Overview

"Where is the wisdom we have lost in knowledge?
Where is the knowledge we have lost in information?"

T.S. Eliot, *The Rock*

The Changing Challenge of Development

Since the year 2000, UNCTAD's *Least Developed Countries Report* has argued that there are two possible future scenarios for the 767 million people who now live in the poorest countries in the world.

At the one extreme, the LDCs will remain trapped at a low level of economic development. By 2015, they will be the major locus of extreme dollar-a-day poverty in the global economy. They will continue to fall behind other developing countries and be obliged to call on the international community for aid to tackle humanitarian crises and for peace-keeping missions to deal with recurrent conflicts. They will also be epicentres of the global refugee population, incubators of global health crises and major sources of international migrant workers, who leave their countries, sometimes dramatically risk their lives, for the sake of earning a living because their life-chances are simply too restricted at home.

At the other extreme, it is possible to envisage a progressive transition in which sustained and accelerated economic growth is achieved through the development of productive capacities, and that with the associated expansion of productive employment opportunities, there will be substantial poverty reduction. In that scenario, foreign aid supports development rather than "fire fighting" complex humanitarian emergencies. Moreover, dependence on development aid is reduced as economic growth is more and more sustained by domestic resources mobilization and the LDCs are no longer marginalized from beneficial international private capital flows.

This Report is a contribution to promoting the second scenario. It focuses on how LDC Governments and their development partners can promote technological progress in LDCs as part of their efforts to develop domestic productive capacities.

If one focuses on the problems associated with the first scenario, that may seem to be an irrelevant luxury. Some might also argue that existing policies are already adequate. In the past few years the economic growth performance of the LDCs as a group has indeed much improved. However, from the *LDC Report 2006* it is apparent that a significant number of LDCs still have slow growth and the poverty-reducing effects of the form of GDP growth that is occurring are weak. The recent growth spurt which some LDCs have experienced is also very fragile as it depends in particular on high commodity prices and, for a number of LDCs, high levels of aid and also FDI to exploit natural resources. Experience indicates that such growth spurts can easily be followed by growth collapses unless windfall resources are properly invested.

Sustained economic growth and substantial poverty reduction in the least developed countries require the development of the latter's productive capacities in such a way that the working-age population becomes more and more fully and productively employed. This was discussed at length in the *LDC Report 2006*. National productive capacities develop through the interrelated processes of capital accumulation and technological progress, which in turn lead to structural change. Promoting technological progress is thus vital for achieving a positive scenario in the LDCs. The basic challenge of development is to increase the knowledge intensity of their economies.

The overall argument of this Report is that unless the LDCs adopt policies to stimulate technological catch-up with the rest of the world, they will continue to fall behind other countries technologically and face deepening marginalization in the global economy. Moreover, the focus of those policies should be on proactive technological learning by domestic enterprises rather than on conventionally understood technological transfer, and on commercial innovation rather than on pure scientific research. Since the 1990s most LDCs have undertaken rapid and deep trade and investment liberalization. Liberalization without technological learning will result, in the end, in increased marginalization.

The Approach of this Report

Effective national and international policies to promote technological progress in LDCs require a good understanding of how technological change occurs. This Report builds on the commonly accepted insight that processes of technological change in rich countries, where firms are innovating by pushing the knowledge frontier further, are fundamentally different from such processes in developing countries, where innovation primarily takes place through enterprises learning to master, adapt and improve technologies that already exist in more technologically advanced countries. Policies to promote technological development should be different in technologically leader countries from those in follower countries, including LDCs. The central issue is not acquisition of the capability to invent products and processes. Rather, policies to promote technological change in LDCs, as in all developing countries, should be geared to achieving catch-up with more technologically advanced countries. That is, they are concerned with learning about and learning to master ways of doing things that are used in more technologically advanced countries.

From that perspective some might argue that innovation is irrelevant to the LDCs. But this view is based on a definition of innovation *sensu stricto*, as occurring only when enterprises introduce for the very first time, products or production processes that are new to the world. It can hardly be expected that an LDC is already knocking at the frontiers of technological breakthroughs. Whilst this strict definition has wide currency, it is now common to recognize that creative technological innovation also occurs when products and processes that are new to a country or an individual enterprise are commercially introduced, whether or not they are new to the world. With this broader view, innovation is a critical aspect of technological catch-up even though it does not depend on inventions which are new to the world. Innovation also occurs when a firm introduces a product or process to a country for the first time. It occurs when other firms imitate this pioneering firm. Moreover, it occurs when the initial or follower firms make minor improvements and adaptations to improve a product or production process, leading to productivity improvements. In short, innovation occurs through "creative imitation", as well as in the more conventional sense of the commercialization of inventions.

In the context of technological catch-up, the process of innovation within a country depends critically on its links with the rest of the world. However, there are divergent views on how technological acquisition occurs.

According to one extreme view, technological acquisition in follower countries depends on the transfer of technology. In that process, access to foreign technology is equivalent to its effective use. Such access can be maximized through openness to trade and foreign investment, coupled with investment in education and perhaps increasing access to the Internet and stimulating competition between international telecom providers.

A basic problem with this view is that it largely treats knowledge in static terms, as a commodity with almost instantaneous transformative properties that can be transferred from one context to another quickly and with little cost. From that perspective, technology is seen as a blueprint which can be acquired off the shelf by any producer seeking to transform a particular combination of inputs dictated by a given factor endowment. At its most simplistic level, that perspective assumes that knowledge is like any other commodity, without geography or history. Information, knowledge and learning are all collapsed into one simple input into the universal productive process. In this approach, there is almost no discussion of how information is converted into knowledge or how learning occurs in practice — indeed, learning is not really understood or elucidated in any meaningful way. The complex dynamics of knowledge accumulation are essentially excluded from the picture altogether. This conception of knowledge ignores the fundamentally dynamic character and plural aspects shaping knowledge production and generation, as knowledge is perceived as socially disembodied and universally transferable. That perspective essentially ignores the components and processes that shape the production and generation of knowledge.

In practice, it is clear that the assimilation and the absorption of foreign technology involve costs and risks, and that success depends on technological effort — investments in technological change — of various kinds, and the development of competences and capabilities at the enterprise level.

For agriculture, the type of technological effort that is required reflects the fact that a key feature of agricultural technology is its high degree of sensitivity to the physical environment (circumstantial sensitivity). The strong interaction between the environment and biological material makes the productivity of agricultural techniques, which are largely embodied in reproducible material inputs, highly dependent on local soil, climatic and ecological characteristics. This means that there are considerable limits to the agricultural development which can occur simply through the importation of seeds, plants, animals and machinery (agricultural technology) that are new to the country. What is

required is experimental agricultural research stations to conduct tests and, beyond that, indigenous research and development capacity to undertake the inventive adaptation of prototype technology which exists abroad — for example, local breeding of plant and animal varieties to meet local ecological conditions. Without such inventive adaptation capabilities, knowledge and techniques from elsewhere are locally of limited use.

For industry and services, such circumstantial sensitivity is less important, but nevertheless technological effort is required because technology is not simply technological means (such as machinery and equipment) and technological information (such as instructions and blueprints), but also technological understanding (know-how). The latter is tacit and depends on learning through training, experience and watching. Tacit knowledge is important because various adaptations are required in establishing and operating new facilities. These may capitalize on local knowledge of various kinds. The development of firm-level capabilities and support systems is vital for successful assimilation of foreign technology.

The capabilities which are required in agriculture, industry and services are both core competences and dynamic capabilities. The former refer to the knowledge, skills and information to operate established facilities or use existing agricultural land, including production management, quality control, repair and maintenance of physical capital, and marketing. In contrast, dynamic capabilities refer to the ability to build and reconfigure competences to increase productivity, competitiveness and profitability and to address a changing external environment in terms of supply and demand conditions. The latter "technological capabilities" are particularly important for the process of innovation. The effective absorption (or assimilation) of foreign technologies depends on the development of such dynamic technological capabilities.

R&D can be part of those capabilities, but only a part. Design and engineering capabilities are particularly important for establishing new facilities and upgrading them. Moreover, technological capabilities are best understood not simply in the narrow sense of mastering "physical" technologies which are associated with machinery and equipment, the properties of materials, and the knowledge possessed by engineers and scientists. Beyond this, production processes involve various complex organizational processes related to the organization of work, management, control and coordination, and the valorization of output requires logistic and marketing skills. All these can be understood as part of "technological learning" in a broad sense.

The enterprise (firm or farm) is the locus of innovation and technological learning. But firms and farms are embedded within a broader set of institutions which play a major role in these processes. In advanced countries, national innovation systems have been established to promote R&D and link it more effectively to processes of innovation. In LDCs, what matters in particular are the *domestic knowledge systems* which enable (or constrain) the creation, accumulation, use and sharing of knowledge. Those systems should support effective acquisition, diffusion and improvement of foreign technologies. In short, there is a need to increase the absorptive capacity (or assimilation capacity) of domestic firms and the domestic knowledge systems in which they are embedded.

Key Issues Addressed in the Report

The subject of knowledge, technological learning and innovation is a large one, and this Report is the first to address the issue in the context of the least developed countries. It focuses on five issues:

- The extent to which the development of technological capabilities is occurring in LDCs through international market linkages, particularly through international trade, FDI and licensing;
- The way in which science, technology and innovation (STI) issues are currently treated within LDCs, particularly in the Poverty Reduction Strategy Papers (PRSPs), and how STI policies geared towards technological catch-up could be integrated into the development strategies of LDCs;
- Current controversies about how stringent IPR regimes affect technological development processes in LDCs and policy options for improving their learning environment;
- The extent of loss of skilled human resources through emigration and policy options for dealing with that issue; and
- How ODA is supporting technological learning and innovation in the LDCs and ways to improve it.

The rest of this overview summarizes the major findings and recommendations of the Report in each of those areas.

Building Technological Capabilities through International Market Linkages

The level of development of technological capabilities in LDCs is very weak. Indicators to show this are scarce and not wholly appropriate. But examination of where LDCs stand on some of the key indices reveals a dismal performance from an international comparative perspective:

- UNDP Technological Achievement Index (TAI) classifies countries as leaders, potential leaders, dynamic adopters and marginalized countries, and all the LDCs for which there are data are in the last category.
- Work conducted within the RAND Corporation has classified countries into scientifically advanced, scientifically proficient, scientifically developing and scientifically lagging countries, and of the 33 LDCs in the sample all except Benin are in the scientifically lagging category.
- LDCs are ranked at the bottom of UNCTAD's Innovation Capability Index. Moreover, for half the LDCs their "innovation capability", relative to the rest of the world, was worse in 2001 than in 1995.

The domestic knowledge systems in the LDCs are very weak and the level of technological capabilities of domestic enterprises is very low. Initiating a sustainable process of knowledge accumulation that could accelerate the development of productive capacities in the LDCs is not a simple task, but it is not an impossible one either. A strategy for catch-up needs to focus on the building of an endogenous knowledge base, but also facilitate the transfer and effective absorption of foreign technology. Informal knowledge systems in LDCs and in informal sectors in other countries include creative repair, reprocessing and recycling of artefacts, including in some cases complex technologies. In addition, traditional knowledge plays a crucial role in various sectors, including agriculture, health and creative industries. The design of policies aimed at upgrading technological capabilities in LDCs should not ignore but develop the potential offered by existing local innovation and integrate it with transferred technologies. However, learning through international linkages is vital. A fundamental issue for LDCs is how to access the international knowledge pool, master foreign technologies and thus benefit from international technology diffusion.

This Report examines the extent to which the diffusion of foreign technology is now occurring in LDCs through international trade and FDI, and has a number of key findings.

Imports of capital goods

By far the most important source of technological innovation in LDCs, as perceived by firms themselves, is new machinery or equipment. Most of the machinery and equipment operated in LDCs is imported, and therefore imports of capital goods, and their effective use, are overall the main source of innovation for firms in LDCs.

Total capital goods imports by LDCs have lost momentum over the last 25 years. While expanding in nominal terms, they have either been stagnant or risen only marginally when compared with macroeconomic variables or the population. While the technological effort of acquiring foreign embodied technology was comparable in LDCs and other developing countries (ODCs) in the 1980s, the gap has widened greatly since that time. In 2000–2005 LDC capital goods imports corresponded to 6 per cent of GDP, only half the level for ODCs.

In the LDCs, imports of capital goods have been hampered by their premature de-industrialization process, the slow progression of the investment rate, the composition of their fixed capital formation (with a low share of machinery and equipment) and balance-of-payments restrictions. The sluggishness of those imports means that domestic firms are upgrading their processes and products only marginally. Importing relatively few capital goods implies that LDC firms are forgoing the potential technological learning and adaptive innovation associated with a greater volume of imports of technology embodied in those goods, in contrast to what ODC firms are doing.

The composition of LDCs' capital goods imports to a large extent mirrors changes in those countries' productive structure, trade specialization, FDI patterns and overall level of technological development. African LDCs were the group of countries that imported mining and metal-crushing machinery most intensively in 2000–2005, as compared with all groups of developing countries. At the same time Asian LDCs were the group with the relatively highest imports of textile machinery. As a group LDCs imported relatively little agricultural machinery and ICT capital goods. This

indicates, on the one hand, the low level of technological development of those countries' agriculture and, on the other hand, the still incipient penetration by the recent wave of ICT and ICT-based innovation.

Exports and the role of global value chains

LDC firms can develop their technological capabilities through the market linkages they develop with their downstream customers, including in particular the foreign ones. Integration into global value chains (GVCs) often represents one of the very few options for LDC firms and suppliers to secure access to international markets and innovative technologies, and to learn by exporting. However, the upgrading process is fraught with difficulties and obstacles, which are particularly great for LDC firms.

International value chains are increasingly driven by buyers and downstream lead firms. The latter have the power to set the standards (technical, quality, environmental) that must be met in order to participate in the chain. Chain leaders, however, rarely help producers to upgrade their technological capabilities so that they are able to fulfil those requirements. Barriers to integrate GVCs are therefore becoming higher.

Although LDCs had increased their specialization in several value chains since the mid-1990s, they did not manage to significantly upgrade their specialization within those chains. The analysis of 24 selected value chains that are relevant for LDC exports reveals that the LDCs have achieved upgrading in only nine of them. By contrast, their exports were downgraded in 12 value chains. The latter represent 52 per cent of total merchandise exports, but the former account for just 18 per cent. In most cases LDCs have increased their specialization in relatively basic products at a low stage of processing. Those export patterns indicate that little technological upgrading has taken place recently among LDC firms, irrespective of their participation in GVCs.

Foreign direct investment

It is generally contended that the arrival of TNCs leads to technological upgrading of domestic firms through technological spillovers via imitation, competition, training, labour mobility, backward and forward linkages, and exports (which entail exposure to the technology frontier). Those spillover effects have the potential to increase the productivity of other firms. However, the materialization of the potential positive impacts of FDI on knowledge accumulation in host countries hinges on a large number of conditions, including their structural characteristics, the type of insertion of TNCs in host economies, their job-generating impact, and the direct consequence of their entry for domestic firms.

FDI inflows into LDCs have increased markedly since the early 1990s. Between 2000 and 2005 they were on average three times higher than during the preceding 10 years. LDCs accounted for 3.5 per cent of total developing country inflows during that period and for 2.7 per cent of the total FDI stock of developing countries in 2005. Since the 1990s the FDI intensity of LDCs has accelerated considerably, so that FDI inflows as a share of both GDP and gross fixed capital formation doubled between the 1990s and 2000–2005. During the early years of the 21st century LDCs largely surpassed other developing countries in those respects.

There is little evidence of a significant contribution by FDI to technological capability accumulation in LDCs. This is not due to those countries' insufficient "opening" to foreign investors, given the policy changes that they have enacted since the 1980s and the substantial growth of FDI penetration since the 1990s. Rather, its limited contribution is due to the type of integration of TNCs into host countries' economies, the sectoral composition of FDI, the priorities of policies enacted by LDCs and the low absorptive capacity of those countries.

In African LDCs typically the mineral extraction activities of TNCs are capital-intensive, have little impact on employment, are highly concentrated geographically, have high import content and result in exports of their output as unprocessed raw materials. Most of those operations are wholly owned by foreign investors (rather than joint ventures) and a large share of their foreign exchange earnings is retained abroad. Those operations tend to operate as enclaves since they are weakly integrated into domestic economies, as they have few forward and backward linkages in host economies. Some of the main channels for potential knowledge circulation between TNCs and domestic firms are largely absent, namely linkages, joint ventures and labour turnover.

In Asian LDCs the rapid growth in garment-related FDI inflows, employment and exports has not been accompanied by a corresponding development of firms' technological capabilities. The Governments of these countries have not enacted an effective policy to develop garment manufacturing and foster its anchoring in the domestic economy, although the industry plays a major role in those economies. Their policy actions have been limited to liberalizing foreign investment regulation, promoting private enterprise, coordinating investment approvals, customs facilitation and basic infrastructure provision in exporting processing zones to stimulate the growth of the different segments of activities in the value chains. Indeed, none of these economies has even imposed training levies on firms to stimulate upgrading. The lack of embedding in the domestic economy and of technological learning in the garment industry means that garment manufacturing in LDCs remains dependent on preferential market access conditions and is therefore vulnerable to their disappearance.

Licensing

The use of licensing as a channel for accessing the international knowledge pool (through imports of disembodied technology) is directly related to the income level and technological sophistication of economies. Licensing should therefore be less relevant to LDCs than to other developing countries as a channel for foreign technology diffusion, and this is borne out by evidence. Licensing activity in LDCs is much lower than in ODCs: licence payments as a share of GDP in the former was just 6 per cent of the level of the latter in 2000–2005. Moreover, while ODCs have increased their effort to acquire foreign technology through licensing since the mid-1990s, in relative terms this has been stagnant in the LDCs.

To summarize this analysis of international linkages, technological assimilation and absorption in LDCs through market mechanisms are taking place only to a very limited degree, as reflected in the weak development of technological capabilities and productive capacities. For some channels, notably capital goods imports, the scale of interaction in relation to GDP is much too low. For other channels, notably FDI and exports, the scale of interaction is actually high, but the learning effects of those channels are low. Thus, the growing integration of LDCs into international trade and investment flows since the 1980s has not prevented their marginalization from technology flows.

The learning associated with international transactions does not occur automatically. There is, for example, no "fixed quotient" of learning that arrives in developing countries with every "unit" of exports or FDI. Consequently, measures to increase the volume of exports or FDI inflows do not guarantee any increase in learning. Instead, the learning intensity of such transactions is variable, and the key policy issue is to raise that learning intensity — that is, to increase the magnitude of knowledge and skill acquired "per unit" of exports, imports or inward FDI. It is on the learning potential of international linkages that policy — at national, regional and international levels — should focus.

National Policies to Promote Technological Learning and Innovation

Analysis of recent PRSPs in a sample of LDCs shows a striking paradox. Although LDC Governments are concerned with promoting sustained economic growth as a basis for poverty reduction, the treatment of technological change as a source of economic growth in PRSPs is generally weak. Only four out of the sample of 11 recent PRSPs which were systematically analysed include science and/or technology as a priority policy for poverty reduction. But all mention the importance of agricultural research and extension. However, there is only a marginal concern for how to learn through international linkages. Moreover, only three countries note the need to expand business services to support the technological upgrading efforts of local firms.

The limited attention to technological change reflects the marginalization of technology policies within structural adjustment programmes, which have been particularly intensely implemented within the LDCs, the omission of technology issues from the PRSP approach, and the failure to embed PRSPs, which are essentially three-year public expenditure plans within broader development strategies which include actions to promote technological progress. But it is paradoxical because promoting technological change is recognized as a key source of economic growth. It is at the heart of efforts by the OECD to promote growth in member countries. Moreover, it is becoming a central component of development strategies in more and more developing countries.

The broad revival of interest in policies to promote technological change, partly inspired by the East Asian success, is indicative of wide dissatisfaction with current policies. There is a desire to find a new, post-Washington Consensus policy model, as well as the intuition that it is in this area — promoting technological change — that it is possible to find more effective policies to promote growth and poverty reduction. If LDCs do not participate in this policy trend they will be increasingly marginalized in the global economy, where competition increasingly depends on knowledge rather than on natural-resource-based static comparative advantage. Moreover, accelerated and sustained growth depends on diversification out of economic activities subject to diminishing returns into activities with increasing returns, which generally are knowledge-based.

New policy directions

As argued in earlier LDC Reports with respect to international trade, LDC Governments should elaborate development strategies which include a strategic vision for national economic development and the way to achieve that vision. Technology issues should be included in the development strategy through the integration of an STI policy as part of the development strategy. The priority actions within PRSPs can be derived from those development strategies.

Successful developing countries have adopted policies to promote technological learning and innovation which are geared towards achieving technological catch-up with more advanced countries. There is no reason why LDC Governments should not adopt a similar orientation. However, policies to promote technological learning and innovation in LDCs need to be appropriate to their level of technological development, economic structure and the capabilities of their Governments and business sector.

Technological catch-up in LDCs will require the co-evolution of improvement in physical infrastructure, human capital and financial systems, together with improved technological capabilities within enterprises and more effective knowledge systems supporting the supply of knowledge and linkages between creators and users of knowledge. It will also require a pro-growth macroeconomic framework which can ensure adequate resources for sustained technological learning and innovation, as well as a pro-investment climate which stimulates demand for investment.

Improving physical infrastructure, human capital and financial systems is absolutely vital because many LDCs are right at the start of the catch-up process and have major deficiencies in each of those areas. Without an improvement in these foundations for development, it is difficult to see how technological change will occur. But it is important that LDC Governments and their development partners go beyond these foundations. In that regard, it is possible to identify six major strategic priorities for LDCs at the start and the early stages of catch-up:

- Increasing agricultural productivity in basic staples, in particular by promoting a Green Revolution;
- Promoting the formation and growth of domestic business firms;
- Increasing the absorptive capacity of domestic knowledge systems;
- Leveraging more learning from international trade and FDI;
- Fostering diversification through agricultural growth linkages and natural-resource-based production clusters; and
- Upgrading export activities.

Those priorities should be promoted through a systems rather than a linear model of the innovation process. This requires measures which go beyond those that are traditionally identified with S&T policies, particularly supporting scientific research, expanding universities and setting up research institutes. It should include measures to stimulate the supply side of technology development, but also measures to stimulate the demand for technology development, measures to lubricate the links between supply and demand, and measures that address framework conditions. They should influence all the interrelated factors that affect the ability and propensity of enterprises (both firms and farms) to innovate.

The relevant STI policy tools thus include explicit measures which are concerned with S&T human resource development, public S&T infrastructure and policies to affect technology imports. But beyond this they include a number of implicit measures — for example, public physical infrastructure investment; financial and fiscal policies which increase the incentive for investment and innovation; trade policy and competition policy; public enterprises and

public procurement; and regulation, notably in relation to intellectual property rights and other innovation incentive mechanisms. There is above all a need for improved coherence between macro- and microeconomic objectives. Excessive pursuit of macroeconomic stabilization objectives can undermine the development of conditions necessary for productive investment and innovation.

In the past the instruments of STI policy were articulated through an old-style industrial policy which involved protection and subsidies for selected sectors. Those instruments should now be articulated within the framework of a new industrial policy which is based on a mixed, market-based model, with private entrepreneurship and government working closely together in order to create strategic complementarities between public and private sector investment. Within the new industrial policy, the State should act as a facilitator of learning and entrepreneurial experimentation. The private sector is the main agent of change. However, the relevant institutions and cost structures are not given but need to be discovered. The State should facilitate this process and play a catalytic role in stimulating market forces; and it should perform a coordinating function based on an agreed strategic vision of country-level priorities for technological development. There are significant private sector risks in undertaking pioneer investments which involve setting up activities that are new to a country. Moreover, there are significant spillover effects which are beneficial to the country but which the private entrepreneur cannot capture. This implies the need for a partnership and synergies with the public sector to socialize risks and promote positive externalities. The State stimulates and coordinates private investment through market-based incentives aimed at reducing risks and sharing benefits.

STI GOVERNANCE

There are many who would argue that the types of STI policies described above can work hypothetically, but they are inappropriate for LDCs because State capacities are simply too weak. But the PRSPs in which the LDCs are currently engaged are as complicated as the type of STI policies envisaged here. There are major deficiencies in governmental capacity in LDCs, particularly with regard to long-neglected STI issues. However, the problem of State capacity needs to be seen in dynamic rather than static terms. Just as firms learn over time by doing, Governments also learn by doing. The key to developing State capacity in relation to STI issues is therefore to develop such capacity through policy practice. Policy space is required in order to pursue independent and experimental policies in line with countries' development objectives.

Government bureaucracy must not only be competent and independent. An important lesson from successful catch-up experiences is that the Government does not act as an omniscient central planner, but formulates and implements policy through a network of institutions which link government to business. The establishment of intermediary government–business institutions should be a priority in the good governance of technological learning and innovation. A basic condition for success is that policies to promote technological learning and innovation do not favour or protect special interest groups, or support particular firms ("cronyism").

Finally, good governance of technological learning and innovation is likely to require organizational restructuring within the State apparatus itself owing to the cross-sectoral nature of technological learning and innovation. Some countries have started to establish ministries of science and technology to take a lead on S&T issues. But the mere establishment of such a ministry can be counterproductive, as it can lead to an overemphasis on science and an underemphasis on innovation at the enterprise level. The appropriate organizational structure for integrating technological development issues into policy processes needs careful consideration.

Intellectual Property Rights and Other Incentive Mechanisms for Innovation

A number of difficult issues arise with respect to the role of IPRs in the LDCs. Economists have found it notoriously hard to measure the costs and benefits of IPRs, particularly at different stages of development. It seems clear, however, that IPRs do not automatically lead to learning and innovation, and may even jeopardize the latter in an LDC context.

In that regard, important lessons for LDCs' learning strategies can be drawn from the successful development experiences of countries that have achieved catch-up, such as a number of East Asian countries. In the first, *initiation*

stage of their technological development, the basic conditions for patents to operate as incentives for innovations, namely large R&D investments and capacity for reverse engineering and low-cost production, do not exist. In the second, *internalization* stage, local firms can learn through imitation under a flexible IPR regime; technology owners face a growing risk of imitation and tensions between domestic and foreign firms increase. It is only in the third, *generation* stage that local innovative firms in the most dynamic sectors aim at a more stringent IPR regime to protect greater R&D investments and accumulate IPRs as a defensive strategy, as well as to improve their bargaining position vis-à-vis competitors.

In the light of that, IPRs are unlikely to play a significant role in promoting local learning and innovation in the initiation stage, the point in the catch-up process where most LDCs are now located. Moreover, technology transfer through licensing is unlikely to provide great benefits for LDCs. Even if under certain conditions IPRs were to positively encourage technology transfer through licensing, LDCs are unlikely to become significant recipients of licensed technology. The low technical capacity of local enterprises constrains their ability to license in technology, while the low GDP per capita in LDCs is not likely to stimulate potential transferors to engage in such arrangements. IPRs, particularly patents, promote innovation only where profitable markets exist and where firms possess the required capital, human resources and managerial capabilities. Similarly, licensing is out of reach for firms without a certain level of absorptive capacity, particularly in countries with low GDP. As firms' capability increases, patents may increasingly perform their incentive, transactional and signalling functions and the information contained in patent applications may be more useful for planning and undertaking innovative activities.

Case study of Bangladesh

The case study of Bangladesh, which is one of the most advanced LDCs in terms of its technological development, confirmed those theoretical and historical observations. The study, which is the first on IPRs in least developed countries and was commissioned specially for this Report, focused on three sectors: agro-processing, textiles and garments, and pharmaceuticals. It showed that innovative capacity within local firms remains very low across all three sectors. Moreover, irrespective of the presence of intellectual property rights, in the local context those rights do not play a role either as a direct incentive for innovation or as an indirect incentive enabling knowledge spillovers (through various technology transfer mechanisms such as licensing, imports of equipment or government–firm technology transfer). Currently, intellectual property rights are benefiting mostly the TNCs operating in the local market, as the local firms are not sufficiently specialized to protect their innovations under the current IPR regime, which in any case may not be appropriate for the types of incremental innovations in which most firms engage. For the large majority of local firms there was no observable positive impact of intellectual property rights on licensing, technology transfer or technology sourcing through foreign subsidiaries. The only important sources of innovation at the firm level are the firms' own innovation efforts and innovation through imitation/copying.

Although the study found that intellectual property rights do not contribute to new product/process development in any of the three sectors, domestic entrepreneurs had serious concerns regarding the impact of intellectual property rights on their inputs, such as seed availability and seed price. Larger firms tended to view IPRs differently and in a more benevolent light than the smaller firms, as a tool through which they could protect their products and secure benefits. Others, which regarded IPRs as detrimental to innovation, based their assessment largely on the indirect impact of IPRs on increasing prices of seeds and other inputs. In the textiles and ready-made garment sector, most of the firms interviewed were of the view that IPRs did not play any role as an inducement for innovation, because they simply assembled the final output according to precisely given, buyer-determined specifications, since they did not possess any indigenous design-related capabilities. The firms in the pharmaceutical sector were very concerned that since foreign firms can obtain patents on their products in the country, this might adversely affect their efforts to venture into reverse engineering of active pharmaceutical ingredients. The patents on pharmaceutical products (approximately 50 per cent of the 182 granted in 2006) are not on local innovations, and this point to the presence of other reasons for patenting, such as strategic use, monopoly profits and prevention of parallel imports.

It will be important conduct more studies of this type. But many experts in the area of IPRs now argue that "one size does not fit all', implying that the design and implementation of IPR policies need to consider the impact of varying levels of development and countries' initial conditions. IPR protection has historically followed rather than anticipated economic and technological development. There is thus a significant movement towards thinking about how to add a development dimension to IPR regimes. As the Secretary-General of the United Nations, Mr. Ban Ki-moon, put it, when

speaking at the opening of ECOSOC's session on 16 April 2007, "The rules of intellectual property rights need to be reformed, so as to strengthen technological progress and to ensure that the poor have better access to new technologies and products".

LDCs in the multilateral framework

The current IPR regimes can be adapted in order to provide a more supportive multilateral governance regime that is needed to ensure that low-income countries are assisted in building their knowledge base and technological and productive capacities. There are two major types of improvements that can be made: (i) fine-tuning and calibrating of norms and standards, namely, improved adaptation, in line with needs and specific initial conditions; and (ii) enhancing TRIPS flexibilities. Simultaneously, LDCs, in collaboration with their development partners, should explore the full panoply of non-IP options available to enhance incentives for innovation in an LDC context.

Developing countries are entitled under the TRIPS Agreement to the same minimum standards of protection applicable to developed countries, subject only to transitional periods. The same treatment was granted to the LDCs; only longer transitional periods, renewable upon request, were permitted. In many cases, TRIPS-plus regulations in bilateral and regional agreements impose on LDCs even higher standards and greater obligations than on other WTO members. However, a differential approach for LDCs was recognized by the TRIPS Agreement (Article 66.1), and this is reflected in the lack of LDC obligations for IP protection under the Agreement, so that LDCs can develop "a sound and viable technological base" (Preamble to the TRIPS Agreement). Until 2013, LDCs still have the opportunity to undertake an imitative path of technological development, as developed countries had in the past (and until 2016, in the case of pharmaceutical products and processes). However, such a window of opportunity may close in a period shorter than that enjoyed by the majority of developed countries, and although LDCs may have the freedom to imitate, foreign markets will be closed to their products, as higher standards of IPR protection have almost become universal. As interactive learning is a time-consuming, cumulative and historical process involving many agents, the major recommendation of this Report is that the transitional period for LDCs should not be subject to an arbitrarily predetermined deadline, but become only enforceable once those countries have achieved "a sound and viable technological base".

Furthermore, Article 66.2 requires the granting of incentives to promote transfer of technology to LDCs by developed countries. Those incentives should be accorded to enterprises and institutions that specifically aim at facilitating the transfer of technology to LDC enterprises (such as through tax breaks and subsidies). This obligation cannot be met merely through cooperation provided by public agencies. It is also recommended that the concept of "transfer of technology", for the purposes of compliance with Article 66.2, be elucidated by the WTO, so as to make it clear that developed countries' Governments should provide firm-based incentives for the transfer of IPRs and non-IPR-protected technology, and that "technology" should be understood as manufacturing methods, formulae, designs, basic and detailed engineering — that is, knowledge that may be effectively applied to upgrade the technological capacity of LDC recipients, rather than merely transfer of general training and technical assistance or scientific cooperation.

With regard to technical assistance, it is recommended that the supply of technical assistance by WIPO and other organizations be inter alia unbiased and development-focused, and clearly inform LDCs about all the flexibilities allowed by the TRIPS Agreement. The content and forms of delivery of IPR-related technical assistance should be defined by the recipient Government, in accordance with its own priorities and development objectives and in full consultation with other stakeholders, including public-interest-oriented NGOs. Moreover, independent studies should be carried out, assessing the economic impact of IPR regimes on the development of productive capacities in LDCs, with the assistance and cooperation of all relevant partners, including those from the wider international community, for example UNCTAD and public-interest oriented NGOs.

The LDCs that are currently in the process of accession to the WTO should not be required to provide accelerated and TRIPS-plus protection, and should be granted the same transitional periods as for other LDC members. Additionally, it is recommended that LDCs use to the fullest extent possible the flexibilities allowed by the TRIPS Agreement (such as parallel imports, compulsory licences, permissible exceptions to exclusive rights and fair dealing), and seek to avoid the erosion of such flexibilities through FTAs, BITs or bilateral trade and investment agreements, or in the context of accession to the WTO. Moreover, it is recommended that the inclusion of IPRs as "covered investments" be reviewed in any bilateral or regional agreement.

Furthermore, the international community should reconsider the development dimension of the TRIPS Agreement, with a view to meeting the need for a balanced approach and pro-development IPR regime, especially with regard to LDCs, and particularly concerning LDC-specific standards relating to novelty, the nature of inventions, terms of protection and calibrated disclosure. For example, the full use of exceptions and limitations should be granted to LDCs, especially in research and fair use. In order to reverse the trend for imposing TRIPS-plus requirements, it is recommended that IPR provisions be excluded from any future FTAs and BITs. In drafting national legislation, LDCs would be well advised to develop their own guidelines in patent offices with respect to patentability criteria, — that is, to examine applications carefully rather than simply copy international standards. With a view to increasing their bargaining position in multilateral forums, the LDCs are advised to pool LDC-based resources and knowledge in the search for economies of scale and collective efficiency solutions in all IPR-related institutional arrangements.

As regards alternative non-proprietary mechanisms for knowledge governance, the LDCs, in collaboration with the international community, should explore the panoply of existing mechanisms that are being successfully used in many other countries in order to stimulate learning and knowledge governance — for example, patent buy-outs, price discrimination mechanisms, public–private partnerships, subsidizing research (directly and indirectly) via grants, tax credits, fiscal measures to support R&D and other types of innovative activities, developing prizes, government-based advanced market commitments, open source collective mechanisms, information and knowledge commons, joint research initiatives of various kinds, local as well as regional technology-sharing consortia, joint research ventures, licensing agreements with technology transfer clauses and compensatory liability regimes. Moreover, improving linkages between S&T institutions and the enterprise sector is highly recommended. In order to encourage institutional diversity for enhanced knowledge ecology (the institutional framework that enables access to and production and use of, knowledge for learning and innovation), a plurality of options should be explored with a view to accelerating technological learning and innovation.

In conclusion, the main challenge that policymakers in LDCs need to address is how to devise supportive policy frameworks to enhance learning and to consider the plurality of options available with a view to better managing and benefiting from the LDCs' own as well as already available knowledge resources. Establishing proprietary IPR systems and creating property rights are but one, among various responses, to a more generic and fundamental problem, which is how to create and improve LDCs' knowledge ecology. This challenge goes beyond fine-tuning the existing intellectual property rights regime.

International Migration of Skilled Labour

Brain drain and brain gain

The cross-border movement of persons possessing a particular type of knowledge is a means of international technology diffusion. Countries may either gain or lose from the permanent (or long-term) international migration of skilled persons. International migration of skilled persons in principle contributes to building the recipient countries' skills endowment, while entailing a loss in the origin country's stock of human capital (at least immediately). Those two processes are commonly referred to as "brain gain" and "brain drain" respectively. The most important issue for countries' long-term development is the net effect of migratory flows.

LDCs have a low skill endowment. Therefore, the international migration of skilled persons from and to those countries can have a strong impact on their human capital stock. The human capital endowment of an economy is a fundamental determinant of its long-term growth performance, its absorptive capacity and its performance in technological learning. It is also a requirement for the effective working of trade, FDI, licensing and other channels as means of technology diffusion. In LDCs the major migratory flow of qualified professionals is that of skilled people settling mainly in developed countries.

On the other hand, if emigrants are unemployed before leaving the country, the immediate loss for the latter is less great. Moreover, the costs of emigration can in principle be (partly) offset by other developments, including higher enrolment in tertiary education, an increase in remittances and the eventual brain gain through the return of emigrants, brain circulation by means of temporary return, and creation of business and knowledge linkages between emigrants and home countries (leading to technology flows, investment, etc.). These increased flows in knowledge, investment and

trade are more likely to occur in the case of industries producing tradable products than those producing non-tradables. Many of those positive effects, however, occur only once countries have reached a certain level of development and income growth. That implies the existence of considerably improved economic conditions in home countries, which provide incentives for temporary or permanent return of emigrants and for the establishment of stronger knowledge and economic flows. Moreover, an improved domestic environment entails lower out-migration pressure. That situation is obviously not the one prevailing in LDCs. Those countries are therefore the most likely to suffer from brain drain, rather than benefiting from brain circulation, brain gain or the other positive effects possibly associated with emigration.

Causes of international migration

International migration of skilled persons is driven by both supply pressures in home countries and demand forces in destination countries. In countries of origin, the main reasons for emigration of qualified persons are limited employment possibilities, poor working conditions and/or weak career paths, slow economic growth and political instability, as well as the low level of pay and the huge and widening gap between earnings in LDCs and those in developed countries for the same careers (in some cases amounting to 20 times in PPP terms).

At the same time, demand pressure for greater deployment of skilled migrants from developing countries (including LDCs) has grown in industrialized countries, despite their rapidly rising numbers of tertiary graduates. Opportunities for work among professionally qualified immigrants in developed countries have greatly increased since the 1990s. While skill shortages have been experienced across the board in many increasingly technologically advanced developed countries, three sets of factors have been especially important in influencing renewed demand for skilled manpower. First, the ageing of developed country populations, especially in Europe and later in Japan, has contributed to slow growth in labour supply and increased demand for skill-intensive non-tradable services, particularly in health and aged care. Second, the information technology revolution has greatly increased the demand for skilled manpower in the production of computer software and the demand for computer and ICT engineers. Third, shortages of lower- to middle-level skilled manpower — technicians, electricians, plumbers, nurses and teachers — have been especially marked, as developed country workers shun difficult blue-collar and related jobs, and the output of those countries' educational institutions has failed to keep pace with demand. The major labour-importing economies, particularly the United States, the EU and its member States, Canada and Australia, have reacted to increasing shortages of skilled manpower by implementing more open policies to attract qualified immigration.

Developments in LDCs

Three main features of skilled emigration from LDCs since the 1990s stand out:

- Emigration rates were generally high among tertiary-educated persons by international standards, with an unweighted mean for LDCs of 21 per cent in 2000. That was much higher than for all lower-middle-income and low-income countries, whose skilled emigration rate was below 8 per cent (weighted).
- There was considerable variation in the total rates of emigration among tertiary–educated persons by and within country groups among the LDCs. They were close to 25 per cent (unweighted) in the island LDCs, West Africa and East Africa, and lowest in the generally more populated Asian LDCs (6 per cent), with Central Africa falling in between (14 per cent). Apart from in island LDCs, out-migration rates were especially high in countries that had experienced political instability in the 1980s and 1990s (Sudan, Liberia, Mozambique, Somalia and Eritrea) and in some of the poorest countries (e.g. Sierra Leone). By contrast, emigration rates were lowest in all the more populous Asian countries (especially Nepal, Myanmar and Bangladesh) and in some of the larger countries (Democratic Republic of the Congo, Sudan, Niger and Malawi).
- Out-migration among tertiary-educated persons from LDCs to OECD countries has accelerated over the last 15 years. The unweighted mean emigration rate rose from 16 per cent in 1990 to 21 per cent 10 years later. That intensification of emigration among skilled persons was much stronger than among all emigrants from LDCs.

Emigration of highly educated persons with more than basic tertiary training tends to be much greater than for the tertiary-educated population as a whole. It is estimated that as many as 30–50 per cent of the developing world's population trained in science and technology (including those from LDCs) live in the developed world. This has a direct impact on those countries' skills base, their absorptive capacity and their technological catch-up possibilities.

Policy recommendations

It is not possible to halt the emigration of qualified persons from LDCs to developed countries. Therefore, policies in both sending and receiving countries should be targeted at reducing the flows that are shown to be most detrimental to national development, and at increasing the benefits deriving from all types of skilled out-migration. Those policies should be implemented by destination countries and origin countries, and at the international level.

The main policy actions to be considered in destination countries are as follows:

- Favouring the temporary entrance of qualified professionals from LDCs, rather than permanent immigration;
- Establishing development assistance programmes that help LDCs to retain their professionals (e.g. in academia or in the health sector) through better pay, redesign of career paths and better working conditions;
- Creating programmes of assistance for skilled emigrants returning to their home countries, which support their professional reinsertion and their gainful employment by making use of their skills; and
- Refraining from recruiting LDC professionals in those careers where it is clear that emigration has negative consequences for home countries.

Home countries have three basic lines of policy alternatives for dealing with the emigration of skilled persons:

- Retention. Preventing immigration requires that professionals be offered more job opportunities, better working conditions and career paths. This depends on general economic conditions, but targeted government initiatives in sectors such as education, research and health can have an immediate impact.
- Return. LDCs gain more from the permanent return of skilled emigrants than from short-term stays. However, policies to that end are more difficult to devise and implement. Therefore, in the short run they should focus more on the short-term return of emigrants. This can involve teachers and professors giving crash courses, engineers providing specific inputs in sectors relevant to their field of expertise, doctors returning to assist with specific health-care campaigns, and so forth. Such programmes can eventually lead to permanent return.
- Diaspora. Countries of origin can benefit from diaspora professionals by maintaining contact with them and attracting them to specific activities and projects. This requires that databases of emigrated skilled persons be established and maintained, so as to engage them in those activities and projects.

International action by donors, international organizations and/or developing countries themselves should concentrate on:

- Supporting LDCs in attracting back emigrants on both a permanent and a temporary basis by establishing target programmes;
- Providing assistance to LDCs in enhancing the gains from diaspora links; and
- Establishing regional initiatives that facilitate temporary movement of professionals so as to enable LDCs to benefit from brain circulation.

Knowledge Aid

The justification for foreign aid is usually articulated within a framework which stresses the limited ability of most LDCs to mobilize the domestic financial resources needed to meet a range of pressing economic, social and political objectives. But equally important, and actually even more fundamental, aid can help to build up the knowledge resources and knowledge systems of LDCs. This is particularly important for the LDCs because their level of technological development is so low and technological learning through international market linkages is currently weak. Aid can play an important role in developing a minimum threshold level of competences and learning capacities which will enable LDCs to rectify that situation. Indeed, the provision of more knowledge aid, if directed towards the right areas and appropriate modalities, may be the key to aid effectiveness.

There is no agreed definition of knowledge aid. Since the 1990s, there have been an increasing number of knowledge-based activities designed to increase aid effectiveness by strengthening the knowledge base of the donors

themselves — for example, through internal reforms to increase intra-organizational knowledge-sharing, better knowledge management and IT system development. But in the present Report, knowledge aid is defined as aid that supports knowledge accumulation within partner countries. Knowledge aid is provided in two ways: either through supplier-executed services, where, for example, donors provide consultants who advise on, or design and develop, projects, programmes and strategies; or through strengthening the knowledge resources and knowledge systems of the partners themselves, a process which may be called partner learning. In either case, those activities might be designed to increase knowledge resources for institutional, regulatory and policy development, or to support the development of productive capacities through technological learning. Aid to build science, technology and innovation capacity is a particular form of knowledge aid. Aid for STI should support (i) the development of productive capacities through building up domestic knowledge resources and domestic knowledge systems, and (ii) the development of governmental capacities to design and implement STI policies.

It is very difficult to quantify the scale of aid for STI to LDCs. But the available evidence indicates that this is a low priority in LDCs. Reported aid disbursements for research and the development of advanced and/or specific human skills (including agricultural education and extension), constituted only 3 per cent of total aid disbursements during the period 2003–2005, with 90 per cent allocated to building human skills, particularly higher education. Reported aid disbursements for agricultural research to all LDCs were equal to only $22 million per year during 2003–2005 and LDCs received only $62 million for vocational training, $12 million per year for agricultural education and training and $9 million per year for agricultural extension. The non-agricultural sector was also neglected, with disbursements for the development of advanced technical and managerial skills constituting only $18 million per year, while disbursements for what is described in the reporting system as "technological research and development" — which covers industrial standards, quality management, metrology, testing, accreditation and certification — received only $5 million per year during 2003–2005.

It may be argued that those low levels of reported aid reflect the weak treatment of STI issues in PRSPs. But in practice, for the one STI area that is emphasized in the PRSPs, namely agricultural research and extension, aid commitments to LDCs have actually fallen rather than risen since the late 1990s. Donor priorities are starkly evident in the fact that annual technical cooperation commitments to improve governance (in the widest sense) in 2003–2005 were $1.3 billion, which may be compared with annual aid commitments for agricultural extension during the same period of $12 million. Of course, improving governance is vital. However, it will be impossible to achieve this sustainably unless LDC governments strengthen their fiscal base through the development of the productive base of their economies.

A qualitative survey of the types of STI projects and programmes which are being supported in LDCs found that there needs to be stronger coordination between STI human resource capacity projects and sector development projects, and that projects and programmes need to be more integrated, rather than disjointed, and embedded within a systemic approach. Only one project that sought to develop STI policy capacity in LDCs was identified. Similarly, global linkage initiatives, such as scientific networks and business-to-business matchmaking schemes, tend to exclude LDCs. Furthermore, the provision of global and regional public goods in the form of scientific research is not sufficiently responsive to LDCs' research needs.

Strengthening aid for science, technology and innovation

There are a number of new initiatives by donors to elaborate a coherent strategic perspective on aid for STI, including by the International Development Research Centre (IDRC) of Canada, the United Kingdom's Department for International Development (DFID), the Swedish International Development Agency (SIDA), the African Development Bank and the World Bank. It is important that the role of STI in LDCs is not neglected in those initiatives. However, beyond that, the Report makes a number of specific recommendations, which are set out below.

Firstly, there is a need for a rapid increase in ODA for agricultural R&D for the LDCs. Although agriculture is the major livelihood in the LDCs, the current agricultural research intensity — expenditure on agricultural research as a share of agricultural GDP — is only 0.47 per cent. That compares with 1.7 per cent in other developing countries. The LDC agricultural research intensity is far below the 1.5 to 2 per cent recommended by some international agencies. Moreover, the low level reflects a serious decline in the agricultural research intensity in the LDCs since the late 1980s, when the figure stood at 1.2 per cent.

Secondly, the effectiveness of ODA for non-agricultural technological learning and innovation has been severely compromised because donors typically do not support this activity. Although agriculture is still the major source of employment and livelihood in the LDCs, the employment transition which they are undergoing means that this position is not tenable if development partners wish to reduce poverty sustainably and substantially. There are, however, difficult issues regarding how aid should be used to support technological learning and innovation outside agriculture. One important recommendation is that donor-supported physical infrastructure projects should all include components use the construction process to develop domestic design and engineering capabilities. In addition, there is a need for public support for enterprise-based technological learning, which should be in the form of grants or soft loans for investment in the relevant types of knowledge assets. Such support should be undertaken as a cost-sharing public–private partnership for creating public goods, particularly in relation to the development of design and engineering skills through enterprise-based practice. These STI capacity-building activities could be particularly useful if they are linked to value chain development schemes, FDI linkage development and the facilitation of South–South cooperation.

Thirdly, LDC development partners have expressed strong support for "Aid for Trade" and there is widespread support for scaling up this kind of aid. Experiences show that technological learning and innovation are central to successful cases of trade development. However, technological learning and innovation have been conspicuously absent from past efforts to provide Aid for Trade for LDCs through the Integrated Framework and are neglected within current attempts to define the scope of the subject. It is recommended that aid for technological learning and innovation for tradable sectors be a key component of Aid for Trade, and LDC development partners should adopt best practices which are evident from successful cases of trade development, such as palm oil in Malaysia and Nile perch in Uganda. In that regard, technological development should be seen as an integral part of the definition of "supply-side capacities", as it was in the Monterrey Consensus.

Finally, there has been some discussion of ways in which trade preferences for LDCs could be enhanced not simply by extending their depth and coverage but also by linking them to supply-side support, for example through complementary measures to encourage FDI. From the point of view of technological assimilation, it is clear that trade preferences, in particular in relation to garments, have successfully stimulated the initial implementation of manufacturing activities within some LDCs. However, they do not explicitly facilitate the diffusion of best practices to domestic firms within a country and do not encourage technological upgrading. Against this background, it is worth examining whether trade preferences can be supplemented with some kind of technology fund that seeks to leverage the technological learning effects of the productive activities that are stimulated through such preferences, in particular through diffusion of best practices and encouragement of upgrading. In the current context, as transitional arrangements associated with the ending of the Agreement on Clothing and Textiles come to an end, this is likely to be particularly important in order to ensure the sustainability of existing activities in a number of countries. Work should be done on the possible design of such a fund.

* * *

This Report does not provide all the answers to the issues which it raises. It is intended to provoke fresh thinking about development strategies and poverty reduction in the LDCs by both LDC Governments and their development partners. There is at the present time a search for alternatives to the current development paradigm, and the role of knowledge in development is critical for the formulation of new approaches. The LDCs should not refrain from exploring new paths of knowledge-based development through technological learning and innovation. We hope that this Report will open up avenues for further policy-oriented research and policy innovation. Our common goal is to ensure that a positive future scenario for the LDCs prevails.

There is a choice.

Dr. Supachai Panitchpakdi
Secretary-General of UNCTAD