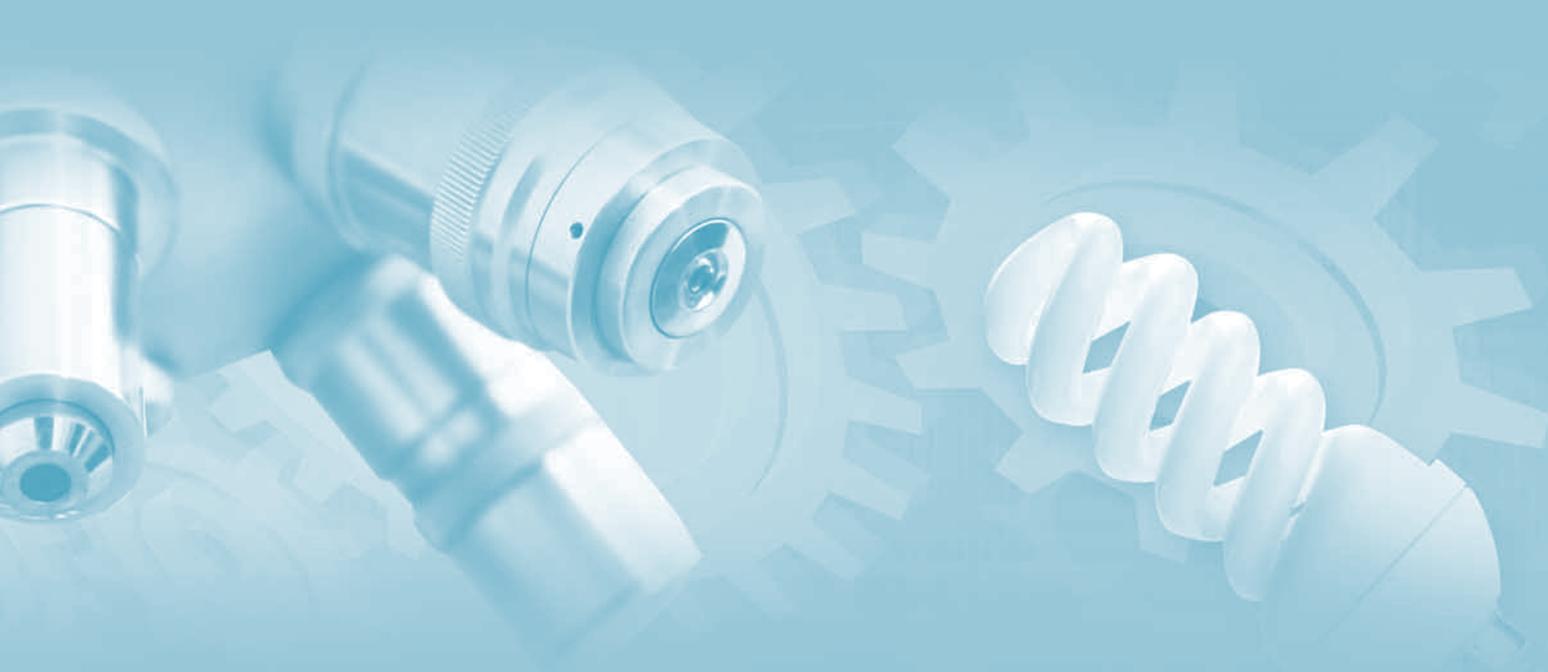




A FRAMEWORK FOR
Science, Technology and
Innovation Policy Reviews

Helping countries leverage
knowledge and innovation
for development





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PREFACE

Since its establishment in 1964, UNCTAD has originated and supported a broad range of development-focused policies dealing with international trade, finance, investment and technology. UNCTAD relies on its ahead-of-the-curve research and analysis, technical cooperation and intergovernmental dialogue to bring the development perspective into national and international policy agendas and to help align them with the priorities of sustainable and equitable development.

UNCTAD serves as a focal point within the United Nations secretariat on issues of science, technology and innovation (STI) for development. The work programme on STI, including the STI Policy (STIP) Review programme is based on the mandates set by UNCTAD X (Bangkok, 2000), UNCTAD XI (São Paulo, 2004), and UNCTAD XII (Accra, 2008). The deliberations of the United Nations Commission on Science and Technology for Development¹ (CSTD) have also contributed to the definition of the STIP programme and have provided a forum for the dissemination and analysis of the outcome of STIP Reviews.

Over the past few years UNCTAD has experienced increased demand from member States for strategic advice on STI policy, reflecting a renewed awareness of the crucial role of technology and innovation in the development process. As the need for knowledge-based alternatives to finance-led development strategies becomes more evident, the STIP Review programme aims to support the development of national productive capacity in developing countries through technological development and innovation. Technological development and innovation processes are complex, they involve linkages and feedback loops among a broad set of actors and are greatly influenced by social, economic, institutional, cultural and historical factors. Designing and implementing innovation policies are therefore necessarily complex exercises too. STIP Reviews are conceived to support STI policy-making in developing countries by assessing the effectiveness of their current STI policies and identifying priorities for action leading to sustainable development outcomes.

STIP Reviews are undertaken at the request of member States. Following an extensive review and evaluation of the country's STI actors, networks, interactions, institutions, capabilities, policies and overall environment, which involves consultations with all the STI stakeholders, a diagnosis is established and policy options formulated and presented to the STI policymakers and then to the other national STI players. A systematic effort is made to involve all the STI stakeholders through a process of consultations, including national STIP Review workshops. The outcome of the analysis, diagnosis and policy options formulation process is documented in a STIP Review report which sets out an action plan for the consideration of the Government. The STIP report is disseminated through the UNCTAD intergovernmental mechanisms, the CSTD and among the national STI stakeholders through workshops and other events.

The diagnosis and recommendations also provide the basis on which specific capacity-building activities targeting various elements of the innovation system and environment can be formulated, funded and delivered. Another important benefit of the STIP Review process is that it can help generate a consensus among STI policymakers and development stakeholders on future lines of action and can establish a strong sense of ownership of the related policy programmes.

As of the end of 2011, UNCTAD had implemented 11 national STIP Reviews and 7 other countries had requested one. In several beneficiary countries, STIP Reviews have ignited significant renewal in STI policy, helped raise its profile in national development strategies and facilitated the inclusion of STI activities in international cooperation plans.

¹ The CSTD is a functional commission of ECOSOC that is serviced by the UNCTAD secretariat.

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I. INTRODUCTION

Economic development essentially involves a process of structural transformation of which technological learning and innovation are an integral part. Without them the productive base of a country cannot be expanded or diversified, opportunities to benefit from international trade and investment are missed and potential growth in employment is lost. Innovation can stem from science-based technological progress, or from the acquisition, adaptation and diffusion of existing technological knowledge. It can also result from entrepreneurial activity leading to new, more efficient combinations of productive resources. Whatever its source, without innovation productivity growth stalls and long-term income and welfare improvements become impossible.

The basic premise for the STIP Review programme is the recognition of this central role of innovation in the process of economic development. In this context, technological innovation is understood as a broad notion that includes not only the introduction by firms of products, marketing methods, organizational forms or productive processes that are new to the world, but also when these are new to the market or new to the firm.² Innovation can thus take place not only by pushing forward the frontiers of knowledge, but also (and this is the most frequent case in developing countries) when firms learn to implement and use technologies that are already available elsewhere. For developing countries, technology acquisition, imitation and adaptation are key innovative processes that can be as important, if not more, than research and development.

Innovation takes place essentially within firms. But firms do not engage in technological learning and innovative activity in isolation. They do so as participants in systems in which they interact with other agents, public and private, that generate and intermediate knowledge and technology flows. At any point in time, such innovation systems (discussed in more detail in section 2 below) will be largely the result of the interplay of many economic, historical and cultural factors. However, the characteristics of any innovation system are far from static and targeted policy actions can profoundly affect the dynamics and effectiveness of a country's innovation system. Experience, for example in East Asia, such as in the Republic of Korea or Taiwan Province of China, has shown that policies that promote technological learning and in-

novation are among the most powerful levers that can be used to stimulate structural change, improve firm competitiveness and create growth and jobs.

As the crucial role of technology and innovation is increasingly recognized, there is a growing interest among developing countries in establishing the institutional processes that can lead to a better definition of STI policy's role in their overall strategic development policies and priorities. Currently, STI policies are on the periphery of many countries' development strategies. The problem is compounded by typically weak and fragmented national systems of innovation, whereby linkages among STI stakeholders are few and nodes of collaboration and coordination may be nearly non-existent. It is therefore necessary to establish the centrality of technology and innovation as a development issue and connect it to other development policies.

Effective STI policymaking cannot be designed, implemented, monitored and adjusted without a sound understanding of the capabilities of the country's STI agents, their interactions and the set of incentives and disincentives that they face, which are all highly country-specific. STI policies also need to reflect the fact that the mechanisms of technological change and the concept of innovation itself will also be very different in developing countries from those of developed economies.

The Science, Technology and Innovation Policy Reviews (STIP Reviews) undertaken by UNCTAD are conceived as a process through which a country's STI stakeholders can reach a clear understanding of the key strengths and weaknesses of their innovation systems and identify strategic priorities for its development. They also aim to present STI stakeholders with a set of policy options to strengthen the technological and innovative performance of the economy. Finally, through the implementation of a STIP Review more solid collaborative linkages among STI agents should be established.

The STIP Review programme is at the core of UNCTAD's technical cooperation work in the field of STI. It draws on decades of accumulated policy research and advocacy in science and technology for development. It also takes advantage of UNCTAD's position as the institutional home of the CSTD to share best practices identified through the implementation of STIP Reviews and to promote cooperation in STI among development partners. The STIP Review programme is financed through extra-budgetary resources. An average of three countries per biennium have benefited from the programme since 2007.

² *Organization for Economic Cooperation and Development (OECD) (2005).*

This publication is intended to provide UNCTAD's constituency with information about the thinking that underpins the programme, the major aspects of the implementation process of STIP Reviews and their expected short- and medium-term outcomes. It presents some conclusions extracted from the experience accumulated in UNCTAD through the implementation of the programme. Its preparation also involved exchanges with a network of STI academics and policymakers, many of whom have participated in the production of STIP Reviews. An ad hoc expert meeting on STIP Reviews that was held in Geneva in December 2010 greatly contributed to the crystallization of those ideas in the present document. The contributions of all the participating experts are gratefully acknowledged.³

II. SCIENCE, TECHNOLOGY AND INNOVATION POLICY FOR DEVELOPMENT: KEY CHALLENGES

When STI first became an area of explicit, active policy-making in some developed economies in the first half of the twentieth century, thinking about innovation processes tended to emphasize investment in formal research and development (R&D) and efforts to achieve efficient transfer of the outcomes of R&D to the commercial sector. This represented a linear approach to innovation policy. In this approach, neoclassical arguments about market failures provided the justification for State policies to support R&D. As a result of these failures, the free operation of the market would result in a suboptimal level of investment in R&D. Usually, three kinds of market failures are considered to apply to the production, dissemination and accumulation of knowledge: externalities, uncertainty and indivisibilities.

The main reason for the existence of externalities in the production of knowledge is the difficulty to fully appropriate the outcome of research efforts. Since it is not always possible for a firm to fully monetize the value of the knowledge it generates and competitors can benefit from spillovers, their investment in R&D will be smaller than the social optimum. Uncertainty, which is intrinsically linked to innovation, represents a market failure because infor-

mation asymmetries and variations in the perceptions of risk of various players may result in under-investment in R&D by, for example, making it difficult for would-be innovators to access external financing. As for the problem of indivisibility, economies of scale are often important in R&D activities, providing strong incentives for a departure from normal competitive conditions under which a socially optimal equilibrium can be reached. Under these conditions, markets left to their own devices will not be sufficient to generate adequate levels of innovative activity. In this traditional approach, government intervention can address such market failures through mechanisms such as the enforcement of intellectual property rights or the provision of incentives (subsidies) to the innovative activity of businesses.

More recent theoretical developments with roots in evolutionary economics⁴ have emphasized the need to understand the systemic nature of innovation processes⁵ and pointed out that the traditional concepts of market failure are insufficient as a guide for policy. In this approach, policy needs to address also issues of systems failure, including aspects such as the ability of firms to learn, the connections between the various players in the innovation system and problems of institutional design.⁶

The literature provides many different definitions of the concept of the innovation system (see a sample in box 1). Broadly speaking, the key insight of the systems approach is that the differences observed in the innovative performance of economies are mainly due to differences in the system of interacting actors (firms, universities, research centres, public agencies) involved in the production, diffusion and use of science and technology as well as the environment in which those actors operate. Since the interactions within the innovation system can take place through market and non-market mechanisms, the justification for policy action is not merely to respond to market failures but also to systemic failures (in infrastructures, institutions,

³ Jean Eric Aubert (consultant), Cristina Chaminade (Lund University, Sweden), Norman Clark (Open University, United Kingdom), Kathy Stokes (consultant), Xiaolan Fu (Oxford University, United Kingdom), Yuko Harayama (OECD), Roberto López Martínez (Universidad Nacional Autónoma, Mexico), Banji Oyeyinka (UN/Habitat) and April Tash (UNESCO).

⁴ *Evolutionary economics is a school of thought with a rich and varied intellectual background that includes economists such as Friedrich List, Thorstein Veblen and Joseph Schumpeter. Evolutionary economics tends to emphasize the study of endogenous novelty within economic systems and to analyse how novelty emerges, how it spreads across the economy and how, once it is widely adopted, it creates new conditions for the future change of the system itself.*

⁵ See for example Freeman (1987), Lundvall (1988 and 1992), Nelson (1993).

⁶ See UNCTAD (2007) for a discussion of the implications of a systems approach to innovation for STI policy in a developing country context. UNCTAD (2010) considers innovation systems in the specific case of the agricultural sector.

networks, regulations, coordination, path-dependency and lock-in effects, etc.) that impede innovation.

It is also important to recognize the importance of tacit knowledge that cannot be appropriated simply by buying equipment or receiving a set of operation instructions. The ability to capture tacit knowledge is developed over time through practice and interactions in specific environments, and is not easily transferable. Hence the impor-

tance of enabling those learning interactions that generate technological absorptive capacity. The effectiveness of a national system of innovation (NSI) is largely defined by how it incentivizes and supports such learning interactions. An example of this is whether there are forces in the system that help align the activity of knowledge generation bodies (Universities, research centres) with the knowledge needs and problems of the productive sector of the economy.

Box 1: National Systems of Innovation: Some Definitions

“... The network of institutions in the public- and private-sectors whose activities and interactions initiate, import, modify and diffuse new technologies” (Freeman, 1987)

“... The elements and relationships which interact in the production, diffusion and use of new, and economically useful knowledge ... and are either located within or rooted inside the borders of a nation State” (Lundvall, 1992)

“... The set of institutions whose interactions determine the innovative performance of national firms” (Nelson and Rosenberg, 1993)

“... The national system of innovation is constituted by the institutions and economic structures affecting the rate and direction of technological change in the society” (Edquist and Lundvall, 1993)

“... The system of interacting private and public firms (either large or small), universities, and government agencies aiming at the production of science and technology within national borders. Interaction among these units may be technical, commercial, legal, social, and financial, in as much as the goal of the interaction is the development, protection, financing or regulation of new science and technology” (Niosi et al., 1993)

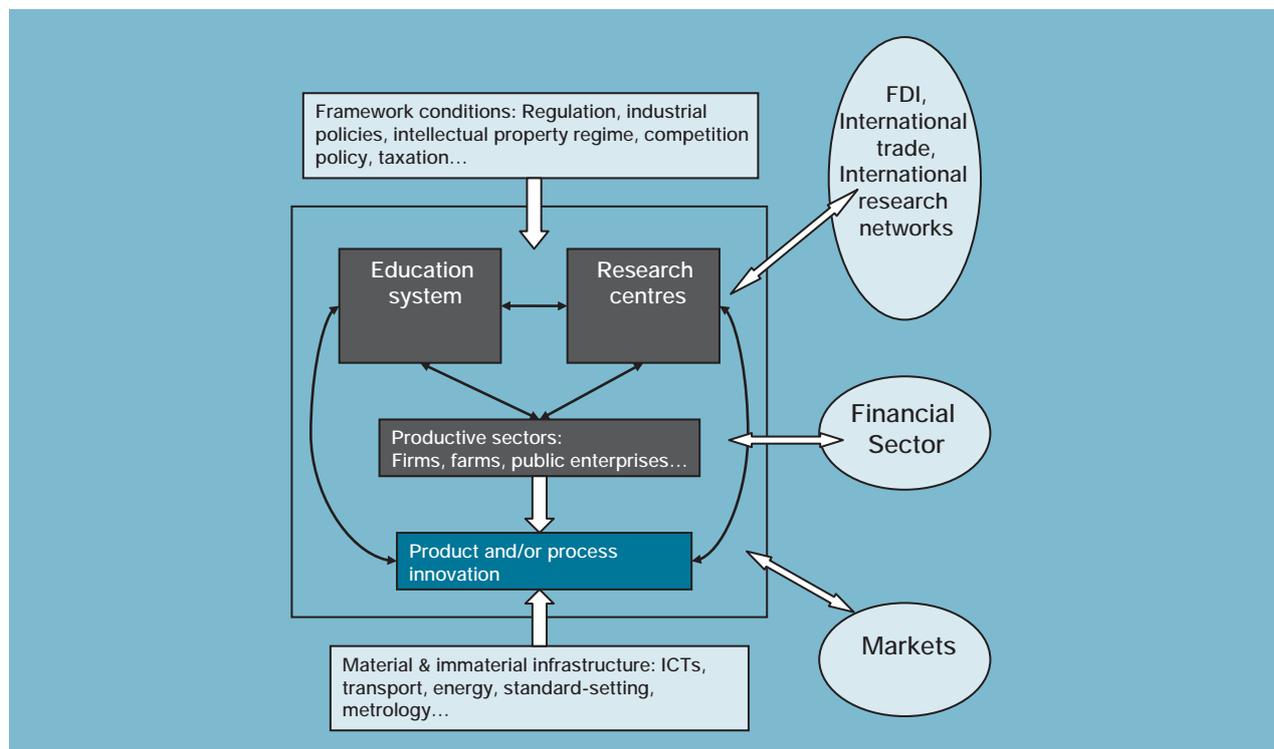
“... The national institutions, their incentive structures and their competencies, that determine the rate and direction of technological learning (or the volume and composition of change generating activities) in a country” (Patel and Pavitt, 1994)

“...System of interconnected institutions to create, store and transfer the knowledge and skills and artefacts which define new technologies” (Metcalf, 1995)

Figure 1 sets out the fundamental elements and interactions in a typical NSI. An implication of an approach based on the concept of the NSI is that STI policy is complex and demanding in its design, implementation and monitoring. Such a policy is not only concerned with the strengthening of the “supply side” of knowledge and technology, but needs also to consider the management of the “demand side” (the use that firms, farms and public sector entities make of knowledge and technology in the production of goods and services) as well as the interactions between the two sides and the development of enabling framework conditions. This will require the coordinated management of an extensive arsenal of explicit and implicit policy instruments. Examples of the first group include education policies at all levels, the

development of STI infrastructure, technological support services, and policies regarding transfer of technology through foreign direct investment, trade and other market-based mechanisms. Implicit STI policy instruments concern aspects such as general trade policies, public procurement, taxation, infrastructure (electricity supply, roads, telecoms), or direct and indirect financial support to enterprises. The complexity of the policy challenge is also shown by the need to articulate policies that address both market and systemic failures, to combine horizontal policies (education and training, access to finance or knowledge dissemination) and vertical ones (to support specific sectors and/or technologies), and to incentivize collaborative interactions between firms, universities and research centres.

Figure 1 A schematic diagram of a national system of innovation



Source: UNCTAD.

A fundamental consideration for STI policy in developing countries is that innovative activity occurs there mostly through the adoption, absorption and adaptation of existing technological knowledge that has been generated abroad. Thus, innovation policy for development is fundamentally concerned not with the generation of new knowledge but with jump-starting, fuelling and managing a process of learning, and with creating and developing the competences and capabilities that are required at various levels for such technological learning and catch-up to succeed. Therefore, a critical factor for the success of technological catch-up strategies is the creation of absorptive capacity at the level of the firms but also of other key actors of national innovation systems so that the economy can actually benefit from any increased exposure to international knowledge and technology flows that may be gained through trade, investment or other channels. Such absorptive capacity is defined by the availability of a wide range of skills and expertise as well as of material and immaterial infrastructure. Policies to strengthen absorptive capacity can be organized along three main axes: (a) human resources development; (b) supporting investment by firms in learning and innovation; and (c) stimulating the emergence of linkages among domestic and foreign firms and with universities, research institutions and technology intermediaries.

Many other aspects of STI policymaking are particularly relevant in a development context. These include, for example, the optimization of trade and investment links with foreign sources of technology and the relationship between these linkages and the generation of endogenous technological capacities. Also included are (a) the much greater importance of accelerating innovation in agriculture; (b) a different balance with regard to the incentives and disincentives to innovation provided by the intellectual property regime; (c) the importance of understanding and addressing innovation processes in the informal sector; and (d) the need to consider the social consequences of rapid structural change induced by technological catch-up and innovation.

The success of a number of developing countries in technological and economic catching-up, mainly in East Asia, has renewed interest in technology and innovation among policymakers in many developing countries. However, the inherent complexity of a systems-based approach to STI policies, the need for a highly sophisticated understanding of policy interactions and for strong coordination and collaboration among Ministries, agencies and other public and private actors can represent a strain for the human and institutional resources of many developing countries.

Often, innovation policy is entrusted to ministries of science and technology which, given their focus on science and research, may help perpetuate a linear, research-driven approach to innovation. Given the low levels of investment in R&D in many developing countries, these ministries tend to lack the political weight that would be needed to push through an approach to STI policy that cuts across ministries and includes a focus on linkages to production, competitiveness and development. In addition, in many developing countries the budgets for STI policymaking are extremely low, when they exist at all. Another difficulty is that measuring innovation in developing countries presents material and conceptual challenges, which makes it difficult to articulate evidence-based advocacy for STI policies. All these factors often result in a lack of integration of STI policies into national development strategies. Consequently, STI issues often do not feature in the major documents through which the interaction between the Government and the country's international development partners are articulated, such the United Nations Development Assistance Frameworks (UNDAFs) or the Poverty Reduction Strategy Papers (PRSPs).

The STIP Review process acknowledges these realities of STI policy in a development context and aims to provide a structured framework for policymakers to address the importance of technology and innovation as crucial inputs to the development strategies of their countries.

III. THE STIP REVIEW PROCESS

The STIP Review process is conceived as part of UNCTAD's broader, integrated approach to technical cooperation in the field of STI that goes from the diagnosis of a country's innovation systems to the design and implementation of capacity-building programmes that address specific STI gaps. When the STIP Review leads to the identification of capacity-building needs in a particular area, an action plan is proposed and UNCTAD works with the concerned government to put together a set of technical cooperation activities based on it. For this, UNCTAD can draw on internal expertise in areas such as STI policy, the trade and development aspects of information and communications technologies (ICTs), intellectual property rights and transfer of technology, foreign direct investment, entrepreneurship development and others.

In this regard, it is important to ensure that awareness about the potential contribution of technology and innovation to national development, as well as about its

challenges, exists among the country's policymakers and other stakeholders. The implementation process of the STIP Review itself represents an important opportunity to achieve this and it is therefore crucial that the STI players involved in the Review are well familiarized with the STIP Review process and fully engaged in it.

A. Purpose

The first purpose of a STIP Review is to enable the STI stakeholders of the concerned country to establish a diagnosis of their NSI and to assess the extent to which existing STI policies promote its functioning and development. The STIP Review process is also intended to raise awareness and to stimulate a policy dialogue among stakeholders about the role of STI in national development and to encourage the emergence of stronger linkages among the STI players. Furthermore, a key goal of the STIP Review process is to identify practical actions that favour technological capacity-building (the capacity to generate, absorb and diffuse knowledge and to create and support dynamic linkages and learning processes among STI stakeholders) and the strengthening of their innovation capabilities (the practical and productive materialization of science and technology into socially or commercially valuable products and services).

In line with UNCTAD's institutional mandate on economic development, the STIP Reviews consider innovation policies in the overall context of the development of productive capacities and the structural transformation of the economy. Policies are reviewed from a strategic and long-term development perspective and in concert with overall development policy. The STIP Review thus provides a basis for national action and for the design of technical cooperation packages to enhance the knowledge base, improve technological capabilities and strengthen innovation performance.

B. Outcome

The main material outcome of the STIP process is contained in a STIP Review report that is published by UNCTAD. The report includes a diagnosis of the NSI, an assessment of the STI policies in place, and is normally complemented by in-depth studies of specific sectors, institutions or STI-related problems that are of particular relevance to the country under review. The report includes a number of recommendations that aim to:

- Improve policy formulation and implementation, including through an improved national dialogue in the area of STI;

- Develop stronger linkages and more effective interactions among the players in the NSI;
- Identify measures that encourage the development of absorptive capacity by the various actors in the NSI and facilitate the transfer of technology through international trade, investment and other channels of transfer of technology;
- Identify specific short-, medium- and long-term actions that can lead to stronger technological capabilities across sectors and measures to promote sectors of specific potential for technological development.

The STIP process takes into account the fact that, in many developing countries, government agencies are the crucial catalysts of economic development and have a lead role in providing institutional coordination and leadership on STI to promote the development of technological capabilities. Thus, the recommendations necessarily focus on the STI policies that would be under the purview of the relevant ministries and other governmental institutions. While some of the analysis will be sector-specific, often there will be a need for cross-sector measures to create an environment conducive to innovation and growth. Typically, foremost among these policy tasks is fostering and strengthening human capital development.

The outcome of the STIP Review normally includes a road map or action plan intended to provide the government and the stakeholders with options for the practical implementation of the recommendations formulated in the STIP Review report. On the basis of the recommendations and the action plan, UNCTAD and the national counterpart may cooperate in the definition of specific technical cooperation activities that constitute the practical follow-up to the STIP Review and that address the capacity gaps or other problem areas identified through the STIP Review.

More details about the structure, approach and coverage of the STIP Review report are provided in section IV below.

C. Stakeholders' participation and country ownership

The STIP Review process is an inclusive exercise whereby the views of a large number of development stakeholders are requested and considered. These include government officials from a broad spectrum of ministries and agencies (such as science and technology, education, economy, industry, agriculture, trade, development planning, finance, health, enterprise development, invest-

ment promotion, export promotion, competition authorities, among others), entrepreneurs (both small and medium-sized enterprises and larger enterprises), universities and other education institutions, research centres, and non-governmental organizations. The full involvement of the national counterpart designated by the government is crucial for the success of the STIP Review. Therefore, close consultations and cooperation are maintained with the counterpart throughout the process. A strong effort is also made to reach out to all the relevant stakeholders through an extensive programme of round tables, interviews and workshops at the various stages of preparation and implementation of the STIP Review.

Cooperation with the United Nations Country Team is systematically sought. Efforts are made to secure the consideration of STI policy issues and related capacity-building in the framework of national UNDAFs. Early in the STIP Review process, contacts are also established with other development partners who may be interested in supporting the implementation of its outcome.

D. The process

The STIP Review process takes place through a series of consecutive phases as described in figure 2, which go from the launching of the Review to report preparation, dissemination, implementation and long-term assessment.

1. Launching the STIP Review

The STIP Reviews are undertaken at the official request of United Nations member States. Therefore, the first step to launch the STIP process is the formulation by the Government of an official written request addressed to the Secretary-General of UNCTAD. High-level political commitment is essential for the success of any policy review exercise. This is normally signaled by a ministerial level endorsement of the request for a STIP Review, preferably including the support of those ministries with significant roles in STI policy, such as Science and Technology, Education, Industry, or Economy.

The official request should identify the main counterpart of the UNCTAD secretariat for the implementation of the STIP Review. The identification of a strong, credible national counterpart is a critical step for the success of the process and for ensuring long-term impact. It is therefore strongly recommended that careful consideration be given by the national authorities to their choice. Ideally, this role should be assigned to an institution with sufficient human resources to provide sustained support and collaboration during the STIP Review process. Its leadership

should enjoy access to policymakers at the ministerial level and have widespread contacts among STI stakeholders, including the private sector.

Another measure that helps to ensure a high-quality STIP Review process is the inclusion in the official request of a brief issues note outlining the specific questions to which the STIP Review process is expected to help develop a response and formulating what are the Government's expectations in terms of the contribution of the STIP Review to ongoing national STI policy processes.

UNCTAD's STIP Reviews are extrabudgetary activities. Therefore, before substantive activities can be launched, funding for the exercise needs to be identified. When funding is not immediately available, the secretariat will assist the authorities of the requesting country in securing the necessary funds. In 2009–2010 the cost of a typical STIP Review was in the region of \$150,000.

2. Definition of the terms of reference and establishment of the STIP Team

Once approved and funded, the review process begins with the preparation of draft Terms of Reference (ToR) of the STIP Review by the UNCTAD secretariat. A first preparatory mission may be undertaken to agree on the ToRs, which define the thematic scope and specific content of the STIP Review and establish a common understanding about its objectives and expected outcome. The scope and content of the review is tailored to fit the country's circumstances and priorities, including its productive structure and key development challenges. At this stage, agreement is reached about the respective roles and responsibilities of UNCTAD and the national counterpart. The optimal timing for the implementation of the review is determined, including the consideration of any political calendar issues, reforms in institutional structures or legislative changes that may affect the STIP Review. An implementation schedule including field missions, national workshops and the publication and dissemination of the outcome of the STIP Review is also agreed upon.

On the basis of the ToRs a STIP Review team is put together. The STIP Review team is led by UNCTAD staff and includes STI experts from UNCTAD and other United Nations agencies that may have been identified as relevant for the particular review,⁷ as well as a small number of leading academics. A systematic effort is made to include in the team national STI expertise.

⁷ STIP Reviews have been implemented in cooperation with UNESCO, the Economic Commission for Latin America and the Caribbean and the World Bank.

In parallel, the national counterpart is strongly encouraged to put together a national STIP Review group in which representatives of the major ministries with a role in STI and other key STI stakeholders are represented. Their engagement in the process facilitates project visibility, contributes to the continuity of the process, helps address concerns that may emerge about threats for institutional mandates or resources that may emerge from the STIP Review process, and facilitates a broader dissemination of the outcome of the STIP Review. It is recommended that the national STIP Review group prepare a brief (10–20 pages) self-assessment of the major STI capacities and policy challenges confronting the country and the group's expectations and perspectives about the STIP Review. This document can provide the starting point for the discussion of the STIP Review team with national stakeholders and can be included in the final STIP Review report. An introductory workshop with stakeholders in the context of which a quick innovation survey is conducted among key stakeholders may be implemented at this stage.

3. Research, analysis and preparation of the STIP Review report

Field missions (typically two missions of duration of two to three weeks over a period of three to five months) are organized to allow the STIP Review team to collect information and data about the key STI issues and players, to conduct interviews with an extensive representation of the country's STI actors and to carry out site visits. The outcome of the missions, together with desk research, provides the content of a draft STIP Review report that is submitted to the national counterpart for comment.

Often, implementing the outcomes of policy review exercises requires a change of institutional culture and operational habits. To this extent, the STIP Review process necessarily engages local STI stakeholders at every step of the way, particularly the development of the final outcome and conclusions. A revised draft STIP Review report is therefore presented and discussed in a national workshop with national STI stakeholders. The workshop provides an opportunity to openly discuss and validate the information and to receive feedback about the analysis and the recommendations reflected in the STIP Review report. Equally important is the fact that the STIP Review workshop often becomes an opportunity for the establishment of a longer-term national dialogue about STI policy. Experience indicates that launching such processes can facilitate the inclusion of STI policy

considerations in broader strategic national development discussions and planning.

A strong effort is made to facilitate national ownership by ensuring the fullest possible involvement of the national counterpart throughout the preparation of the report. The final STIP Review report, which takes into account the field missions' research as well as the outcome of deliberations with policymakers and STI stakeholders, including those of the national workshop, is prepared by the UNCTAD secretariat for publication at the end of this phase.

4. Publication and dissemination

The report is published under the exclusive responsibility of the Secretary-General of UNCTAD, and its findings and recommendations are not binding. However, the whole process is designed to encourage strong national ownership of its outcome. The presentation of the report at the annual session of the CSTD, normally with the participation of ministerial level representatives from the client country is an important step to achieve this.

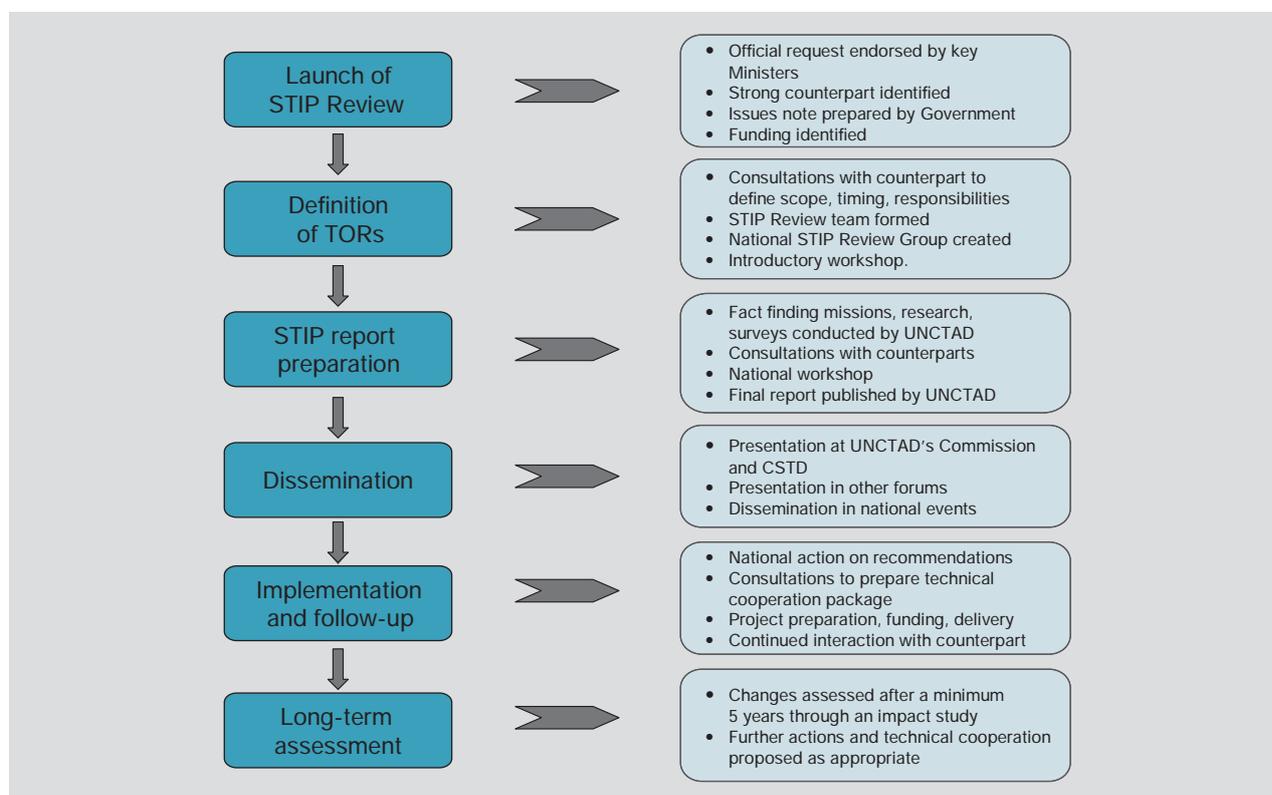
The CSTD is the top global forum for science and technology for development, and provides the General Assembly and the Economic and Social Council of the

United Nations with high-level policy advice. The presentation of the report at the CSTD enables Governments to benefit from a discussion of their main concerns and to share experiences in the area of STI with world-class experts. It also provides a forum in which the Government can give visibility among development partners to its plans in the area of technology and innovation and to launch proposals for technical cooperation to implement the STIP Review recommendations. With the agreement of the Government, the STIP Review may also be presented in other intergovernmental bodies of UNCTAD, such as the Investment, Enterprise and Development Commission, as appropriate.

Efforts are also made to disseminate the report in other appropriate forums in order to ensure that the policy analysis and research is shared with the broadest audience of STI peers and policymakers.

The presentation of the findings and recommendations in the United Nations intergovernmental bodies concludes the research, analysis and discussion phase of the STIP Review process and marks the beginning of the implementation of follow-up activities that are presented in section five.

Figure 2 The STIP Review process



IV. THE STIP REVIEW REPORT

The STIP Review process is based on the notion that innovation is an intrinsically systemic process. STIP Reviews therefore focus on the analysis of the agents, networks and interactions within a country's innovation system, and the socio-economic, institutional and cultural environment that shapes and facilitates (or hampers) its operation. STIP Reviews also aim to identify policies and practices that favour STI capacity-building and integrate these in the overall national development policy. The outcome of the STIP process is documented in the STIP report. The report is structured in a manner that allows for country-specific study of STI policy and practice. In addition, the STIP report's structure maintains sufficient consistency across different country reviews to allow for cross-country comparability of policy experiences.

A. Conceptual framework

The systems approach to innovation provides the basic conceptual framework for the production of STIP Reviews. The NSI intrinsically cuts across many institutional boundaries and involves a variety of links inside and among many different actors which may take quite different shapes across countries. The NSI is therefore necessarily complex and difficult to characterize by assessing its conformity with any particular model. This is all the more so in the case of developing countries, in which elements that could integrate an "ideal" description of an NSI are either immature or non-existent, and the nature, conditions and dynamics of innovation tend to be significantly different from those found in advanced economies. It is also important to clarify that the STIP Review process uses the NSI concept as an analytical framework to better understand the dynamics of innovation processes in the country under review. It does not constitute a normative framework that specifies how the innovation players and their relationships should be configured in a particular country.

The characteristics and needs of emerging innovation systems are not the same as those of NSI geared for innovation at the frontier. For countries at an early stage of development the NSI needs to prioritize the ability to access, absorb, adapt and diffuse technology, in most cases of foreign origin. Accordingly, the emphasis in the analysis of the STIP report is placed on the development of broad innovation capabilities among economic actors, as opposed to merely strengthening R&D or some par-

ticular advanced technical capabilities. The aim may not necessarily be to attempt to develop a full-fledged NSI in the short term, but rather to improve absorptive capacity and to facilitate the emergence of local and sectoral innovation subsystems that can integrate later into a NSI. The Review should thus help policymakers understand how policies addressing systemic failures (coordination and networking problems, infrastructural deficiencies, rules and regulations, incentives and disincentives) and building capabilities among the various NSI players can enhance technology absorption. The discussion in the STIP report also avoids unnecessarily technical or academic analysis and abstract language. It concentrates on identifying the key policy issues and generating practical policy recommendations and options for action.

B. Structure of the STIP Review report

The typical structure of a STIP Review report consists of an introductory chapter, a chapter dealing with the NSI, one or more chapters of analysis at the sector level, and a closing chapter that presents the key recommendations emanating from the STIP Review.

The introductory chapter presents the overall context of the development process of the country under review, including its major socio-economic features, an account of its recent macroeconomic performance and a review of the human, economic and technological resources available in the country. The role of STI policy in the overall development strategy of the country and any specific features of innovation activities in the national context are also discussed.

This is followed by a chapter that documents and assesses in detail the main features of the country's national system of innovation, including its main actors, the capabilities available, the linkages among the major players, their sectoral integration, the framework conditions, the main STI policy instruments being used and the STI governance arrangements in place.

Typically, the report also includes a variable number of chapters (two or three) that provide a more detailed analysis of STI in selected sectors or subsectors (for example, agroindustry or energy). These studies may also address a specific technological theme (for instance biotechnologies) or a combination of a sector and technology theme (ICT in education). Sectoral studies allow the identification of key STI issues that affect the competitiveness of industries and sectors where local firms can most improve their competitiveness. Horizontal as

well as forward and backward linkages among sectors can indicate where synergies can be achieved and where focused STI policies can have the broadest positive effect. Sectoral studies also document the country's existing or potential windows of opportunity in terms of using trade and investment links to optimize technology transfer flows.

A final chapter summarizes the key findings of the report. Typically, the report presents a combination of long-term, systemic proposals for action (including in terms of options for the consideration of policymakers) and more specific, short-term actions (such as legislative changes). This may be presented in the form of a proposed plan of action or roadmap that can provide the basis for the implementation and follow-up phase that is discussed in section V below.

Although most STIP Reviews conform to this structure, there is no fixed, predetermined template. A certain amount of structural flexibility allows for the consideration of specific national objectives underlying a particular STIP Review. For instance, recent STIP reviews have focused on the analysis of institutional structures and STI linkages, leaving out sectoral studies. The balance between the analysis of the NSI as a whole and that of sectoral innovation systems may also depend on the size and level of development of the country. For smaller economies or for many least developed countries, the study of the general issues confronting the NSI may be more relevant. For larger or more developed economies, the analysis of the innovation systems dynamics in specific industries may be more useful.

Pragmatic considerations are fundamental in the definition of the scope and content of each individual STIP Review. Priority is given to analysing those STI problems in which a greater need for policy advice is identified in the preparatory phase of the STIP Review and those sectors and issues that are considered to be of high priority by national stakeholders and for which STI can play a useful role.

C. The question of STI indicators

STI indicators that describe inputs (such as human capital and financial resources), outcomes and impact on social and economic development of the innovation process are essential for effective policy formulation, implementation, monitoring and assessment. The lack of useful and reliable indicators in many developing countries presents

a serious difficulty for all aspects of STI policymaking, and also for the preparation of STIP Reviews.

The measuring of the inputs to STI processes usually focuses on the extent of R&D activities as the key activity that increases the national stock of knowledge and endogenous capacities for innovation. The results are often measured by the number of scientific publications and patents. Such indicators are useful but have drawbacks as well. They give an important indication of the principal areas of scientific knowledge development and can indicate potential areas for international collaboration. However, they do not reveal the relevance for development of a particular process or activity. In addition, much innovation taking place in developing countries does not result in patents, as it concerns products or processes that are only new to the firm or industry but not novel in general. Indeed, minor adaptations that can play an especially crucial role in developing countries and may yield enormous benefits are not necessarily patented or patentable. Given these limitations, it is important to backstop any available data and contextualize it against the specific STI realities and policy environment in the country under review.

Regarding data on innovation outcomes, these can be collected through periodic innovation surveys. Information needs to be gathered on firm-level innovation activities, including not only technological innovation but also organizational innovations. It is important to objectively assess the barriers to innovation and surveyed companies need to be queried on issues such as access to financing for innovation and access to and cost of training in order to build technological absorption capacities. Again, the reality in many developing countries is that, given overall resource limitations in national statistical offices, such surveys can be justified only when STI policy is considered at the highest strategic level as being a critical component of overall development policy.

Although the importance of innovation surveys must be stressed, the STIP Review methodology needs to acknowledge the fact that, in many developing countries, innovation surveys are not easily available, which in itself is an indication of the weak position of innovation in national policy agendas. Alternative methods to obtain information on key innovation dynamics in the country must be used in many cases. They can include in-depth structured interviews with key players, or the implementation of a quick innovation survey among selected policymakers and other stakeholders. Obtaining quantitative

information is not necessarily the most relevant goal of these exercises. Case studies providing easy-to-grasp qualitative information can also be extremely important in order to credibly document the problems and present them in a manner that generates momentum for change

V. IMPLEMENTATION AND FOLLOW-UP

The dissemination among national stakeholders of the findings and recommendations of the STIP Review report is intended to start a process of change in the country's STI policy approaches and structures. Typically, an action plan or road map is proposed in the STIP Review report that can be the catalyst for that process. As the government, with the involvement of other STI stakeholders, considers the policy options and recommendations formulated in the STIP Review, UNCTAD seeks to remain engaged in continued interaction with the STIP Review counterparts to provide technical support and advice.

Often the recommendations contained in a STIP Review can be undertaken directly by the Government once their implications have been understood and accepted. This can refer, for example, to relatively simple legislative changes, funding mechanisms, or improved STI governance arrangements. In this case, strong Government commitment, expressed for example by the adoption of an action plan with specific deadlines, can deliver positive results. However, in other cases the STIP Review will reveal systemic weaknesses whose treatment may require complex reforms or concern specific issues where there may be a need for specialized technical assistance, such as reforming the intellectual property regime, strengthening capacity to collect and analyse STI indicators, putting in place technology extension services, implementing programmes to facilitate collaboration among universities and firms, devise entrepreneurship promotion programmes that include innovation aspects and others. UNCTAD's expertise in many areas of economic development policy can be drawn upon to design specific technical cooperation activities to facilitate the implementation of these recommendations. The likelihood of a long-term impact from the STIP Review can increase if the planning and launching of follow-up activities takes place at an early stage in the process; this may be even before the publication of the report of the STIP Review. The secretariat will work together with the national counterpart in order to identify sources of extrabudgetary funding that enable the delivery of the proposed technical cooperation activities.

When funding is available, the experience of similar policy review exercises undertaken by UNCTAD, such as the Investment Policy Reviews, indicates that conducting a stock-taking exercise about five years after the publication of the Review is advisable. In that case, a team from UNCTAD undertakes a mission to evaluate the extent to which the recommendations have been implemented, the impact that they have made and the extent to which further action may be needed, in view of the evolving development challenges of the country.

VI. CONCLUSION

The STIP Review programme is the most practical expression of UNCTAD's vision of science, technology and innovation as fundamental components of sustainable development strategies. The programme has succeeded in raising awareness about the need to better integrate STI into national development strategies and policies and has helped trigger change processes that could put a number of developing countries on a path of faster technological learning and catch-up.

An external evaluation of UNCTAD's activities in the area of STI conducted in 2011 found that feedback from the countries where STIP reviews have been completed was very positive. For example, the evaluators found that the STIP Review recommendations provided a guide for the preparation of a new national STI policy in Ghana, an implementation plan for it and a World Bank-financed project for skills and technology development. In Lesotho, both the national counterpart and the United Nations country team have written to UNCTAD to indicate how the STIP Review process has directly contributed to an improved understanding of the strategic role of STI and to the articulation of national STI policies.

Leaving aside the expertise of the UNCTAD regular staff assigned to it, the STIP Review programme is entirely dependent on the availability of extrabudgetary funding. Six of the seven STIP reviews implemented between 2007 and 2011 have been funded through the United Nations Development Account, the remaining one having been funded by the UNDP country office.

Many Governments recognize the strategic nature of STI as a powerful driving force of economic change, growth and development. This recognition could become the basis for a reinforcement of the attention paid to issues of knowledge and STI in international cooperation

programmes and budgets. A useful point to start could be the more systematic inclusion of STI questions in the documents, such as the UNDAFs, around which technical cooperation plans are increasingly conceived. In this context, it is hoped that this publication will help to im-

prove the perception of the need to enhance STI capacity in developing countries as an essential contribution towards providing effective answers to today's major development challenges.

ANNEX

STIP Reviews implemented by UNCTAD and pending requests

STIP Reviews implemented by UNCTAD:

Angola (2008)
Colombia (1999)
Dominican Republic (2011)
El Salvador (2011)
Ethiopia (2002)*
Ghana (2010)
Islamic Republic of Iran (2005)
Jamaica (1999)
Lesotho (2010)
Mauritania (2009)
Peru (2010)

Pending requests as of September 2011:

Ecuador
Iraq
Kenya
Pakistan
Papua New Guinea
Philippines
Sudan

* This study was a hybrid *Investment and Innovation Policy Review* covering both investment and innovation.

REFERENCES

Edquist C and Lundvall B-A (1993). Comparing the Danish and Swedish Systems of Innovation, in Nelson, RR (ed.) *National Innovation Systems; A comparative analysis*. Oxford University Press, Oxford.

Freeman C (1987). *Technology and Economic Performance: Lessons from Japan*. Pinter, London.

Lundvall B-A (1988). Innovation as an interactive process: From user-producer interaction to the National System of Innovation, in Dosi G, Freeman C, Nelson RR, Silverberg G and Soete L (eds.). *Technical Change and Economic Theory*. Pinter, London.

Lundvall B-A (1992). *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning*. Pinter, London.

Metcalf J (1995). The economic foundations of technology policy: equilibrium and evolutionary perspectives. In Stoneman, P (ed.), *Handbook of Economics of Innovation and Technology Change*. Blackwell, Oxford.

Nelson RR (ed.) (1993). *National Innovation Systems: A Comparative Analysis*. Oxford University Press, Oxford.

Nelson RR and Rosenberg N (1993). Technical Innovation and National Systems, in Nelson, RR (ed.), *National Systems of Innovation: A Comparative Analysis*. Oxford University Press, Oxford.

Niosi J et al. (1993). "National Systems of Innovation: in search of a workable concept". *Technology in Society*, 15 (2): 207-27.

OECD (2005). *Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data*. Organization for Economic Cooperation and Development, Paris.

Patel P and Pavitt K (1994). The Nature and Economic Importance of National Innovation Systems. *STI Review*, 14: 9-32, OECD, Paris.

UNCTAD (2007). *The Least Developed Countries Report 2007: Knowledge, Technological Learning and Innovation for Development*. United Nations publication. Sales No. E.07.II.D.8. New York and Geneva.

UNCTAD (2010). *Technology and Innovation Report 2010: Enhancing Food Security in Africa Through Science, Technology and Innovation*. United Nations publication. Sales No. E.09.II.D.22. New York and Geneva.

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