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Science & Technology and the PRSP Process: A Survey of Recent Country Experiences

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A. Abstract

This paper examines how the role of science and technology as a driver of economic growth and poverty reduction has been addressed in poverty reduction strategy papers (PRSP) formulated over the last five years in various least developed countries. This analysis is based on a synoptic review of eleven PRSP documents prepared in countries in the sub-Saharan Africa, Asia and Latin America regions; Also, on a case study of the policy process that lead to the formulation of Mozambique's second PRSP. It finds that, overall, the incorporation of S&T in PRSPs in somewhat weak. Hence, whilst most countries recognise, in some form or other, the importance of promoting S&T development as part of their PRSP strategies, they fail to incorporate these issues in a systematic way in the various policy spheres relevant for S&T development. This is especially notable in areas such as international trade and investment, private sector development or the generation of local scientific and technological knowledge. As a result, these documents generally lack of clearly defined and comprehensive strategies that put S&T at the centre of these countries' development programmes. In this context, the case study of the Mozambican PRSP formulation process suggests that some of these problems may relate to underlying weaknesses affecting these countries' planning and budget formulation systems, highlighting the need to address the incorporation of S&T in PRSPs in the wider context of general government reform and the harmonisation and alignment of donor practices in these countries. It is in this perspective that the paper concludes with some suggestions as to how the full incorporation of S&T considerations can be improved in the formulation of future country PRSPs.

B. Introduction

Over the last decade the development policy agenda in many least developed countries (LDCs) in sub-Saharan Africa, Asia and Latin America has been heavily dominated by the formulation and implementation of Poverty Reduction Strategy Papers (PRSP). An initial wave of PRSP documents started being formulated in the early 2000s. Since then, over forty countries have participated in this PRS process.

These policy documents have aimed at instilling a greater poverty focus to these countries' developmental programmes by presenting a comprehensive package of policy initiatives in the various relevant spheres of government intervention. Frequently, they have been accompanied by comprehensive reforms in government budgeting, planning and financial management systems aimed at strengthening their mid-term policy frameworks and strategic planning tools for poverty reduction. In most instances, the preparation of these strategic policy papers has also involved some degree of consultation with relevant national stakeholders – e.g. government agencies, parliament, civil society and the private sector – in an attempt to increase country ownership of these programmes and, ultimately, add force to these poverty reduction policy efforts.

In recent years numerous programmes have been established to monitor and assess progress in the formulation and implementation of the PRS process around the world. These range from those set up by international development agencies, such as the World bank, the IMF, the UNDP or UNIDO, to more independent and research-based initiatives, including the Overseas Development Institute's PRSP Monitoring and Synthesis Project, EURODAD's work on Poverty Reduction Strategy Papers (PRSP) or the Bretton Woods Project's work on structural adjustment and poverty reduction strategy programmes (SAPs/PRSPs). In this

context, several studies have been conducted to examine particular aspects of the PRS process and the content of related PRSP documents. These include both cross-country and conceptual papers examining the PRSP coverage of issues such as gender (Whitehead, 2003), trade (Hewitt and Gillson, 2003; UNCTAD, 2004), private sector development (EURODAD, 2002), macroeconomic and growth considerations (Gottschalk, 2005; Driscoll and Evans, 2006), or issues relating to civil society participation in country-level PRS processes (Wood, 2005), their integration within national public expenditure and financial management systems[1] and country ownership of PRSPs (Stewart, 2003).

Following this earlier comparative literature on the PRS process, this paper examines how recent PRSP country documents have addressed and incorporated science and technology (henceforth S&T) considerations into their poverty reduction policy strategies. This analysis is partly based on a synoptic survey examining the S&T content in eleven recently finalised PRSP documents. This exercise is complemented with a case study of the Mozambican 2005 PRS process that lead to the elaboration of the 2006–2010 Action Plan for the Reduction of Absolute Poverty (PARPA, in its Portuguese acronym). This case study provides insight into how S&T issues were addressed during the process that lead to the formulation of this document, as well as into the various constraints and problems faced during this process, therefore, enriching the more 'static' analysis resulting from the synoptic survey undertaken in the previous section. On the basis of these various analyses the paper concludes with a summary of main findings and some policy recommendations of how the PRS process can be improved to enhance the S&T content and focus of poverty reduction efforts in least developed countries.

C. The links between S&T and poverty reduction: Theoretical considerations

Two main avenues can be identified through which scientific and technological efforts in LDCs can contribute to poverty reduction initiatives in these countries. Firstly, by enhancing their economic performance. Secondly, by improving the living conditions of the population, including those groups living in relative or absolute poverty. In both instances, several channels and policy spheres can be identified through which S&T affect poverty reduction efforts, highlighting the crosscutting nature of science and technology development and associated policy considerations.

From an economic perspective, the role of technological development and change as a key driver of economic growth is well established in the economic literature, starting from the seminal works of Marx, Schumpeter (1942), Solow (1956, 1957) or Kaldor (1957) to the more recent endogenous growth (e.g. Lucas, 1988; Romer, 1986; or Tamura, 1991), neo-Schumpeterian (Aghion and Howitt, 1992; Grossman and Helpman, 1991a, 1991b; or Romer, 1990, 1994), and evolutionary literature (e.g. Nelson and Winter, 1982; Dosi, et al., 1988). From an economic perspective, technology development efforts contribute to raise the rate of growth and social welfare through the incorporation of new or improved products and crops, the development of improved inputs or the introduction of more efficient production technologies and practices that improve a country's level of competitiveness.

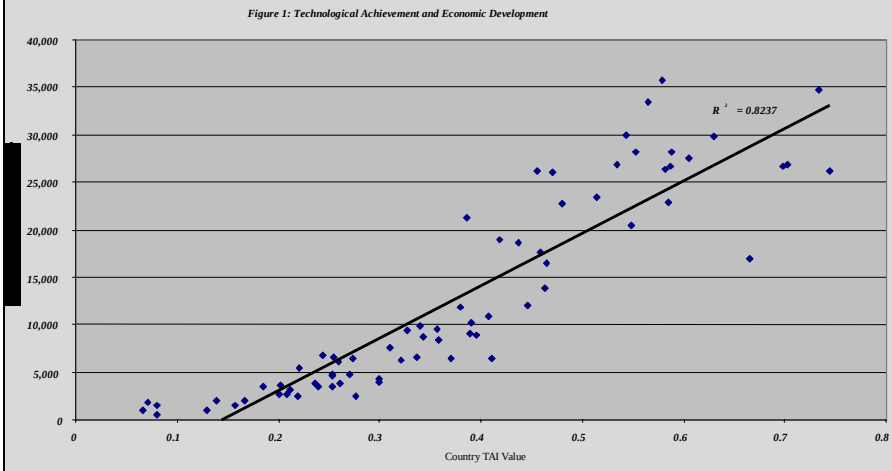
[1] See the various publications on PRSPs and public expenditure management by ODI's Centre for Aid & Public Expenditure (CAPE) at http://www.odi.org.uk/PPPG/cape/index.html

In some cases, this process of technological development and change has its origin in new scientific discoveries developed through basic R&D efforts which may, ultimately, lead to radical changes in international techno-production and social paradigms (Pérez, 1983). However, more frequently, they are the result of innovative efforts undertaken directly by economic agents, or by these in collaboration with technology-related institutions such as universities or applied research centres; also, from learning-by-doing, using or interacting dynamics that take place in the various sectors of the economy. These result in incremental upward movements in the international frontier of available technologies.

Whilst the generation of frontier scientific knowledge and technological innovations is largely circumscribed to developed economies, science and technology considerations also play a critical role in developing countries, including in low-income least developed economies. In this sense, from an economic perspective the process of economic development can largely be viewed as a process of technological catching-up, by which economic agents in less developed economies learn to master new technologies of production already in use in more advanced economies, so as to close the technological gap that separates them from the international technological frontier (Pack and Westphal, 1986). This process enables developing countries to increase productivity levels, enhance their international competitiveness and enter new markets or market segments for higher value added goods. Ultimately, this may lead to higher degree of economic development and, eventually, to a reduction in poverty levels through the generation of new employment opportunities, higher salaries in manufacturing activities and commercial agricultural enterprises, a general expansion of agricultural production, including family based farming, etc. It may also lead to a better insertion in the world economy, reducing their vulnerability to external shocks characteristic of international primary commodity markets.

BOX 1: TECHNOLOGY PROGRESS AND ECONOMIC DEVELOPMENT

Several indicators have been devised to measure national levels of technological development [See World Bank (2005) or Archibugi and Coco (2004)]. Of these, the UNDP's Technological Achievement Index, (TAI) is perhaps one of the most comprehensive of these measures, since it includes for any given country measures of both <u>technological</u> <u>skills</u> <u>and</u> <u>conditions</u>–as measured by the mean years of schooling; tertiary enrolment levels in science, maths and engineering; per capita electricity consumption and number of telephones per person– and <u>technological outcomes</u> –captured by the number of patents granted to each country and the value of royalty and license fees receipts (both in per capita terms). In this sense, the graph above highlights the strong correlation that exists between national levels of technological attainment, as measured through this Technological Achievement Index (TAI), and levels of economic development, in terms of 2001 GDP per capita values.



In developing countries this process of technological catching-up largely involves the transfer and absorption of technology and (scientific) knowledge generated in more advanced economies. However, this process is not automatic, with several factors impinging on the successful transfer, dissemination and subsequent use of foreign technologies and know-how in developing economies. These include: (1) the trade and investment policy regimes regulating the flow of goods and ideas between these countries and the rest of the world, as well as the policy mechanisms set up to maximise the technological, economic and poverty impact of international trade and foreign direct investment. These are critical, since they will determine the rate at which the transfer of technology and know-how to the local economy takes place; (2) the incentives to exploit these new scientific and technological opportunities, as determined by prevailing social, sectoral and macroeconomic conditions; (3) the infrastructural conditions that enable the effective use of modern technologies and the application of scientific knowledge; (4) people's skills and firms' capabilities, which allow them to understand and use in an effective and efficient way scientific and technological knowledge; and (5) the institutional setting for technology and know-how dissemination, which can help overcome the various market failures associated with the provision and dissemination of the S&T knowledge necessary for the promotion of innovation, technology use and technological change.

In addition, there is likely to be substantial need for locally generated scientific knowledge, innovation and other technology development efforts aimed, for instance, at adapting foreign technologies and know-how to local or country-specific circumstances (Evenson and Westphal, 1995), developing modified versions of foreign technologies or

generating locally useful S&T knowledge. These local innovative efforts can be particularly important in maximising the economic and poverty impact of this process of technological catching-up, absorption and change.

D. The S&T content of PRSPs: A cross-country examination

It is against this theoretical background describing the links between S&T development, economic growth and poverty reduction that this paper examines the science and technology content in eleven country PRSP documents published since 2004. This cross-country assessment focuses on six key policy dimensions encapsulating the various aspects contained in this theoretical framework: (1) the general policy approach taken in each of these documents with regard to S&T considerations; (2) the policy frameworks regulating international trade and investment, which, consequently, play a critical role in enabling the international transfer of technology and know-how; (3) the institutional settings promoting the generation of local scientific and technological knowledge; (4) the S&T content of educational and skill development policies; (5) the inclusion in each of these documents of policy initiatives for S&T dissemination in the spheres of infrastructure development and technology extension, including those relating to NICTs; and (6) the incorporation of S&T initiatives in other policy areas aimed at improving government service delivery, environmental sustainability and the general living conditions of the population.

1. Preliminary methodological considerations

The 11 PRSPs examined in this paper were selected on the basis of being produced by a least developing country, as defined by the United Nations' country classification system. The sample was limited to those documents that have been finalised since 2004, so as to capture, to the extent possible, new developments and trends that have emerged in recent years in the preparation of country PRSP documents. These mainly refer to the fact that recent academic and policy debates on the PRSP process have been giving greater consideration to economic and growth concerns,[2] potentially covering important areas for the analysis of S&T content in poverty reduction efforts. Several countries meeting these two criteria were excluded from this evaluation so as to make the analysis more manageable. These were all small nations with populations of less than a million people.[3]

In all, the sample includes six countries from sub-Saharan Africa — Burkina Faso, Lesotho, Mozambique, Sierra Leone, Tanzania and Uganda — two from South Asia — Bangladesh and Bhutan, an additional two from South East Asia — Laos and Cambodia — and one country from the Caribbean and Latin American region: Haiti. In all but two cases the documents reviewed corresponded to the second such document produced by each of these countries, including their interim PRSP (I-PRSP) report[4]. Only in the cases of Bhutan and Haiti was the first (and only) version of their PRSP considered. In the case of Haiti, the

[2] See, for instance, Gottschalk (2005), Driscoll, et al. (2006), UNIDO (2004), UNCTAD (2004).
[3] Cape Verde, São Tomé e Principe the Comoros islands and Djibouti.
[4] Interim PRSPs are first versions of country PRSPs laying out the main thrusts of poverty reduction efforts and which have not yet undergone a full process of consultation with civil society and other relevant agents.

document reviewed was in fact its I-PRSP, since the final report is still in the process of being finalised. However, it was included since it was the only LDC in the Latin American & Caribbean region to have recently undergone the PRS process and, in any case, the main elements of its poverty strategy should already be included in this I-PRSP document, including those in the sphere of S&T development.

It is necessary to note that the analysis of the science and technology content of country PRSPs documents presents a number of difficulties. First, it only allows for an assessment of these issues in terms of policy outcomes, as captured in the set of initiatives included in these documents. Therefore, it impedes an assessment of the underlying policy processes that lead to the formulation of these poverty reduction strategies. In this respect, it is important to note that, in some instances, PRSP documents are devised as '*soft*' policy documents that exist in parallel to regular planning and budget systems, partly written to meet these countries' commitments with IFIs and donor countries. Consequently, in these cases, it is hard to assess how well these documents reflect true government intentions and priorities.

Second, whilst most documents present a similar basic format, they frequently play different roles within these countries' planning and budgeting frameworks, which may lead to S&T considerations being addressed in different ways and depths. Some are conceived as detailed mid-term strategic government programmes, fully integrated within government planning and budget systems, as is the case of Mozambique's 2006 PRSP document. Consequently, they tend to present a more detailed discussion of policy priorities and initiatives, including those in the sphere of S&T. Others, however, are formulated as high-level white papers, only setting out the general principles of policy intervention that guide the preparation of more detailed annual and sectoral policy instruments. In these cases, it is harder to assess the S&T contents of these documents and compare them to other more detailed PRSPs, since these issues are often only formulated in a very generic way.

Finally, the crosscutting nature of S&T, together with the fact that initiatives in this sphere are likely to coincide with policy objectives in other priority areas – such as general infrastructure development, improved educational attainment, greater integration with the world economy, etc. – makes it hard to assess to what extent issues relating to S&T development are fully, purposefully and appropriately incorporated in these documents. In this respect, whilst some of these problems are addressed with the case study examination of the Mozambican 2006 PRSP document undertaken in Section 4, it is necessary to view with caution the findings reported in this cross-country synoptic survey of the S&T content of LDC's PRSP documents.

2. Economic and technological backgrounds of countries in the sample

Despite some significant differences, prevailing socio-economic conditions in this group of 11 countries remains very poor, with some of them ranked amongst the very poorest economies in the world, according to the UNDP's Human Development Index (HDI) classification. GDP *per capita* levels range from a low of around 700 USD per person in purchasing power of parity (PPP) terms for countries such as Sierra Leone and Tanzania, to over USD 2,000 in the cases of Lesotho and Cambodia, in all instances, well below the world's average GDP per capita, which reached USD 9,476 per person in 2005 in PPP terms.

Poverty incidence levels, measured in terms of the percentage of their population living below the national poverty line, are also very high, although with significant variations. Some of these countries, such as Cambodia, Laos, Tanzania and Uganda have made significant progress in recent years in their poverty reduction efforts, with the proportion of the population living below the national poverty line in the 30 per cent range. However, others, mainly Haiti and Sierra Leone, continue to present poverty levels above the 60 per cent mark, largely reflecting the effects of the civil conflicts that have affected these countries in the last decade. A third group of countries, which includes Mozambique, Bangladesh and Burkina Faso, presents less dramatic poverty incidence levels, although absolute poverty still affects a very high proportion of their population, in the range of 50 per cent.

Table 1: PRSP country sample: Basic Socio-Economic Indicators, 2004

Country	PRSP year of publication	Population (millions)	Per capita GDP (PPP) [a]	Poverty Headcount[b]	HDI (Rank) Max 177
Bangladesh	2005	139.2	1870.4	49.8	137
Burkina Faso	2004	12.8	1170.2	46.4	174
Buthan	2004	2.1	1,969.0	n.a.	135
Cambodia	2005	13.8	2422.9	35.9	129
Haiti	2006	8.4	1777.0	65.0	154
Laos, P.D.R.	2004	5.8	1962.5	38.6	133
Lesotho	2006	1.8	2659.1	n.a.	149
Mozambique	2006	19.4	1243.5	54.1	168
Sierra Leone	2005	5.3	757.8	70.2	176
Tanzania	2005	37.6	678.1	35.7	162
Uganda	2004	27.8	1456.6	37.7	145

Source: World Bank (2006) "World Development Indicators" and UNDP (2006) "2006 Human Development Report".

a) Values expressed in current US dollars

b) Poverty headcount values correspond to the most recent figure reported by the UNDP (2006).

A similarly bleak picture emerges when examining the available evidence on current technological conditions and technological development efforts in this group of 11 countries. The figures reported in Table 2, which provide some indication of existing levels of skills, technology infrastructural development and technology development efforts/outcomes in each of these economies, are illustrative of this situation. Whilst these figures do suggest the existence of some important differences within this group of countries in the various areas under consideration, the overall picture is one of a weak skill, science and technology base and generally poor technological performance. In all instances, values reported for each of the indicators included in Table 2 for this group of countries remain well below average world levels. This is not only true when compared to international standards — which are likely to be strongly upward biased by the inclusion of data for the economically more advance countries of the OECD — but also with respect to the group of upper-middle, lower-middle and low income countries. This latter comparison is particularly striking, since all of these eleven LDCs also pertain to this last group of low-income countries. It also highlights the wide technological gap that separates these eleven countries not only from technology leading economies of the OECD but also from the group of middle income and low-income countries of which they are immediate technological followers.

Table 2: Selected Science and Technology Indicators, (Most recent value in the 2000-2005 period)

Country(s)	Literacy Rates (5 of people ages 15 or above)	School enrolment, tertiary (% gross)	Tertiary students in science, en-gineering (% total tertiary)	Electricity consumption (kWh per capita)	Fixed line and mobile phone subscribers per 1000 people	Population covered by mobile phone	PCs per 1000 people	Secure Internet servers per million people	Internet users per 1000 people	ISO-9001 Certified Firms	High-tech exports (% of total exports)
Bangladesh	..	6.51	13	145	37.02	50	11.85	0.021	2.15	570	0.049
Bhutan	47.0	..	..	218	52.89	..	12.28	..	22.32	0	..
Burkina Faso	21.8	1.67	..	32	37.39	60	2.23	0.16	4.15	2	9.76
Cambodia	73.6	2.91	19	9	39.52	87	2.75	0.145	2.97	6	0.157
Haiti	..	..	..	61	64.23	..	..	0.594	59.47	0	..
Laos P.D.R.	68.7	5.86	11	135	48.21	6.69	3.79	..	3.60	0	..
Lesotho	82.2	2.76	6	..	109.14	80	..	..	23.91	0	..
Mozambique	..	1.19	24	399	26.94	..	5.76	0.051	7.10	8	9.365
Sierra Leone	35.1	2.14	8	49	27.17	35	..	0.213	1.87	0	..
Tanzania	69.4	1.20	..	78	32.23	25	7.38	0.026	8.85	20	1.664
Uganda	66.8	3.43	..	59	44.44	70	4.33	0.071	7.18	45	13.108
Low Income Countries	61.50	9.10	..	358.11	70.99	42.91	11.21	0.39	24.33	..	4.25
Lower Middle Income Countries	88.97	22.52	..	1,309.74	431.11	75.27	45.22	1.98	74.09	..	23.01
Upper Middle Income Countries	93.59	44.43	..	3,342.72	563.36	84.35	121.79	13.10	161.54	..	16.36
WORLD	..	24.81	..	2,510.20	470.85	69.47	129.82	65.25	139.96	776,608	19.570

Source: World Bank's (2006) "*World Development Indicators*" and UNDP (2006) "*2006 Human Development Report*".

3. General approach to S&T and economic development in PRSPs

Given these countries' general technological backwardness and the ample evidence linking economic development, growth and poverty reduction to S&T development, issues of this nature would be expected to figure prominently in these country PRSPs. Yet, this is only partly so. Hence, all eleven PRSPs contain references to S&T development in the various priority areas that comprise their poverty reduction strategies, although less so with regard to science and general knowledge generation than in relation to technology considerations. Most also make some form of acknowledgement to the importance of S&T for economic development, although often limited to specific areas of policy intervention, such as agricultural development or in discussing new information and communication technology (NICT) policies. Moreover, PRSP documents tend to give extensive coverage of policy spheres that are critical for S&T development, such as education, technical and vocational education and training (TVET), or general infrastructure development, in line with the weight that these issues receive in policy and academic debates.

However, the overall coverage of S&T as a priority policy in its own right and an issue of a crosscutting nature is generally weak in these PRSPs documents. Hence, as indicated in Table 3, only four out of these eleven documents include science and/or technology as a policy priority for poverty reduction: Bangladesh, Mozambique, Tanzania and Uganda. Of these, only Tanzania's and Mozambique's explicitly include science and scientific knowledge amongst their priorities, the other two focusing solely on technological development issues; and only one, Mozambique's, included S&T as a crosscutting issue during its preparation. Finally, the Lao's PRSP whilst not explicitly including S&T as one of its policy priorities, does refer to the need to "*develop and modernise social and economic infrastructure, in order to facilitate economic development in each region of the country and accelerate the Lao PDR.s regional and international economic integration"* (GoL, 2004: 3), which could be understood as an indirect reference to S&T development considerations. The remaining six PRSPs do not even include a section or paragraph dedicated to discuss separately S&T issues.

Of these four documents, it is Bangladesh's PRSP which presents the most comprehensive formulation of its strategy for S&T development, with a relatively detailed discussion of the different economic and, thus, technological options available to that country, their chosen strategic priorities –largely centred around ICT and biotechnology development– as well as of their likely economic, technological and policy implications. The preparation process that lead to the Mozambican 2006 PRSP also included a similar strategic approach, with a discussion in the initial phases of this process of the different development strategies for economic development available to Mozambique,[5] although this was not explicitly included in the final version of this document.

Table 3: General approach to S&T in PRSPs: evidence from the sample

	Was S&T considered a priority area in the PRSP document?	Was S&T considered or addressed as a crosscutting issue?	Is there a specific section/paragraph covering S&T issues?	Is there an analysis of S&T relating to overall poverty conditions?
Bangladesh	√	+/-	√	√
Bhutan	*x*	*x*	*x*	*x*

[5] See Jensen and Tarp (2004) for a presentation of some elements of this discussion.

Burkina Faso	*x*	*x*	*x*	+/-
Cambodia	*x*	*x*	*x*	*x*
Haiti	*x*	*x*	*x*	+/-
Lao	+/-	+/-	*x*	*x*
Lesotho	*x*	*x*	*x*	*x*
Mozambique	√	√	√	+/-
Sierra Leone	*x*	*x*	*x*	*x*
Tanzania	√	+/	√	√
Uganda	√	+/	*x*	√

Legend: √: yes; x*:* No; **+/-**: more or less.

In the remaining nine documents S&T considerations are presented in a very formulaic form, generally lacking a substantive analysis of existing S&T-related economic and social conditions, their relationship to development and poverty patterns prevalent in these countries, or an in-depth discussion of the various policy options available and their likely implications for technology and economic development, as well as for poverty reduction efforts. In this respect, most PRSP documents tend to present their poverty diagnosis as poverty mappings, in which the analysis of poverty conditions and trends is presented in the form of individual characteristics — e.g. gender, educational attainment, access to water, etc. — associated with households that fall below the national poverty line, therefore they tend to overlook wider considerations (e.g. S&T) that go beyond the realm of the individual household and which can also have an impact on poverty levels. Furthermore, these analyses seldom relate back to higher-level policy discussions regarding the policy options and strategies available to address these situations, and how each of these may affect economic prospects and poverty trends in the mid to long term. Overall, this points to a generalised weakness in the economic, social and poverty diagnostics undertaken in these PRSP documents, also found in other areas (see, Hewitt and Gillson, 2003; UNCTAD, 2004; in relation to the trade content of PRSPs).

Whilst these shortcomings do not necessarily disqualify these documents from a science and technology perspective, nor entail that key policy elements for S&T development in these countries are not addressed in their poverty reduction strategies, they are telling of a generalised lack of attention given to S&T issues in PRSP documents. Moreover, by lacking a more holistic approach, they may also come at the cost of an excessive fragmentation of relevant policy interventions in this sphere, in terms of addressing S&T issues in an isolated way in each of the relevant policy dimensions, and a reduced focus on efforts to improve S&T conditions in these countries. Many of these problems are patent when examining the S&T content of PRSPs in the various relevant policy spheres examined in the sections that follow.

4. PRSPs and international transfers of scientific and technological knowledge

As indicated in Section 2, the process of technological catching-up in developing countries largely takes the form of transfers of technology and (scientific) know-how from abroad to local agents. Whilst this transfer may take many forms, two channels are of particular importance: international trade in goods and services and foreign direct investment. Hence, trade can boost the transfer of foreign technologies by facilitating the import of new technologies and know-how embodied in capital equipment, intermediary goods or scientific materials; Also, by enabling the acquisition of disembodied technology in the form of technology licensing or patent agreements. Exports activities, on the other hand, may take local enterprises and agents to enter international markets or value chains and benefit from the know-how and technologies that flow through these systems.

Still, whilst trade in goods may increase the availability of technical and scientific knowledge, it also affects agents' incentives to engage in technology upgrading efforts, and it does so in an ambiguous way. Hence, although greater international competition might stimulate technology-related investments by local enterprises to increase their competitiveness in local and international markets, it may also have a technology-depressing effect, for instance, by reducing the share of national firms in local markets or the returns on these technological and learning investments, as highlighted by the infant industry literature[6].

From a policy perspective, increased participation in the world trading system is likely to be the overall preferred policy objective in terms of promoting technological development, as it will increase the availability of technological and scientific know-how. However, this greater participation in international trade may be achievable through a wide range of policy arrangements and, consequently, cannot be understood as only meaning greater openness to international trade flows or across-the-board trade liberalisation (Rodriguez and Rodrik, 2000). In fact, specific trade interventions may be considered necessary to temporarily protect the technological investments made by local economic agents, facilitate technological learning and, as a result, maximise the technological impact of international trade.

On the other hand foreign direct investment (FDI) can lead to considerable technology and knowledge spillovers in developing economies; directly, by resulting in the introduction of new production technologies, goods, methods of production and know-how; indirectly through employment channels — e.g. by contributing to human capital development in these countries (Asiedu, 2004) — or by generating upward and downward linkages with local firms. Moreover, the available evidence (e.g. Blomstrom & Kokko, 1996) indicates that subsidiaries of foreign (multinational) firms tend to engage in greater R&D efforts than local enterprises.

However, the degree of technological transfer through this investment mechanism largely depends on the extent to which FDI projects are able to create employment and learning opportunities for national workers and generate linkages with the local economy (e.g. local manufacturing firms, farmers, service providers, etc.), as well as on the impact they have on local competitors. Also on local institutions' ability to maximise these knowledge and technological spillovers through linkages programmes, employment and training initiatives, content requirements, or the promotion of joint-venture arrangements, among other mechanisms. Finally, foreign firms' willingness to invest and engage in dynamics that lead to greater technology transfer flows through these employment and linkages mechanisms will also depend on prevailing local investment climate conditions, regarding labour regulations for expatriate workers — which constitute an important channel of skills and knowledge

[6] See, for instance, the symposium on infant industry literature on Oxford Development Studies, Vol. 31, No. 1, 2003, for a recent discussion of some of these issues.

transfer — intellectual property rights legislation or general investment regulations, among others. All of these aspects are likely to be relevant for all sectors in the economy, including in agriculture and manufacturing activities.

Despite the centrality of the technology transfer mechanism as a means of upgrading LDCs' technological and skill bases and its far reaching policy implications in a wide range of policy spheres (e.g. trade, investment, competition regulation, etc.) PRSP documents tend to pay little attention to these considerations, at least in an explicit way.

Trade and investment do figure prominently place in most of these documents.[7] Yet, beyond a very formulaic approach to these issues, PRSPs generally lack an in-depth analysis of recent trade and investment trends and how these relate to local economic and poverty dynamics. Hence, they tend to lack any discussion of how trade and foreign direct investment can contribute to economic development and poverty reduction efforts, or an analysis of the different options and strategies available and their economic and social implications. They also give little consideration to the conditions that need to be met so as to maximise the potential benefits derived from trade and foreign investment, or of the policies that need to be in place so as to materialise these benefits. This also applies to the coverage given to S&T considerations in trade and FDI policies included in these PRSPs.

Table 4: S&T content in trade and investment PRSP policies

	International trade policy		**Foreign direct investment policy**	
	S&T issues taken into account?	**Include specific S&T initiatives?**	**S&T issues taken into account?**	**Include specific S&T initiatives?**
Bangladesh	√	√	√	√
Bhutan	*x*	*x*	√	*x*
Burkina Faso	*x*	*x*	*x*	*x*
Cambodia	*x*	*x*	*x*	*x*
Haiti	*x*	*x*	*x*	*x*
Lao	*x*	*x*	√	+/-
Lesotho	*x*	*x*	√	√
Mozambique	√	+/-	√	+/-
Sierra Leone	*x*	√	*x*	*x*
Tanzania	*x*	*x*	√	+/-
Uganda	*x*	+/-	*x*	*x*

Legend:* √*: yes; x*: *No;* +/-*: more or less

As a result, trade issues are usually presented in PRSP documents in very general terms, typically alluding to the need to improve these countries' insertion in the world economy and, from a macroeconomic perspective, in terms of increasing trade openness, usually understood as greater tariff reductions and general trade liberalisation efforts. Yet, little attention is paid to other trade-related issues, including science, technology, and skill transfers considerations in the terms described above.

[7] See Hewitt and Gillson (2003) or UNCTAD (2004) for an in-depth discussion of the trade content of PRSPs.

In this sense, only two documents make direct reference to the links between international trade and S&T transfer and development: those of Bangladesh and Mozambique. Bangladesh's PRSP is perhaps the most explicit, referring to the country's reliance on imports of goods and services for its technological requirements and the need, in some instances, to adapt these foreign technologies to local circumstances. In this context, it advocates for greater government involvement in facilitating technology transfers through imports of capital equipment, intermediary goods and foreign direct investment (GoBa, 2005: 81). To this purpose, it advocates for a comprehensive technology development strategy to be put in place, infusing *"dynamism in the working of the technology related institutions which will require initiative and collaboration on the part of the trade bodies supported by appropriate matching grant facilities"*. At the same time, it argues that *"the government should provide policy support to stimulate technology transfer and diffusion to local industries from foreign investors and actively participate in regional and global initiatives in support of transfer of technology favouring the developing countries"* (GoBa, 2005: 64).

On the other hand, in the case of Mozambique's PRSP there is a general allusion to how improving the country's insertion in the world economy, both in trade and investment terms, can potentially facilitate the process of technology transfer, as well as some vague references making the establishment of export processing zones conditional on their contribution to the local economy, which could be interpreted as partly referring to the generation of technology and skill spillovers.

Two other documents, Sierra Leone's and Tanzania's, also include initiatives that could be understood as aiming at maximizing the transfer of technology and know-how through trade mechanisms.[8] In the first case referring to the need to reduce current import duties on capital goods (GoSL, 2005: 123); in the second, stating the need to *"build capacity to provide trade services to tap into global production, outsourcing and marketing networks, enhance export guarantee mechanisms"* (GoT: 2005: 2, strategic Matrix), which could be taken as referring to the potential technology transfer benefits derived from participating international value chains.

A similar situation arises with regard to FDI considerations and how these may relate to greater S&T development in these countries. In this case, a larger number of documents (6) recognise, to some degree or other, the role of foreign direct investment in facilitating the international transfer of technology and know-how. Yet, only two — Bangladesh and Lesotho — make explicit mention to initiatives that may enhance these technology and know-how flows. For instance, the Bangladeshi PRSP includes in its strategic matrix the government's intention to articulate a policy support framework for technology transfer from foreign investors (GoBa, 2005: 257). Lesotho's PRSP document, on the other hand, states in its discussion of FDI policies that *"issues related to the choice of technology, strategic links with local firms and higher learning and R&D institutions, technical capabilities and readiness of local firms and labour–force to adapt technology will be examined"* (GoL, 2006: 30). Three other documents — Lao's, Mozambique's and Tanzania's — also include indirect references to initiatives in the sphere of investment promotion that could be read as being aimed at enhancing the transfer of technology and skills from foreign direct investment projects.

In this respect, investment policies in these papers are generally discussed in terms of investment climate concerns. The prominence that these issues take in PRSP documents is

[8] In this respect, the summaries presented in Table 4 should be viewed with caution, since they only indicate whether these documents include any initiative of this kind, not their number, quality of depth.

understandable, given the ample evidence pointing to the heavy constraints that poor business environment conditions impose on foreign investment and, more generally, private sector development prospects in these countries.[9] However, this should not impede the discussion and inclusion of other, complementary, policy initiatives that have the potential of maximising the economic and social impact of FDI, also in relation of S&T transfer considerations.

Despite these shortcomings, investment and trade policy strategies and specific initiatives included in these PRSPs should not be downplayed, even from an S&T transfer perspective. Clearly, policies aimed at improving general investment climate conditions and promoting trade are bound to impact, to some degree, on these countries' technological, scientific and skills base. Furthermore, other policy areas, such as those regarding skills and infrastructure development, that are critical in enabling these countries to positively benefit from a greater trade and investment integration in the world economy, including in S&T terms, are covered in greater detail and depth in these documents, as discussed below. Yet, the general absence of this type of discussions and policy initiatives in these PRSPs is indicative of the weak and insufficient consideration given to science, technology and skill development concerns in trade and investment policy discussions included in these documents.

5. PRSPs and local scientific and technological generation

Whilst technology transfer is likely to constitute the main technological catching-up mechanism for most developing economies, there remains substantial scope for technology development efforts in these countries, as well as for basic scientific research. Technology development efforts may actually involve the development of entirely new indigenous technologies. However, it will most likely entail the adaptation of foreign technologies and products to local conditions and country specific circumstances, so as to maximise their productive impact in the local economy (Evenson and Westphal, 1995).

The importance of local technology development activities in developing countries has long been recognised, especially in relation to applied agricultural research (see Schultz, 1964; or Hayami and Ruttan, 1971), with many developing countries running programmes of this kind. Perhaps less attention has been paid to other equally important dimensions of applied technological research, in areas such as industrial technology development, the development of construction materials, or research on renewable energies, although recent literature on national innovation and technology systems (e.g. Lall, 1992; Nelson, 1993, 2004; Lall and Pietrobelli, 2002) has been paying greater attention to these issues in the context of development. There is also scope in developing countries for the promotion of basic scientific research activities. Whilst these may not necessarily lead to cutting-edge contributions by international standards, local scientific research institutions play an important role in training local researchers, disseminating international scientific work and generating local scientific knowledge that can be used in applied technology development activities.

From a policy perspective, the promotion of local research and technological development efforts requires the strengthening of national innovation and technology systems. These include local R&D capabilities in higher education institutions, technology institutes, government agencies conducting applied research and non-governmental organisations

[9] See, for instance, the World Bank's 2005 World Development report (World Bank, 2005).

working in this field, among others. It may also require of stronger links between these institutions and the private sector and other relevant economic agents, given the applied nature of most technology development efforts.

In general, poverty reduction strategies pay little attention to the promotion of basic scientific research activities and capabilities in these countries, with only three countries in the sample, Bangladesh, Tanzania and Uganda making direct reference to these issues in their PRSPs. Of these, only Bangladesh and Uganda's poverty reduction strategies make specific proposals of this kind. In the first case, essentially centred around the creation of institutional mechanisms that regulate scientific research in higher education in terms of (i) compiling lists of publications for all universities; (ii) developing standards for scientific publications; (iii) recommending policy measures to ensure budgetary allocations to support research and (iv) establishing standards on university lecturers' time allocations between research and teaching activities (Government of Bangladesh, 2005: 303). Uganda's PRSP, on the other hand, refers to the need to establish a *"system a system of incentives that reward hard-working scientists that produce innovations that have practical relevance to Uganda's situation"* (Government of Uganda, 2004: 68). In the case of Tanzania, references to the promotion of basic scientific research as part of its poverty reduction efforts is limited to stating its *"Support will be increased to higher education, technical and R&D institutions, especially where the institutions address development needs of the local environment and contribute to enhancing the country's international competitiveness in knowledge creation and propagation"* (Government of Tanzania, 2005:44); yet, this is not followed by any indication of how this support will be articulated during the period of implementation of its PRSP, nor of whether it will prioritize R&D in certain areas.

Table 5: PRSPs and the generation of local S&T knowledge

Does it include initiatives to promote:	Basic R&D activities?	Applied R&D activities in agricultural research?	Applied R&D in industrial /engineering research?
Bangladesh	√	√	√
Bhutan	*x*	+/-	*x*
Burkina Faso	*x*	√	*x*
Cambodia	*x*	+/-	*x*
Haiti	*x*	*x*	*x*
Lao	*x*	√	*x*
Lesotho	*x*	*x*	*x*
Mozambique	*x*	√	*x*
Sierra Leone	*x*	√	√
Tanzania	√	√	√
Uganda	√	√	√

Legend: √: yes; x*:* No; +/-: more or less

The little weight given to basic scientific research considerations is partly compensated in most country PRSPs with a greater emphasis given to applied R&D capabilities in agricultural and, to a lesser extent, engineering and industrial technology research. Hence, 9 out of the 11 documents reviewed here include at least some reference to initiatives aimed at promoting agricultural research activities during their implementation. These go from very general statements indicating the government's intention to promote this

type of services, as in the case of Bhutan's and Cambodia's PRSPs, to more detailed programmes such as that of Burkina Faso, which even includes a detailed breakdown of intended activities by type of crop. Applied research efforts in fields other than agricultural development also receive some coverage in these PRSPs, although only four of these documents — Bangladesh, Sierra Leone, Tanzania and Uganda — make explicit reference to initiatives of this kind. Of these, Bangladesh's and Tanzania's are perhaps those that cover a greater range of fields, with initiatives in areas such as ICT development, biotechnology research, renewable energy sources, environmental pollution, water and sanitation and construction materials. Uganda's strategy, on the other hand, is centred on promoting general industrial research capabilities and extension through a combination of incentive mechanisms, incubator centres, the development of technology prototypes and a closer cooperation between the various institutions involved: the Ugandan Industrial Research Institute (UIRI), Council of Science and Technology (UNCST), its Export Promotion Board (UEPB) and National Bureau of Standards (UNBS). Finally, the Sierra Leonean PRSP document mentions in its matrix of strategic initiatives the creation of a R&D institute for the agro-processing industry.

These results highlight the uneven consideration given to applied research and technological development issues in agriculture, on the one hand, and non-primary economic activities, on the other. Hence, agricultural research and technology initiatives are, on the whole, reasonably well framed within these country PRSP programmes, usually presented as a key instrument in raising agricultural productivity, rural incomes and contributing to general economic growth and social development. Yet, this is not the case, of the very limited number of non-agricultural research and technology development initiatives examined in the previous paragraph. In this respect, only in the cases of Bangladesh and Uganda are these initiatives clearly set and framed within these countries' poverty reduction strategies, with a reasonably clear understanding of how they will contribute to economic development and poverty reduction efforts. The other two — Tanzania and Sierra Leone — basically consist of isolated initiatives, that hold little relationship to their overall PRSPs strategies.

6. Science, technology and human capital development

Technological assimilation, catching-up and development are inextricably associated with human capital development. Thus, even at the more basic level, the efficient use of any given technique, technology or piece of scientific knowledge requires of a basic understanding of its constituent elements, and how these relate to the external economic, social and natural environment in which they are used. Moreover, not all of these elements are codified, so that substantial technological improvements and efficiency gains can be achieved in the use of any technology through a process of continuous interacting and learning. In this respect, the process of economic, technological development can be understood as a process of technological learning and acquisition of technological capabilities (Pack & Westphal 1986).

From a technology policy perspective, human capital development is typically associated with skill development and technological capabilities schemes, such as Technical and Vocational Education and Training (TVET) programmes or the creation of business development services that support the development of firm-level technological capabilities. Some of these skills and technical capabilities can be very specific to certain sectors and activities, or might involve an element of continuous learning, requiring a strong interaction between government agencies and relevant local economic/social agents –e.g. private sector

organisations, trade unions, peasant or rural development associations– that make use of them, or setting up specialised training and technical capacity building facilities.

At a more basic level, human capital development in least developed economies will also benefit from general education initiatives in primary, secondary and higher education aimed at improving educational levels of the population, including their numeracy and scientific skills. Hence, a better educated population will generally have a greater command of new or, even, basic scientific and technological knowledge, and will be able to engage better with modern technologies for production, social or personal purposes. In this sense, any improvements in education, even at the most basic level, can potentially have large benefits from a S&T perspective, especially when starting from a very low literacy or educational base. In fact, given their greater social reach, initiatives in the sphere, especially in primary education, may actually be those with a larger impact on poverty reduction, by ensuring the provision of basic skills and technological competence to all segments of the population, including those living in relative or absolute poverty.

In this sphere of human capital development all eleven PRSP documents give extensive coverage to both skill development and general education considerations. In this respect, all documents present educational initiatives that have the potential of improving these countries' S&T learning and skill base. The centrality that these issues occupy in these strategies is not surprising, given the vast theoretical and empirical research linking poverty incidence and, more generally, economic and social development to educational and skill development, and the prominence that these issues have traditionally received in development policy and international aid spheres. In this sense, all of these documents highlight in their poverty diagnostics the strong and negative correlation that exists between poverty incidence and education attainment levels, and identify improvements in this sphere as a top priority for poverty reduction and growth efforts.

General education policies in these documents mainly focus on increasing primary and, to a lesser extent, secondary school enrolment and attainment levels, in line with the MDG target of achieving universal primary education by 2015. Educational initiatives usually include: (i) infrastructure investments to expand the number of education facilities throughout these countries, especially in rural areas; (ii) efforts to increase the number of teachers and the quality of teaching in primary and secondary education; (3) measures aimed at closing the gender gap that usually exists in enrolment and educational attainment levels and; (4) to a lesser extent the revision of school curricula.

Table 6. PRSPS and S&T content in education and skill development policies

	Bangladesh	Bhutan	Burkina Faso	Cambodia	Haiti	Lao	Lesotho	Mozam-bique	Sierra Leone	Tanzania	Uganda
1. Does the PRSP include specific S&T initiatives in?											
Primary Education	√	*x*	*x*	*x*	*x*	+/-	√	*x*	*x*	*x*	√
Secondary Education	√	*x*	√	*x*	*x*	+/-	√	√	√	*x*	√
Higher Education	√	*x*	*x*	*x*	*x*	+/-	√	√	√	√	√

2. Does it include initiatives to promote basic R&D activities?	√	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	√	*x*
3. Technical & Vocational Education Training (TVET)											
Is it acknowledged?	√	√	√	√	√	√	√	√	√	√	√
Does it include specific initiatives?	√	*x*	√	√	√	√	√	√	√	√	√
Does it take into account Market/demand needs?	√	*x*	√	*x*	*x*	√	√	√	√	*x*	√
Does it include partnerships with private sector?	√	*x*	√	*x*	*x*	*x*	*x*	*x*	√	*x*	√

Legend: √: yes; x*:* No; +/-: more or less

Beyond these more general initiatives in the sphere of education, basic S&T skills of the population can be further enhanced by increasing the science and numeracy content in education curricula, or by improving the aptitudes of primary and secondary teachers in these subjects. The evidence of such initiatives in the eleven PRSP documents reviewed in this paper is mixed, as indicated in Table 5, with some countries incorporating this type of initiatives in their strategies — including as Bangladesh, Lesotho, Mozambique, Sierra Leone and Uganda — whilst in others these are largely absent. A similar situation arises with respect to higher education, in the sense of including specific initiatives to promote scientific and engineering courses and enhance scientific research capacities in higher education institutions based in these countries, with only a handful of countries doing so. However, this finding should be viewed with caution, given that, often, this type of initiatives are only detailed in sectoral education policy documents and, thus, may not appear in higher-level PRSP papers.

The area in which S&T receives greater coverage in PRSP's education policies is that of technical and vocational education training (TVET). TVET programmes constitute a critical instrument for the promotion of S&T development in LDCs and, therefore, for general developmental and poverty reduction efforts. This is so because they are generally aimed at the development of technical skills that are directly applicable to production purposes in the various sectors of the economy – agriculture, manufacturing, the informal sector or family based activities – and, consequently, underpin efforts to raise productivity, employment and income levels. Additionally, they contribute to train specialised workers in fields that are important for service delivery in socials sectors, such health technicians, pharmacists, etc.

In this sphere, all countries except Bhutan include TVET initiatives as part of their poverty reduction strategies. Still, these tend to be formulated in very general terms, without indicating, for instance, what type of skills will be prioritised and for what purposes. Several of these documents also recognise explicitly that these programmes need to be partly demand-driven, and devised so as take into account the specific skill requirements of their productive

sectors; although, in this respect, hardly any reference is made of specific initiatives (e.g. private-public partnerships) that could lead to greater involvement of the private sector in the definition training needs and TVET programmes.

7. Dissemination of scientific and technological knowledge

A final aspect that needs to be taken into consideration in the assessment of the S&T content of PRSP strategies relates to the articulation of policy measures aimed at enhancing the dissemination of modern technologies, know-how and best practices across these economies. Two main issues need to be taken into account in assessing technology diffusion efforts: (1) the provision and extension of basic infrastructure services throughout these countries that enable the effective and efficient use of these new technologies and the dissemination of S&T knowledge; and (2) the active promotion of best technological practices, through extension efforts and services. In this sphere, special consideration needs to be given to S&T diffusion in rural areas, since poverty incidence levels are generally higher in these regions and access to scientific and technological knowledge and assets is frequently hampered by low incomes and poor infrastructural development.

(i) Dissemination of S&T and basic technology infrastructure

At the most basic level, the development of technology-related infrastructure will involve the expansion and improvement of: (i) electricity networks that make possible the use of electronic devices, as well as electrically powered equipment and machinery; (ii) irrigation infrastructures, including small-scale irrigation schemes, given the water requirements of most modern agricultural technology packages; (iii) and telecommunications services and networks, including those associated with the use of new information and telecommunications technologies (telephony, internet servers, etc.), since these infrastructures facilitate the flow of information and know-how, including that of a S&T nature.

Table 7. PRSPs and the incorporation of infrastructural technology concerns

	Electricity Networks		Telecommunication Networks		NICT Extension Strategy	
	General	Rural	General	Rural	General	Rural
Bangladesh	√	√	√	√	√	√
Bhutan	√	√	+/-	*x*	*x*	n.a.
Burkina Faso	√	√	√	√	*x*	n.a.
Cambodia	√	√	√	√	+/	*x*
Haiti	√	*x*	√	*x*	+/	*x*
Lao	√	√	+/-	+/-	+/	+/-
Lesotho	√	√	√	√	√	*x*
Mozambique	√	√	+/	*x*	√	*x*
Sierra Leone	√	√	+/	+/-	√	√
Tanzania	√	√	+/	*x*	√	*x*
Uganda	√	√	√	√	+/-	*x*

Legend: √: yes; x*:* No; +/-: more or less

As with education and skill development considerations, PRSP documents reviewed in this paper tend to give extensive coverage to policies aimed at developing and upgrading technology-related infrastructures. In this sphere, the main focus of all PRSP documents is in the extension and upgrade of national electricity grids, especially in rural areas where network coverage tends to be very poor. The importance given to (rural) electrification initiatives largely responds to the ample evidence linking poverty levels to access to basic infrastructures and pointing to problems of access to reliable sources of energy, including electric power, as a key constraint to social and economic development in these countries.[10] In this respect, all eleven PRSP documents acknowledge these problems, and most identify them as a main factor associated with poverty incidence in the poverty diagnostic sections included in these documents. Programmes in this sphere of electrification cover a wide range of initiatives, including the implementation of rural electrification programmes, regulatory measures, increased participation of the private sector in the provision of electricity services and the promotion of renewable energy sources (e.g. solar panels).

The provision and extension of telecommunication services – such as fixed and mobile telephony, data transmission networks or television services – also receives considerable attention in PRSP strategies, although less so than the provision and extension of electricity grids. All documents acknowledge, to some degree, the importance of improving general telecommunication infrastructure as a prerequisite for raising general productivity levels and improving living standards by widening access to telecommunication services. However, only some of these documents define specific initiatives of this kind, and even fewer take into account the greater needs of extending this type of infrastructures in rural areas. Furthermore, of these documents, only those of Bangladesh, Burkina Faso and, to a lesser extent, Mozambique present a comprehensive package of initiatives, including regulatory measures, steps to increase the participation of private initiatives in this strategic sector, efforts to expand and upgrade existing services and special programmes or initiatives to promote the use of these services in rural areas. The remaining three documents — Haiti, Lesotho and Uganda — only include isolated initiatives, such as the submission of draft Telecommunications Law to Parliament in the case of Haiti, the privatisation of postal services in the case of Uganda or the development of a Universal Access Policy for Telecommunications and Media in Lesotho.

A similar situation emerges with regard to efforts to extend the use of new information and communications technologies (NICTs). Again, most documents acknowledge the positive role that NICTs can have in poverty reduction efforts, as well as statements highlighting the need to extend the use of these types of technologies, in line with the extensive coverage that NCIT issues have received in the development literature in recent years; Yet only those of Bangladesh, Lesotho, Mozambique, Tanzania, Sierra Leone and, to a lesser extent, Cambodia present specific initiatives in this sphere. Of these, Bangladesh's PRSP perhaps presents the most comprehensive package for the extension of NICT services and, even, the development of a national NICT sector. In this sense, the government of Bangladesh considers NICT as an area of strategic policy intervention, and has developed a comprehensive policy package that includes interventions in various spheres: skills development, extension of NICT infrastructures and networks, the promotion of NICT use by the rural poor, the private and informal sectors, and the creation of a national software/outsourcing industry.

[10] See, for instance, the investment climate assessment work undertaken by the World Bank, at www.worldbank.org/investmentclimate

The remaining PRSPs documents tend to make reference to more isolated measures, rather than taking the more comprehensive approach followed by the Bangladeshi government in this sphere. These are typically aimed at promoting the use of NICT technologies in specific areas, such as the private sector (Lesotho and Tanzania), government (Cambodia, Tanzania and Mozambique) or in educational establishments (Tanzania); and include measures such as the liberalization of the NICT sector (Cambodia), supporting human resource development in IT (Cambodia), or expanding NICT services by increasing general telecommunication networks and establishing NICT connections in specialized institutions – e.g. tele-centres, libraries, or educational institutions (Lesotho and Tanzania).

(ii) Efforts to promote the dissemination of S&T knowledge

A second dimension in this process of dissemination that needs to be taken into consideration is the promotion of best technological practices through extension services. In most countries there is a well-established tradition of this type of mechanisms in the agricultural sector, in the form of public agricultural extension services, rural development programmes or NGO and cooperative initiatives. Given the prominence and strategic importance of agricultural and other related primary activities for economic growth and poverty reduction in LDCs, the provision of agricultural extension services is likely to remain a priority policy in PRSPs. Yet, these also play a critical role in ensuring the dissemination of new technologies, best practices and know-how in other economic sectors including industry or the construction sectors.

From a policy perspective, technological extension in these other sectors can take many forms. For instance, the establishment of industrial districts, EPZs, technology parks or industrial incubators facilitates the interaction between firms and between workers, therefore, promoting the flow of relevant technological know-how. Business development and consultancy services can also provide important support to local firms in this sphere, by helping them accumulate greater technological capabilities in production. Finally, standards and metrology services play a key role in promoting international best practices in local firms and agricultural activities (for instance by supporting ISO certification), as well as in ensuring the quality of locally produced goods.

As with local technology development and research activities, extension programmes included in these 11 PRSP documents tend to focus mostly on agricultural extension services. In this area all 11 poverty reduction strategies include, to some extent, initiatives aimed at disseminating and extending best technologies and practices in their respective agricultural sectors. Additionally, with the exception of Haiti's PRSP, all these documents recognise, to some degree, the need to promote the use of agricultural technologies, practices, inputs and crops that are appropriate to the different agro-climatic and social contexts that exist in these countries so as to maximise their productivity impact.

Table 8: PRSPs and technology extension programmes

Does it include initiatives to promote:	Agricultural extension services?	use of appropriate technologies	Business development services?	Product standards and Best practices?
Bangladesh	√	√	√	√
Bhutan	√	√	+/-	*x*
Burkina Faso	√	√	+/-	*x*

Cambodia	+/-	+/-	√	√
Haiti	+/-	*x*	*x*	*x*
Lao	√	√	*x*	√
Lesotho	√	√	√	*x*
Mozambique	√	√	*x*	√
Sierra Leone	√	√	*x*	√
Tanzania	+/-	√	√	*x*
Uganda	√	√	+/-	√

Legend: √: yes; x*:* No; **+/-**: more or less

However the dissemination of best technologies and practices in non-primary economic sectors receives far less attention in these PRSP strategies. In several instances reference is made to the need to promote the creation and expansion of business development, consultancy and advisory services for private sector development, especially for micro, small and medium enterprises (MSME), yet without explicitly linking these initiatives to technology upgrading efforts. This is the case of the PRSPs of Bhutan, Brukina Faso, Tanzania and Uganda. In other cases this type of initiatives are not even mention (e.g. Haiti, Lao P.D.R, Mozambique and Sierra Leone). In fact, only Bangladesh's, Cambodia's and Lesotho's documents make explicit reference to the need to expand business development services that support technology upgrading efforts by local firms. A similar pattern emerges with regard to the promotion of best practices and quality standards in local firms, with only six out of the eleven documents reviewed including initiatives of this kind, typically the creation or capacitation of local standards and metrology institutions. As with applied S&T generation considerations, these results highlight the uneven treatment that PRSPs give to S&T diffusion when addressing these issues in relation to primary and non-primary economic activities.

8. Other dimensions of S&T and poverty reduction

Beyond the role that S&T has in promoting economic development, the extension of scientific and technological knowledge can also contribute to poverty reduction efforts by improving general living standards of the population living in LDCs. For instance, new technological or scientific findings can lead to the development and use of environmentally more friendly technologies and energy sources. Similarly, certain innovations and technological applications may have a particularly positive impact on the living and working conditions faced by the more vulnerable groups of the population, including women, children or disabled. More generally, the extension of basic infrastructures, such as electricity and telecommunication networks, will generally contribute to improve living standards and the dissemination of news and other information.

On the other hand, new technologies and scientific progress can result in important improvements in service delivery to the population, including in social sectors (e.g. health, education, food security or water management) where these improvements can have a large impact on poverty reduction efforts. The most obvious example would be that of advances in medical science (e.g. new drugs or treatments), especially when relating to diseases and medical conditions with a high incidence in these countries (e.g. malaria, HIV-AIDS or tuberculosis), which usually have a disproportionate impact on the living conditions of the

poorer groups of the population. Other examples are advances in water extraction and management techniques or new food-storage technologies. The use of new information and communication technologies may also help to improve the efficiency and reach of government services, not only in social sectors, but also in other important areas such as tax collection, public financial management or the judiciary. Finally, these same NICT constitute an important learning and teaching tool in primary, secondary and higher education.

BOX 2: PRSPs and other dimensions of S&T

The eleven country PRSP documents reviewed for this survey included S&T-related initiatives aimed at improving living standards and service delivery in the following areas:

Bangladesh: **(1)** promoting the use of new and renewable resources of energy (e.g. solar and wind power); **(2)** computerisation and extending the use of ICT technologies throughout the education sector; **(3)** continue the computerisation of tax administration; **(4)** computerisation of port administration, railway and other transport systems; **(5)** Develop alternative technological options to replace arsenic contaminated tube-well; **(6)** Providing training for women on e-commerce, e-business and ICT; **(7)** Encouraging technological innovation for making inexpensive domestic appliances and their dissemination; **(8)** Undertake R&D on
appropriate & affordable technologies and hygiene promotion for water and sanitation; **(9)** Undertake concrete steps to produce skilled health technologists; **(10)** establishment of tele-centres and telemedicine to Increase access of the disadvantaged groups to ICT; **(11)** Implementation of strategies and action plans on crop biotechnology, Animal and Fish biotechnology, medical biotechnology, bio-safety and biodiversity.

Bhutan: **(1)** Use of telemedicine to improve the delivery of health services in remote rural areas.

Burkina Faso: **(1)** R&D to improve water resource management; **(2)** Computerization of tax administration; **(3)** implementation of ASYCUDA information system in all custom offices; **(4)** computerization of revenue component of budget system; **(5)** Implement the information technology master plan of the Ministry of Health; **(6)** development of a computerized master plan for educational program management; **(7)** expansion of photovoltaic solar systems solar-powered lighting programs in rural areas.

Cambodia: **(1)** Extending the use of ICTs in the public administration; **(2)** promoting new water harvesting technologies; **(3)** Improving and installing hydro-meteorological observing and monitoring systems nationwide

Haiti: None.

Lao P.D.R.: **(1)** Use of ICTs to disseminate information on investment and business opportunities; **(2)** Use of management information systems (MIS), geographic information system (GIS) and ICTs to improve planning capacities in the education sector; **(3)** Extending the use of ICT technologies in the public administration; **(4)** Promotion of environmental infrastructure and technology; **(5)** Continue developments of micro-hydropower, solar and wind energy projects for off-grid power supply in remote areas.

Lesotho: **(1)** promoting the use of renewable energy technologies; **(2)** Computerisation of passport issuance system; **(3)** computerisation of government accounting system; **(4)** improving food preservation and storage technologies; **(5)** Use of ICTs to disseminate information on investment and business opportunities.

Mozambique: **(1)** Extending the use of ICT technologies in the public administration; **(2)** use of ICTs and electronic verification procedures to speed customs clearing processes; **(3)** promotion of the use of environmentally sustainable technologies in manufacturing, agriculture and extraction industries; **(4)** use of ICTs to support long-distance education; **(5)** use of ICTs to improve planning and management functions in the education sector; **(6)** use of ICTs to improve access to justice system; **(7)** promoting the use of renewable energy sources and new technologies.

Sierra Leone:**(1)** introduction of an electronic clearinghouse to expedite the settlement of cheque payments between the central bank and financial institutions; **(2)** computerization of National Revenue agency (NRA).

Tanzania: **(1)** promoting the use of new and renewable resources of energy (e.g. solar and wind power); **(2)** Increasing support to R&D institutions that promote environmental best practises; **(3)** Develop and Promote appropriate environment sound technologies for pollution control, waste management; and farming practices; **(4)** adoption of new water conservation technologies; **(5)** Research, identification and promotion of food storage technologies.

Uganda: **(1)** introduction of information technology packages for government M&E functions; **(2)** promoting the use of new and renewable resources of energy (e.g. solar and wind power); **(3)** Extending the use of ICT technologies in the public administration, especially in the context of decentralisation policies (LOGICS); **(4)** computerisation of government budget, auditing, reporting and accounting systems.

The coverage given to these issues in country PRSPs is somewhat mixed (see Box 2). Some countries, such as Bangladesh, Burkina Faso or Mozambique do seem to have made a considerable effort to incorporate S&T considerations in the various priority areas that conform their poverty reduction strategies, with a reasonably wide range of policy initiatives that involve the use of new S&T knowledge to improve government service delivery, or promote the use of environmentally more sustainable technologies, among others. However, other countries have given far lesser attention to these aspects of S&T development for poverty reduction. With regard to the type of issues covered, there tends to be a predominance of ICT-related initiatives, especially in terms of extending the use of these technologies in the public administration. Also, of initiatives linked to the promotion of environmentally friendly technologies in the various priority areas of intervention, including those linked to the use of new (renewable) energy sources, often part of rural electrification programs. Yet, other important areas in which S&T considerations could be incorporated in these poverty reduction strategies receive less attention.

E. S&T in the PRSP process: A case study of Mozambique's 2006 PRSP[11]

The synoptic survey undertaken in the previous section provides some useful findings on how S&T considerations are addressed in PRSPs. In general, there is significant variability in the way each of these eleven documents incorporate S&T into their poverty reduction strategies. Still, certain common patterns can be identified. Firstly, whilst most documents acknowledge the importance of promoting technological progress and, to a lesser extent, scientific development for poverty reduction and economic development, its incorporation as an integral part of these programmes is generally weak. Thus, S&T related initiatives are usually presented in an isolated way, instead of as part of a clearly defined strategy that puts S&T development at the centre of poverty reduction and economic development efforts. There are some notable exceptions, such as Bangladesh's PRSP. The documents of Mozambique, Uganda, Tanzania and, to a lesser extent, Sierra Leone also give considerable coverage to S&T issues, although without presenting such a holistic approach to S&T development. Secondly, PRSPs tend to pay greater attention to skill development and educational and infrastructural considerations and less so to policies directly addressing S&T development, such as those aiming at promoting the international transfer, dissemination and generation of S&T knowledge. This is more evident in sphere of industrial development than for agricultural growth considerations, probably as a result of the long tradition of agricultural research and extension services that exists in most LDCs. Finally, there appears to be substantial scope in most of these papers to incorporate S&T initiatives aimed at improving the delivery of public services, ensure environmental sustainability and, more generally, improve the living standards of the population.

However, this approach to the analysis of the S&T content of PRSPs presents some limitations. A critical shortcoming is that it cannot capture the policy background against which each of these documents was drafted, nor the policy processes that shaped their formulation. Put in other words, it focuses on policy outcomes, as reflected in each of these documents, rather than on policy processes. Therefore, it impedes an examination of how these backgrounds and processes may have shaped the incorporation of S&T considerations in the formulation of these poverty reduction strategies. In this respect, the case study of the policy process that led to the formulation of Mozambique's second PRSP provides some clarifying and useful insights. It also offers some insight into why, in the Mozambican case, PRSP discussions in the sphere of private sector development might have sidelined important industrial technology development considerations.

1. The Mozambican PARPA-II strategy: Preliminary considerations

The government of Mozambique (GoM) approved its second PRSP strategy, the *Action Plan for the Reduction of Absolute Poverty (*PARPA-II), on 2nd May 2006. The PARPA-II, which is to be implemented between 2006 and 2009, is envisaged as an operationalisation of the government's 2005–2009 five-year program, prepared by the then recently elected FRELIMO government during the first quarter of 2005.[12] In this respect, it is

[11] This section largely draws from the author's experience as economic policy advisor to the PARPA-II Technical Secretariat at the Mozambican Ministry of Planning of Development and the various working groups involved in the preparation of the Mozambican second PRSP, PARPA-II; Also, from the author's own PhD research on technology and private sector development in Mozambique (Warren-Rodriguez, 2007).

[12] Presidential elections were held in Mozambique in late 2004 with Armando E. Guebuza being elected as president. The new government was formed in February 2005, headed by Luisa Diogo as Prime Minister.

fully integrated within the government's planning and budgeting system. Hence, it constitutes the mid-term policy instrument linking policy priorities set out in the government's five-year programme with its sectoral and annual policy plans. On the other hand, the financial projections included in PARPA-II provide the basic guidelines for the government's mid-term expenditure and fiscal framework (MTEFF), on the basis of which the its annual state budgets are prepared. Finally, the PARPA-II Strategic Action Matrix constitutes the basis of the government's national monitoring and evaluation (M&E) system.

The preparation of the PARPA-II document took place during a period of over one year, starting in the fall of 2004 and ending during the first quarter of 2006. This process was organised in four different stages: during an initial phase, the government defined the PARPA-II methodological approach. This was followed by a three months period devoted to setting up thematic working groups for each priority area and defining the basic strategic policy guidelines of the PARPA-II document. These were presented during the 3rd National Poverty Observatory[13] held in Maputo in August 2006. During a third stage policy initiatives and action matrices in each of these priority areas were defined and '*costed*', and a first draft of the PARPA-II document presented at the 4th National Poverty Observatory that took place in November 2006. This was followed by a fourth and final phase devoted to the finalisation of the document and its accompanying instruments: the strategic action matrix and the PARPA-II financial framework. In all, a total of twenty-three working groups, organised around five main thematic pillars, were involved in this process (See Table 9), with the participation in each of these groups of members from the government, civil society and the various international development organisations operating in Mozambique.

Table 9. Mozambique's PARPA-II: Pilars and Thematic Working Groups

Pilar	Working Group
Macroeconomics and Poverty	Economic Growth & Macroeconomic Stability
	Poverty analysis and M&E
	Public Financial Management
Governance	Public Sector Reform
	Reform of the Legal and Justice System
	Governance and Decentralization
Economic Development	Financial Sector
	Private Sector
	Agriculture
	Infrastructure: transport &Telecommunications
	Infrastructure: Energy Sector
Human Capital	Health
	Education
	Water and Sanitation
Cross Cutting Issues	Demining
	Environment
	Natural Disasters
	HIV/AIDS
	Gender
	Food Security

[13] Poverty observatories were first held in 2003 as a consultative mechanism between the government, civil society and the international community to accompany progress in national poverty reduction efforts. They are usually convened on an annual basis and are also organised at a provincial level. Further information on these observatories can be found in www.op.gov.mz

Source: PARPA-II (GoM, 2005)

The approval of the PARPA-II document follows the implementation of the first Mozambican PRSP strategy (PARPA-I) between 2001 and 2005. Whilst maintaining the strong focus on social and human development that characterised Mozambique's first poverty reduction strategy, PARPA-II gives greater weight to economic and growth considerations (GoM, 2006: 1). This follows evidence that the very significant gains achieved in poverty reduction efforts in Mozambique since the mid 1990s — with poverty incidence levels falling from 69.4 per cent in 1996/97 to 54.1 per cent in 2002/3 — owe largely to the strong and pro-poor performance of the Mozambican economy during that same period, with rates of GDP growth averaging 6 percent between 1997 and 2003.[14] It also reflects growing concerns that, after several years of fast economic growth, largely driven by post-conflict recovery factors (e.g. impact of returning refugees, greater economic and political stability, initial low growth base, etc.), economic performance in Mozambique might have reached a plateau as a result of low rates in productivity growth, weak inter-sectoral linkages and a predominantly subsistence economy, among other factors.[15]

In addition to growth and economic development considerations, PARPA-II pays particular attention to a number of crosscutting issues that are considered critical for the success of its poverty reduction efforts (GoM, 2006: 61). These include (i) continuing with de-mining efforts; (ii) ensuring environment sustainability; (iii) improving the response to natural disasters and addressing factors that magnify their economic and social impact; (iv) ensuring food security to the population; (v) improving the incorporation of (vi) HIV/AIDS and (vii) gender issues in poverty reduction, social and economic development efforts; (viii) giving greater prominence to rural development and (ix) promoting S&T development.

2. S&T in the Mozambican PRSP process

In this context, science and technology development received, in principle, considerable attention during the preparation of the Mozambican second PRSP document. In this sphere the government's overall, long-term mission, as stated in PARPA-II, is to:

"To promote the furnishing of scientific and technological solutions to priority sectors as defined in national development programs such as PARPA and Agenda 2025, for the benefit of Mozambican society." (GoM, 2006: 69)

With the vision of ensuring by 2015:

"The omnipresent and equitable availability and the use of science, technology, innovation, and TICs as a right of all Mozambicans to accelerate the reduction in poverty, create wealth, and improve their social well-being." (GoM, 2006: 69)

The PARPA-II strategy for S&T development essentially revolves around the need to consolidate the Mozambican national S&T system by strengthening the institutional

[14] See, for instance, Arndt *et al.* (2006) or INE (2003) for an indepth analysis of these issues.
[15] See for a recent indepth analysis of current conditions and future challenges faced by the Mozambican economy the World Bank's Mozambican Country Economic Memorandum (World Bank, 2005).

framework for S&T, improving S&T financing mechanisms and developing the Mozambican S&T human resource base (GoM, 2006: 68). To this purpose, it sets out a number of objectives to be met during the implementation of PARPA-II, including (GoM, 2006: 69):

a. *"Constructing and improving the policy instruments, institutions, and infrastructures of the national S&T system;*
b. *Establishing policies on financing, and mechanisms for research and innovation;*
c. *Promoting human resources development at all levels in the fields of science, technology, and innovation;*
d. *Inculcating a culture of innovation into Mozambican society;*
e. *Promoting innovation in the existence and use of S&T approaches by poor and less favored communities;*
f. *Promoting innovation in the industrial and public sectors;*
g. *Improving leadership and administration of the S&T system;*
h. *Reviewing, evaluating, and improving the performance of the S&T system*".

Work on S&T during the PARPA-II preparation process was lead and coordinated by the Ministry of Science and Technology (MCT), a ministry created in 2000, which, until 2005, was also responsible for higher education. Being responsible for an area that cuts across policy spheres that depend of other line ministries,[16] its role is largely one of coordinating, rather than directly implementing the government's S&T strategy; also, of ensuring that line ministries incorporate these issues in their sectoral strategies. This same arrangement was also reflected during the preparation of PARPA-II. Hence, a specific working group on S&T was established in April 2005, which was responsible for setting out the basic principles of the PARPA-II strategy for S&T and identifying specific initiatives that could be incorporated by other working groups involved in this process in their respective sectoral strategies, with the aim of improving the S&T content of the PARPA-II document and ensure that S&T was addressed in a holistic crosscutting way.[17]

Overall, the approach to S&T development taken during the preparation of Mozambique's second poverty reduction strategy and the weight given to these issues by the GoM — as reflected in its five-year program — seems to have partly paid off, in terms of giving considerable coverage and attention to these issues in the final PARPA-II document. Hence, the Mozambican PRSP document is perhaps on of the eleven documents reviewed in Section 3 which better addresses and incorporates S&T in its various relevant policy dimensions as part of the government's poverty reduction and economic development efforts. Thus, the Mozambican PRSP is one of only four documents identifying S&T as a priority policy for poverty reduction and economic development[18], and the only one that explicitly acknowledging its crosscutting nature. It also '*performs*' well in the other relevant areas of policy intervention in the sphere of S&T development examined throughout Section 3, when compared to the remaining ten documents. Only the Bangladeshi's PRSP strategy clearly incorporates better S&T concerns in all of these dimensions, whilst Uganda's, Tanzania's and, perhaps, Sierra Leone's would probably rank similarly to Mozambique's PRSP.

Yet, despite these positive developments and the inclusion of S&T as a crosscutting priority policy in the PARPA-II document, the Mozambican PRSP fails to clearly define and

[16] For instance, the formulation of TVET policies depends of Ministry of Education; NICTs and technology-related infrastructure development is the responsibility of the Ministry of Transport and Communication, whilst the Ministries of Agriculture and Industry & Trade, are responsible for applied technological research and extension in each of these areas.
[17] The S&T working group's contributions to the PARPA-II can be found at http://www.op.gov.mz/Relatorios
[18] The other three are Bangladesh, Tanzania and Uganda (See Table 3 above).

articulate a comprehensive strategy for S&T development that systematically covers these issues across all relevant policy spheres and fully integrates them within the government's poverty reduction and growth strategy in a consistent and holistic way. Some areas, such as that of agricultural development, do give substantial coverage to these issues, with a considerable weight given both to agricultural research and extension efforts. Yet, in other policy spheres they are either absent — as in the case of education, international trade or investment policies — or consist mainly of isolated initiatives that do not appear to respond to an overall strategy for S&T development. In fact, none of these initiatives directly deals with the challenges identified at the beginning of the document — related to the need to strengthen the national institutional framework for S&T, improve S&T funding mechanisms and develop the national S&T human resource base — that the government itself considers that need to be addressed so as to consolidate the Mozambican national S&T system. In this respect, it is not clear that these (isolated or sectoral) initiatives respond to an overall strategy to put S&T at the top of the government's poverty reduction, growth and social development agenda.

A key element underlying these problems regarding the integration of S&T in the PARPA-II strategy relates to the fragmentation of the Mozambican planning and budgeting formulation system. Fragmentation in the Mozambican policy context has been well documented (see, for instance, Hodges and Tibana, 2005; Batley, et al., 2006a; de Renzio and Sulemane, 2006) and basically refers to the weak integration that exists within the government between sectoral and central/coordination ministries, as well as between planning and budgeting institutions and mechanisms.

Beyond historical, institutional and political economy considerations, a key factor driving this process of policy fragmentation is the fragmented nature of development aid in Mozambique, with a plethora of donor agencies, NGOs and international development organizations operating in the country, each using a variety of funding and technical assistance mechanisms and most aid funds, as well as associated technical assistance, being disbursed directly to sectoral ministries or, even, specific projects in priority areas: health, education, HIV/AIDS, agriculture, etc.[19] The significance of this factor in driving policy fragmentation should be viewed in a context in which aid flows into Mozambique have averaged about USD 1 billion a year from 1992 to 2004, around 30 per cent of Gross National Income (Batley, et al., 2006b:1), and directly finance over half of the government's budget (Hodges and Tibana, 2005: 119).[20] Aid fragmentation strengthens the financial autonomy of line ministries with respect to central funding mechanisms (e.g. the State Budget). The same applies to other agencies such provincial and district administrations, government projects or semi-autonomous agencies. It also gives them greater independence in the definition of sectoral policy initiatives. Conversely, it weakens the coordinating and strategic planning role of central ministries, such as the ministries of Finance and Planning & Development.

As a result of this fragmentation of the Mozambican planning and budgeting system and the financial and policy autonomy of line ministries in priority sectors, strategic policy formulation is largely sectorally driven in Mozambique, undermining the consistency of government-wide programmes.[21] These problems are mirrored in the PARPA-II document, in terms of consisting, to a large extent, of an amalgamation of sectorally defined programs, rather than a unified, integrated and programmatic strategy for poverty reduction and economic development.

[19] See Killick, Castel Brando and Gerster (2005) for a recent assessment of aid trends in Mozambique.
[20] The amount of government expenditure financed through development aid is most likely to be significantly higher, given the large amount of off-budget funding that exists in line ministries (See Cabral, et al., 2005).
[21] Sere Hodges and Tibana (2005: 45-48) for an analysis of the ascendancy of sectoral ministries in Mozambique.

The crosscutting nature of S&T, together with the fact that that the Mozambican Ministry of Science and Technology (MCT) only holds a coordinating role in the definition and implementation of most S&T related policy initiatives, magnified the impact of policy fragmentation in the formulation of PARP-II's strategy in this sphere. Hence, the incorporation of S&T initiatives and considerations in the PARPA-II document put forward by the MCT was not decided directly by this ministry but, rather, by line ministries responsible for each of the relevant policy areas of intervention — education, transport & communications, etc., which included them on the basis of whether they conformed to previously defined Sector Strategic Programs. In some instances this was the case, as with the considerable coverage given to agricultural research and extension, which is considered by the ministry of agriculture as a strategic area of policy intervention. [22] Yet this was not always so, with many policy spheres giving little coverage of S&T considerations.

The little clout that the MCT holds in the Mozambican government system, partly explained by the fact that this ministry was only created in 2000, magnified these problems, since it has impeded the creation and consolidation of institutional mechanisms that could ensure a better inter-ministerial coordination in this sphere, and therefore, a better coverage of S&T issues during the preparation of the PARPA-II document. Altogether, this situation is likely to have been made worse by the fact that, despite being identified as a crosscutting issue, S&T is not a priority area of support for most donor agencies and, therefore, receives little technical or financial donor support.[23]

3. S&T and private sector manufacturing development in Mozambique

An area in which these problems affecting the incorporation of S&T considerations in the formulation of programmatic strategies for poverty reduction and, more generally, economic and social development are more evident is that of private sector development. In this sphere, current government policies in Mozambique largely fail to address key constraints hampering industrial technology development, despite the evidence that the general technological backwardness of the Mozambican manufacturing industry is a major factor undermining broad-based growth in this sector.

At a macroeconomic level, the Mozambican manufacturing sector presents signs of what appears to be a considerable strong performance, at least by regional standards. Hence, it currently accounts for around 13.5 per cent of Gross Domestic Product (INE, 2006), a proportion two percentage points above the sub-Saharan average of 11.45 per cent, and almost six percentage points above the region's average when excluding South Africa (World Bank, 2006),[24] whose higher level of economic development tends to distort regional development figures. Furthermore, over the past ten years it has experienced a very significant expansion, with manufacturing production growing at an average rate of 8.4 per cent since 1996.

[22] See, for more detail, the government's strategic programme for agriculture, PROGAGRI (MINAG, 2004).
[23] Hence, the Mozambican ODA database (www.odamoz.org.mz) records only two donor projects that can be considered as being aimed at the MCT: a grant by MICA, the Japanese aid agency, to provide technical assistance to the Mozambican Information and Communication Technology Institute (MICTI) amounting to USD 285.000, and the secondment of an ICT Advisor for the Minister of Science and Technology by the UNDP.
[24] According to the World Bank (2006) the regional average excluding South Africa was 7.61 per cent in 2004.

However, this strong performance has largely been driven by a small number of large enterprises and mega projects operating in Mozambique, amongst which the MOZAL aluminum smelting plant is perhaps the most renowned[25]. Beyond this very small number of industrial projects, manufacturing activity in Mozambique has remained sluggish, leading to a process of gradual industrial concentration and thinning of the Mozambican manufacturing base. Hence, according to the WTO (2001), in 1999 only nine firms accounted for 56 per cent of industrial production in Mozambique, with the two largest, South African Breweries (SAB) and Coca-Cola, responsible for 25.7 per cent of industrial output; this, before MOZAL had even initiated its operations in 2000, or South African Breweries had taken over the second largest Mozambican brewery, Laurentina, in 2002.[26] At the same time, traditionally important manufacturing sectors, such as the cashew processing industry and the textiles & garments sector, have almost ceased to exist, whilst others have experience a very significant decline (Castel Branco, 2002).

Several factors have been identified in the literature as constraining manufacturing development in Mozambique. The most frequently cited typically refer to investment climate constraints and include the lack of access and high cost of finance, an uncertain and burdensome regulatory/administrative environment and the general inadequacy of business infrastructures. These problems have been repeatedly raised by the numerous studies, reports and conferences held on private sector development in Mozambique (e.g. FIAS, 2001; World Bank, 2003; CTA, 2004, 2006). It is indicative of this poor business environment that Mozambican firms face the fact that the World Bank's "Doing Business" program[27] places Mozambique towards the bottom of its investment climate ranking for most of its indicators.

Yet, in addition to these business climate considerations, the Mozambican manufacturing sector suffers from other important structural problems that equally hamper industrial development in Mozambique and which have received less attention. These include, amongst others, this sector's general technological backwardness and weak skill base; also, the weak institutional framework for industrial policy formulation, which undermines the articulation of a consistent strategy for industrial development that addresses the technological and skill constraints that affect this sector, among other issues.

With regard to technological and skills considerations, the available evidence (e.g. ANEMM, 1996; DNEAP/KU, 2006; Warren-Rodriguez, 2007) indicates that manufacturing firms in Mozambique operate with very old equipment and production technologies, very often dating back to the pre-1975 colonial period. Furthermore, the skill and educational level of their workforce tends to be very low, factor that is made worse by the general lack of skilled workers in Mozambique and the legal restrictions that exist on the employment of foreign skilled workers. They also engage in very little formal innovation, with only 10 per cent of the 193 firms surveyed by the World Bank in its 2002 RPED survey (World Bank, 2003) employing personnel dedicated to R&D activities, and only 7 per cent outsourcing any form of external R&D services. In fact, only 20 firms surveyed for this study had ever used

[25] The MOZAL aluminium smelter plant started its operations in Mozambique in late 2000 and has involved a total investment of USD2 billion. It is currently considered one of the largest aluminium smelters in the world supplying an estimated 2 per cent of the world consumption of aluminium ingots. It is by far the largest Mozambican private corporation, roughly accounting for 6.7 per cent of the country's GDP in 2004, over 38 per cent of GDP growth and 55 per cent total exports (GOM, 2005) although, with around 1,500 workers, its impact on employment is much smaller.

[26] SAB had already purchased the first Mozambican brewery, Cervejas de Moçambique, in 1995 during the process of mass privatization of State Owned enterprises in which the the GoM embarked during the 1990s.

[27] These rankings can be viewed at http://www.doingbusiness.org

external training or consulting services. The general technical backwardness of the Mozambican private sector is also evident in that only nine Mozambican firms had obtained an ISO-9001: 2000 certification by 2004,[28] only one in manufacturing, partly due to the weak institutional setting for quality control and standardisation services.[29]

At a more aggregate level, the findings of UNIDO's (2003) *'Industrial Development Report of 2002/3'* are also illustrative of the general technological backwardness of the Mozambican manufacturing sector, with the share of medium and high technology industries in total manufacturing value added in Mozambique estimated by this report to be around 12 per cent in 1998, ranking number 80 of the 87 countries included in its survey. The technological structure of Mozambican manufacturing exports appears somewhat more advanced in this study, ranking 69th in 1998, although it had previously ranked 65 in 1985. On a more positive note, this same paper reports a reduction in the proportion of low technology and resource based exports, from 40 per cent of total exports in 1985 to 21.8 per cent in 1998; and, conversely, a, somewhat more modest, increase in Mozambique's exports of complex goods from 1.1 per cent to 3.4 per cent of total exports during that same period.

Several factors have contributed to Mozambique's poor techno-industrial performance, including those relating to the poor business environment for investment, the inadequacy of basic infrastructures and the lack of access and high cost of finance, this last factor largely being driven by current the macroeconomic policies implemented by the GoM. Still, an additional, and critical, element is the weak institutional and policy framework for industrial (technology) development in place in Mozambique.

At present there are various institutions and non-government organisations providing technical capacity building support and other technology related services to manufacturing firms operating in Mozambique. These include, amongst others, the World Bank funded Programme for Enterprise Development (PoDE), the National Institute for Standards and Quality Assurance (INNOQ), the Export, Investment, and SME Promotion Institutes (IPEX, CPI and GAPI respectively), the National Engineering Laboratory (LEM) or the MOZLINK business linkages programme.

There have been some instances of success with these programmes, as was the case with the SMEELP/MOZLINK linkages initiative, which was initially created to promote linkages between the MOZAL aluminium smelter and local businesses, and which has now taken a broader mandate (Castel-Branco and Goldin, 2003; Warren-Rodríguez, 2007). Yet, the overall impact and reach of these industrial development initiatives and government programmes has been limited. Partly, as a result of the difficult business climate conditions faced by manufacturing firms operating in Mozambique, which has ultimately reduced the demand for this type of services; But also, as a consequence of the weak and fragmented institutional framework for industrial policy formulation that exists in Mozambique.

Hence, the various institutions engaged in the promotion of industrial development often operate under the tutelage of different ministries and frequently act in an isolated and uncoordinated way. For instance INNOQ, GAPI and IPEX depend of the Ministry of Trade and Industry; CPI of the Ministry of Finance, whilst LEM is under the umbrella of the

[28] This figure compares quite unfavourably with other countries in the region, such as Kenya with 158 ISO-9000 certified firms, Uganda (47), Namibia (23) or Senegal (29).

[29] Hence, despite recent efforts to increase the number of ISO certified firms in Mozambique, there are no internationally recognised certification agencies in Mozambique, making the process of certification too costly for most Mozambican firms. (Warren-Rodriguez, 2007).

Ministry of Public Works. Furthermore, whilst the formulation of industrial policy mostly corresponds to the National Directorate of Industry — which is part of the Ministry of Industry and Trade — issues affecting primary-processing activities are under the responsibility of the Ministries of Agriculture, in the case of agro-processing activities, Fisheries, for fish processing projects, and Mineral Resources, with regard to extractive activities.

In addition to these problems relating to the fragmented nature of policy articulation in the sphere of industrial development, many of these institutions frequently lack the technical and financial means to assume the tasks they are mandated to undertake. It is elucidative of this situation that, in 2004, the National Standards and Quality Institute had a staff of only 13 people, of which only 5 had a university degree, earning around USD200 a month. Furthermore, this agency had no laboratory or calibrating facilities. Or the fact that, of the 100 people working at the National Engineering Laboratory only 10 had a university degree, and most of these held management positions within this institution, whilst 15 others had technical secondary education qualifications (Warren-Rodriguez, 2007). On top of this general lack of qualified technicians, many of these institutions remain heavily under funded, with the Ministry of Industry and Trade receiving in 2005 only 40 per cent of its programmed budget, for instance (Sitoe, 2004).

Altogether, these problems end up undermining the articulation of a consistent policy framework that responds to a clear strategy for industrial and, more generally, private sector development that is an integral part of the government's economic development and poverty reduction agenda, and which gives due consideration to technological capacity building. The Ministry of Industry and Trade does currently have a National Strategy for the Industrial Sector (GoM, 1997), which sets out the guiding principles for government intervention in this sphere and which also places some weight to technology development considerations. However, this document, which dates back to 1997, only presents these issues in a very general and formulaic form and is generally considered not to have been developed or implemented since its approval in the mid 1990s. [30]

Clearly, this situation emerges as a result of the overall weak policy and institutional framework for industrial development that exists in Mozambique; yet, it also reflects the little attention that issues of industrial development receive, both from the government as well as from the international aid community in Mozambique. Hence, beyond general investment climate considerations, manufacturing development, including in its technological and skills dimensions, does not constitute a priority area of policy intervention in Mozambique, in line with the prevailing Washington Consensus thinking on private sector development.[31] This is perhaps most evident in the underlying inconsistency that exists between a macroeconomic framework which favours financial restraint, on the one hand, and the investment needs of the manufacturing sector, on the other; the latter having systematically been identified as a top constraint to private sector development in Mozambique undermining, amongst other things, investments in much needed technological and skills upgrading. As a result or the prevailing thinking in this field, issues related to industrial development are given very little attention in Mozambique and institutions working in this policy sphere only receive some scant support from the international aid community.

[30] As acknowledged in interviews held with senior officials at the National Directorate of Industry, DNI (Warren-Rodriguez, 2007). A similar appreciation can be found in Castel-Branco (2002).
[31] See Castel-Branco (2002, 2004) for a more in-depth analysis of this issue.

These problems underlying the Mozambican industrial policy and institutional framework also affected the preparation of the PARPA-II document, impeding the full incorporation of S&T considerations in its strategy for private sector development. In general, the PARPA-II strategy has made some progress in incorporating productive considerations in the government's poverty reduction efforts, including those related to private sector development, especially when compared to Mozambique's first PRSP. However, it continues to lack a consistent strategy for private sector development, in terms of defining a comprehensive and coherent set of policy initiatives that addresses all relevant constraints undermining manufacturing growth in Mozambique, including those of a S&T nature.

Hence, the PARPA-II discussions on private sector development, in which representatives of the government, the business community and aid agencies participated, essentially focused on investment climate issues, largely leaving aside other considerations. Questions relating to international trade and investment policy, infrastructure development, industrial capacity building or institutional reform, which could have provided an opportunity to address issues relating to S&T development, were, for the most part, absent in these discussions. As a result, the document put forward by the PARPA-II Private Sector Working Group basically consisted of some key measures relating to major investment climate constraints, plus an amalgamation of initiatives put forward by the various ministries involved in these discussions –tourism, agriculture, mineral resources, energy, fisheries, or trade and industry. These initiatives did not only not respond to any coordinated effort to formulate a consistent strategy for private sector development, but, in addition, their quality was considerably impaired by the weak institutional and, in particular, planning and policy formulation capacities that exist in many of these ministries.

Furthermore, the organisation of the PARPA-II preparation process into working groups of a sectoral nature, together with lack of effective inter-sectoral coordination mechanisms prior and during the preparation of PARPA-II,[32] made it difficult to address issues cutting across the various policy spheres intervening in the promotion of private sector development. For instance, the private sector's concerns on the lack and cost of investment finance in Mozambique were not incorporated, or even taken into account, in the PARPA-II discussions regarding macroeconomic policy considerations, issue which, on the other hand, is largely driven by the government's PRGF negotiations with the IMF. Similarly, the discussion and definition of initiatives in the spheres of TVET or infrastructure development undertaken by the PARPA-II Working Groups dealing with education and infrastructures did not include the participation of members of the Private Sector Working Group, nor explicitly incorporate the private sectors' concerns in each of these areas. The same was the case with the incorporation in the PARPA-II private sector development strategy of the recommendations made by the S&T working group, which were generally not explicitly addressed during this process.

As a result, the PARPA-II strategy for private sector development largely neglects technical capacity and technology upgrading considerations, essentially focusing on investment climate issues, whilst also including some initiatives specific to the various sub-sectors: fisheries, tourism or mining industry. In its text, the document does include several references to the need to "*promote the creation of a strong, dynamic, competitive, and*

[32] In this respect, several meetings were supposed to have taken place at a Pillar level, bringing together representatives of the various working groups to address crosscutting issues. However, none of these were held during the last two phases of the PARPA-II preparation process, during which policy initiatives and matrices were defined for each sector and included in the final document.

innovative private sector" through the promotion of (i) technical and vocational training programmes; (ii) firm level technological capabilities and skills; (iii) the production, importation, and distribution of electricity and (iii) telecommunications services (GoM, 2006: 127–130). A limited number of these issues are also developed in the PARPA-II private sector operational matrix in the form of specific policy initiatives to be undertaken during the implementation of PARPA-II. Yet, these are largely absent in the matrix of strategic initiatives included at the end of the PARPA-II document — against which the implementation of this strategy and is monitored and assessed —[33] which is indicative of the little clout that these issues relating to industrial technological development currently hold in the Mozambican policy agenda. There is some notable, yet isolated exceptions, such as the revision of the labour legislation, which imposes important restrictions on the employment of foreign workers and which is generally considered to be detracting the private sector of highly needed skills (e.g. CTA, 2004, 2006); also, a reference to efforts in the sphere of standardisation and quality assurance. But, overall, the focus of the document in this sphere of private sector development is on business environment considerations.

As indicated in previous paragraphs, this outcome largely reflects the direction that the policy debate on private sector and, more specifically, manufacturing development has taken in Mozambique during the last decade, as well as the nature of the discussions on these issues held during the preparation of the PARPA-II document. Clearly, investment climate problems constitute a major constraint to private sector development in Mozambique. Yet, in the current Mozambican policy context, the attention given to these issues appears to have come at the cost of sidelining other important considerations for private sector development in Mozambique, including the need to improve general technological capabilities and skills in local manufacturing firms, issue which could have been partly addressed by giving greater weight to S&T considerations during the preparation of the PARPA-II document.

F. Concluding comments and policy recommendations

This paper has aimed at assessing how national PRSPs documents recently formulated in various least developing countries have incorporated science and technology development considerations into their poverty reduction and development strategies. As highlighted in the brief theoretical discussion of these issues undertaken in Section 2, science and technology development emerges as a critical factor underlying the process of economic and social development. Hence, it contributes to close the technological and knowledge gap that separates these countries from more advance economies, enabling them to engage in higher productivity activities, enhance their international competitiveness, enter new markets or market segments for higher value added goods and generate new employment opportunities paid with higher salaries. Ultimately, this may to a general expansion of agricultural and manufacturing production. On another note, the use of new S&T knowledge and devices can help improve living standards in these countries, including those of the poorer segments of their populations, by facilitating the delivery of public services and contributing to the environmental sustainability of the development process. In this respect, it can prove a valuable tool for poverty reduction efforts in least developing countries.

[33] Hence, the PARPA-II strategic matrix forms the basis of the performance assessment framework (PAF), a M&E instrument jointly developed by the GoM and its main international aid partners to monitor progress on the government's reform agenda (See www.pap.org.mz). Interestingly, whilst the PAF matrix includes several S&T related indicators for agriculture, there are none in the section devoted to private sector development policies.

Still, the promotion of science and technology development is not a simple or straightforward task, requiring a mix of initiatives encompassing various areas of policy intervention. These include initiatives that promote the development of skills and general S&T learning in the population; interventions to upgrade and extend basic technological infrastructures, such as energy networks, telecommunication services or systems associated with the use of NICTs; also, policies in the sphere of international trade, investment and employment that promote the international transfer of technology and (scientific) know-how, as well as initiatives to promote the generation of local S&T knowledge and its dissemination throughout the economy. The wide range of initiatives involved in this process highlights the crosscutting and holistic nature of the process of S&T development.

In view of the results of the synoptic survey of PRSPs undertaken in Section 3, the experience in incorporating these considerations into developing countries' poverty reduction and economic growth strategies is somewhat mixed. Clearly, most countries do recognise the importance of science and technology in their PRSP documents, and include numerous S&T-related policy initiatives in the various relevant spheres of policy intervention. Yet, in most cases, they fail to incorporate these issues in a systematic way that can be interpreted as an attempt to put forward a clearly defined and comprehensive strategy that places S&T development at the centre of their poverty reduction and growth efforts. There is also a tendency to focus only on the creation of conditions required for S&T development, in the form of initiatives aimed at promoting educational, skill or infrastructural development. However, less attention is given to policies that can directly contribute to S&T development by promoting the international transfer and dissemination of S&T, or the generation of local scientific and technological knowledge. This is more evident in the sphere of private sector development than it is for agricultural policies.

In this context, the case study of the Mozambican PRSP process provides some useful lessons for improving the inclusion of S&T development considerations in poverty reduction and economic/social development programmes. In this respect, The Mozambican government's decision to include S&T as a PRSP priority sector of a crosscutting nature (and the ensuing methodological approach taken in the incorporation of these issues), appears to have partly paid off, given the considerable coverage given to S&T in the its PARPA-II document. However, the full integration of S&T in its poverty reduction strategy appears to have been hampered by problems underlying the Mozambican planning and budget system, largely related to the fragmentation of its policy formulation and institutional framework; Also, by the little clout that S&T issues currently have in key areas for poverty reduction and economic development, such as that of international trade and private sector development.

In this perspective, the incorporation of S&T considerations in future PRSP processes could benefit from taking an approach during their preparation that deals with these issues in a more crosscutting way, explicitly addressing how S&T development can contribute to poverty reduction and economic development efforts in each of the relevant policy spheres. Particular attention should be given to S&T transfer considerations in international trade and investment policies; also to efforts to promote the dissemination of S&T knowledge and its local generation, especially in the formulation of private sector development strategies. More generally, PRSP documents could benefit from broadening their poverty diagnostics to incorporate an analysis of the relation and impact that different 'sectoral' strategies — including those regarding S&T development — may have on existing poverty and economic trends. International development agencies can contribute to this by raising the awareness of the importance of S&T development for poverty reduction and growth efforts in each of their areas of specialisation, as well as by promoting a holistic approach to these issues.

Yet, the case study of the Mozambican PRSP process highlights the need to also address potential policy and institutional problems underlying these countries' planning and budgeting systems, so as to make effective the incorporation of S&T considerations in their development programmes. In this respect, (international) support to the incorporation of S&T considerations in national PRSPs should be framed within current international efforts to improve the harmonisation of donor practices and their alignment with policy priorities defined by national governments in least developed countries. It should also take a longer-term, more strategic and broad-based perspective, and not only focus on providing this support during the formulation of these PRPSs documents.

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