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## The role of capacity-building for supporting pro-poor science, technology and innovation policies

**Note by the UNCTAD secretariat**

*Executive summary*

This note explores policies to establish an environment conducive to increasing productivity and competitiveness of the enterprises of developing countries and, in the process, generate the employment and income needed to reduce poverty and promote economic growth. It identifies some fundamental elements of an enabling science, technology and innovation (STI) environment for poverty reduction and highlights several key lessons learnt in STI policymaking. Attention is paid to small and medium-sized enterprises (SMEs) as well as microenterprises and, in this regard, the note should be read in conjunction with the background note on Key elements of entrepreneurship policy (TD/B/C.II/MEM.1/2).

Three particular aspects are discussed: (a) means to improve understanding of the role of STI policies to generate the wealth and income needed to reduce poverty; (b) best practices in promoting the general technological upgrading of enterprises and the development of technology-based businesses to support poverty eradication; and (c) opportunities available to enhance the regulatory framework of STI, to facilitate access to knowledge and transfer of technology, including through the promotion of open access approaches.

Contents

## Introduction

1. This note examines effective ways to apply STI capacity-building to increase productivity, innovation and competitiveness of enterprises in developing countries and, in the process, reduce poverty and promote development. In this regard, it should be read in conjunction with the background note on Key elements of entrepreneurship policy (TD/B/C.II/MEM.1/2). The note highlights, in particular, lessons learnt in STI capacity-building, through, inter alia, technology transfer, to help countries establish an environment to generate the employment and income needed to reduce poverty and promote economic growth. The note presents countries with different options to help their enterprises innovate and achieve technological upgrading. It suggests a number of issues to be addressed by the experts at the first multi-year expert meeting, and provides background analysis and information thereon.

2. Historically, STI has played a fundamental role in the acceleration of economic growth, leading to higher per capita incomes and a reduction of poverty. Developing countries with low scientific and technological capacities face a huge cost in terms of lost opportunities to address their most basic development needs. Building STI capacity must therefore be an integral part of strategies and policies aimed at the achievement of the Millennium Development Goals. More generally, there is growing recognition of the need for poverty reduction agendas to incorporate a strong component of interventions that aim at the reinforcement of STI capabilities in developing countries.

3. Building capacity in STI involves interventions around five key areas of a national innovation systems: (a) supporting the development of STI policies and institutions; (b) encouraging technology-based businesses and the overall technological upgrading of enterprises; (c) creating an enabling regulatory framework, that among others, encourages the transfer of technology; (d) promoting STI human resources development; and (d) making available basic infrastructure and financial resources.[1] A national system of innovation is largely described by the roles and relationships of the different actors – including enterprises, education and research institutions, policymakers or intermediate organizations – involved in STI. Therefore, from the perspective of the national innovation system, STI capacity-building initiatives should look at enhancing the ability of a wide range of stakeholders to generate, access, adapt and apply knowledge to a particular context and at how the relationships among different actors can be strengthened. In this approach, STI capacity-building goes beyond the provision of training and encompasses the strengthening of capabilities, resources and institutional opportunities to use, generate and, above all, benefit from STI knowledge.

4. This note considers STI capacity-building as an instrument to promote economic growth and reduce poverty that works through interventions targeting, in particular the more disadvantaged countries and communities. It identifies the fundamental elements of an enabling STI environment for poverty reduction and several key lessons learnt in STI policymaking, including available policy options and best practices, to build national pro-poor STI capacities.

5. Pro-poor STI can be defined as a system of innovation that enhances the ability of poor women and men to participate in, contribute to and benefit from STI. Consequently, building pro-poor STI capacities involves the development of the capacities to generate, access, adapt and apply knowledge to the particular context of people living in poverty. In other words, it means enhancing the ability of people living in poverty to participate in the development of and benefit from science,

[1] United Nations (2005).

technology and innovation. While there have been important and crucial science and technology developments and innovations, these have not necessarily benefited countries or groups of people in economic and socially disadvantaged positions. For example, sub-Saharan Africa has largely missed the opportunities of the green revolution. Scientific plant breeding programmes have provided limited benefits both because of the limited adoption of improved varieties due to broader infrastructure conditions as well as because of generation issues, that is, the limited appropriateness of technological development to local context given that "progress in developing varieties that perform well under drought, heat, flood, and salinity has generally been slower than for pest and disease resistance".[2] In the health sector, only 1 per cent of new compounds marketed in the last 30 years targeted developing world diseases.[3]

6. Moreover, current data indicate that this trend may be further accentuated in the generation and use of newer technologies such as biotechnologies. Data from genetically modified crop field trials in the United States and in Europe show that limited research is done on traits of high relevance to developing countries (such as on stress resistance to drought temperature or poor soils) and on plant varieties commonly grown in sub-tropical and tropical climates.[4]

7. Pro-poor STI policies should aim at addressing the identified problems of adoption and generation of appropriate technologies. Supporting and building pro-poor STI policies and institutions involves developing institutions – that is, the norms, rules, customs and routines – that effectively support pro-poor STI, aligning STI policies with national poverty reduction strategies and fostering an inclusive and participatory approach in the design and management of STI policies and interventions.

8. Encouraging technology-based businesses and the overall technological upgrading of enterprises to support poverty eradication involves broader policies to set an enabling business environment that facilitates technology transfer and supports innovation, thus leading to increased productivity, particularly in sectors of interest to disadvantaged communities, as well as specific interventions to support social entrepreneurship in technological sectors.

9. To create an enabling regulatory framework that serves the needs of people living in poverty, Governments should favour policies that facilitate access to knowledge and technology transfer. Intellectual property right (IPR) systems can prevent access to valuable research to those that cannot afford to pay the necessary licenses to conduct research and/or to distribute the technology. Four complementary approaches[5] to support improved knowledge access can be distinguished:

(a) Promoting at the global level improvements to the IPR system to reflect the needs and constraints of countries at different stages of development;

(b) Utilizing to the maximum extent the flexibilities within the existing IPR system;

(c) Supporting alternative systems that promote public commons and that can coexist with existing IPR regimes, in particular open source approaches; and

(d) Providing/seeking incentives to promote research and development (R&D) in neglected areas essential for developing countries.

[2] World Bank (2008).
[3] Shetty (2005).
[4] Arundel (2002).
[5] UNCTAD (2007b).

10. Promoting pro-poor STI human resources development involves aligning human resources development policies to support the above pro-poor STI strategies, promoting policies that address gender inequalities in science and technology training and careers and dealing with brain-drain concerns.

11. Making available basic infrastructure and financial resources for poverty reduction through STI involves supporting infrastructure development – particularly in a manner that is useful for technological learning and that addresses the disadvantages of rural communities – and using different financial mechanisms, including donor aid, to support pro-poor STI.

12. Because of space limitations, the following chapters highlight a few selected interventions for building STI capacities for enhanced enterprise competitiveness, economic growth and poverty reduction. The selected interventions fall within three of the five identified areas of STI capacity-building, namely, supporting the development of STI policies and institutions, creating an enabling regulatory framework, and encouraging technology-based businesses. Capacity-building interventions in the other two areas are, however, equally important. The note illustrates the issues with case studies and examples of capacity building interventions on technologies essential to developing countries, including health, agricultural, and information and communication technologies.

# I. Supporting the development of pro-poor STI policies and institutions

13. A prerequisite for the achievement of STI capacity-building is the establishment of appropriate policies and institutions. The key elements that support pro-poor STI policies and institutions, include: (a) developing a common understanding of how STI policies can best support poverty reduction; (b) encouraging effective relationships among different sets of actors to support pro-poor STI, including providing incentives for the private sector to develop and transfer of technology relevant to low-income countries and disadvantaged communities; and (c) addressing power imbalances in the design and management of STI policies and interventions by building the capacities of STI-based organizations with a strong pro-poor perspective, such as civil society organizations.

## A. Understanding pro-poor STI policies

14. To develop a common understanding on how STI policies best support poverty reduction, STI policy making must become an integral part of national development strategies and address the needs of different groups of technology users. However, as pointed out in UNCTAD's *2007 Least Developed Countries Report*, STI only peripherally appears in national poverty reduction strategy papers.[6]

15. Taking the example of information and communication technologies (ICTs) it is clear that technologies can support the productive capacities of those living in poverty. However, policymakers and practitioners face several barriers to supporting pro-poor ICT policies and practices.[7] Among others, the fact that international debates and commitments are not focused on ICT for poverty reduction, the cross-cutting nature of ICTs requires policymakers to understand both ICT and poverty reduction issues, scaling up successful best practices requires another level of commitment, and there is little incentive to coordinate ICT strategies and poverty reduction policies.

[6] UNCTAD (2007b).
[7] UNCTAD (2006).

16. To address these concerns, policymakers and practitioners can (a) promote a pro-poor focus in ICT research, policies, and interventions; (b) design and implement sound policies that adopt and adapt best practices; (c) carry out poverty and gender analysis of ICT policies and programmes; (d) collect data disaggregated by sex, age, education and location to identify who is benefiting or not from ICTs; (e) support local Governments and sectoral agencies adopting pro-poor ICT polices and practices; and (f) support approaches that enable the poor to be heard and to participate.

17. Governments looking at creating awareness and building pro-poor ICT capacities, both at policy and programme levels, can use UNCTAD's framework to examine to what extent specific ICT policies or programme are pro-poor.[8] The framework helps policymakers understand, question and propose pro-poor ICT interventions by questioning 12 key areas for meeting the needs of the poor. Box 1 provides more details on this framework.

**Box 1. Twelve key areas to ensure that ICTs benefit those living in poverty**

| | |
|---|---|
| **C**onnectivity | Can people living in poverty access and afford ICT? |
| **C**ontent | Can women and men access content and use it to meet their needs? |
| **C**ommunity | Who benefits from the policy/programme? |
| **C**ommerce | Does the policy/programme support economic activities? |
| **C**apacity | Do the organizations involved have the capacity to implement the programme? |
| **C**ulture | Is there a supportive culture for using ICTs for poverty reduction? |
| **C**ooperation | Does the cooperation among the different stakeholders support pro-poor ICTs? |
| **C**apital | Are there sufficient financial resources? |
| **C**ontext | Is the policy/programme adapted to the context? |
| **C**ontinuity | Could the ICT programme be scaled up? |
| **C**ontrol | Do beneficiaries have ownership of the policy? |
| **C**oherence | Is the ICT policy consistent with other poverty reduction policies? |

*Source:* Derived from UNCTAD (2006).

## B. Institutional incentives for pro-poor STI

18. Another avenue to promote the generation of technology relevant to poverty reduction is to create incentives for the private sector to develop technologies relevant to people in low income countries.[9] In recent years, the preferred approach has been the promotion of public–private partnerships (PPPs). Collaboration between the public and private sector can help overcome market failures by building on complementarities and sharing costs and risks. It is, nevertheless, important to examine the potential and shortcomings associated with PPPs, based on key lessons learnt, particularly in the area of STI.

19. A recent study of over 70 formal and informal collaborations in agricultural research between the Consultative Group on International Agricultural Research (CGIAR), a network of leader agricultural centres, and private partners highlights the potential of PPPs to support poverty reduction.[10] In general terms, the lessons

[8] UNCTAD (2006).
[9] For instance, the United Nations MDG Gap Task Force Report has highlighted this approach among its key recommendations to address the lack of essential medicines and access to technologies in developing countries.
[10] Spielman et al. (2007).

drawn indicate that, to build capacities through partnership agreements, partners should strengthen:

(a) The basis on which partners collaborate, including the agreement of mutual objectives and the assignation of roles and responsibilities;

(b) Their resource commitments, both on the specific activities of the partnership and on the coordination of the partnership;

(c) The exchange of implicit knowledge in order to promote joint innovation;

(d) Benchmarks and decision points to evaluate and review progress; and

(e) Risk management, including formal legal and financial strategies and informal strategies to enhance support for the project.

20. More importantly, the above-mentioned study estimates that these PPPs benefit research funding but are not sufficient to reduce poverty. To build the pro-poor dimension of PPPs, partners ought to thoroughly identify the pro-poor potential of a given intervention through *ex-ante* poverty impact analysis, and pledge their support to poverty reduction. Two key areas determine the potential impact that a PPP will have on poverty reduction. First, the choice of the collaboration subject. For instance, the choice of crop in an agricultural research collaboration has a direct effect on who will ultimately benefit from such research – that is, whether it will support the small-scale producers or food insecure consumers or benefit larger farmers or corporate agriculture. The second main determinant of the impact of a PPP is the choice of partners and the level at which the partners operate. In PPPs, the "private" partner can also be a non-governmental organization (NGO) and/or they may be tripartite, including public institutions, private companies and NGOs. PPPs will have a more solid pro-poor approach the stronger the participation of partners with a pro-poor vision is and the more extensively their comparative advantage is used.

21. In both cases, to ensure that PPPs are pro-poor and identify the right interventions, a poverty impact analysis must be carried out. For example, the report recommends that *ex-ante* poverty analysis should be carried out to assess the wider impact that the exclusive licensing of seed technologies, or the sale of potential technologies through market segmentation, (i.e. at subsidized rates for poor clients and market rates for others) will have on the technologies price and market performance before committing these partnership modalities. The study also points out that organizations with a primary objective to support poverty reduction should prioritize PPPs in key poverty subjects least likely to be covered by other players. For instance, the report recommends CGIAR to focus on poverty-oriented research for which financial support is not forthcoming instead of conducting research on high-value crops for which alternative suppliers of research exists.

## C. Strengthening STI governance

22. To establish an environment that generates the wealth and income needed to reduce poverty, it is necessary to examine the governance of STI policies and interventions, including understanding who controls innovation processes and priority setting and from which perspectives. Power relations have a direct effect on the design and outcomes of STI policy and interventions. Budget differences among different groups of players – for instance, in the agricultural field the five largest multinational companies spend $7.3 billion per year on agricultural research, 18

times more the budget of CGIAR[11] – have a direct impact on their ability to control innovation processes and STI priority setting.

23. In addition to budget disparities, the ability to express different perspectives on the role of STI also has a bearing on the governance of STI. Involving citizens in the governance of STI, for example through supporting citizen participation on STI commissions, can help raise awareness and facilitate priority-setting in STI policies to support the lives of ordinary citizens, as well as build broader support for controversial STI issues. Another approach to link better science and technology with the needs of people living in poverty is to increase awareness among scientists and policymakers on the needs of underprivileged citizens. In Uganda, Makarere University has established an internship programme for its Masters in Public Health students that offers students the opportunity to experience life as a public servant in one of Uganda's outlying areas and to engage first-hand with health issues as felt in poor rural communities.[12] Other programmes (e.g. the World Bank's Grass Roots Immersion programme) encourage senior officials to live and work a few days with families in poorer communities, with the aim to help fold poor people's perspectives into policy and practice at the highest level.[13]

24. Strengthening the capacity of STI of civil society organizations to support rural innovation involves a stronger effort to develop pro-poor STI capacities than involving civil society organizations in the dissemination of technology. While public programmes involving NGOs to deliver technology interventions (e.g. pest management and vaccination campaigns) can successfully help disseminate crucial technology applicable to different contexts, programmes designed with the objective of developing the capacities of STI civil society organizations have the added potential of fostering the generation and use of STI knowledge relevant to specific contexts, stimulating local innovation, and increasing the ability to adapt to changing needs.

25. For example, in India, the Science and Technology Applications for Rural Development programme of the Department of Science and Technology is a programme that aims at build the capacity of STI-based NGOs to develop not only technology interventions but also to make linkages with research organizations, in order to support research efforts that bring rural innovation.[14]

26. To effectively promote innovation relevant to low-income communities, capacity-building programmes, including agricultural extension programmes, should move their focus from supporting the dissemination of technology to supporting interaction among different stakeholders along the different stages of innovation, from conception to dissemination and adoption.[15] Lessons learnt from an innovative livelihoods support programme in poor communities of Orissa, India, noted the importance of moving from a linear conception of extension services that focused on dissemination of technology (mainly through training) to a system approach that builds capacity by supporting a platform for different actors to interact.[16] Experience showed that the ability to incorporate different partners with complementary assets, knowledge and skills (including technical, marketing and social mobilization) along the different phases of the project, enjoying a space for learning and experimenting rather than being tightened by institutional rigidities, and keeping a pro-poor focus – in terms of the intervention area, donor focus, engagement with a local NGO and focus on capacity development rather than

[11] Leach and Scoones (2006).
[12] Ibid.
[13] Ibid.
[14] United Nations University (2005).
[15] Sulaiman et al. (2006).
[16] Ibid.

technology adoption) – make a difference when building the innovative capacities of low-income communities.

# II. Encouraging the development of technology-based businesses and the overall technological upgrading of enterprises

27. This chapter describes two approaches for encouraging technology-based businesses that support income generation and poverty reduction. First, it looks at general approaches to promote the technological upgrading of enterprises, including technology transfer, to foster increases in productivity. Secondly, it provides examples and lessons learnt from specific capacity building interventions to support social entrepreneurship in technological sectors.

## A. Promoting the technological upgrading of enterprises

28. Creating an enabling environment for SMEs to conduct their activities is the single most important approach to support SME innovation. Policies that facilitate the development of a basic infrastructure, encourage efficient competition, provide a stable regulatory framework and a sound financial system, and support the development of human resources skills provide a more enabled environment for SMEs to use technology to conduct economic activities and to innovate.

29. Measures to encourage technology-based businesses include increasing the internationalization of the economic activities through increased foreign direct investment, trade in goods and participation in global value chains. However, particularly in the case of countries at earlier stages of development, the internationalization of economic activities does not automatically bring the benefits of technological spillovers and learning.[17] Businesses should be ready to seize such opportunities for technological learning. In this regard, Governments should consider putting in place specific programmes to develop the absorptive capacity of local SMEs and to strengthen their capacity to innovate. This requires four basic types of active policy and interventions: (a) skill development programmes; (b) business extension and technology services programmes; (c) access to finance and financial incentives; and (d) the promotion of national and international linkages among the different actors of the knowledge economy.[18]

30. Skill development programmes promote technical and managerial skills relevant to the economic activities of local SMEs. In this regard, sectoral training authorities jointly set up by the public and private sectors can support the development and certification of training curriculum relevant for technological enterprises. A comprehensive participation of the private sector in such sectoral training authorities can secure the relevance of the curriculum to business needs as well as the necessary financing. Any such mechanism should remain responsive to business sector needs (see South Africa case study in Meyer–Stamer, 2007).

31. Business extension and technology services programmes, rely on (a) technology intermediaries that facilitate the transfer and uptake of technologies; (b) business and technology incubators that facilitate the creation of technological SMEs; (c) logistic technology centres that support SMEs participation in global value chains; and (d) initiatives that encourage ICT uptake among SMEs. Technology intermediaries, often undervalued, provide key services to ensure the transfer of technology that meets the needs of businesses. Chapter 4 of UNCTAD

[17] UNCTAD (2007b).
[18] See OECD (2007) and UNCTAD (2007b).

(2007a) presents several examples of programmes being implemented in developing countries and that aim at SMEs and that combine the objectives of supporting innovativeness and accelerating the adoption of ICTs and e-business by smaller enterprises. Smaller and/or informal enterprises play a large role in developing economies but face particular challenges to benefit from technologies. Therefore, Governments may want to consider putting in place specific measures to facilitate the adoption of ICTs and e-business by smaller enterprises.

32. For instance, Governments could support innovative and productive uses of mobile telephony by adopting policies and supporting programmes that facilitate access to mobile phones and their economic applications (see box 2). This includes promoting regulation appropriate for conducting financial transactions through mobile phones and supporting initiatives that promote economic services and content suitable for mobile formats and supportive of the economic activities of local microenterprises.

**Box 2. Mobile telephone services and microfinance in Kenya**

Microfinance is the provision of financial services to poor people. Microcredit, micro-savings and micro-insurance are essential support services to enable poor people to trade and take part in the mainstream economy. Realizing the potential of mobile technology for extending financial services beyond urban areas, Vodafone/Safaricom in 2003 initiated a pilot mobile telephone-based project in Kenya. While the initial objective was to create efficiencies to reduce the cost of loan disbursement and recovery, the technology was found by users to be convenient for person-to-person transfers. Since early 2007, the project has been commercialized and is currently subscribed by more than 175,000 users.

To implement this scheme, Vodafone/Safaricom partnered with the Commercial Bank of Africa, Citibank, DFID-FDCF and the Faulu microfinance company to design and test the M-PESA micro-payment platform. M-PESA allows customers to use their mobile telephones like a bank account and debit card. Customers credit their accounts with their prepaid time vendor and can, in addition to spending their credit on calls and messages, transfer funds to another subscriber, or make small or micro-payments for goods and services without the need for cash.

See:

http://www.financialdeepening.org/default.asp?id=694&ver=1;
http://www.iht.com/articles/2007/07/08/business/micro09.php.

*Source:* UNCTAD (2007a).

33. SMEs in developing countries operating in more innovative sectors, such as ICT, face particular difficulties to access the necessary financing to scale up their activities because their financial perspectives are harder to assess and they have a higher risk profile as well as lower valued collaterals. A recent study of SMEs in the ICT sector of eight developing countries (Zavatta, 2008) shows important financing gaps for SMEs needing to raise between $50,000 and $1,000,000.[19] Generalist funds, including more development oriented funds, face limitations in assessing the particular risks and revenue potential of the SMEs in this sector. Hence the relevance of supporting special financing initiatives targeted at firms in innovation sectors, such as dedicated credit lines or credit guarantee schemes. Credit guarantee schemes can cover the greater financial needs of SMEs in development and expansion stage by mitigating the lack of sufficient financial track record required

[19] Zavatta (2008).

by commercial banks. While in Europe these schemes have played an instrumental role, in the countries surveyed in Zavatta (2008) the availability of credit guarantee schemes is generally limited.

34. When supporting financing initiatives, Governments may wish to consider demand-side constraints, in particular the limited capacity of technological entrepreneurs to obtain financial support or their apprehension to recourse to external financing and more in general limitations in management skills of technological entrepreneurs. In this regard, networks of business angels can be an effective recourse. Business angels are affluent individuals who provide financing for start-ups often coupled with management support. They are an alternative to formal equity funds and their potential is that, as they tend to support start-ups of sectors in which they have some experience, they can provide valuable management support. However, the promotion of business angels is primarily relevant for economies that already have a relevant technological business sector, with affluent individuals that have direct experience in these sectors. Box 3 presents an example of a business angel network and of specific initiatives targeted at financing SMEs in the ICT sector. Governments should prioritize financial mechanisms that support and complement other initiatives supporting technological entrepreneurs, such as technological parks and incubators, provide them on a competitive basis and link them to the achievement of specific technology goals.

**Box 3. Examples of initiatives that support the technological upgrading of SMEs in the ICT sector**

**India's Band of Angels** (BoA) is an umbrella organization established in 2006 that brings together entrepreneurs and high-net-worth individuals from India and overseas, with the aim of making joint investments in seed and early stage deals. The BoA operates as a facilitator, and individual members decide how much they want to invest. Those interested in going ahead with a proposed investment form a subgroup. Within any subgroup, investments are made on an equal basis, but better conditions may be granted to those members who devote more time and effort to providing assistance to the investee enterprise. At present, five deals have been finalized in the ICT/ICTE and media and entertainment sectors.

In **Brazil,** the ***Programa para o Desenvolvimento da Indústria Nacional de Software e Serviços Correlatos*** **(PROSOFT)** targets local software houses with a direct lending window that provides long-term investment loans that cover up to 85 per cent of investments cots for amounts of at least $200,000. It also has two refinancing widows that promote bank loans for the commercialization of ICT solutions and the export of software products, through the refinancing of loans extended by commercial banks. Moreover, the ***Pró-innovaçao*** and the ***Juro*** programmes respectively provide longer loans (up to 10 years) to innovative enterprises involved in R&D and interest-free medium-term loans to ICT firms.

*Source:* Zavatta (2008).

35. It is vitally important that linkages between the various actors of the knowledge economy – including those active in the three areas mentioned before (education, financial and business services) – are promoted and developed. Studies indicate that the relevance of technology incubators depends on their proximity to research organizations and economic poles and their ability to merge their functions

with other instruments supporting technological development including science and technology parks, technology transfer offices, and equity funds.[20]

36. Overall, the set of capacity-building initiatives to be selected will depend on domestic characteristics including the level of technological development, national sources of competitiveness, specific needs and the capacities of the private sector and other players to support innovation. For instance, a study of technoparks in Kazakhstan notes their lack of effectiveness in creating innovative firms due to the limited national demand for local R&D and suggests that government action should prioritize the promotion of technopark "activities" (i.e. innovation projects, innovation skills development) "to assisting companies to upgrade their technology to the level that they can formulate their won R&D needs" rather than supporting technopark "organizations" that spend heavily on infrastructure.[21]

## B. Supporting social entrepreneurship and enterprises in technological sectors

37. Social entrepreneurship in technological sectors offers targeted opportunities to support pro-poor STI. Social entrepreneurs are entrepreneurs – that is, agents of change who play a key innovative role in seeking and exploiting opportunities by combining resources in new ways[22] – with an explicit social mission. Social entrepreneurship initiatives (such as the example from box 4) can be successful in supporting innovation and technological upgrading among disadvantaged communities by combining the design/adaptation of technologies to the needs of people living in poverty and support members of the community to commercialize such technology.

**Box 4. A social entrepreneurship initiative in the technology sector supporting innovation and technological upgrading**

**KickStart** is a non-profit organization based in Kenya that develops adapts and markets technologies in Africa. Low-cost technologies are bought by local entrepreneurs and used to establish small businesses. They create new jobs and income for poor people. Examples of products include a brick press, oil press, treadle pump and hip pump (a manual water pump).

KickStart (a) identifies high potential small-scale business opportunities that could be established by local people with limited capital investment; (b) develops technologies and business packages – the tools, equipment, manual sand business plans required to establish small enterprises; (c) trains manufacturers to produce the new technologies; (d) develops the market among small-scale business, ensuring that the new technologies are available for purchase by businesses; and (e) monitors its impact.

According to Kickstart, to date over 64,000 new businesses have started (800 new businesses per month) and $79 million a year in new profits and wages have been generated by the new businesses. Such new revenues equivalent to more than 0.6 per cent of Kenya's gross domestic product (GDP) and 0.25 per cent of the United Republic of Tanzania's GDP.

*Source:* Adwera Ochieng (2008) and KickStart (www.kickstart.org).

38. Measures to support social entrepreneurship include general entrepreneurship promotion interventions – in particular, supporting entrepreneurship training and support infrastructure, good inter-sectoral relationships, and special funds for

[20] Goddard (2008).
[21] Radosevic and Myrzakhmet (2006).
[22] For a discussion on the concept of entrepreneurs and entrepreneurship see UNCTAD (2008).

enterprise formation and development[23] – plus specific measures to support social enterprises. Such specific measures focus on creating an enabling legal and fiscal environment that does not discriminate against social enterprises and supports their social dimension, and on supporting an institutional framework where social enterprises have similar access to markets and self-representation as SMEs.[24]

39. There is also great potential in further developing pro-poor technology programmes so that they can offer economic opportunities, promote entrepreneurship and support innovative enterprises. For example, a recent UNCTAD study found that telecentres, a key policy instrument to support wider access to ICT, have not yet been fully successful at providing economic opportunities for their managers and users.[25] This was largely due to the limited availability of content and services, lack of capacity of the Governments to develop e-government services in the short term, and the absence of broader economic and business structures and conditions.[26]

40. A review of best practices shows that such ICT capacity-building programmes can enhance their ability to provide economic opportunities to disadvantaged communities when:

(a) The telecentre supports the local livelihood strategies, for example, by providing access to government services such as land records or by offering customized information services;

(b) Niches of economic opportunity are developed. For instance, telecentres in an impoverished community in Nunavut (Canada), by concentrating resources and know-how in film production and providing scientific research support, two locally new economic areas, have managed to support technological upgrading and innovative enterprises that provide additional economic opportunities to the community;

(c) Specific support to those that need it most is provided. For example, using community "infomediaries" (those who can make a link between information available through the Internet and individual information needs) is particularly needed if communities with low literacy levels are to benefit from the Internet.

# III. Creating an enabling regulatory framework

41. Creating an enabling regulatory environment is essential to the promotion of research, development and transfer of technology. Of the many different options in which a regulatory framework can support research and technology transfer, this chapter explores innovative ways that depart from more traditional models for which literature is available.[27] Given that access to knowledge is essential for enterprises to increase their productivity and competitiveness, this chapter proposes in particular the discussion of open source approaches and alternative uses of licensing agreements to support access to knowledge.

42. UNCTAD (2007b) notes that the costs and benefits of a strong IPR system are unequally distributed between the users and producers of knowledge, and low-income countries are likely to bear high costs without receiving much benefit in return. Therefore, the preferable strategy for low-income countries may be to focus

[23] UNCTAD (2008).
[24] UNDP (2008).
[25] Telecentres are public facilities where people can access the Internet, computers and other information and communication technologies to gather information, communicate with others and develop digital skills (telecentre.org).
[26] UNCTAD (2007a).
[27] See for example UNCTAD (2001) and UNCTAD (2003b).

on developing capacities to absorb technology rather than focusing on harmonizing their national IPR system with international IPR systems.

43. This chapter describes two types of opportunities to support a legal environment that facilitates access to knowledge while respecting current IPR systems. The first is a broader approach to support open access to knowledge and the second seeks to utilize to the fullest extent the flexibilities of licences to support access to technology.

## A. Open source approaches

44. Open access to knowledge, also known as open source approaches, covers two distinct but interrelated concepts:[28]

(a) Distributed innovation – Scientists, engineers and other experts located in different locations work in a cooperative and loosely coordinated fashion towards a common project. The overall project is divided in smaller units of work that is distributed among peers;

(b) Open licensing – Promotion of a range of rights, and responsibilities, that foster a more open access to knowledge. The range of rights and responsibilities may provide freedom to operate to a range of actors, enable research by requiring materials and methods to be made available to others, unrestricted distributed innovation, self-binding commons (i.e. requiring innovations to be shared back), and humanitarian licensing.

45. Open source approaches contribute to development in multiple manners. Foremost, they provide a practical and legal alternative approach to innovation. Distributed innovation or distributed peer production makes use of the power of crowd-sourcing (benefiting from the expertise of thousands of individuals) to find solutions to complex research or ICT development issues by dividing such research issues into smaller workable research projects and/or by opening the challenge to a wider range of people. Moreover, through their collaboration in the process, participants have the opportunity to learn and develop their skills. Open licences favour better access to knowledge by providing a legal set of rights and responsibilities to access information. They provide incentives and reassurances to those wishing to contribute to the public good by, for example, ensuring that innovations coming from distributed peer production processes are shared back to the community. However, open licences cover a wide rage of instruments with different degrees of openness, some instruments being more restrictive than others.

46. In the field of ICTs, free and open source software (FOSS) approaches have been very successful in creating and disseminating innovative software.[29] Making the source code of software freely available has allowed broader collaboration in software production, whereby software is created and reviewed by large numbers of voluntary developers. Access to the source code has also allowed the customization of software to meet different commercial, regulatory, cultural and linguistic requirements, and has allowed today's and tomorrow's experts to acquire skills and advance their knowledge rapidly. Moreover, FOSS allows Governments and enterprises to have better control of their data by understanding what exactly software programmes are programmed to do, and by providing an alternative to proprietary software, FOSS enhances competition.

[28] For a discussion of the terms see Open Source Models of Collaborative Innovation in the Live Sciences. Bellagio Meeting, September 2005, Bellagio, Italy.
[29] For further information on the concept and development impact of FOSS see chapter 4 of UNCTAD (2003a).

47. In the life sciences area, there are a number of initiatives to support open access to life sciences technology. Two major ones are PIPRA and BiOS. PIPRA (the Public Intellectual Property Resource for Agriculture) is a coalition of public-sector universities in the United States which, using its ownership of 24 per cent of agricultural biotechnology innovations as leverage, has launched a programme to improve the availability of research outputs by promoting public access to agricultural biotechnology innovations.[30] PIPRA aims to improve agriculture in emerging economies by lowering intellectual property barriers and increasing technology transfer, working with farmers and scientists in mature economies who are growing specialty crops, and making sure the technological innovations of their member institutions get to those who need it most. To do so, it promotes open access by facilitating access to licenses, exploring their openness, and promoting open licensing among its member institutions. BiOS (Biological Innovation for Open Society) is an initiative promoted by the not-for-profit organization CAMBIA, to develop new innovation systems that address market failures and neglected priorities. BiOS supports open approaches to biological innovation, both in terms of distributed innovation and open licences, through three interrelated groups of activities:

(a) The Patent Lens: An information technology toolkit that helps people understand and investigate patent rights and assess the patent landscape;

(b) BioForge: An Internet platform that facilitates cooperative invention, based on open access technology development activities;

(c) The BiOS Foundation: Lobbies for a structural reform of the innovation system by, among others, promoting an open licence for biological patents (BiOS licence). It also examines, beyond intellectual property (IP) regimes per se, alternative regulatory and investment frameworks and incentives to promote more open source innovation (CAMBIA 2006).[31]

48. In order to build stronger pro-poor STI capacities, Governments may consider establishing their own open access initiatives. An example of this can be India's Open Source Drug Discovery Initiative (see box 5). Governments may also consider encouraging existing open initiatives to address their critical national health and agricultural concerns, prioritizing public spending in research that supports/uses open sourcing and open access models, and developing awareness among the public and private scientific research community on open access, both in terms of distributed innovation and open licensing.

**Box 5. India's Open Source Drug Discovery Initiative**

India's Council of Scientific and Industrial Research (CSIR) has recently launched the Open Source Drug Discovery (OSDD) initiative. This is a new open source initiative for developing drugs to treat diseases such as tuberculosis, malaria and HIV. OSDD's aim is to make available affordable medicines for deserving populations by supporting open collaborative research for the entire spectrum of processes in drug discovering.

The initiative publishes online design challenges for developing drugs to treat drug-resistant tuberculosis malaria and HIV. Research teams and individual scientists from public research institutions, universities and the private sector can volunteer to contribute solutions to the posted challenges. Problem solvers and contributors will receive microcredits for their inputs and, once a number of microcredits have been accrued, the person will receive a monetary reward.

[30] Benkler (2006).
[31] CAMBIA (2006).

Tuberculosis (TB) is the first target of this initiative. Two billion people – a third of the world's population – are infected with the TB bacilli and 98 per cent of TB deaths are in developing countries (WHO, 2005). TB is curable but it kills 5,000 people every day. In India, 370,000 deaths due to TB occur each year.

The Government of India has committed $38 million to this initiative, and biophysicist Samir Brahmachari, Director-General of CSIR, hopes to raise a third of the overall project cost from donations and charity.

India's Open Source Drug Discovery initiative is still at an early stage of development and its long-term success may depend on its ability to provide sufficient, monetary and non-monetary (i.e. professional recognition) incentives.

*Source:* Singh (2008), Open Source Drug Discovery web site (www.osd.net); WHO (2005); UNCTAD.

## B. The use of flexible terms of licences

49. Different tools/approaches exist to facilitate the use of licenses that facilitate development, while at the same time guarding the commercial interests of those developing and disseminating the technology. Box 6 provides an example of how humanitarian IP management can facilitate the research and transfer of technology in developing countries. PIPRA's Handbook of Best Practices (Krattiger et al. (eds.), 2007) provides a useful overview of different instruments available to licensors and other technology parties for promoting the use of technology, including:

(a) Out-licensing – that is, awarding non-exclusive licences to generic manufactures (i.e. of medicines) allowing them to produce low cost drugs for sale exclusively in designated markets;

(b) Reservation of rights for humanitarian uses – that is, including clauses in licence agreements where the licensor reserves and retains certain rights for humanitarian use. Some of the challenges of the reservation of rights for humanitarian uses lies in negotiating the definition of humanitarian use, whether in geographical terms (i.e. which developing countries or markets), income level or purpose;

(c) Use of non-exclusive licensing, as this allows the licensor to subsequently licence the technology for humanitarian applications;

(d) Setting humanitarian conditions in research funding agreements;

(e) Inserting humanitarian conditionality or performance milestones in licence agreements, which require the licensee to do specific things to benefit disadvantaged communities (i.e. selling a product at a lower price in developing countries or requesting the identification of a generic drug supplier by a certain date). For example, the TB Alliance obtained an exclusive worldwide license to PA−824 and related compounds from Chiron Corp. under an agreement that eliminates royalties for drugs marketed in impoverished countries;[32]

(f) Promoting the use of non-assertion covenants – that is, a pledge by the licensor not to sue a third party when using a patent that they would otherwise infringe. For example, several ICT companies (i.e. Sun Microsystems and Microsoft Corp.) announced in 2006 that they would not enforce a list of product patents related to certain web applications.

[32] Brewster et al. (2005).

**Box 6. Humanitarian IP management supports development of vitamin A-enriched golden rice**

One of the most noted examples of humanitarian IP management involves vitamin A-enriched "golden rice". Although developed mainly with public sector funding and research, around 45 patents associated with golden rice are owned by approximately 30 companies and public institutions in the United States, and only a few patents are held in developing countries. The inventors of golden rice licensed their inventions related to golden rice to Greenovation, a biotech spin-off company from the University of Freiburg that is owned by the inventors themselves. Greenovation then exclusively licensed its golden rice-related patents to AstraZeneca (now Syngenta). Subsequently, Syngenta entered into a license agreement with the inventors that allowed them and Syngenta to license golden rice technologies to developing countries. Other companies holding golden rice-related patents also agreed to the same arrangement. That arrangement allows both Syngenta and the inventors to grant licenses – with the right to sub-license – to any bona fide research organization for the development of golden rice. The rice can be used royalty-free and allows farmers to earn as much as $10,000 per year from its sale. Higher sales would require farmers to acquire a commercial license from Syngenta. The example of golden rice illustrates that it is possible to make IP available for research and commercialization in developing countries.

*Source*: Brewster et al. (2007).

50. So far, the use of humanitarian licenses has been limited,[33] but the expansion of their use would facilitate the development and transfer of technologies essential for developing countries. Efforts to build capacities for humanitarian IP management primarily target public institutions and private corporations conducting licensing and patenting (mostly in developed countries). Nevertheless, public IP and technology transfer managers from developing countries would also benefit from understanding the different options available to use existing licences for humanitarian purposes and more broadly to support pro-poor STI.

# IV. Preliminary findings and issues to be addressed by experts

51. A review of various experiences underscores the importance of selecting initiatives that are based on local needs and characteristics to improve enterprise productivity, innovation and competitiveness. Capacity-building interventions should be examined in light of their ability to effectively support STI for development.

52. Building pro-poor STI capacities involves interventions at the institutional and policy level, in order to establish an environment (e.g. regulatory environment that promotes access to knowledge) conducive to wealth generation and economic growth for poverty reduction as well as mindful of the specific needs of disadvantaged communities at the micro level.

53. Finally, the portfolio of selected interventions should include building the capacities of a wide range of players from the public, private and civil society sector. The examples of KickStart, a social entrepreneurship initiative in the technology sector, and India's science and technology applications for rural development programme show the role that civil society can also play in the transfer of technology.

54. To complement the checklist of good practices to be used by developing countries to promote the design and implementation of STI policies that can

[33] Among others, because the use of humanitarian transfer of technology can be cumbersome and time-consuming (see for instance Rwanda and Canada's use of compulsory licences to ensure the export of medicines to Rwanda (South Centre, 2007).

contribute significantly to poverty reduction, the following issues are raised for the experts' consideration:

(a) What are the key policy instruments for supporting pro-poor STI capacity-building, technology transfer and innovation? In which situations are PPPs an appropriate instrument?

(b) What are the instruments needed to support innovation and technological upgrading among SMEs and social entrepreneurs? Identify examples and best practices.

(c) Can open source approaches, including open licensing and open innovation, facilitate access to knowledge and the transfer of technologies? If so, which interventions can encourage the most effective use of open source approaches?

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