UNCTAD/LDC/2007

UNITED NATIONS CONFERENCE ON TRADE AND DEVELOPMENT
Geneva

# THE LEAST DEVELOPED COUNTRIES REPORT, 2007

## Chapter 5

UNITED NATIONS
New York and Geneva, 2007

# Knowledge Aid

Chapter 5

## A. Introduction

This chapter focuses on how foreign aid can be used to support enhanced use of science, technology and innovation (STI) for economic development and poverty reduction in the LDCs. The scale and the effectiveness of aid are critically important for those countries' economic development and the achievement of substantial poverty reduction. The justification for aid is usually articulated within a framework which stresses the limited ability of most LDCs to mobilize the domestic financial resources needed to meet a range of pressing economic, social and political objectives. But equally important, and actually even more fundamental, aid can help to build up the knowledge resources and knowledge systems of LDCs. This is particularly important for the LDCs because, as we have seen in chapter 1, knowledge accumulation and technological learning through international market linkages are currently weak in the LDCs. In that situation, there is a real danger of socio-economic marginalization for the now-open LDC economies as knowledge becomes increasingly important in global competition. Aid can play an important role in developing a minimum threshold level of competences and learning capacities which will enable LDCs to rectify that situation. Knowledge aid that strengthens the knowledge resources and knowledge systems of the LDCs is an essential component of aid which is not a hand-out, but rather a hand-up.

*Knowledge aid that strengthens the knowledge resources and knowledge systems of the LDCs is an essential component of aid which is not a hand-out, but rather a hand-up.*

Thinking about knowledge aid is particularly important for ensuring aid effectiveness. Towards the end of the 1990s, a strong consensus emerged that aid worked if the recipient country's policies and institutions were right. As discussed, in earlier LDC Reports, the econometric research underlying that position was flawed (see Hansen and Tarp, 2001; UNCTAD, 2002: box 19). Although it is clear that good domestic policies are necessary for effective aid, the precise nature of what constitutes the right policies is not as clear-cut as earlier thought. Moreover, by emphasizing the importance of recipients' policies, the role of donors' policies in the effectiveness of aid was left out of the picture. In effect there was a "one-eyed approach" to aid effectiveness (UNCTAD, 2000). With the Paris Declaration on donor alignment and the harmonization of aid practices, much more attention is now being paid to the role of donor practices in aid effectiveness. But there is still insufficient discussion of the impact of the composition of aid on aid effectiveness. This chapter is a contribution to the widening of the discussion. It is based on the belief that the provision of more knowledge aid could, if it is directed towards the right areas and through appropriate modalities, be the base for a radical break with past aid failures.

*The provision of more knowledge aid could be the base for a radical break with past aid failures.*

The chapter is organized into five major substantive sections. Section B defines knowledge aid and its relationship to aid for STI, and summarizes the findings of recent surveys on donor support for STI. Section C focuses on aid for STI in LDCs, identifying the scale and composition of STI-related ODA and also the types of projects and programmes towards which it is directed. From that analysis it is possible to identify a number of strategic weaknesses in knowledge aid for LDCs, and the next two sections make recommendations for improving aid for LDCs in building science, technology and innovation capacity, focusing firstly on agriculture (section D) and, secondly, on industry and infrastructure (section E). Section F looks at the current and potential role of aid for STI within Aid for Trade initiatives, and more specifically within the Integrated Framework for Trade-Related Technical Cooperation, and suggests how it may be possible to deepen

trade preferences for LDCs through support for technological development. The conclusion summarizes the major message of the chapter.

## B. Knowledge aid and aid for STI

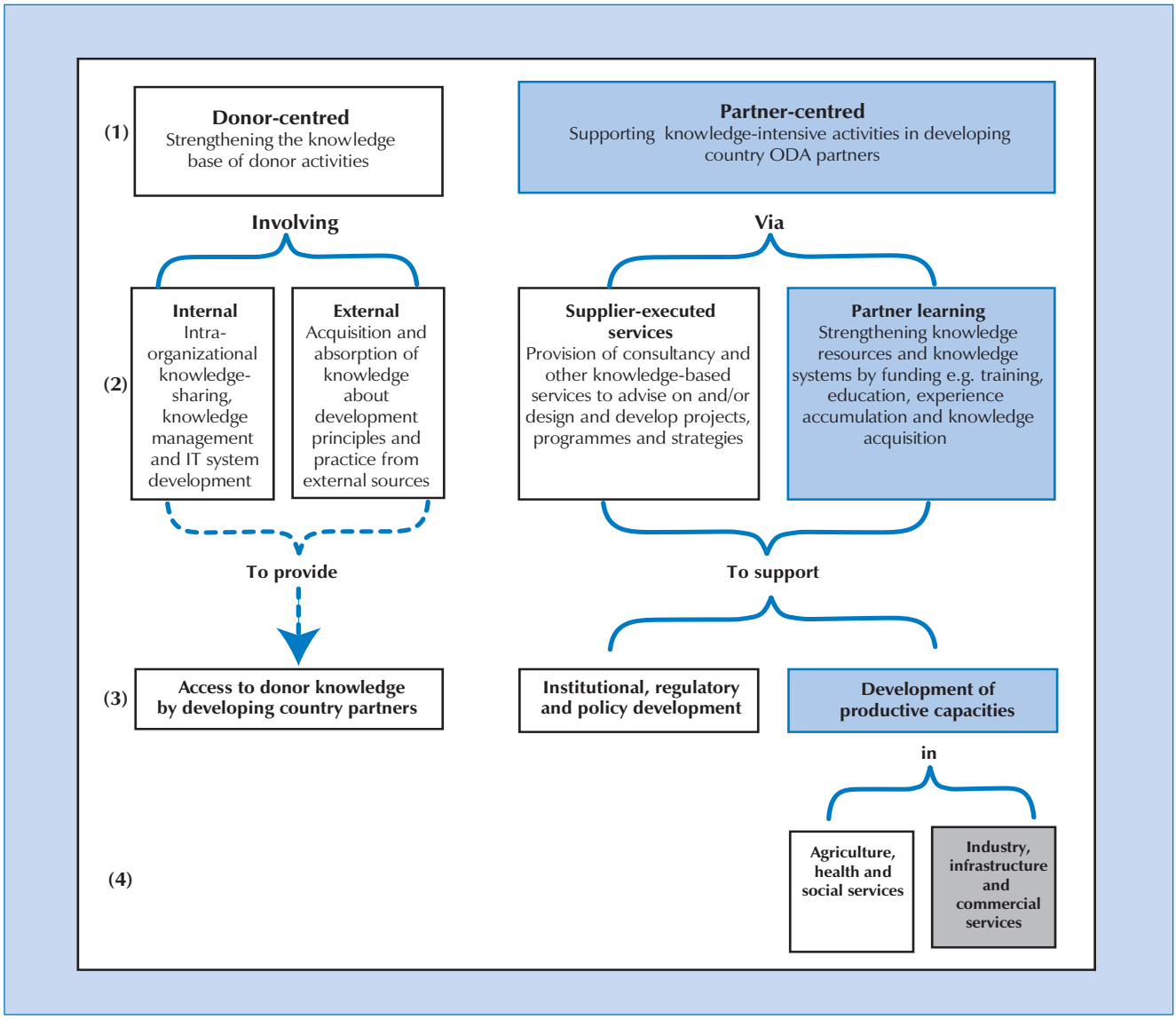
*By intensifying the knowledge content of their aid activities donors could increase aid effectiveness.*

### 1. Forms of knowledge aid

The idea that by intensifying the knowledge content of their aid activities donors could increase aid effectiveness has been recognized since the 1990s (King and McGrath, 2004). But there is no agreed definition of knowledge aid. In the present Report it will be defined as aid which supports knowledge accumulation in partner countries through the development of their knowledge resources and their domestic knowledge systems.

Chart 13 sets out different donor approaches to intensifying the use of knowledge for development to clarify the scope of knowledge aid. It distinguishes between approaches that are donor-centred and those that are partner-centred. The former approaches are designed to strengthen the knowledge base of

**Chart 13. Donor approaches to intensifying the use of knowledge for development**




*Source:* Bell (2007).

the donors themselves: this can be done through internal reforms to increase intra-organizational knowledge-sharing, better knowledge management and IT system development. It is intended to increase the effectiveness of formulation and implementation of aid activities. It can also go further by providing partner countries with access to that donor knowledge — a notion that underlay the idea that the World Bank should act as a "knowledge bank". Partner-centred approaches, in contrast, are designed to support directly knowledge accumulation in partner countries. This can be done in two ways: either through supplier-executed services, where, for example, donors provide consultants who advise on, or design and develop, projects, programmes and strategies; or through strengthening the knowledge resources and knowledge systems of the partners themselves, a process which may be called partner learning. In either case, these activities might be designed to support better governance through increasing knowledge resources for institutional, regulatory and policy development, or to support the development of productive capacities through technological learning and innovation.

*Aid for science, technology and innovation (STI) is a particular form of knowledge aid that can support innovation in productive sectors as well as social services.*

In this Report, knowledge aid is equated with partner-centred approaches. Aid for science, technology and innovation is a particular form of knowledge aid which is focused on building the science, technology and innovation capacity of partner countries. This can support innovation in productive sectors as well as social services such as health, and it can include enhancement of the capacity of policymakers to formulate and implement STI policy. The types of activities which have been traditionally supported as aid for S&T can include human capacity-building in relation to STI; support for other types of STI infrastructure, notably scientific research, technological R&D, and agricultural and industrial extension, and support for standards compliance and metrology. But aid for STI goes beyond this in supporting enterprise-based learning and innovation — for example, through enterprise-centred training activities, the development of domestic business linkages and the development of STI-related international linkages, including scientific cooperation and business-to-business links.

*Aid for STI develops innovation capacity within enterprises (both firms and farms), which is key to economic dynamism in the LDCs.*

Aid for STI is a particularly important form of knowledge aid because developing innovation capacity within enterprises (both firms and farms) is the key to economic dynamism in the LDCs.

Technical cooperation grants are one mechanism for delivering knowledge aid. Technical cooperation is provided in two ways: firstly, as technical services required for the implementation of specific investment projects; and secondly, as free-standing technical cooperation, which is defined as "the provision of resources aimed at the transfer of technical and managerial skills or of technology for the purpose of building up general national capacity without reference to the implementation of any specific investment projects" (see OECD, 2006: 113). Some part of free-standing technical cooperation may be directed at building science, technology and innovation capacity within a country and as such would be part of aid for STI as defined here. But technical cooperation is not synonymous with aid for STI.

This chapter focuses on aid for STI as a form of knowledge aid. However, it is important to emphasize at the outset that donor approaches to intensifying the use of knowledge for development have generally been more donor-centred than partner-centred. King and McGrath (2004) demonstrate with respect to the experience of the World Bank and bilateral agencies in Sweden, the United Kingdom and Japan, that a very large part of the effort to mobilize knowledge for development has been concentrated on donor-centred activities. Moreover, even when this has ostensibly also been designed in a way that provides partner

countries with access to donor knowledge, the extent of such knowledge-sharing has been less effective than expected (King and McGrath, 2004).

Similarly, with respect to technical cooperation, the OECD's Development Co-operation Report 2005 distinguishes between technical cooperation which involves (a) "direct supply of skills from outside" and (b) "efforts to enhance the capacities of the local population" (OECD, 2006: 112), and noted that "In the past, donors have broadly assumed that they will promote capacity development, but reality has proved much more complex" (p. 111). A detailed case study of Cambodia shows how difficult it is to build domestic capacity in a situation in which there is chronic underfunding of government and very low salaries (Godfrey et al., 2002). Much technical assistance in that case actually served to facilitate donor resource flows rather than build domestic capacity, and the sustainability of donor projects and the effectiveness of government were undermined as key personnel were drawn out of the public sector to service a succession of donor projects.

*In a situation in which there is chronic underfunding of government and very low salaries, much technical assistance served to facilitate donor resource flows rather than build domestic capacity.*

## 2. Aid for STI: Evidence from recent surveys

Various recent surveys enable the reconstruction of trends in aid for STI from multilateral and bilateral donors.

Crawford et al. (2006) survey World Bank lending for science and technology over the period 1980–2004. Their conclusion is stark: "Maybe with the exception of long-term support for agricultural research, the analysis of S&T projects over the last 25 years reveals no consistent approach or strategy on the part of the Bank toward developing S&T capacity in its client countries. In agriculture, sustained efforts have been put into supporting NARS [national agricultural research systems], much of which has been in the form of minor support undertaken in connection with other rural development activities. Regarding nonagricultural projects in general, the Bank's approach has been ad hoc, experimenting with different mechanisms for different circumstances as they occurred" (Crawford et al, 2006: 28–29). Quantifying the level of financing for S&T projects is difficult. But the study estimates (with quite a stringent definition of aid for S&T[1]) that:

*The analysis of S&T projects over the last 25 years reveals no consistent approach or strategy on the part of the World Bank toward developing S&T capacity in its client countries.*

- "Although 647 projects provided some support for science and technology, only 119 of the World Bank's 6,059 projects were dedicated primarily to promoting science and technology or contained a significant science and technology capacity building component" (p. 10).
- Over the last 25 years only 3.9 per cent of total World Bank lending has on average gone to S&T projects (p. 33).
- "Lending to science and technology in the last 5 years has declined significantly with respect to the previous 20 years" (p.14).
- Commitments to agricultural research projects have been declining since the 1990s, as part of a dramatic decline in World Bank lending to agriculture which began in the mid-1980s.

The geographical distribution of World Bank non-agricultural S&T lending during this period is also significant. The Republic of Korea was by far the largest borrower and other large borrowers were India, Indonesia, Brazil, Chile and Mexico. The only LDC in the list of countries with major non-agricultural S&T projects is Bangladesh. The overall focus has been on countries with a large population and on more advanced developing countries, with LDCs (other than Bangladesh) thus being effectively excluded.

Although S&T projects constituted a minor share of total World Bank lending and may have been "ad hoc", there was long-term involvement and continuity with a few countries. For non-agricultural projects, this focused on STI capacity-building blocks, namely the development of factor markets (for both technical skills and capital) and the development of public R&D and the general higher education system (Yammal and Casabonne, 2005). Table 33 summarizes some of the distinctive feature of this lending, differentiating between two major approaches — R&D system-centred capacity-building (exemplified by Brazil and Mexico) and firm-centred capacity-building (exemplified by India and the Republic of Korea). It seems that the latter approach was more effective.

*Although S&T projects constituted a minor share of total World Bank lending and may have been "ad hoc", there was long-term involvement and continuity with a few countries.*

With regard to bilateral lending, Watson, Crawford and Farley (2003) write: "Bilateral support has fluctuated enormously, with funding for research being one of the first activities to be cut when budgets are declining. This is especially damaging as continuity of support is vitally important to research and capability building. In general, only a small sub/group of donors have made systematic

**Table 33. Different approaches to World Bank lending for STI: A cross-country comparison**

| | Brazil/Mexico | India/Republic of Korea |
|---|---|---|
| **Content of lending** | | |
| Human capital | • Emphasis on the scientific PhD/Master's level<br>• General tertiary education | • Emphasis on technical, vocational level and engineering<br>• Mostly engineering at the tertiary level |
| Public R&D system | • Maintenance investment in public R&D infrastructure (almost no buildings)<br>• Priority is given to cutting-edge research<br>*- Centres of excellence* | • Expansive investment in R&D infrastructure (staff, and equipment intensive building)<br>• Priority is given to developing technical skills<br>• Support for technology diffusion (e.g. electronic projects in the Republic of Korea and India) |
| STI legal framework | • Sparse STI legislation linked to World Bank projects | • Dynamic legal reform, institutionalized incentive structure |
| Breadth of intervention | • Mostly horizontal<br>*- Petrochemicals (Brazil)* | • Vertical and horizontal<br>*- Electronics (India, Republic of Korea)*<br>*- Petrochemicals (India)*<br>*- Machinery (Republic of Korea)*<br>*- Cement (India), software (India)*<br>*- Pharmaceuticals (India)* |
| Financial mechanisms | • Predominant use of matching grants in more recent projects<br>• Very recent venture capital initiatives<br>• Private sector as passive beneficiary<br>• Industrial credit dispersed (in addition to banking reform, trade and export) | • Targeted credit for import and absorption of technology<br>• Early efforts on venture capital<br>• Private sector as co-investor and beneficiary<br>• Focus on providing credit to industries |
| **Methodology of lending** | | |
| Size of projects | • Fewer, larger projects (Mexico: 19; Brazil: 13) | • More, smaller projects (India: 37; Republic of Korea: 29) |
| Number of projects | • Fewer repeater projects (back to back or with minor gaps within a project series)<br>*- 4 loans for industrial equipment fund (Mexico)*<br>*- 4 loans for small- and medium scale industrial development (Mexico)*<br>*- 3 loans for comprehensive STI (Brazil)*<br>*- 3 loans for development banking (Brazil)* | • Many repeater projects, overlapping; "holding hand" approach of Bank lending that enabled learning feedback<br>*- 11 loans supporting ICICI (India)*<br>*- 9 loans for industrial import project (India)*<br>*- 4 loans for technology development (Republic of Korea)*<br>*- 3 loans for technology advancement (Republic of Korea)*<br>*- 5 loans for technical education (Republic of Korea)* |
| Focus | • Comprehensive and multi-component ("omnibus" projects)<br>• Sectoral budget support | • Highly focused and single-component |
| Intensity | • Low intensity: few concurrent projects<br>*- Brazil and Mexico, 1980s: up to 4 concurrent projects* | • High intensity: many concurrent projects<br>*- India, 1990s: up to 9 projects*<br>*- Republic of Korea, 1980s: up to 7 projects*<br>*- Republic of Korea, 1990s: up to 9 projects* |
| Priorities | • R&D system-centered capacity-building | • Firm-centered capacity building |
| Timing (start of continued involvement) | • Mexico: 1972 (exc. 1950)<br>• Brazil: 1976 | • India: 1955<br>• Republic of Korea: 1969 |

*Source:* Yammal and Casabonne (2005).

attempts to: (i) give prominence to improving S&T capacity as an essential long-term development goal; (ii) approach S&T in an integral manner, emphasizing cross-sectoral connections; and (iii) reach out to smaller and poorer countries that have the greatest need and face the greatest challenges in improving S&T capacity. Success has been notable, although it has been on a small scale with modest resources" (p. 25–26).

*Support to science, technology and knowledge for development is increasing across the donor community, but this support appears to be driven without a parallel increase in strategic guidance within donor institutions.*

This situation is now changing. Farley (2005: 7), in a snapshot of the global landscape of support for science, technology and knowledge for development, found that: "Support to science, technology and knowledge for development, as defined by the institutions profiled, is increasing across the donor community and resulting in a wide array of activities and modalities for support". However, "this increase in support appears to be driven without a parallel increase in strategic guidance within donor institutions, or between them although their attention is now turning to this oversight".

Moreover, an updated and extended analysis of the pattern of donor support shows that some donors are beginning to develop a strategic approach to aid for STI (Farley, 2007). In particular:

- The International Development Research Centre (IDRC) has crystallized its vision for support to STI through its new Innovation, Technology and Society (ITS) Program Initiative with its 2006–2011 Prospectus.
- The United Kingdom's Department for International Development (DFID) has appointed a Chief Scientific Adviser and is formulating a science and innovation strategy.
- The Swedish International Development Agency's Development for Research Cooperation (SAREC) is completing a revised research strategy that will focus more on innovation systems research, climate, water, biodiversity and urban research.

*Some donors are beginning to develop a strategic approach to aid for STI.*

- A reorganization at the African Development Bank in 2006 has led to the creation of a new unit that focuses explicitly on higher education, science, and technology. This unit recently started a draft Strategy on Higher Education, Science and Technology and an accompanying Action Plan.
- The World Bank's new Science and Technology Coordinator has commissioned a number of studies that examine the Bank's approach to STI for development, which is being re-evaluated at present.[2]

Meanwhile, a number of other donors — the Netherlands, Denmark, Norway and the Canadian International Development Agency — are in the process of rethinking their strategies, which may change the proportion of aid they each devote to STI and the countries to which this aid is allocated.

## C. Aid to STI in LDCs

### 1. The scale and composition of aid for STI-related human resources and research

One of the striking facts emerging from discussions with donors is that they cannot actually quantify how much aid they are giving for STI (Farley, 2005). This is indicative of the low priority given to the issue, as well as of the unclear

conceptualization of the subject. There is no accepted definition of aid for STI, and thus this section uses the imperfect information which can be gathered from available OECD reporting codes to identify a number of features of the scale and composition of aid for STI in the LDCs.

It focuses on two categories of aid for STI that are identifiable:

- Aid for research, which includes agricultural, forestry and fishing research; technological research and development (essentially related to non-agricultural activities); education and medical research; and energy and environmental research;
- Aid for advanced and/or specific human skills, which includes vocational training, higher education, statistical capability-building, agricultural extension and various specific types of education and training related to social sectors, production sectors and trade.

*Aid for STI in LDCs is a low priority for donors.*

Those categories (for which the Annex provides a complete list of the OECD Credit Reporting System Codes used in the analysis) are equivalent to a traditional view of aid for S&T which encompasses the development of human resources and building the institutional infrastructure for scientific research and technological development. The analysis examines reported aid disbursements and commitments.

*Aid for advanced and/or specific skills is the major priority in STI-related aid, constituting 90 per cent of the total disbursements during 2003–2005 as against only 10 per cent for research.*

Table 34 summarizes annual aid disbursements to LDCs for the two categories of aid for STI and their subcategories during the period 2003–2005. From the table, it is apparent that:

- Aid for STI is a low priority for donors. Annual disbursements for the development of advanced and specific skills and for research during the period 2003–2005 constituted $727.7 million, which was equivalent to only 3.6 per cent of total disbursements.
- Aid for advanced and/or specific skills is the major priority in aid for STI, constituting 90 per cent of the total disbursements during 2003–2005 as against only 10 per cent for research.
- Of aid for advanced and/or specific skills, 65 per cent was allocated to higher education. Without the latter, only 1 per cent of the total aid disbursements to LDCs in 2003–2005 was provided for developing advanced and/or specific skills. This included only $62.1 million per year for vocational training, only $12.4 million per year for agricultural education and training, and only $9.2 million per year for agricultural extension. This is equivalent to 8 cents per person for vocational training and 3 cents per agricultural worker for agricultural education and training and agricultural extension. Aid disbursements for advanced technical and managerial skills constituted only $17.6 million per year.
- During 2003–2005, 37 per cent of the total disbursements for aid for research was earmarked for medical research. Agricultural research received 30 per cent of total aid disbursements for research, equal to only $22.1 million per year during the period 2003–2005. This is equivalent to 0.03 per cent of agricultural GDP. Aid disbursements for industrial technological research and development in LDCs — a category which covers industrial standards, quality management, metrology, testing, accreditation and certification — received only $5.1 million per year during 2003–2005. This is equivalent to 2 cents per non-agricultural worker.

*Aid disbursements for industrial technological research and development in LDCs received only 2 cents per non-agricultural worker.*

These aggregate numbers are stark. But there is also a geographical concentration of STI-related aid disbursements, and thus some LDCs did even

**Table 34. Composition of STI-related aid to the LDCs, 2003–2005**

*(Disbursements, average annual)*

| | Total disbursements *(million, 2004 $)* | Share of total aid disbursements *(%)* | Sector share in total defined STI-related aid (%) | Subcategory share in each sector (%) |
|---|---|---|---|---|
| **Research** | **73.5** | **0.4** | **10.1** | **100.0** |
| Agricultural research | 22.1 | 0.1 | 3.0 | 30.1 |
| Medical research | 27.5 | 0.1 | 3.8 | 37.4 |
| Environmental research | 13.5 | 0.1 | 1.9 | 18.4 |
| Industrial technology R&D[a] | 5.1 | 0.0 | 0.0 | 6.9 |
| Other | 5.3 | 0.0 | 0.7 | 7.2 |
| **Advanced and specific human skills** | **654.2** | **3.2** | **89.9** | **100.0** |
| Higher education | 425.23 | 2.1 | 58.5 | 65.0 |
| Vocational training | 62.1 | 0.3 | 8.5 | 9.5 |
| Advanced technical and managerial training | 17.6 | 0.1 | 2.4 | 2.7 |
| Research institutions | 30.1 | 0.1 | 4.1 | 4.6 |
| Agricultural education and training | 12.4 | 0.1 | 1.7 | 1.9 |
| Agricultural extension | 9.2 | 0.0 | 1.3 | 1.4 |
| Other | 109.97 | 0.5 | 15.1 | 16.8 |
| **Total** | **727.7** | **3.6** | **100.0** | |

*Source:* UNCTAD secretariat calculations based on OECD/CRS database; data extracted on 28 February 2007.

*Notes:* Data refer to disbursements from bilateral and multilateral agencies that report to OECD. For comparative purposes, the average annual real disbursements are as follows: ICT $28.7 million; road transport $894.9 million; primary education $580.8 million; and secondary education $29.3 million.

*a* This relates to the CRS code 32182, Technological Research and Development.

*African LDCs received 82 per cent of total aid for research for LDCs during the period 2003–2005, and Senegal alone accounts for a third of that aid.*

worse than those figures indicate. African LDCs received 82 per cent of total aid for research for LDCs during the period 2003–2005, whilst Asian LDCs received 15 per cent. Senegal alone accounts for a third of STI-related aid disbursements going to African LDCs and for 28 per cent of total aid for research going to LDCs.[3] Similarly, over half of the aid disbursements for research to Asian LDCs go to Bangladesh alone. In value terms, however, Bangladesh received the equivalent of a fourth of aid for research going to Senegal. Similarly, African LDCs received more than 70 per cent, that is, $427.3 million, of the aid disbursements for advanced and/or specific skills for the period 2003–2005. As with research, Senegal is an important recipient. It received 11 per cent of aid disbursements for advanced and/or specific skills to LDCs during 2003–2005.

Disbursement data do not allow an over-time comparison to be drawn, as important donors started to report to the OECD's Creditor Reporting System (CRS) only from 2002. It is, however, possible to make a comparison with the recent past using aid commitments. The OECD's CRS aid database contains data on donors' commitments and donors' disbursements. Differences between the two series could be due to bottlenecks, administrative delays and unrealistic pledges by donors as well as limits to the recipients' absorptive capacity (Roodman, 2006).

*African LDCs received more than 70 per cent of the aid disbursements for advanced and/or specific skills for the period 2003–2005.*

Table 35 shows the level of STI-related aid commitments for LDCs during the periods 1998–2000 and 2003–2005. From the table, it is clear that there can be major divergences between aid commitments and aid disbursements during a particular period. However, the aid commitments indicate donors' intended priorities and in that regard a number of key trends are apparent:

- Aid commitments to LDCs for advanced and/or specific skills more than doubled between the periods 1998–2000 and 2003–2005. However, the

major driving force behind this was an increase in commitments to higher education and, to a lesser extent to research institutions. Aid commitments for advanced technical and managerial training stagnated, and those for agricultural education and training and for agricultural extension actually fell between the period from 1998–2000 to 2003–2005.

- Aid commitments to LDCs for research remained at about the same level between 1998–2000 and 2003–2005. However, there was a major shift in the composition of aid commitments for research. Commitments for agricultural research halved to the benefit of medical and environmental research.

*The kinds of activities which can support innovation at the enterprise level are all poorly funded.*

Those figures are indicative of the low level of importance that donors attach to STI and its role in strengthening productive sectors. There is, however, a major effort to strengthen universities. But the kinds of activities which can support innovation at the enterprise level — vocational training, advanced technical and managerial training, agricultural education and training, agricultural extension, and strengthening key technological support services such as industrial standards, quality management, metrology, testing, accreditation and certification — are all poorly funded. The last category, which is so important for developing enterprise competitiveness, received 0.02 per cent of total aid disbursements to LDCs during 2003–2005.

It may be argued that those low levels of reported aid for STI reflect the insubstantial treatment of STI issues in PRSPs (see chapter 2). But in practice, for the one STI area which is emphasized in the PRSPs, namely agricultural research and extension, aid commitments to LDCs have actually fallen rather than risen

**Table 35. Composition of STI-related aid to the LDCs, 1998–2000 and 2003–2005**

*(Commitments, average annual)*

| | Total commitments (million, 2004$) | | Share of total aid commitments (%) | | Sector share in total defined STI-related aid (%) | | Subcategory share in each sector (%) | |
|---|---|---|---|---|---|---|---|---|
| | *1998–2000* | *2003–2005* | *1998–2000* | *2003–2005* | *1998–2000* | *2003–2005* | *1998–2000* | *2003–2005* |
| **Research** | **84.7** | **86.8** | **0.5** | **0.3** | **20.5** | **10.5** | **100.0** | **100.0** |
| Agricultural research | 65.4 | 32.0 | 0.4 | 0.1 | 15.8 | 3.9 | 77.2 | 36.9 |
| Medical research | 5.4 | 26.1 | 0.0 | 0.1 | 1.3 | 3.2 | 6.3 | 30.1 |
| Environmental research | 1.2 | 16.1 | 0.0 | 0.1 | 0.3 | 1.9 | 1.4 | 18.6 |
| Industrial technology R&D[a] | 1.3 | 6.7 | 0.0 | 0.0 | 0.3 | 0.8 | 1.6 | 7.7 |
| Other | 11.5 | 5.9 | 0.1 | 0.0 | 2.8 | 0.7 | 13.5 | 6.8 |
| **Advanced and specific human skills** | **329.4** | **740.4** | **1.8** | **2.4** | **79.5** | **89.5** | **100.0** | **100.0** |
| Higher education | 141.3 | 427.5 | 0.8 | 1.4 | 34.1 | 51.7 | 42.9 | 57.7 |
| Vocational training | 67.3 | 99.0 | 0.4 | 0.3 | 16.3 | 12.0 | 20.4 | 13.4 |
| Advanced technical and managerial training | 15.5 | 16.3 | 0.1 | 0.1 | 3.8 | 2.0 | 4.7 | 2.2 |
| Research institutions | 9.6 | 37.2 | 0.1 | 0.1 | 2.3 | 4.5 | 2.9 | 5.0 |
| Agricultural education and training | 23.2 | 10.2 | 0.1 | 0.0 | 5.6 | 1.2 | 7.0 | 1.4 |
| Agricultural extension | 13.7 | 12.4 | 0.1 | 0.0 | 3.3 | 1.5 | 4.2 | 1.7 |
| Other | 58.7 | 137.9 | 0.3 | 0.4 | 14.2 | 16.7 | 17.8 | 18.6 |
| **Total** | **414.1** | **827.3** | **2.3** | **2.7** | **100.0** | **100.0** | | |

*Source:* UNCTAD secretariat calculations based on OECD/CRS database; data extracted on 28 February 2007 and 22 April 2007.

*Notes:* Data refer to commitments from bilateral and multilateral agencies that report to OECD. For comparative purposes, the average annual real commitments for the period 2003–2005 are as follows: ICT $73.6 million; electricity production and distribution $363.1 million; road transport $2,044.6 million, primary education $1,162 million; and secondary education $227.7 million.

a This relates to the CRS code 32182, Technological Research and Development.

since the late 1990s. It would thus seem that the low priority for STI reflects donors' practice rather than recipients' concerns.

## 2. STI PROJECTS AND PROGRAMMES

A more detailed picture of aid for STI in LDCs can be obtained by examining the types of projects and programmes that donors are supporting in LDCs. Farley (2007) analyzes 170 separate donors' initiatives undertaken in both the LDCs and other developing countries by eight bilateral donors (United Kingdom, Canada, Denmark, Norway, Sweden, Switzerland, United States and European Union), four multilateral donors (Asian Development Bank, Inter-American Development Bank, UNESCO and World Bank), and two foundations (Carnegie Corporation and Rockefeller Foundation). The analysis identifies some of the key characteristics of projects and programmes supported by donors in developing countries and how donor support in LDCs differs from that in other developing countries.

*The low priority for STI reflects donors' practice rather than recipients' concerns.*

Farley (2007) identifies four major orientations for donor support for all developing countries (table 36). They are as follows:

*Cluster 1 — global or regional public goods initiatives.* These includes projects such as the International Aid Vaccine Initiative (IAVI) and the East Coast Fever Vaccine Project (see Chataway, Smith and Wield, 2005) or support for the CGIAR.

*Cluster 2 — initiatives that deepen domestic STI capacity.* These include projects for developing human resources, supporting domestic research institutes, improving universities or supporting the development of technological capabilities at the enterprise level.

*Cluster 3 — international linkage initiatives.* The emphasis of donor-funded activities, projects and programmes in this cluster is on the creation of capacity to link up with global and regional knowledge networks.

*Cluster 4 — integrated initiatives.* These initiatives seek to strengthen innovation systems or to integrate the multiple dimensions of STI capacity-building addressed in clusters 1, 2, and 3.

**Table 36. Four major orientations of donor support to STI for development**

| Cluster 1 | Cluster 2 | Cluster 3 | Cluster 4 |
|---|---|---|---|
| *Global or regional public goods initiatives* | *Initiatives that deepen domestic STI capacity (i.e. sectoral, subnational or national)* | *Linkage-based initiatives* | *Integrated initiatives* |
| • Support to research for global or regional public goods | • University development in STI-themed disciplines<br>• Technical and vocation education and training<br>• Sector-focused skill upgrading through graduate and post-graduate training<br>• Productivity enhancement through technology and skills deepening in the private sector<br>• Research and development<br>• Centres of excellence<br>• STI decision-making and priority-setting<br>• Science and mathematics in primary and secondary schools, including teacher training<br>• STI infrastructure and equipment<br>• Information and communication technologies | • North–South linkage initiatives<br>• South–South linkage initiatives<br>• North–North–South linkages for policy alignment<br>• Sectoral and cross-sectoral linkages initiatives<br>• Linking individuals or institutions | • National innovation systems initiatives<br>• Integrated innovation initiatives |

*Source*: Farley (2007).

Of those four orientations, projects and programmes to deepen domestic STI capacity (cluster 2) are the most numerous for developing countries as a whole. They include the following types of programmes: development of S&T in universities; technical and vocational education; sector-focused graduate and postgraduate training; enterprise-based productivity enhancement; support for public R&D institutes; development of centres of excellence (research programmes within a university, a research institute or a centre operating independently); support for STI policy development and implementation; support for science and mathematics in secondary schools; support for STI equipment and buildings; and ICT infrastructure investments. Programmes to support international science and technology linkages (both North–South and South–South) are of increasing interest to donors. Integrated initiatives (cluster 4) are not a major approach for most donors, with the notable exception of the Inter-American Development Bank and the IDRC, with its Innovation, Policy and Science Programme, although many donors do have a few projects of this type.

*Global and regional public goods initiatives (such as the CGIAR) are important for LDCs, but they do not appear to be sufficiently responsive to LDCs' research needs.*

From this overall sample of projects and programmes, a number of clear patterns and concerns emerge with regard to the types of STI projects and activities that are supported for LDCs.

Firstly, global and regional public goods initiatives (such as the CGIAR) are important for LDCs. However, they do not appear to be sufficiently responsive to LDCs' research needs.

Secondly, programmes and projects to develop domestic STI capacity are the most numerous types of projects in LDCs, but they have a number of weaknesses:

- They are disjointed and there is in general very weak coordination between STI human resource capacity projects and sector development projects. This is evident in both Uganda and Rwanda.
- There needs to be more projects to develop capacity for STI policy formulation and implementation. An important example is the World Bank initiative in Rwanda to support the articulation of an S&T action programme.
- The non-agricultural sector is neglected.

*The STI capacity building programmes in LDCs are disjointed and are neglecting the non-agricultural sector.*

Thirdly, global linkage initiatives (cluster 3) are becoming an increasingly important aspect of donor support and they could be particularly important for LDCs. However, they tend to exclude LDCs because of the lack of a critical minimum level of capability for collaboration to take place. This is readily apparent in international science cooperation. But it is also apparent in technology cooperation. An example of this is NORAD's matchmaking project, which is currently benefiting some developing countries but has not started in the LDCs because lack of infrastructure and human skills is preventing potential investors from matching with suitable local companies (see box 10).

Fourthly, with regard to systems initiatives (cluster 4), there are no national innovation system initiatives in LDCs. However, there are examples of integrated initiatives which combine elements of the previous three clusters. One example is the USAID-funded PEARL project and follow-on SPREAD project in Rwanda (see box 11).

*There needs to be a more systemic and strategic approach to supporting the development of STI capabilities in the LDCs.*

To sum up, there needs to be a more systemic and strategic approach to supporting the development of STI capabilities in the LDCs. This should go beyond ad hoc projects to strengthen parts of public STI infrastructure, particularly unversities, and support innovation at the enterprise level by supporting the development of capabilities and knowledge systems. It should support firms as well as farms.

### Box 10. An example of how technology transfer could work in the LDCs: The Norwegian Matchmaking Program

Originally started in 1994 in Sri Lanka, the Matchmaking Program (MMP) was later extended to South Africa and India. It is currently being extended until May 2009.

The MMP aims at enabling business links between local companies and Norwegian companies through technology transfers, and exchange of management and skills. Norwegian companies create business links with their local partner companies mostly through outsourcing and joint ventures, and, depending on country characteristics, through more flexible forms of cooperation such as subcontracting and licensing. The investing companies ensure that adequate technical competence, capacity and financial resources are available and included in long-term investment plans.

Furthermore, they have to meet financial requirements in order to qualify for the programme. The investing companies' areas of interest can be very diverse, ranging from sector-specific to product-specific activities.

Once the investing companies have been selected, the local contact point tries to find a potential partner. Although the companies have to pay a participation fee, financial support is provided by the Norwegian Agency for Development and Cooperation (NORAD) to enable them to visit the potential partners, and to support the start-up phase of outsourcing/joint ventures up to set levels. Matchmaking is successful when (i) it is commercially interesting for the investor and the local partner, (ii) the type of technology transfer is of interest to the local country, and (iii) there is enough capital to cover the risk.

The benefits of such a programme are multiple. They include unquantifiable benefits deriving from technology, and skills- and education-related transfers, as well as quantifiable ones deriving from the number of new joint ventures and new jobs created. For example, over the period 1994–2006, the programme has created 48 new joint ventures and some 3,000 news jobs in Sri Lanka. On average, 84 per cent of the Norwegian companies [that have joined the MMP] have been matched with one or more Sri Lankan profile.

Undoubtedly, similar projects would be very beneficial to the LDCs. However, the lack of suitable infrastructure and human skills, as well as weak capabilities, are regarded as being the major factors that discourage potential investors. LDCs have therefore not been included in this programme so far.

*Source:* Direct communication with NORAD.

### Box 11. Coffee sector agribusiness development projects in Rwanda

In 2001, a USAID-funded project — Partnership for the Enhancement of Agribusiness in Rwanda (PEARL) — was started with the aim of improving rural livelihoods by reviving the coffee sector in Rwanda. PEARL has been successful in (i) improving-capacity building in the agricultural sector, (ii) improving agricultural quality, (iii) providing market diversification of export products, and (iv) empowering local farmers and building linkages with other actors in the private and public sectors.

In just six years the PEARL project has had a considerable impact. It introduced new practices for rural smallholder farmers, which increased the quality of the final product and made changes in local production, technology and supply-chain development. Two technological transformations that contributed to increased quality were (i) the introduction of new and improved washing stations, which enabled cleaning and sorting in accordance with qualitative standards, and (ii) training facilities to improve local washing techniques as well as tasting skills. The latter type of knowledge is necessary in order to enable sellers to negotiate a fair price for their coffee products. In 2006, for example, 60 individuals received training in testing, tasting and other quality-improving processes. The training, tasting and research facilities provided through the programme also facilitate the creation of a closed collaboration and linkages between farmers, sellers and researchers at the National University of Rwanda.

It is estimated that the technology and innovation programmes implemented through the PEARL project have increased the price for a kilo of unprocessed dried coffee — from $0.22 to roughly $2.00 — to the benefit of the local smallholder farmers. Furthermore, the number of farmers engaged in the cooperative increased from 400 in 2002 to 1,600 in 2006. The quality improvements brought about by the new washing facilities led to the creation of 75 stations throughout Rwanda.

Once the capacity to produce and sustain the production and export of high-quality products had been acquired, second-level agribusiness activities, such as coffee roasting and spin-off enterprises could be started. Building upon this improved capacity, a second project was launched as a follow-up to PEARL in 2007. The new programme — Sustaining Partnership to Enhance Rural Enterprise and Agribusiness Development SPREAD — aims at introducing the second-level activities as well as strengthening the linkages between development partners, including NGOs and universities. The SPREAD programme will increase linkages with technology extension agronomists and business development specialists to include health professionals, ICT experts and media programmes in a more integrated approach.

*Source:* Farley ( 2007).

## 3. The orientations of technical cooperation

The current orientations of technical cooperation reinforce this picture. How statistics on technical cooperation are collected is now a subject that is being discussed, and it is therefore impossible to indicate where LDCs stand in detail in terms of modalities of technical cooperation.[4] However, table 37 shows the sectoral composition of technical cooperation disbursements to LDCs during the period 2003–2005 and technical cooperation commitments during 1998–2000 and 2003–2005. A number of very important patterns are apparent.

*Only 22 per cent of total technical cooperation disbursements to LDCs during 2003–2005 were devoted to economic infrastructure and productive sectors.*

- Sixty-six per cent of total technical cooperation disbursements to LDCs during 2003–2005 were allocated to social infrastructure and services, with 20 per cent of total disbursements during that period going to governance (government and civil society), 18 per cent to education and 10 per cent to health.
- Only 22 per cent of total technical cooperation disbursements to LDCs during 2003–2005 were devoted to economic infrastructure and productive sectors (including multisector).
- Nine per cent of total technical cooperation disbursements in 2003–2005 went to emergency assistance and reconstruction.
- The share of total technical cooperation commitments to LDCs devoted for governance increased from 14 per cent during the period 1998–2000 to 25 per cent in 2003–2005.
- The share of technical cooperation commitment for economic infrastructure and productive sectors fell from 32 per cent during 1998–2000 to 25 per cent during 2003–2005.

**Table 37. Scale and composition of technical cooperation activities**

*(Disbursements and commitments, average annual)*

| | Disbursements | | | Commitments | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | *Million, 2004 $* | *As % of total TC* | *As % of totai aid* | *Million, 2004 $* | | *% of total technical cooperation* | | *% of total aid* | |
| | *2003–2005* | | | *1998–2000* | *2003–2005* | *1998–2000* | *2003–2005* | *1998–2000* | *2003–2005* |
| Social infrastructure and services | 2 308.1 | 65.8 | 11.2 | 1 579.3 | 3 452.5 | 62.1 | 66.0 | 8.8 | 11.3 |
| *of which:* | | | | | | | | | |
| Education | 626.2 | 17.9 | 3.0 | 577.3 | 794.9 | 22.7 | 15.2 | 3.2 | 2.6 |
| Health | 361.1 | 10.3 | 1.8 | 291.2 | 480.8 | 11.4 | 9.2 | 1.6 | 1.6 |
| Population Programmes | 343.7 | 9.8 | 1.7 | 189.0 | 509.7 | 7.4 | 9.7 | 1.1 | 1.7 |
| Water Supply and sanitation | 46.6 | 1.3 | 0.2 | 84.7 | 71.2 | 3.3 | 1.4 | 0.5 | 0.2 |
| Government & civil society | 684.5 | 19.5 | 3.3 | 343.2 | 1 299.4 | 13.5 | 24.8 | 1.9 | 4.2 |
| Other social infrastructure | 245.9 | 7.0 | 1.2 | 93.9 | 296.6 | 3.7 | 5.7 | 0.5 | 1.0 |
| Economic infrastructure | 198.5 | 5.7 | 1.0 | 170.6 | 354.0 | 6.7 | 6.8 | 1.0 | 1.2 |
| Production sectors | 269.9 | 7.7 | 1.3 | 366.9 | 379.9 | 14.4 | 7.3 | 2.0 | 1.2 |
| Multisector | 297.9 | 8.5 | 1.4 | 278.9 | 553.1 | 11.0 | 10.6 | 1.6 | 1.8 |
| Commodity aid/ general programme assistance | 103.3 | 2.9 | 0.5 | 23.2 | 96.2 | 0.9 | 1.8 | 0.1 | 0.3 |
| Action relating to debt | 1.5 | 0.0 | 0.0 | 3.0 | 2.3 | 0.1 | 0.0 | 0.0 | 0.0 |
| Emergency assistance & reconstruction | 306.8 | 8.8 | 1.5 | 58.0 | 366.6 | 2.3 | 7.0 | 0.3 | 1.2 |
| Administrative costs of donors | 2.4 | 0.1 | 0.0 | 18.1 | 1.2 | 0.7 | 0.0 | 0.1 | 0.0 |
| Support to NGOs | 3.0 | 0.1 | 0.0 | 0.9 | 3.6 | 0.0 | 0.1 | 0.0 | 0.0 |
| Refugees in donor countries | 0.5 | 0.0 | 0.0 | 1.3 | 0.5 | 0.1 | 0.0 | 0.0 | 0.0 |
| Unallocated/unspecified | 13.9 | 0.4 | 0.1 | 46.6 | 23.5 | 1.8 | 0.4 | 0.3 | 0.1 |
| Total | 3 505.5 | 100 | 17.0 | 2 546.7 | 5 233.5 | 100 | 100 | 14.2 | 17.1 |

*Source:* UNCTAD secretariat calcualtions based on OECD/CRS; data downloaded on 5 March 2007.

From this it is very clear that technical cooperation activities in LDCs are basically designed to improve public sector capabilities for governance and provision of services rather than private sector capabilities related to production. Donor priorities are starkly evident in the fact that annual technical cooperation commitments to improve governance (in the widest sense) in 2003–2005 were $1.3 billion, which may be compared with annual aid commitments of $12 million for agricultural extension during the same period.

*A change in the use of technical cooperation funds towards developing private sector capacities, and in particular STI capacities, is needed.*

A new approach to technical cooperation has been strongly advocated; it would be focused on "capacity development", which is defined as "the process whereby people, organizations and society unleash, strengthen, create adapt and maintain capacity over time" (OECD website), with capacity being broadly defined as "the ability to perform functions, solve problems and set and achieve objectives" (Fukuda-Parr, Lopes and Malik, 2002: 8). Similarly, the Commission for Africa (2005) defines capacity development as "investment in people, institutions and practices that will, together, enable a country to achieve its development objectives" (p. 389). This open-ended definition of capacity opens up the possibility that there can be greater use of technical cooperation to support technological learning and innovation at the firm level. But implementing this vision in the LDCs requires a change in the use of technical cooperation funds towards developing private sector capacities, and in particular STI capacities, rather than simply public sector capacities.

## D. How donors can improve aid for STI in LDCs: Agriculture

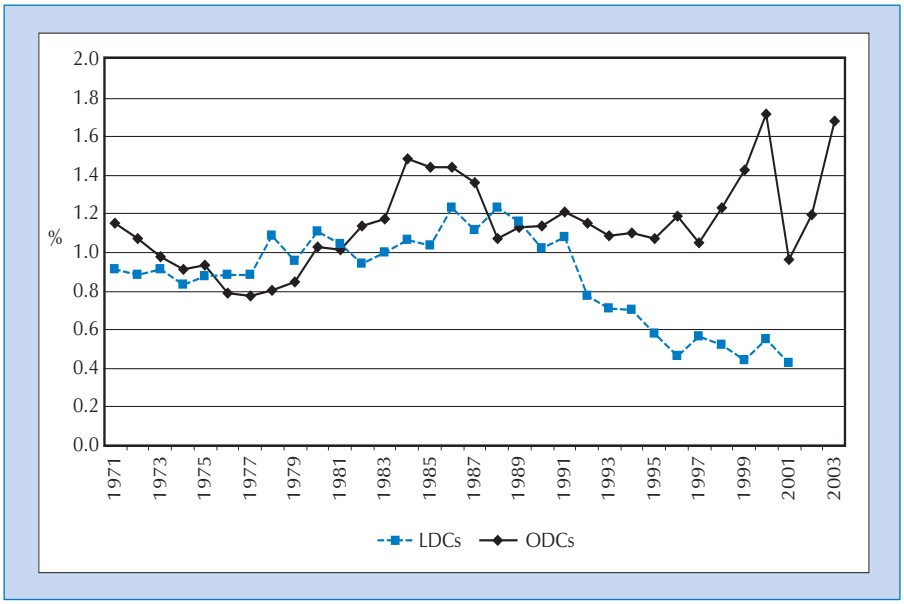
This section and the next one consider how donors could improve aid for STI in LDCs in, firstly, agriculture, and secondly, industry and infrastructure. One of the important findings of the quantitative analysis of the scale and composition of aid for STI in LDCs is the very small scale of aid disbursements for agricultural research. This is particularly surprising, and not only because agricultural research is identified as an S&T priority in all the PRSPs analysed (see chapter 2, table 17). Empirical evidence suggests that there are "high rates of return from agricultural R&D investments, making agricultural research a cost-effective way for Governments to accelerate agricultural development" (Beintema and Stads, 2006: 1). The Bangladesh Rice Research Institute (BRRI), for example, has developed and released 31 modern varieties of rice (the main staple food) in the past two decades, and these now account for 65 per cent of total rice production. It is estimated that annual rice production doubled between 1970 and 2002 from 10.8 million metric tonnes to 24.3 million metric tonnes, but that without the BRRI's modern varieties, it would have increased by just 10 per cent over that period (UNESCO, 2005: 258).

*The low level of donor support for agricultural research in LDCs makes it very difficult for LDCs' Governments to sustain sufficient public investment in agricultural research.*

The low level of donor support for agricultural research in LDCs makes it very difficult for LDCs' Governments to sustain sufficient public investment in agricultural research.[5] An agricultural research intensity ratio is typically used to measure the agricultural research investment effort of a country or a group of countries. It is calculated as the percentage share of investment in agricultural research in agricultural output. The latest agricultural public research intensity ratio for the LDCs amounts to 0.47 per cent versus 1.7 per cent for the other developing countries.[6]

Chart 14 shows the average evolution of public agricultural research intensity for the LDCs and other developing countries from 1971 to 2003. It can clearly be

**Chart 14. Agricultural research intensity in the LDCs and other developing countries (ODCs), 1971–2003**




*Source*: UNCTAD secretariat calculations based on data extracted from the ASTI database on 5 May 2007.

seen that agricultural research intensity was at about the same level in each group of countries until 1991, when that of the LDCs dropped by more than half. If the slow increase in agricultural research intensity in the 1980s had continued in the 1990s, it would have resulted in a ratio equal to 1.4 by 2001, three times higher than the actual measured intensity ratio.

*Raising the level of agricultural R&D expenditure even just to 1 per cent of agricultural GDP will require a major increase in investment in the agricultural R&D.*

Although there is no official recommendation about preferred intensity ratios for agricultural R&D investments, the World Bank has suggested a 2 per cent target rate, while the Inter-Academy Council, focusing particularly on sub-Saharan Africa, recommends that an agricultural research intensity ratio of 1.5 be reached by 2015 (Beintema and Stads, 2004: 4). Raising the level of agricultural R&D expenditure even just to 1 per cent of agricultural GDP by 2015 will require a major increase in investment in the latter.

Part of that increase could come from the private sector. However, past patterns are not encouraging. Estimates suggest that only 2 per cent of total agricultural research expenditure in sub-Saharan Africa in 2000 came from the private sector (Beintema and Stads, 2006). It is extremely unlikely that the pattern is different in other LDCs. Pray and Umali-Deininger (1997: 1143) note that "profitability is the main determinant of private for-profit participation in agricultural research". Thus, they argue that private research can fill the gap created by stagnating or declining public research budgets in countries and industries with large markets for modern input and products for which returns on research are highly appropriable. But "products and sectors that may be of high social value, but command only a small market and exhibit a high degree of geographical and ecological specificity will most likely be ignored by the private for-profit sector. Because of their public good nature and their 'distance' from commercial application, basic and strategic research usually receive little attention by the private for-profit sector. This implies that the private for-profit sector will not always fill the gap and that alternative sources of research output, that is public and private non-profit sectors, have to be found to service socially beneficial but privately unprofitable 'orphan sectors' "(p. 1144).

*Only 2 per cent of total agricultural research expenditure in sub-Saharan Africa in 2000 came from the private sector. It is extremely unlikely that the pattern is different in other LDCs.*

Similarly, a study of ongoing attempts to privatize certain parts of agricultural research in seven African countries, including Ethiopia, Senegal, Uganda and the United Republic of Tanzania, warns of the possible emergence of a two-

track research system (Chema, Gilbert and Roseboom, 2003). Such a system may emerge if there is a large degree of privatization of research services and if farmers' associations, the agribusiness community (exporters, processors, input suppliers and commodity traders) and other beneficiaries are called upon to finance the research programme and researchers are paid incentives according to their proven contribution to farming profitability. In such a situation, peasant farmers who are engaged in low-value subsistence-oriented food production and keep livestock will be relatively neglected and there will be little incentive for researchers to work in those areas. Thus, the two-track research system could emerge "with a reduced number of researchers, drawing low salaries, conscripted to the war against poverty, while the best researchers work on those commodities for which there is private funding" (ibid.: 26).

*Although the private sector can make a small contribution increasing the agricultural research intensity ratio in LDCs will require increased public R&D expenditure and this will, in turn, need increased ODA for agricultural R&D.*

Against that background, it would be wrong to believe that public research expenditure has been crowding out private sector investment in LDCs and that the latter will automatically increase as the former declines. Although the private sector can make a small contribution and there are certainly opportunities for some kinds of public–private partnerships, increasing the agricultural research intensity ratio in LDCs will require increased public R&D expenditure and this will, in turn, need increased ODA for agricultural R&D. Indeed, ODA flows to agricultural research for the LDCs must increase to levels much higher than the current ones.

*There is evidence of a large and sustained, if not growing gap, between a comparatively small group of scientific haves and a substantial group of scientific have-nots.*

There may be some reluctance to increase levels of and owing to disappointing results from past aid for agricultural R&D. However, there is an increased understanding of the weaknesses in national agricultural research systems (NARS). Those include imbalances in financing for research, extension and education, with Eicher (2001) pointing out the very low level of expenditure on agricultural education and Hayami and Ruttan (1985) the bias towards extension. Emphasis is now being placed on a systems approach to agricultural innovation (World Bank, 2006). Moreover, it is generally agreed that key elements for more effective NARS include a pluralistic institutional structure with many actors, including NGOs and the private sector; new competitive mechanisms for research funding; and management reforms to improve the efficiency and effectiveness of public research organizations (Byerlee, 1998). The African case studies referred to earlier also indicate that important reforms in NARS are taking place and include decentralization of agricultural research, greater stakeholder participation, a shift from block grants to competitive research funds, and the strengthening of system linkages.

*The role of the network of international agricultural research centres is particularly important in undertaking scientific research relevant for increasing agricultural productivity in the LDCs.*

Finally, global scientific linkages are important for increasing agricultural productivity in the LDCs. In that regard, recent research has identified worrying trends in global R&D in which "there is evidence of a large and sustained, if not growing gap, between a comparatively small group of scientific haves and a substantial group of scientific have-nots" (Pardey et al., 2006: 2). Those authors note that the rich countries' agricultural research agendas are shifting away from simple productivity concerns, and to high-technology inputs (such as precision farming technology), which are not as easily adopted and adapted by the developing countries as they were before and are particularly irrelevant for LDCs. They indicate that some fear that less developed countries will become "technological orphans".

Against the background of global shifts in agricultural R&D, the role of the network of international agricultural research centres known as the Consultative Group on International Agricultural Research (CGIAR) is particularly important in undertaking scientific research relevant for increasing agricultural productivity in the LDCs.[7] In the 1990s there was a broadening of the CGIAR's research agenda

away from research on agricultural production of staple foods towards post-harvest handling, food processing and food safety and environmental issues, and this was accompanied by a stagnation of donors' financing. This change in goals reflects the developed countries' concern about environment and agriculture-related issues that are not strictly related to farming improvements, as well as the rise of new and powerful lobbying groups. Whilst issues related to post-harvest handling, environmental sustainability and food processing are certainly relevant, it is important that agricultural research continues to not reflect the reality of subsistence-oriented smallholder agriculture in LDCs. It has been estimated that in 2003 CGIAR spent only 10 per cent of the combined real spending by the African national agricultural research agencies on "African" issues (Beintema and Stads, 2006). Alston, Dehmer and Pardey (2006) argue that "Over time, the CGIAR has misplaced its original, well-defined sense of purpose and to some extent has degraded its capacity to meet its original objective: to stave off hunger by enhancing the capacity of the world's poor people to feed themselves, through research-induced improvements in agricultural productivity" (p. 348).

*A priority for aid for STI in the agricultural sector is to ensure that CGIAR work remains LDC-relevant.*

Thus, a second key priority for aid for STI in the agricultural sector is to ensure that CGIAR work remains LDC-relevant.

## E. How donors can improve aid for STI in LDCs: Industry and infrastructure

*There is at present very little aid that is supporting STI capacity in industry and infrastructure.*

Donors should not neglect aid to build STI capacity outside agriculture. There is at present very little aid that is supporting STI capacity in industry and economic infrastructure. Moreover, what is provided appears to be for supporting the development of human capacities and public S&T infrastructure. In contrast, very much less attention is given to enterprise-based STI activities and to strengthening the capacity to innovate.

Against that background, Bell (2007) identifies three broad directions for an ODA strategy aimed at STI-related technological learning and capability development relating to industrial and physical infrastructure development:

- Supporting expanded activities and reoriented approaches to STI infrastructure development in LDCs;
- Developing new, modified or substantially expanded forms of ODA for fostering enterprise-based technological learning and capability building;
- Supporting policy development and implementation relating to industry and infrastructure-oriented activities.

*With regard to STI infrastructure, the major objective should be to increase the scale of support for those activities and to reorient them so as to increase their relevance for industrial development and physical infrastructure development.*

With regard to STI infrastructure, the major objective should be to increase the scale of support for those activities and to reorient them so as to increase their relevance for industrial development and physical infrastructure development, and to improve their effectiveness. Reorientation might involve, for example, increasing support for engineering in university education or re-examining the content of technical and vocational training. But beyond that, there is a need for a shift in the way in which technical and business support services away from providing services to enterprises towards supporting arrangements for strengthening capabilities in enterprises by embedding support services alongside commercial transactions in value chains. Such embedded business services are packaged within or bundled around commercial transactions between a buyer and a seller. An example of such an approach is the Local Industry Upgrading Programme set up in Singapore in 1986, which included the conclusion of cost-

sharing contracts between the Government and subsidiaries of multinational corporations (MNCs) for enhancing local firms' learning and their linkages with the subsidiaries.

*New approaches are needed to support enterprise-based technological learning and capability-building.*

The second broad direction for ODA is the development of new approaches to support enterprise-based technological learning and capability-building. This requires novel forms of ODA which recognize that there is a need for investment in knowledge assets (particularly design and engineering capabilities) and that those assets must in large part be created through the training and learning activities of enterprises, because there are limits to what can be achieved through formal learning. Problems of non-appropriability, externalities and public goods mean that there is insufficient investment in those activities. Addressing that issue requires grants and soft loans for investment in the relevant types of knowledge assets. That could be achieved not by initiating totally new activities but by "stretching" existing donor activity to include STI capability-building. The following areas are particularly important:

- Value-chain development schemes;
- FDI complementation and linkage development;
- Industrial and infrastructure project funding, including through public–private partnerships;
- Promoting the role of the World Federation of Engineering Associations and NGOs dealing with engineering issues, including through fellowship funding;
- Facilitating South–South collaboration.

*There is a need now to consider how to apply the principle of explicitly contracting with larger firms to augment the capabilities of value chain partners.*

### 1. Value-chain development schemes

Some donor-funded projects to strengthen the technological capabilities of firms in the value chain and to foster knowledge-centred interactions between them are already in place. However, there is a need now to consider how to apply the principle of explicitly contracting with larger firms to augment the capabilities of value chain partners, and also the potential for such contracts with large importer organizations. Donors may be resisting the introduction of such projects because (i) it might appear that "subsidies" are being provided to large firms; (ii) there is limited funding; and (iii) limited analyses of the structure of the value chains prevent them from knowing the key actors and points for action. Those constraints should be actively addressed. Box 12 presents a successful value-chain development scheme in which business support services are embedded in commercial transactions along the value chain.

*Donor should consider cost-sharing partnerships with TNC subsidiaries investing in LDCs in order to forge new supply linkages with domestic firms and strengthen the capabilities of existing suppliers.*

### 2. FDI complementation and linkage development

Donors should consider cost-sharing partnerships with TNC subsidiaries investing in LDCs in order to forge new supply linkages with domestic firms and strengthen the capabilities of existing suppliers. The idea that TNC subsidiaries can be expected to engage in such efforts to build the capabilities of local suppliers without financial incentives is farfetched. However, evidence suggests that they are willing to collaborate in skills development activities if they are reimbursed for conducting expanded training activities. An example of this is the way in which SME linkages with the MOZAL aluminium smelter in Mozambique have been fostered by providing firms with packages of business and technical training and with access to finance, together with the development of local consultant support, partly funded by the International Finance Corporation.

### Box 12. Building Support Service Capabilities into Value Chains: Ghana's Craft Basket-making Industry

During the 1990s Ghana developed an export trade in craft products including woven baskets. This was based on a value chain that ran from small producers (many in rural areas) via export companies, some of which were also producers, to importers and wholesalers in advanced country markets. The Ghanaian exporters had played an important role in providing a range of services to their suppliers (independent producers and sub-contractors). These services fell into two roughly distinguishable categories: *market and management services* (e.g. shipping, market intelligence, financing) and *technological services* (e.g. product design, quality management).

By the early 2000s, it was evident that, although they were important, these services that were embedded in the transactions of the value chain were falling far short of achieving their full potential. In particular the more 'technology-centred' services were seriously constrained by a combination of limited skills in firms and limited incentives to invest in creating or hiring them - because of various forms of externality. This can be illustrated, for example, by the case of product design. Exporters sometimes passed on to their suppliers ideas about new product designs they received from importers. However this was a relatively 'passive' process. The importers seldom had the design skills or time required to work with exporters on more purposeful product development. Also, besides lacking design capabilities, the exporters were hesitant to invest in new product designs because these would be rapidly copied by competitors. There had been one or two cases in which aid donors had sponsored international design consultants to advise on design and production, but this service was much too expensive to be sustained by the industry on an ongoing basis beyond the one-off, donor-funded 'injections'.

To address this gap between potential and realised achievement, a project was implemented in 2002-2003 with donor support to strengthen the business service support system for the industry. This involved an integrated array of services, cutting across both 'technological' and others. It was distinguished from many such schemes by a simple principle: the aim was not to use specialised service suppliers to provide services for firms in the industry, but to strengthen the capabilities of firms in the value chain to provide services along the chain to other firms – focusing in particular on the capabilities of the Ghanaian exporters to provide support services to their upstream suppliers. Three *selected components* of the project can illustrate this principle in operation.

- Quality management (QM). Initially rejection rates by exporters were high and several had lost overseas clients because of poor quality. The project set up a two stage programme. The first involved several training workshops for teams of QM trainers. Each team brought together different actors in the value chain: technical officers from the exporters, co-ordinators of sub-contracted producers, and master weavers from producers. In the second step these teams provided training workshops for producers. Supported by a radio campaign, this resulted in reject rates falling to negligible levels, and key actors in the value chain had learned about organising QM development activities and about the gains they could derive from doing so.
- Market access. Exporters were supported in connecting to new international markets (e.g. via visits to trade fairs in the US and by training in ICT skills). This enhanced not only their own trade opportunities but also the opportunities for their suppliers to expand output and test-market new products.
- Product design and development. The design capabilities of exporters were enhanced by arranging firm-based internships for students from the College of Art at the Kumasi University of Science and Technology. This enabled the exporters to elaborate and test product design ideas they had not been able to fully develop. This formed the basis for securing large trial orders from importers and for providing new product specifications to producers. It also led to a critically important form of learning: "… a growing realization among the export companies that investment in new product development was the only way to remain competitive on the international market" (source, p. 42). This was linked to the demonstration of a mechanism for organising such in-house design activity on a sufficiently low-cost basis to be sustainable.

There were two important learning outcomes. One was the enhanced knowledge-base of the value chain firms (especially the exporters) that enabled them to provide key services to other value-chain members. The other was the exporters' learning that it was in their longer term interest to bear the short term costs of playing this role. Their trade volume increased, their costs fell and their margins widened - also their export market position was more sustainable relative to competition from Asian copiers of 'Ghanaian' craft products.

*Source:* Bell (2007).

## 3. Industrial and physical infrastructure project funding

This is the area where donors can have the greatest effect on STI development in the LDCs. What is required is that industrial and physical infrastructure investment projects are implemented in such a way that they incorporate substantial learning elements and are organized to generate knowledge spillovers. Donors should thus introduce STI capability components alongside core investment projects. Physical infrastructure development can be expected to provide a major contribution to the development of design and engineering skills in LDCs (see United Nations Millennium Project Task Force, 2005; Juma, 2006).

The basic constraints knowledge accumulation through industrial projects and physical infrastructure development are conceptual, namely (a) limited recognition by developing country clients and Governments (as well as aid donors) of the longer-term developmental significance of investing in engineering-centred knowledge assets as well as the physical assets of industrial and infrastructural facilities; (b) limited recognition of the importance of enterprise-based learning as a large part of the process of creating those assets; and (c) limited recognition of major investment projects as potentially important vehicles within which to embed such learning activities. However, it is clear that donor practices have also sometimes militated against local learning. For example, Marcelle, in her study of the wide variation in learning across a sample of investment projects for telecommunications facilities in four African countries, noted that "operating companies in Uganda and Tanzania, which relied on development assistance for network expansion programmes, reported the least satisfaction with the quality of the [learning] interface with suppliers" (Marcelle, 2004: 120). The limitations on learning arose from aspects of donor intervention that led, for example, to increased numbers of suppliers — resulting in poor long-term relationships with suppliers and lack of interoperability among equipment and network components. Larger operator companies in other countries that implemented network development programmes without such dependence on donors gained from the learning-intensive nature of long-term relationships with suppliers as well as from the ability to build up cumulatively deeper competence by standardizing equipment and network facilities across successive projects.

*What is required is that industrial and physical infrastructure investment projects are implemented in such a way that they incorporate substantial learning elements and are organized to generate knowledge spillovers.*

Donors should explore innovative mechanisms for exploiting the learning potential of physical infrastructure investment projects with which they are already involved. Some of those mechanisms may be particularly promising in the context of donors' existing activities to foster public–private partnerships in infrastructure development.

## 4. Engineering associations and NGOs

Several engineering associations and NGOs, such as the World Federation of Engineering Organizations and Engineers without Borders, are active in pursuing development-related issues in the LDCs. Together with donors' support for engineering education activities and support for engineering volunteers to act in developing countries, those professional associations and NGOs constitute another way of pushing forward specific technical training and capacity development at the local level. Donors currently provide fellowship funding for collaborative research projects and technical training carried out at universities in the donor countries. Another way to strengthen STI capacity in LDCs would be to use the in-house training programmes of private engineering companies in developed countries. This would be an innovative way of involving the private sector through cost-sharing in building engineering capabilities in LDCs.

*Another way to strengthen STI capacity in LDCs would be to use the in-house training programmes of private engineering companies in developed countries.*

## 5. Facilitating South–South collaboration

A particular problem in developing engineering capabilities in LDCs is the small size of the economies of those countries, the sporadic nature of investment projects and thus weak incentives to invest in creating engineering capabilities. That problem may be addressed if, in implementing the above proposals, donors foster greater South–South cooperation. In Africa, for example, this might involve a collaborative approach amongst neighbouring LDCs.

The third and final broad direction of policy that is required is greater donor support for STI policy formulation and implementation by LDC Governments.

# F. Technological learning and Aid for Trade

## 1. Technological capability-building: The overlooked component of Aid for Trade

In response to the calls which were made by the G8 at the Gleneagles Summit in 2005 for reduction of the adjustment pressure that developing countries will face with the current round of trade negotiations, the Ministerial Declaration of the Hong Kong Ministerial Conference calls for an "Aid for Trade" (AfT) framework whose aim is:

> *"to help developing countries, particularly LDCs, to build the supply-side capacity and trade-related infrastructure that they need to assist them to implement and benefit from WTO agreements and more broadly to expand their trade. Aid for Trade cannot be a substitute for the development benefits that will result from a successful conclusion to the DDA, particularly on market access"* (Hong Kong Ministerial Declaration, 2005, para. 57, WT/MIN(05)/DEC).

*Although the Ministerial Declaration called for AfT to build supply-side capacity and trade-related infrastructure, no definition of supply-side capacity was included, and thus the scope for AfT is rather flexible.*

Although the Ministerial Declaration called for AfT to build supply-side capacity and trade-related infrastructure, no definition of supply-side capacity was included, and thus the scope for AfT is rather flexible. An informal understanding on the meaning of supply-side capacity exists, but it is equally vague as it defines supply-side constraints as "those that impede the efficient production of goods and services".

WTO (2006a: 2) — which is now the basic reference document on what constitutes Aid for Trade — states that "the scope of Aid for Trade should be defined in a way that is both broad enough to reflect the diverse trade needs identified by the countries, and clear enough to establish a border between Aid for Trade and other development assistance of which it is a part". It extends the categories of AfT to (a) trade policy and regulations, (b) trade development, (c) trade-related infrastructure, (d) building productive capacity, (e) trade-related adjustment, and (f) other trade-related needs. Along similar lines, the OECD (2006) proposes a definition of Aid for Trade that uses the objectives of the activity to be financed, rather than the type of activities it is supposed to finance, including (i) trade policy and regulations, (ii) economic infrastructure, and (iii) building productive capacity.[8]

*One striking feature of this conceptual debate is that the role of technological capability-building and upgrading and its impact on export competitiveness and poverty reduction are currently marginal to the ongoing discussions.*

One striking feature of this conceptual debate is that the role of technological capability-building and upgrading and its impact on export competitiveness and poverty reduction are currently marginal to the ongoing discussions. The importance of physical infrastructure is clearly recognized, but the development of technological capabilities is largely overlooked. This is a serious omission which must be rectified. Interestingly, the United Nations Conference on Financing for Development, which took place three years before the Hong Kong Ministerial Conference, provided a definition of supply-side constraints and asked donors to:

> *"remove supply-side constraints, through improving trade infrastructure, diversifying export capacity and supporting an increase in the technological content of exports, strengthening institutional development and enhancing overall productivity and competitiveness"* (United Nations, 2002: para. 36: 8).

The role of technological upgrading has been clearly demonstrated in a number of case studies on successful export development (Chandra and Kolavalli, 2006). There is thus an urgent need explicitly to integrate measures to promote technological development in the framework of AfT.

## 2. The Integrated Framework (IF) for Trade-Related Technical Assistance

Similar arguments can be applied for the IF. The IF is the major initiative through which donors, LDCs and agencies are seeking to improve the efficiency of trade capacity development within LDCs. Created in 1997, it was revamped in 2001 with the aim of including trade in the countries' poverty reduction strategies or development plans and assisting in the delivery of trade-related technical assistance. The Diagnostic Trade Integration Studies (DTIS), which are the main output under the first of the two funding "windows", contain an analysis of the constraints on trade competitiveness, and of policy responses and capacity-building strategies to overcome them. After discussion between Governments and stakeholders, the trade-capacity-building priorities should be integrated into the development plans, while concrete projects listed in the Action Matrix are financed under the second funding "window" (see UNCTAD, 2002 and 2004, for more details).

*There is thus an urgent need explicitly to integrate measures to promote technological development in the framework of AfT.*

Several evaluation exercises have been conducted recently to assess the efficacy of the IF. Their results highlighted weak country ownership, inadequate capacity-building support, and failure to integrate trade into the PRSP process and to finance the priorities identified in the action matrix (WTO, 2006a) The increased interest in the development dimension of trade to which the current round of trade negotiations has given rise led to the current and ongoing discussions on how to increase the effectiveness and timeliness of the IF (Hong Kong Ministerial Declaration, para. 48). The task force that was created to discuss the modalities for "enhancing" the IF "agreed that the scope of the IF should be broadened to support activities related to the analysis and prioritization of needs" (WTO, 2006a: 6). The DTIS template includes broader trade-related issues and response to needs emanating from the ongoing round of trade liberalization negotiations. Furthermore, the core areas eligible for intervention cover (i) institution-building to handle trade policy issues, (ii) strengthening of export supply capabilities, (iii) strengthening of trade support services, (iv) strengthening of trade facilitation capacity, (v) training and human resource development, and (vi) assistance in the creation of a supportive trade-related regulatory and policy framework to encourage trade and investment (WTO, 2006a).

Clearly, the current attempt to enhance the IF[9] fits into the broader discussions on how to strengthen the domestic (country-driven) approach of Aid for Trade. Specifically, the policies that would need to be implemented to achieve the DTIS core areas (ii) and (iv) include domestic technological upgrading and other structural transformation policies. At the current level of technological development, the LDCs have only a limited comparative advantage in exports other than primary commodities and low-skill manufactures.

An analysis of how science and technological upgrading is treated in the latest eight DTIS shows that, with some exceptions, S&T initiatives and considerations are included in the main body of the DTIS, but their relevance has not been fully recognized in the Action Matrices (table 38). In five out of eight DTIS, S&T matters are given only scant consideration in the Action Matrices. In those in which they are mentioned, the focus is related only on research (mostly agricultural-based) and training. The Action Matrices of Sierra Leone and the Lao People's

Democratic Republic refer only to the development of processing activities that could lead to higher-value products. Undoubtedly, new or improved processing techniques are an important, although not an exclusive, effect of the introduction of new technologies in the domestic production processes. Only the Action Matrix of Maldives contains specific projects aimed at fostering domestic technological improvements.

*An analysis of how science and technological upgrading is treated in the latest DTIS shows that S&T initiatives and considerations are included in the main body of the DTIS, but their relevance has not been fully recognized in the Action Matrices.*

The scant consideration given to S&T matters in the Action Matrices does not reflect the way in which technological changes and improvements are treated in the main text of the DTIS. In the case of the Lao People's Democratic Republic, the DTIS states that "[…] the rapid pace of globalization and technological change threatens to bypass Laos and relegate its producers to relatively low rungs on the value chain unless action can be taken to adapt and adopt emerging technologies […] (p. 124). The DTIS of Sierra Leone states that "efforts to export new products or to maintain competitiveness or exposure to imports, can lead to the introduction of new technology which results in higher productivity and lower costs per unit of output" and that "the most obvious way to use trade for poverty reduction is to expand output and employment. [.] A way to increase output and employment is through the introduction of better farming practices or new technologies, which improve farmer productivity and increases the range of options regarding production" (p. 19/20).

The majority of the DTIS contain a specific paragraph or section covering and highlighting the importance of S&T issues. For most of the DTIS, trade policies include S&T initiatives, which are primarily linked with projects aimed at improving the technological content and capabilities of the domestic customs authorities through ASYCUDA and related technological improving projects. Surprisingly,

**Table 38. How S&T is treated in the latest eight DTIS**

| | Benin | Chad | Lao PDR | Maldives | Rwanda | Sao Tome & Principe | Sierra Leone | Zambia |
|---|---|---|---|---|---|---|---|---|
| | *(Dec. 05)* | *(Oct. 06)* | *(Nov. 06)* | *(Nov. 06)* | *(Nov. 05)* | *(Mar 06)* | *(Oct. 06)* | *(Oct. 05)* |
| In the main text of the DTIS: | | | | | | | | |
| Is there a specific section/paragraph covering S&T issues? | N | N | Y | Y | Y | Y | Y | N |
| Do international trade policies include S&T initiatives? | N | N | Y | Y | Y | Y | Y | N |
| Are S&T issues treated at the level of | | | | | | | | |
| - trade policies | N | N | Y | Y | Y | Y | Y | N |
| - FDIs | Y | N | Y | N | Y | N | N | Y |
| Are there technology-related infrastructure projects to improve | | | | | | | | |
| - electricity | N | Y | N | N | Y | Y | N | N |
| - telecommunication | Y | N | Y | Y | Y | Y | Y | N |
| Are there projects aimed at increasing technological awareness through | | | | | | | | |
| - vocational training | W | Y | Y | Y | Y | Y | Y | Y |
| - R&D activities | N | Y | Y | Y | N | Y | Y | N |
| Are there sector-specific technology extension programmes | N | | | | N | | | |
| - in agriculture | | Y | | Y | | Y | Y | |
| - other (tourism, mining) | | | Y | | | | | Y |
| Are S&T considerations included in the Action Matrix? | W | W | Y | Y | W | W | Y | W |

*Source:* UNCTAD secretariat compilation based on IF, DTIS studies.

*Note:* Y = yes; N = no; W = weak.

the technological implications arising from FDI inflows have not been accounted for in four DTIS. Although the development of technology-related infrastructure requires the expansion and improvement of electricity networks (necessary for the use of electrical machineries and devices) and of telecommunications (necessary for facilitating the flow of information and know-how), not all DTIS include them and they give priority to telecommunications. Virtually all DTIS recognize the importance of education, training and R&D activities for raising technological awareness. As in the PRSPs, vocational training is considered to be a critical instrument for the promotion of S&T development in the LDCs and for economic development in general, as the new skills can be directly applied to production processes. Furthermore, half of the DTIS include initiatives aimed at promoting and disseminating best practices in agriculture[10] and agriculture-related sectors (e.g. fisheries).

*The DTIS could be a key instrument for ensuring that the role of technological upgrading in trade development is fully recognized in Governments' and donors' policy agendas.*

The DTISs have great potential since they could become the vehicle that could provide domestic Governments with an overall vision of where they are in terms of the technological upgrading policies for tradable activities, and what can be done to improve the domestic technological level on the basis of an ad hoc analysis of the countries' technological landscapes and policies. Furthermore, the DTIS could be a key instrument for ensuring that the role of technological upgrading in trade development is fully recognized in Governments' and donors' policy agendas. The DTIS Action Matrix is the means that Governments can utilize to present their policies on technological and human skills improvements for donors' financing. It has a dual role: (i) to summarize in single identifiable projects the analysis and recommendations contained in the main body of the DTIS, whether or not related to technology development, and (ii) to provide donors with clear projects in sectors and industries that are considered to be crucial for countries' development prospects and that require financing. The main text of the DTIS and the sector' studies are a useful tool that would enable Governments to identify the sectors and the industries with the greatest potential for expansion, whether it is for export-related purposes or not, and to indicate technological needs to ensure that export competitiveness is built up.

## 3. Deepening preferential market access through a technology fund

For some LDCs market access preferences have supported the development of simple manufacturing activities, particularly garment manufacture. Those preferences enable exporters from the LDCs to pay lower tariffs or even enter markets quota- and duty-free. As discussed in past LDC Reports, the effectiveness of trade preferences can certainly be improved, particularly by widening the scope of product coverage and relaxing the rules of origin. However, some specialists have argued that they would be even more effective if they addressed supply-side constraints at the same time. In that regard, it has been suggested, for example, that trade preferences be linked to FDI.

If this issue is examined through the point of view of technological learning and innovation, it is apparent that trade preferences have succeeded in some countries — such as Bangladesh, Cambodia, Lesotho and Madagascar — in initiating the development of new sectors. But there has been limited diffusion of technological capabilities within domestic enterprises and little upgrading of production. This is particularly apparent in the case study of Cambodian ready-made garments discussed in chapter 1.

Against that background, it may be worthwhile to consider how a dedicated technology fund could be designed in such a way as to be linked to trade preferences. Its specific aim would be to increase the local learning impact of new economic activities stimulated by trade preferences. In particular, such a fund — which could be part of AfT provisions — should support local technological diffusion from foreign to domestic investors and also technological upgrading. Without such local learning effects, the benefits of market access preferences could be transitory. Enhanced technological learning is particularly important at the present time for the garments industry in LDCs as the transitional arrangements following the expiry of the Agreement on Textiles and Clothing themselves come to an end.

*One of the most important insights regarding development in the last 25 years is that knowledge and learning are at the centre of the process, and most of the LDCs' development partners still need to translate this insight effectively into their programmes.*

## G. Conclusions

The main message of this chapter is that one of the most important insights regarding development in the last 25 years is that knowledge and learning are at the centre of the process of economic growth, and that most of the LDCs' development partners still need to translate this insight effectively into their programmes. Increasing knowledge aid which is directed to supporting knowledge accumulation in recipient countries by expanding their knowledge resources and supporting their knowledge systems could be the key to increasing aid effectiveness.

It is difficult to quantify the level of aid for STI in LDCs. But only 3 per cent of aid disbursements went to research and advanced and/or specialized training during the period 2003–2005. Moreover, aid for STI in LDCs is currently provided in a disjointed way with insufficient focus on systemic support for enterprise learning and innovation. The declining level of aid commitments for agricultural research, agricultural extension and agricultural education are particularly disturbing since agricultural research and extension are identified as priorities in LDCs' PRSPs. But it is equally important that donors support technological learning and innovation outside agriculture.

*There is a need for a rapid increase in ODA for agricultural R&D for the LDCs.*

The Report makes a number of specific recommendations with regard to aid for STI in relation to agriculture, industry and trade. Firstly, there is a need for a rapid increase in ODA for agricultural R&D for the LDCs. Secondly, the effectiveness of ODA for non-agricultural technological learning and innovation has been severely compromised because donors do not prioritize that activity. It is recommended that donor-supported physical infrastructure projects all include components which use the construction process to develop domestic design and engineering capabilities. In addition, there is a need for public support for enterprise-based technological learning, which should be in the form of grants or soft loans for investment in the relevant types of knowledge assets. Such public support should be undertaken as a cost-sharing public–private partnership for creating public goods, particularly in relation to the development of design and engineering skills through enterprise-based practice. These STI capacity-building activities could be particularly useful if they are linked to value-chain development schemes, FDI linkage development and the facilitation of South–South cooperation.

*There is a need for public support for enterprise-based technological learning, which should be in the form of grants or soft loans for investment in the relevant types of knowledge assets.*

Thirdly, it is important to integrate a technological development component into "Aid for Trade" and ensure that technological development issues are included in the Action Matrices of DTIS. Finally, there has been some discussion of ways in which trade preferences for LDCs could be enhanced not simply by extending their depth and coverage but also by linking them to supply-side support, for

*Trade preferences for LDCs could be enhanced by linking them to supply-side support in the form of a technology fund which seeks to leverage the technological learning effects of the productive activities that are stimulated through such preferences, in particular through diffusion of best practices and encouragement of upgrading.*

example through complementary measures to encourage FDI. From the point of view of technological assimilation, it is clear that trade preferences, particularly in relation to garments, have successfully stimulated the initial implementation of manufacturing activities in some LDCs. However, they do not explicitly facilitate the diffusion of best practices to domestic firms within a country and do not encourage technological upgrading. Against that background, it is worth examining whether trade preferences can be supplemented with a trade-preference-related technology fund which seeks to leverage the technological learning effects of the productive activities that are stimulated through such preferences, in particular through diffusion of best practices and encouragement of upgrading. Work should be done on the possible design for such a fund.

## Notes

1 This includes (i) agricultural projects which involve investments in adaptive and applied research, the strengthening of national agricultural research systems (NARS) and human capital formation; and (ii) non-agricultural projects which were human resource development projects, including university-based research, projects to restructure public R&D institutes, technology development projects, health projects, environmental projects and comprehensive S&T projects which sought to link supply and demand for S&T services (Crawford et al, 2006: 8–9).

2 The Global STI Forum on "Building Science, Technology and Innovation Capacity for Sustainable Growth and Poverty Reduction", held in Washington, DC, from 13 to 15 February 2007, was an important aspect of that process.

3 Data in the OECD CRS database indicate that half of the aid for research going to Senegal is spent on medical research and a third on environmental research. France is the major donor.

4 For the latest thinking on measuring technical cooperation, see OECD (2007a).

5 For case studies within LDCs, see Ahmed and Karim (2006) and Elliott and Perrault (2006). The latter state that "the erosion of the current research capacity in Zambia" is a "quiet crisis" because it takes place against a positive chorus of achievements in liberalization and privatization while ignoring the simultaneous serious and perhaps permanent loss of institutional and human capacity" (p. 239).

6 Data are taken from the ASTI database and refer to 2001 for LDCs and 2003 for other developing countries. Available from the following URL: http://www.asti.cgiar.org/index.cfm. This database is not a full time-series database and covers only 19 LDCs, with data sparsely available through the period between 1971 and 2003. The implementing agencies considered include Governments, higher education and non-profit agencies. The private sector has been excluded as in Beintema and Stads (2006).

7 For discussion of agricultural research as a global public good, see Anderson (1998), Gardner and Lesser (2003) and Spielman (2007).

8 The OECD definition includes trade policy and regulations and trade development under trade-related technical assistance and capacity-building; transport and storage, communications and energy under economic infrastructure; and banking and financial services, business services, agriculture, forestry and fishing, industry and mining, and tourism under productive capacity (OECD, 2006: figure 5).

9 The objectives of the Enhanced Integrated Framework are to increase the volume and predictability of funding, strengthening of the in-country implementation capacity and improvement of the governance structure of the IF.

10 Specifically cocoa, rice, cotton, and palm oil.

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# Annex

## OECD CRS Codes[a] used to define STI-related aid

| CRS code | Description | Clarifications |
|---|---|---|
| | **1. Research** | |
| 11182 | Educational research | Research and studies on education effectiveness, relevance and quality; systematic evaluation and monitoring |
| 12182 | Medical research | General medical research (excluding basic health research) |
| 23082 | Energy research | Including general inventories and surveys |
| 31182 | Agricultural research | Including plant breeding, physiology, genetic resources, ecology, taxonomy, disease control and agricultural bio-technology |
| 31282 | Forestry research | Including artificial regeneration, genetic improvement, production methods, fertilizer and harvesting |
| 31382 | Fishery research | Pilot fish culture; marine/freshwater biological research. |
| 32182 | Technological research and development | Including industrial standards, quality management, metrology, testing, accreditation, and certification |
| 41082 | Environmental research | Including establishment of databases, inventories/accounts of physical and natural resources, environmental profiles and impact studies if not sector-specific |
| | **2. Improvements of Human Skills** | |
| 11330 | Vocational training | Elementary vocational training and secondary-level technical education, on-the job training, apprenticeships, including informal vocational training |
| 11420 | Higher education | Degree and diploma programmes at universities, colleges and polytechnics; scholarships |
| 11430 | Advanced technical and managerial training | Professional-level vocational training programmes and in-service training |
| 12181 | Medical education/training | Medical education and training for tertiary-level services |
| 12261 | Health education | Information, education and training of the population for improving health knowledge and practices; public health and awareness campaigns. |
| 12281 | Health personnel development | Training of health staff for basic health-care services |
| 13081 | Personnel development for population and reproductive health | Education and training of health staff for population and reproductive health care services |
| 14081 | Education and training in water supply and sanitation | |
| 16062 | Statistical capacity-building | In national statistical offices and any other government ministries |
| 21081 | Education and training in transport and storage | |
| 23081 | Energy education/training | Applies to all energy sub sectors; all levels of training |
| 24081 | Education/training in banking and financial services | |
| 31181 | Agricultural education/training | |
| 31166 | Agricultural extension | Non-formal training in agriculture |
| 31281 | Forestry education/training | |
| 31381 | Fishery education/training | |
| 33181 | Trade education/training | Human resources development in trade not included under any of the above codes. Includes university programmes in trade |
| 41081 | Environmental education/ training | |
| 43081 | Multisector education/training | Including scholarships |
| 43082 | Research/scientific institutions | When sector cannot be identified |

a OECD CRS Codes available as of 2 February 2007.