and environmental sustainability specific policies, programs and actions that promote the production of knowledge, technologies and innovations needed for sustainable development have to be in place everywhere in the world.

These challenges pose important questions:

- What are the core scientific questions and issues that must be addressed in the decades ahead that will form the foundations for sustainability science, technology and innovation?
- What research strategies will be required to enable the scientific inquiry and facilitate the research to address these core questions of sustainability science?
- What kind of innovation strategies will be required to transform the human productive system worldwide to address the environmental and societal problems that the planet and life are facing?
- On STI Policies and STI Governance: (a) What systems of incentive structures—including markets, rules, norms, technological impact, and STI information—can most effectively improve social capacity to guide interactions between nature and society toward more sustainable trajectories? (b) How can today's relatively independent activities of research planning, monitoring, assessment, and decision support be better integrated into systems for adaptive management and societal learning?
- What innovations and changes will be required to more fully enable the institutions and infrastructure essential to the conduct of sustainability science and technology?

These are difficult questions that have to be answered if an enabling environment is to be created. Several concrete actions can be pursued to create the right environment for STI to play its role in development:

- Develop research and innovation policies that are cross-cutting and creating structural base for the other policies:
 - Strengthening science and engineering education at all levels;
 - Promote policy integration in the country, region and continent;

- Improve and scale-up research and innovation programs in crucial and strategic areas for development;
- Spur innovation in the productive sector, including small and medium enterprises (SMEs);
- Popularize science and engineering in society.
- These traversal, cross-cutting policies should have associated with several instruments and mechanisms that promote policy implementation and the capacity to monitor and evaluate the impacts and the needs for new policies, such as:
 - Develop steering mechanisms: peer-review, financial instruments, institutional and research agendas linked to development agendas in the country and in the region;
 - Develop mechanisms to measure and produce high quality STI indicators;
 - Ensure the knowledge cycle in society (identification, production, transfer, appropriation and re-creation of knowledge) happens by building the critical mass in society through actions in Higher Education Institutions, including Engineering Schools, science education needs to be reinforced at all levels and stronger partnerships between universities and industry are needed.
- **Build Networks of Excellence** that ensures knowledge production and identification of existing knowledge. Implying that the Centres do more than sharing ideas, but move towards a common research agenda, have more human capacity and more resources, building synergies for institutional sustainable growth within Africa and with other parts of the world and allowing for:
 - Deep understanding of factors influencing global policy making processes;
 - Capacity to contextualize the policies at national and regional level;
 - Capacity to critically analyze impacts;
 - Capacity to develop alternative policies.
- **Building bridges between development actors** by mobilizing the social energy around a common vision of development, developing the social contract with science through the supporting endogenous capacities and by using diversity to sustain development.
- **Build ownership and commitment:** engage local stakeholders in the design, implementation and resources mobilization by including society in the Networks of Excellence through:
 - Building Centres of Excellence that are embedded in the society;
 - Build partnerships frameworks between the scientific community, Government, productive sector and civil society;
 - Develop link between knowledge-technology and practical solutions to everyday problems;
 - Developing local industry through promotion of partnerships and access to knowledge.

- **Fair trade:** negotiate better intellectual property rights and market conditions.

Policymakers need to have a better picture of their national, regional and global performance with regard to the distribution of knowledge and to estimate the magnitude of the loss of potential innovation due to the limitation of the STI policy instruments which are applied. In this context, a better understanding of the long-term evolution of STI policy institutions and organizations as well as their governance characteristics is also needed.

As a specialized agency of the United Nations (UN), UNESCO contributes to the building of peace, the eradication of poverty, sustainable development and intercultural dialogue through education, the sciences, culture, communication and information. In fulfilling its mission, UNESCO will carry out for the international community its five established functions: (a) Laboratory of ideas; (b) Standard-setter; (c) Clearing house; (d) Capacity-builder in Member States in UNESCO's fields of competence; and (e) Catalyst for international cooperation. To promote sustainable development, the UNESCO *Division of Science Policy and Capacity Building* is promoting two projects: the Global Observatory on STI Policy Instruments (GO→SPIN)¹ and the STI Global Assessment Programme (STI-GAP)². The GO→SPIN platform is based on a recently designed methodology for the standardization and systematization of information on STI policies, policy instruments and indicators that provide new and revolutionary tools for knowledge-brokers, decision-makers and STI policy experts. STIGAP is being prepared with the objective to develop a global dialogue on data collection that will result in the capability to better assess the development of STI at the international, regional and national levels. This assessment will enable the formulation of more appropriate recommendations on policy-making for Member States. Both initiatives not only fulfill the five functions of UNESCO, but also contribute for the generation, analysis, diffusion and sharing of adequate information about complex societal and nature systems. Contribute for the definition of strategies for science, engineering, technology and innovation which are the most valuable assets needed for the establishment of STI policies that can promote long-term planning for sustainable development.

Through UNESCO Chairs/UNITWIN Programme capacity development in higher education in developing countries is a priority and to support higher education networking is a strategy of UNESCO since the 1990s. The UNITWIN Programme has changed over time and it aims to impact socio-economic development effectively, generating new ideas through research and reflection, and facilitating the enrichment of existing university programs while respecting cultural diversity, by promoting transdisciplinary work and the role of the Chairs as

¹ <http://www.unesco.org/new/en/natural-sciences/science-technology/sti-policy/global-observatory-on-policy-instruments/>

² <http://www.unesco.org/new/en/natural-sciences/science-technology/sti-policy/indicators-statistics-and-prospective-studies/science-technology-and-innovation-global-assessment/>

“bridge builders” between academia, civil society, local communities, research and policy-making.

The UNESCO Chair in Technologies for Development, established in 2007 in the Cooperation & Development Center (CODEV) at the Ecole Polytechnique Fédérale de Lausanne (EPFL) in Switzerland, fully plays the dual function of “think-tank” and “bridge-builder”, effectively promoting transdisciplinary research technology adaptation through partnerships with local institutions, in order to develop innovative solutions for the most vulnerable populations.

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