

Science, Technology & Innovation Policy Review

Lesotho



UNITED NATIONS

CONFÉRENCE DES NATIONS UNIES SUR
LE COMMERCE ET LE DÉVELOPPEMENT



UNITED NATIONS CONFERENCE
ON TRADE AND DEVELOPMENT

STIP Review of Lesotho: *An Implementation Strategy*

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EXECUTIVE SUMMARY

The National Policy on Science and Technology 2006–2011 of Lesotho (S&T Policy) calls on the Basotho to harness science, technology and innovation (STI) as tools to reduce poverty, create jobs and transform the country into a dynamic economy and informed society. Lesotho has a number of comparative advantages that could be leveraged towards the achievement of its development goals and beyond, several of which are directly related to STI. The S&T Policy represents a significant move towards this achievement.

The adoption of the S&T Policy is a step towards a greater role of STI in the country's development strategy. The challenge is how to convert it into a series of implementable initiatives. Action has already been taken on some of these, such as setting the legal framework for the Inter-Ministerial Committee on Science and Technology, the Lesotho Advisory Commission for Science and Technology and the Lesotho Innovation Trust Fund. However, there are still gaps in the system that need to be filled in order to accelerate the promotion of science, the use of technology and the growth of innovation on a broader and wider basis. Measures must be taken to ensure that all segments of society benefit from STI, in keeping with the Basotho spirit of *letsema*. In order to chart the implementation of the S&T Policy, the Government of Lesotho, through the Ministry of Communications, Science and Technology (MCST) requested UNCTAD to undertake a *Science, Technology and Innovation Policy (STIP) Review*.

The policy implementation strategy proposed in this *STIP Review* is based on an analytic framework that encompasses technology, human capital, institutions, networking, collaboration and communication and the knowledge base as key attributes of a knowledge society. The analysis was conducted along two dimensions: a sectoral approach and a human capital focus.

What emerges from the analysis is the need to prioritize collaboration and coordination and to bring out shared opportunities for cost-cutting, enhanced efficiency and ultimately improved performance for all sectors and actors. Generally, STI projects and initiatives need to be better coordinated and anchored into the national development strategy. Lead industries and sectors need to be identified, and investments made therein to create the momentum needed to propel other sectors towards an STI-driven productivity gains.

To address these challenges, the present *STIP Review* has designed a mechanism that would proactively coordinate cross-sectoral linkages, priority setting and fund allocation. It is a mechanism for action that would have a systemic impact on the development of STI in Lesotho in that it would facilitate technology flow, ensure human capital development, engage institutions' active contribution, promote networking and collaboration and build up the knowledge base. The expected benefits of such a mechanism correspond to the six major strategic priorities identified in a recent UNCTAD study¹ for LDCs at the initial and earlier stages of technological catch-up. These are: (1) increasing agricultural productivity in basic staples; (2) promoting the formation and growth of domestic business firms; (3) increasing the absorptive capacity of domestic knowledge systems; (4) leveraging more

learning from international trade and foreign direct investment (FDI); (5) fostering diversification through agricultural growth linkages and natural resource-based production clusters; and (6) upgrading export activities. At the institutional level, such a mechanism would reinforce the capacity of the MCST/Department of Science and Technology to deliver a broader range of STI information and services in an effective and timely manner, while maintaining its role as the principal promoter and coordinator of science, technology and innovation.

The *STIP Review of Lesotho* was prepared under the overall supervision of Anne Miroux, Director of UNCTAD's Division on Technology and Logistics, and the direct guidance of Mondy Hamdi, Chief of the Science, Technology and ICT Branch. The report was written by Menelea Masin, with contributions from Sara Farley, Augustina James and Shaun Lake. It also benefited from the comments and suggestions of Angel Gonzalez Sanz, as well as from consultations with the Hon. Mothetjoa Metsing and Maseqobela Williams of the Ministry of Communications, Science and Technology, and with Prof. Francis Peterson. The invaluable collaboration and support provided by Ahunna Eziakonwa-Onochie and N.S. Bereng of the United Nations Development Programme (UNDP) in Lesotho are likewise appreciated. Eleanor Loukass edited the text, Laila Sède provided production support and Nadège Hadjemian designed the cover.

Geneva, December 2009

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ACRONYMS

AGOA	African Growth and Opportunity Act
ATS	Applied Technology Services
BEDCO	Basotho Enterprises Development Corporation
CONACYT	Mexico's National Council on Science and Technology
DST	Department of Science and Technology
EU	European Union
FDI	Foreign direct investment
GDP	Gross domestic product
ICT	Information and communication technology
LACST	Lesotho Advisory Commission on Science and Technology
LDC	Least developed country
LHDA	Lesotho Highlands Development Authority
LHWP	Lesotho Highlands Water Project
LITF	Lesotho Innovation Trust Fund
LMS	Lesotho Meteorological Service
LNDC	Lesotho National Development Corporation
MCST	Ministry of Communications, Science and Technology
MSI	Millennium Science Initiative
NEPAD	New Partnership for Africa's Development
NGO	Non-governmental organization
NSI	National system of innovation
NUL	National University of Lesotho
ODA	Official development assistance
R&D	Research and development
RIC	Regional innovation centre
SACU	Southern African Customs Union
SADC	Southern African Development Community
S&T	Science and technology
SME	Small and medium-sized enterprise
SMME	Small, medium and micro enterprise
STI	Science, technology and innovation
STIP	Science, technology and innovation policy
TVET	Technical and vocational education and training
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization

Chapter 1. OVERVIEW

The Kingdom of Lesotho covers 30,355 square kilometers, about the size of Belgium. It is surrounded on all sides by the Republic of South Africa. It is the only country in the world that lies entirely above 1,000 meters in elevation, for which it is aptly referred to as “the Kingdom in the Sky”. Its lowest point is at 1,400 meters, with over 80 per cent of the country lying above 1,800 meters. Because of its mountainous topography, Lesotho’s ecology is fragile and is characterized by a thin soil layer and limited vegetation cover. However, its geology contains deposits of high value diamonds.

Lesotho is a constitutional monarchy that became independent in 1966. Executive power is vested in the Government, led by the prime minister. The bicameral parliament consists of a 120-member National Assembly, and a 33-seat Senate, with 22 principal chiefs and 11 other members nominated by the King. Its legal system is based on Roman-Dutch law.

1.1 Economic structure and outlook

Since the late 1980s, economic growth has been largely dependent on manufacturing and services, with construction associated with the Lesotho Highlands Water Project (LHWP) periodically boosting growth. By the 2000s, this growth had been restrained by declining migrant remittances and the impending 2005 expiration of the Multi-Fibre Arrangement (MFA). Quick government response with new investor incentives led to a boost in the manufacturing sector that, together with the resumption of diamond mining, helped buoy economic growth. Budget surpluses have been the norm since 2003/2004, in some years due to fiscal restraint but mostly due to windfall payments from the Southern African Customs Union (SACU). With its strong economic ties to South Africa, Lesotho is heavily influenced by the South African inflation rate. Years of declining inflation have of late been reversed by rising international food and oil prices.

Lesotho is a member of the Southern African Development Community (SADC), SACU, the New Partnership for Africa’s Development (NEPAD) and the African Union (AU), each of which offer export development and trade opportunities. It also enjoys preferential trade agreements with the European Union (EU) under the African, Caribbean and Pacific/EU protocols, and with the United States under the African Growth and Opportunity Act (AGOA). The S&T Policy 2006–2011 notes that many of the opportunities and concessions offered under these partnerships have not been fully exploited because of low value adding capacity and weak infrastructure.

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Over the last decade, Lesotho's economy has become increasingly dependent on two key industries: mining and textile and apparel production. As a result, industry accounted for 45 per cent of gross domestic product (GDP) in 2007 (see table 1.1). The government, with its civil service and infrastructure development programmes, plays a key role in the economy. Other important contributors to the economy are services, such as wholesale and retail trade and financial services, as well as remittances from migrant workers. Agriculture remains an important sector in that it is the main source of income for about 57 per cent of the population.

Table 1.1 Per cent share of GDP by sector

	2003	2004	2005	2006	2007
Agriculture	18	17	17	18	15
Industry	41	43	41	42	45
Services	41	40	41	40	40

Source: Economist Intelligence Unit.

The manufacturing of textiles, clothing, footwear and leather for export has grown considerably over the past two decades, owing mainly to the investment-friendly environment set up by the government to leverage its preferential status under the AGOA. As a result, Lesotho became the largest exporter of garments to the United States from sub-Saharan Africa. In 2002, exports totaled over \$320 million and employment reached over 50,000, marking the first time that manufacturing sector workers outnumbered government employees. The following year, however, saw the sector adversely affected by currency appreciation as well as more

competitively priced Asian exports with the impending expiration of the textile quotas under the Multi-Fibre Arrangement at the beginning of 2005. However, the subsequent weakening of the currency, together with improved incentives for investors, has helped to boost manufacturing once again.

Table 1.2 2006 Trade structure of Lesotho

Principal exports	US\$ m	Principal imports	US\$ m
Clothing	3,841.1	Garment inputs	243.1
Diamonds	474.6	Other	1,118.1
Water	138.2	Foodstuffs	72.9
Main export destinations/Per cent share		Main import origin/Per cent share	
North America	47.2	SACU	83.9
SACU	29.3	Asia	14.4
EU	20.6	EU	0.1

Source: EIU Country Report, January 2009.

Diamond mining was revived in 2003 in response to rising international diamond prices. However, only a small number of jobs have been created as the industry is capital intensive. Minor deposits of coal, galena, quartz, agate and uranium have been identified but

are believed to be of little commercial value. Lesotho also has deposits of clay, used in the manufacturing of bricks, ceramics and tiles.

Agricultural activity is basically at subsistence level, with limited commercial farming. Animal husbandry has declined in recent years owing to difficulties such as drought, stock theft, deterioration of grazing land and rural–urban migration.

An important source of employment has been the manufacturing sector, where the number of jobs peaked at 53,000 in 2004. After falling sharply to 40,000 in 2005, employment in the industry recovered strongly the following year to 48,000. Also important to the economy is the remittances from migrants in South Africa. The number of Basotho employed in South African mines was estimated at 54,000 in 2007. More gold mines have been re-activated in the wake of the global financial crisis, which seems to have fuelled the appeal of the metal as a refuge commodity.

The current account has been positive since the early 2000s, mainly due to the increase in export earnings from textiles, apparel and diamonds, and high current transfers. Export growth has generally been strong in recent years. The recovery of the manufacturing sector, together with the start of diamond production, saw exports pick up in 2006. Although textiles and apparel continue to dominate the export profile (60 per cent), by 2007 diamonds accounted for over 20 per cent of total exports. Lesotho's main export destination is North America, predominantly the United States, which offers preferential access for Lesotho's textile and apparel exports. The high growth of exports to date, particularly high value diamonds, is estimated to have driven a current account surplus of 6.4 per cent of GDP in 2008.

Despite royalties on water and power from the LHWP, the services account would be expected to post a moderate deficit because of trade costs. SACU payments are also expected to continue declining. Although remittances from Basotho in South Africa might increase because of the reopening of dormant goldmines due to higher demand for gold as refuge commodity, the current account surplus is expected to swing into a deficit of 3.5 per cent of GDP in 2009 and of 4.1 per cent of GDP in 2010.

1.1.1 Infrastructure

Because of its landlocked position and strong economic ties to South Africa, Lesotho's transport network is interconnected with its neighbour. It does not have its own railway network, and access into Maseru Station is rather limited. Freight exported from the capital Maseru is loaded at Maseru Station, about 1.5 km from nearby Ficksburg in South Africa. About 800 km of tarred roads link Maseru to the northern and southern parts of the country, while roads in the interior have improved with the LHWP coming into operation. A South African airline subsidiary, SA Airways, operates direct flights between Johannesburg and Maseru. There are plans to upgrade the Maseru airport for more freight transport, including for the export of agricultural products.

The Muela hydroelectric power station is the main source of electricity in Lesotho, with the rest coming from South Africa. The electricity supply network in Lesotho is presently concentrated in the urban and lowland areas. Almost 90 per cent of households still rely on

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biomass fuel, a situation that has exacerbated environmental problems. Further hydroelectric projects are being planned to support rural electrification programmes.

Table 1.3 Telephony statistics of Lesotho 2003–2008, per 100 inhabitants

	2003	2004	2005	2006	2007	2008
Telephone land lines	1.9	2.1	2.7	3.0	3.0	3.0
Mobile subscriptions	7.0	10.9	14.0	20.0	22.7	26.0

Sources: International Telecommunications Union & Lesotho Communications Authority.

In recent years, the telephone network has been extensively modernized and expanded. As shown in table 1.3, the number of lines increased from 22,000 in 2000 (1.2 per 100 people) to 53,000 in 2006 (3 per 100 people) but declined to 47,600 in 2008. On the other hand, the take-up of mobile phones especially in the urban areas has been exponential, rising from 21,600 subscriptions in 2000 to 456,000 in 2007 (22.7 per 100 people) and increased further to 482,600 in 2008. The two main providers of mobile phone services are Vodacom Lesotho (which is 88 per cent owned by the South African Vodacom group, the remainder being held by a Basotho consortium) and Econet Ezi-Cel (part of the South African-based Econet Wireless Group).

Lesotho fares better than the sub-Saharan African average in terms of telephony, although rural connection rates have lagged way behind those of urban areas. Projects are underway to promote the use of mobile phones in the rural areas, as shown in box 1.3.

Table 1.4 Telecommunications statistics of selected African countries (2005) per 1,000 inhabitants

	Telephone Landlines	Cellulars phones	Internet users
South Africa	101	724	109
Botswana	75	466	34
Namibia	64	244	37
Lesotho	27	137	24
Swaziland	31	177	32
Sub-Saharan Africa	17	130	26

Source: Human Development Report, 2007 data.

The Internet has made slower inroads into Lesotho, reflecting low incomes, high costs and the small size of the market. Internet bandwidth is mainly sourced from South Africa, while there are six domestic Internet service providers. Table 1.4 indicates that among Southern African countries, Lesotho is the least connected. Its Internet connectivity is in fact slightly lower than the sub-Saharan African average.

Box 1.1 Women farmers and mobile phones

A pilot study of the Regional Hunger and Vulnerability Programme, which builds evidence to help policymakers working on food security and social protection, has indicated that access to mobile phones could boost income in rural Lesotho. The study distributed 10 mobile phones to three cooperative women's farming groups in different agro-ecological zones in the Maseru district, and found that it enabled women farmers to market their produce at more competitive prices.

Additionally, the women managed the phones as an income-generating tool by selling airtime, the income of which they used to purchase more phones. One of the groups also used the money to buy piglets, which were fattened and sold to generate more income.

The study also found that the biggest saving was in time and travel costs in mountainous Lesotho, which has long distances and a poor public transport system. The distances between cooperative groups in the Maseru District participating in the study, for instance, can be up to 200 km – a 16-hour round trip by taxi costing about \$13, with an overnight stay. The phone enabled the groups to organize farm visits and to shorten waiting at the health centres.

The programme has used the project's findings to help the Swaziland Government put out a tender for a private sector partner to handle cash transfers for the government's Old Age Grant, while in Malawi it has undertaken a feasibility study for a potential social pension delivery based on mobile phones.

Source: IRIN Humanitarian news and analysis, UN Office for the Coordinator of Humanitarian Affairs. 31 March 2009. <http://www.irinnews.org/Report.aspx?ReportId=83535>.

1.1.2 Economic policies affecting innovation and technological change

The focus of Lesotho's economic policy has been on the business environment as the major driver of economic growth. As shown in box 1.2, Lesotho has successfully attracted a significant amount of FDI in spite of its landlocked location, relatively poor infrastructure and weak industrial base. A 2003 UNCTAD study² on the investment policy of Lesotho noted, however, that the country was not fully benefiting from FDI in terms of skills transfer and technology acquisition. Unlike other countries in a similar situation, backward linkages that were formed and spin-offs that emerged were insignificant. Foreign affiliates continued to account for the manufactures content in Lesotho's export base.

Among the measures taken to promote Basotho-owned business initiatives was the establishment of the Basotho Enterprises Development Corporation (BEDCO), which reported membership of over 500 enterprises in 2009, up from a little over 200 two years earlier. Most of these enterprises are, thus far, geared to the domestic market and do not export outside the region.

Box 1.2 FDI and technology

Lesotho's performance in attracting FDI has been noteworthy by regional standards, particularly in view of its landlocked and remote location, paucity of natural resources and undeveloped industrial base. Even more noteworthy was that the bulk of FDI was in manufacturing and, within that, in export activity. In contrast to most regional economies that still rely heavily on primary and resource-based exports, Lesotho has a base that, albeit fragile, constitutes an opportunity to benefit and build upon FDI-induced growth.

Employment benefits derived from FDI, particularly for female workers, have been significant and timely, especially during a period when large numbers of Basotho repatriated from South African mines. New skills and work attitudes were acquired, and trade infrastructure and support services geared to export markets were improved. On the other hand, the competitive base for apparel, the dominant activity for FDI, remained fragile, narrow and heavily dependent on trade privileges. Capabilities built in clothing manufacturing, while significant in comparison with other African countries, were not yet sufficient to sustain FDI once trade privileges are withdrawn. Moreover, the benefits derived from FDI have not been as significant as in other countries: local content was negligible; tax revenues appeared small; local employees largely confined to low-skill operations; and there was little investment made in training.

Manufacturing FDI in Lesotho has focused on low technology and low skill activities. While Lesotho has a relatively high level of literacy, it lacks the industrial base, technical capabilities and entrepreneurial skills that foreign affiliates need to set up more advanced facilities. Notwithstanding this handicap, export-oriented manufacturing FDI has created new skills in Lesotho, such as operating industrial sewing machines, cutting and pressing. The full potential for skill transfer and capability building, however, has not been exploited. In contrast to the experience in the service industries, many supervisory, technical and managerial jobs remain with expatriates, even in firms that have been in Lesotho for a decade or more. A few companies do have in-house training and motivation programmes, yielding positive results in productivity and labour relations. These, however, appear to be the exceptions rather than the norm. Language, culture, work practices and perhaps a "footloose" outlook on the part of firms may be the counter-factor, raising the cost of adapting to local circumstances and of creating trust and social capital. Fault could also be attributed to the weak institutional structure of the host country and capital market deficiencies for new entrepreneurs.

Only two local apparel entrepreneurs have emerged in Lesotho some 15 years after the first modern garment factory was established. This is exceptionally low in the garment industry, where entry barriers are low and access to world markets has been made easy. In Bangladesh, for example, a country with low skill levels, weak infrastructure and minimal industrial tradition, several employees of foreign affiliates left the firm after only a few years to set up their own garment export operations. They did have, however, considerable on-the-job training, including apprenticeship in the affiliates' home countries. Bangladesh garment exports in 2003 brought in over \$3 billion in foreign exchange, with a substantial proportion coming from local companies. Similar observations have been made in Mauritius, Morocco and Sri Lanka, and in Central America.

Source: UNCTAD (2003). *Investment Policy Review of Lesotho*. UN publication. New York and Geneva.

1.2 Human development and social conditions

1.2.1 Education

Lesotho has one of the highest literacy rates in sub-Saharan Africa, at 82 per cent of population aged 15 and over, compared to the sub-Saharan rate of 59.3 per cent. This reflects the strong national commitment and investment in education. In 2006, for instance, education accounted for about 30 per cent of the state budget, one of the highest proportions in the world and the highest in the subregion, as shown on table 1.5. Introduction of free primary education in 2000 led to a rise in first-year enrolment from 60 per cent to 85 per cent just three years later.

Table 1.5 Education indicators of selected southern African countries

	Public expenditure	Tertiary students in STI fields
Botswana	21.5	17
Lesotho	29.8	24
South Africa	17.9	20
Swaziland	...	9

Notes: Public expenditure on education, as percentage of total government expenditure, 2002–2005. Tertiary students in science, engineering, manufacturing and construction, as percentage of tertiary students, 1999–2005.

Source: UNDP (2008). *UNDP Human Development Report 2007–2008*.

The government has built new schools, expanded existing facilities and accelerated teacher training. As a result, the pupil–teacher ratio has improved from around 70:1 a few years ago to 50:1 by 2007. However, drop-out ratios from primary schools remain high, and the completion rate was only 65 per cent in 2006. According to the World Bank, the net enrolment ratio at secondary school was just 24 per cent in 2006. The provision of vocational and technical post-secondary education has increased in recent years, but is still insufficient. About 7,000 students attend tertiary institutions each year, with 3,200 going to university. Annual enrolment at the single

national university, the National University of Lesotho (NUL) is around 1,700 students. Many other students attend Southern African universities, and a handful outside the subregion.

In addition to its high literacy rate and government commitment to education, Lesotho has the highest percentage of tertiary students in science and engineering fields among Southern African countries. This indicates an interest in and inclination towards science and technology as well as a capacity for innovative thinking. Interviews with stakeholders both within academia and the business sector, however, point to chronic deficiency of the job market to absorb these graduates and the seemingly massive emigration of university graduates. Indeed, the recent long-term plan for Lesotho, *Lesotho National Development Vision 2020*, lists brain drain as one of the nation's major threats.

1.2.2 Health and other indicators

Throughout the 1980s and the first half of the 1990s, life expectancy in Lesotho was estimated at 60 years. This declined to 54.7 in 1999,³ the major causes of illness and death being preventable and contagious diseases. The health care service delivery system in Lesotho consists of a network of hospitals, clinics and health centres. The Ministry of Health and Social Welfare maintains an integrated health system. The technical aspects of health services cover research and laboratory work, the maintenance of professional standards, disease control, environmental health and health education. The Department of Pharmaceutical Services provides medicines to all hospitals and health centres, while the National Drug Services Organization procures and distributes drugs throughout the health system. A parastatal corporation handles manufacturing and testing. Lesotho's health care comprises curative, preventive and rehabilitative services, and its health infrastructure is well developed.

Lesotho has a very high rate of home ownership, although the quality of housing is relatively poor and the amenities rather basic. Most rural dwellings are of stone walls, while in urban areas the predominant material is cement bricks. About three quarters of roofing is corrugated iron sheets.

Access to safe drinking water improved from an estimated 62 per cent of Lesotho's population in 1996 to 74 per cent in 2002/2003. The overall gains between 1996 and 2002 appear exclusively attributable to better coverage in rural areas.⁴

1.3 STI in the national setting

Citing the development challenges confronting the country, the S&T Policy calls on the Basotho to harness science, technology and innovation as tools to reduce poverty, create jobs and make Lesotho a better place to live. In the words of the Minister of Communication, Science and Technology, "the S&T policy is the best key to empower ourselves with the relevant skills, knowledge, competencies, know-how and attitudes" required to meet Lesotho's development objectives. This policy would enable the country to leverage the opportunities afforded it and meet the challenges confronting it.

The process with which the policy was formulated, representing a "consensus view, derived from a long, open consultation process that engaged all key stakeholders from all walks of life", indicates a commitment to national dialogue and consensus generation. These are key assets in the move toward an STI-led economy. The challenge is to translate the policy to a series of implementable initiatives that would ensure inclusiveness in the benefits of science and technology. The Department of Science and Technology (DST) of the MCST plays the central role in achieving these goals.

Lesotho has a number of comparative advantages that could be leveraged in achieving its development goals. Its unique geography, for instance, of being the only country in the world whose entire territory is located 1,000 metres above sea level could be exploited in the production of disease-free plants and animals. The benefits of such an industry would be manifold and wide-ranging, from improved food security and employment generation to increased government revenue from taxes and duties. Its multiplier effect cannot be underestimated in terms of more STI-related activities and businesses and of attracting more professionals, including the repatriation of Basotho science and technology professionals working abroad and young students.

As well, the country's location inside South Africa could be further exploited to the mutual benefit of both countries. The ties that bind the two neighbours – geographic, historical and cultural – are strong and being strengthened through preferential treatment in all areas including trade, education and free movement of persons. South Africa is not only the largest economy on the continent, it is also the most advanced in science, technology and innovation.

On the human capital side, Lesotho has the highest literacy level in sub-Saharan Africa. Its diaspora both within the subregion and beyond could prove instrumental in bringing in needed capital for local industries and in strengthening business and professional linkages within the country as well as the region.

Additionally, Lesotho's membership in international organizations could facilitate its access to globally available knowledge and technology. With increased globalization and with lesser restrictions on the movement of goods and people, STI in both tangible and intangible forms has become more accessible to a broader range of users. Indeed, for countries at the technological catch-up stage such as Lesotho, the process of innovation depends critically on its links with the rest of the world.² Successful technology acquisition could spell the difference between growth and marginalization. A strategy for catch-up needs to focus on building the endogenous knowledge base, particularly through the adaptation and diffusion of imported technology. The key line of action therefore is to reinforce existing institutions. Better performing and reliable equipment would have to be put in place, and their personnel skills upgraded to include functions such as scanning, identifying, accessing, adapting and diffusing the right technologies to the right users at the right moment.

The policy focuses extensively on building institutional research and development (R&D) capacity. In this regard, linkages with institutions outside the country, especially those in South Africa and in the subregion, could be further exploited. Determining which areas can be outsourced is an essential step in implementing the policy. Equally important is defining funding priorities and strategically leveraging opportunities.

Successful innovation in science and technology is generally underpinned by a functioning network of R&D institutions and a supportive policy framework, as well as a viable domestic market to test and nurture new innovations and technologies. Lesotho has a small domestic market with low purchasing power and weak research capacity. Moreover, it does not have the institutional mechanism for technology acquisition, whether through own indigenous research or through adapting new innovations and technologies produced

elsewhere. Its weak STI institutional infrastructure and scarcity of STI professionals represent serious handicaps in building an STI-led economy.

Furthermore, recent developments at the international front led to the withdrawal of many textile-related FDIs, which had become a major employment sector as well as technology and skills transfer resource in the country. The expiration of clothing and textile agreements (AGOA, EU) that provided preferential treatment to certain categories of countries, for which Lesotho qualified, has diminished its comparative advantage to other least developed countries (LDCs) in South-East Asia. Bangladesh, for instance, has even lower wages than Lesotho with a better skilled, larger and more productive workforce. It also has the additional advantage of closer geographic proximity to the home countries of most textile-related FDI in Lesotho.

The critical mass in the private sector with which STI-based linkages abroad could be built must be encouraged and cultivated. Despite being the largest employer in Lesotho, for instance, the textile sector is almost entirely low technology with minimal skills transfer taking place. Moreover, the growth of Lesotho's infant small and medium-sized enterprise (SME) sector is particularly vulnerable to weak entrepreneurship. The manufacturing sector generally represents the entry point for new technologies and processes, and in the absence of a dynamic entrepreneurial class, the country will most likely be locked out of technologies not only for the productive sector but also for the other key sectors such as health and agriculture. The STIP Review Team were of the impression that few local firms were accessing globally available STI resources such as improved products, processes and even mature technologies. The sector was therefore losing opportunities for technological upgrading and, ultimately, business expansion and higher returns.

Reforms are needed in the educational system to render graduates capable of driving the emerging private sector into fruition, as well as contributing to national development in the full range of sectors that require STI expertise and inputs. The present low number of enrolments in maths and science-related courses at higher education institutions indicate an insufficient crop of science and technology graduates needed to build and drive an innovative, technologically-based industry. Employers often complain about the shortage of technically trained or even technically trainable job applicants. This is borne out in the policy document, which states that "Lesotho is lagging behind its SACU and SADC counterparts in science, technical education, research and manufacturing capacity". As a resource-challenged country, the paramount importance of its human resources as generators of revenue is perhaps even greater than it would be with more significant natural or other capital resources. Unfortunately, Lesotho's human capital does not currently enable significant comparative advantages outside of lower labour costs.

There are other conditions that represent serious challenges to achieving an STI-led growth. Among these are the diminishing SACU revenues, a high rate of unemployment exacerbated by a high incidence of HIV/AIDS and a fast deteriorating environment due to soil erosion, air pollution, climate change and other factors. Even though water at this time is considered one of the country's assets, water supply is expected to become more of a constraint in the future.

These cross-cutting issues require a cross-cutting solution, as well as the collaboration and cooperation of all actors and sectors. The multiplier effect of an STI

upgrade in one sector on other sectors of the economy is infinite. STI input into agriculture for instance, in the form of better adapted and more performing equipments, seeds and techniques as well as improved post-harvest storage facilities and a more efficient transport network, would translate into healthier children with enhanced learning capacity and a more productive workforce with less work absenteeism. As well, there would be more business opportunities both upstream and downstream, generating greater employment. Foreign exchange income would increase from more value added, more diversified and more voluminous export, while on the home front fiscal earnings would be expanded from a thriving business sector and better employed workforce.

1.4 A strategic STI platform

The Government of Lesotho has made clear its commitment to development through the National Science and Technology Policy as well as its Vision 2020 and other key development strategies. Structures have been created to facilitate cross-sectoral dialogue, debate and priority setting. The policy provides for an Innovation Fund that would deliver desperately needed resources to the most industrially- and socially-relevant STI-related initiatives. A critical mass of trained STI talents would gain traction and prominence in the country, acquiring access to critical STI-related functions such as technology scanning, marketing, outreach and web development. They would be able to implement their ideas, promote their research, identify partners and develop technologies. As well, the vital linkages among themselves and with professionals/institutions outside the country would emerge robust and conducive to knowledge and technology transfer.

Lesotho's state of technological and infrastructure conditions might even make it a candidate for technology leapfrogging, a theory of development in which a country can fast-forward development by bypassing the phase of less performing and more expensive technologies and move directly to more advanced, less expensive ones. In fact, technology leapfrogging can offer Lesotho a shortcut to the frontier of technological options across its key sectors – energy, agriculture, health, information and communication technologies (ICT), transportation, education, etc.

But to employ this strategy effectively, Lesotho must urgently affix its National S&T Policy implementation process to the twin pillars of collaboration and linkage creation. The capacity to locate frontier technologies and identify the right partners in developing and adapting them is with those who connect – those institutions, scientists, technologists, engineers, entrepreneurs, innovators and planners who spin a global web of linkages to sources of finance, ideas and inputs for development and progress.

As the analysis presented in the following sections indicates, national commitment to link and collaborate is the key toward the future as conceived in Lesotho's Vision 2020. It would underpin the drive toward functional capacity, an end result of institutional

strengthening, human resources development, technology upgrading and a growing knowledge base.

The case for improved coordination and closer collaboration among the key sectors and actors is highlighted in the present review. Certain industries and sectors need to be identified as focus areas where Lesotho has or can build a comparative advantage. Initiatives and projects, whether donor-funded or privately-owned, should form part of a development strategy led by the sectors in which Lesotho can potentially become competitive. Investments in specific areas could create the necessary momentum needed to propel sectors forward to better utilize science, technology and innovation to fuel productivity gains and increase competitiveness. Lessons could be learned from how Lesotho's textile sector grew to become the largest employer from a zero base and the role played by STI factors in this growth and in the challenges the sector faces for its long-term sustainability. Sharpened focus in certain areas will also assist educational institutions to plan and build programmes to prepare an adequately trained and dynamic human resources base for these industries.

This review builds the case for the use of resources – human, institutional, functional and financial – to boldly and swiftly implement the National S&T Policy. Based on an analysis of key STI resources, the review guides policymakers, researchers, decision-makers and civil society toward a number of mechanisms that can facilitate action. Specifically, the review outlines a structure to proactively coordinate cross-sectoral dialogue, priority setting and fund allocation. This structure is centred on cross-sectoral action committees with access to critically needed resources. Establishing these mechanisms entails building capacity within the Department of Science and Technology to make available different types of STI information and services, while maintaining its role as a promoter of science, technology and innovation. The review also outlines the role of a fund that can be accessed by the researchers, innovators, entrepreneurs and problem-solvers in the country who are equipped to implement the STI projects called for by the committees.

Chapter 2. An STI Situation Analysis

“The S&T Policy must be considered the core national strategy to boost activities, to convert domestic savings into real domestic investment as well as employment, and to add local value.”

The National Science and Technology Policy 2006–2011

The Government of Lesotho has undertaken a number of initiatives to create a conducive framework wherein STI would both drive and underpin the national development process. The formulation of the National Science and Technology Policy itself consisted of a broad-based consultative process. This participatory approach not only drew the viewpoints and concerns of all stakeholders, but also instilled a sense of ownership of the country's development.

The policy represents the consensus view, reflecting the collective aspirations, values and diversity of the Basotho nation. It provides an overview of Lesotho's S&T environment, including the STI-related institutions and their personnel, as well as the challenges and opportunities facing the country. It also proposes a set of policy measures and an implementation strategy, in which four principal measures were put forward: (1) refocusing funding of the science and technology system to include research and development; (2) improving legislation, infrastructure and institutional arrangements; (3) building institutional capacities and systems to better monitor targets, performance and impact; and (4) improving coordination through clearly defined roles of relevant institutions.

The policy also identifies cross-cutting issues that affect science and technology development. These were massive brain drain, standards and quality, gender equity and emerging technologies. Furthermore, the policy calls for measures to shore up institutional capacity to better address national needs through science and technology investment, with the ultimate objective of building a national system of innovation. These measures would include the establishment of two new science and technology bodies, namely the Lesotho Advisory Commission on Science and Technology (LACST) to manage science and technology policy implementation and the Lesotho Innovation Trust Fund (LITF) to mobilize funds for R&D.

2.1 The S&T Policy instruments

In line with the recommendations of the policy, the government has moved to enact a legal instrument on new science and technology institutions. The Science and Technology Institutions Bill 2007 would establish the LACST and the LITF.

The LACST, as proposed in the National S&T Policy, would have as its overarching objective the development of a national system of innovation, with a focus on knowledge development- and innovations-related policy issues. The scope of its advice to the Minister of the MCST would cover the two sides of the science and technology development continuum, that is, requirements for the development of knowledge such as infrastructure, financial and human capital on the one hand, and the socio-economic impact of technological advancement on the other.

The commission would be equipped with sector committees on the following areas: education, culture and human rights; agriculture, land reclamation and food security; health, sanitation and population planning; environment, wildlife and tourism; meteorology; industry and commerce; water and sewage; energy; ICTs; transportation, construction and public infrastructure; indigenous knowledge systems; newly emerging technologies; and any other science and technology-related sector. The LITF, on the other hand, would receive and pay out monies on behalf of the LACST.

In addition to the policy and the legal instruments related to it, the Government of Lesotho also carried out consultations and undertook studies, including a stakeholders' workshop held in 2007 to discuss the key elements of the policy, understand the concerns and issues of economic and social actors and ensure broad commitment to the proposed implementation structures, specifically the LACST and the LITF.

At that workshop, the importance of interagency collaboration and visibility were underlined. As such, participation was clustered into six groups: government ministries, local government administrators, tertiary educational institutions, private sector and students. The recommendations of each group, while wide-ranging, were underpinned by the principles of private sector development, the cross-sectoral impact of science and technology, and the importance of education.

With regards to budgetary resources, Lesotho has set a target of 1 per cent of GDP to be spent on STI activities, which is in line with the NEPAD recommendation. This represents a tremendous increase from the 2004 R&D budget of just 0.1 per cent of GDP.⁶ The 2008/2009 budget for the MCST is M 91.1 million (approximately \$9.1 million), a 50 per cent increase from the previous fiscal year. However, even with an increased budget, the MCST would most likely still be unable to fully implement its mandate on its own. This has been provided for in the S&T Policy, which states that:

It is expected that the private sector and the donor community will assist, in cash or kind, to enable the country to achieve its national development targets. The following options have been identified as potential sources to fund the science and technology policy:

- An annual S&T grant will be provided to the innovation fund after approval by cabinet.
- Funding will be obtained from special government programmes that are required to implement S&T activities.
- Levy portion of tertiary education institution/sector government subvention for institutional S&T research.
- Toll-specific contribution from S&T-related ministries having research institutes under their portfolio.
- Obligate a percentage of S&T contracts offered by line ministries and departments to local private sector and international firms.
- Levy portion of parastatals' budget for public goods research.
- Private sector research expenditure.⁷

2.2 STI indicators

Further to its goal of building an STI-based society, the Government of Lesotho requested UNCTAD to undertake a review of its Science and Technology Policy with the view of identifying concrete steps that could be taken to translate the strategic vision expressed in its national policy into actual changes on the ground. To this end, UNCTAD fielded a team to Lesotho in order to consult with key stakeholders and observe the STI environment firsthand. Extensive use of available literature, with the S&T Policy itself as the underpinning document, was also made in order to arrive at the conclusions and recommendations. As a first step, it sought to organize its findings in order to identify the most crucial needs that must be met to move the country forward. Lesotho benefits from a number of technological, institutional, human, communication and knowledge-related assets that, if harnessed judiciously, can drive forward the aims articulated in its National S&T Policy. Box 2.1 illustrates the importance accorded in the policy to attributes that are closely identified with the information society. These elements are technology, human capital, institutions, networking and collaboration, and the knowledge base.

2.2.1 *Technology*

A recurrent issue brought up by key actors during interviews with the STIP Team was the lack of technical resources. These ranged from physical machinery in terms of insufficient or obsolete equipment, including the lack of metal and woodworking machinery to teach vocational skills, to the lack of resources to operate and maintain equipment due to inadequate skills transfer arrangements upon purchase or import, to deficient teaching basics such as classrooms, library resources and lab facilities. As well, institutions mandated to provide various STI services have been severely constrained for the same reason. A case in point is the Lesotho Meteorological Service (LMS), which has not been able to provide much needed services in flood warning and weather forecasting for lack of resources and equipment.

Box 2.1 An Overview of Lesotho's National Science and Technology Policy 2006–2011

Section 2.5 of Lesotho's National S&T Policy outlines the vision, mission and strategic objectives for developing STI in the country. As illustrated in the extracts from the S&T Policy presented below, the key pillars underpinning STI fall into the following five areas identified in the analytical framework:

T as in technology: a competitive S&T infrastructure that includes ICT infrastructure;
H as in human capital: a skilled and competent labour force with a focus on vocational and entrepreneurial training, ICT skills (and the building of an information society) and a research agenda based on the needs of users in both urban and rural environments;
I as in institutions: efficient and effective, with well-coordinated mechanisms in place that exhibit linkages to government, the private sector and citizens;
C as in communication and collaboration: increased emphasis on outreach activities to small, medium and micro enterprises (SMMEs) as well as broader S&T education;
K as in knowledge base: using Lesotho's indigenous knowledge and comparative advantages to address local market needs and to add local value.

The S&T vision: A free, prosperous and progressive economy and society sustained through intelligent use of S&T assets by progressive and innovative citizens, corporations and government.

The S&T mission: To transform Lesotho into a modern state with a highly skilled, innovative and technically trained civil service, and a competitive S&T infrastructure supporting a growing and dynamic economy.

Objectives and strategies

1. To foster a stronger S&T human resource base

Sustain relevant and accessible S&T programmes; Accord high priority to S&T education, funding and research; Appraise the education system and devise a funding scheme for S&T training and research programmes; Regularly upgrade S&T laboratory equipment and pedagogic materials.

2. To develop a culture of innovation for technological production

Promote an S&T support network for entrepreneurs and SMEs; Enhance and diversify the export base; Provide cost-effective technical support to entrepreneurs and enterprises from production to marketing stages; Set up and nurture a national S&T innovation system and network; Facilitate access to national, regional and global S&T information networks.

3. To create job opportunities and poverty reduction through the use of S&T initiatives

Build maximum synergy, cooperation and coordination between and among S&T users and R&D institutions; Undertake R&D and diffuse technologies that would improve quality of life; Ensure participation of women in S&T management, teaching, learning, R&D, etc.

4. Build a vibrant information society

Adopt a proactive approach to knowledge acquisition and information dissemination in line with the ICT policy, with a view to building a strong knowledge-driven economy.

5. Promote and commercialize indigenous knowledge systems

Safeguard the indigenous knowledge systems, and where possible, convert these to innovative products and services for both domestic and global markets.

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The lack of technologies required to enable the creation of an information society is particularly worrying. Indeed, Section 9.1 of the S&T Policy's sector strategy for ICT specifically states that:

"The pace at which Basotho absorb computer training, programming and systems literacy will determine how quickly we can engage our national capacity to use, apply and benefit from these rapidly emerging technologies. In order to catch up with our regional and international trading partners, development in ICT has to be accorded top priority with urgent financial and infrastructural implications for our schools, training and research institutions as well as for businesses and government. "

Many developing countries in Africa have targeted their efforts towards the creation of ICT access points in schools and educational institutions, as well as through public facilities such as post offices and police stations and through the creation of telecentres in underserved areas. The new Communications Policy of 2008 does provide for the creation of a Universal Service Fund and of public access points through post offices, but this has not yet become operational. Low cost technologies such as wireless networks, which are not presently allowed within the Lesotho Communications Regulatory Framework, may provide a very affordable solution to bridge the digital divide. Box 2.2 illustrates the case of Nepal, which faces similar problems in terms of high altitudes and inaccessible terrain, with scattered villages often isolated due to weather conditions and the lack of road infrastructure. ICT access remains unavailable and unaffordable for most.

Box 2.2 The Nepal Wireless Network Project

The Nepal Wireless Networking Project was initiated in 2002 to provide Internet access to remote villages in Nepal. It is operated by the Himanchal Higher Secondary School and services remote communities largely consisting of subsistence farmers. Using low cost, wireless networks with a network of base and relay stations, the project serves numerous villages that now have telephone service and access to the Internet. Telemedicine, e-learning and business services are now offered in various villages with local people employed to provide such services. The wireless linkages between health clinics and a hospital also provide much needed tele-diagnostic services.

The existing telecommunications framework in Nepal made this network illegal. However, in 2006, and by lobbying the government to liberalize the existing telecommunications policies, the Government of Nepal de-licensed the 2.4 GHz and 5.8 GHz Wifi spectrum in 2007. License fees for starting rural Internet service providers were also reduced from about \$5,000 to a nominal fee of about \$1.50/year. This has stimulated local ICT businesses in rural areas. The lobbying also resulted in the legalization of VoIP (voice over Internet protocol) calls. This has had a very significant effect on getting ICT services to rural communities at an affordable price.

Source: <http://www.nepalwireless.net/>; Mahabir Pun (2009).

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The collaboration between the Government of Lesotho/Ministry of Education and Training, and Malaysia's privately owned Limkokwing University (box 2.3) illustrates the potential of public-private partnerships in rapid planning and implementation. The strong emphasis on new and innovative courses and the benefits of providing ICT infrastructure enables both students and staff to access online resources.

Box 2.3 Public-private partnerships in acadème: the case of the Limkokwing University

The Limkokwing Institute of Creative Technology was established in response to the sixth Malaysian Plan (1991–1996), which accorded high national priority to education and identified export as the engine of economic progress. With industry requirements and global trends as its guide for evolution, it brought industry into sharper focus, particularly through the incubation of business units created by the students themselves. Limkokwing is now an international university with 10 campuses across four continents.

The Limkokwing University of Creative Technology in Maseru was established in August 2008 and presently has an enrolment of 1,066 students with 59 academic staff. The university is well resourced, with physical facilities provided by National Government of Lesotho. The Department of Manpower sponsors the university, which reports to the Council on Higher Education. The university is well equipped with ICT resources such as networked computer laboratories and a resource centre with access to online reference materials. A laptop ownership scheme has been introduced at M 50 per month/student with an onsite booth for servicing this technology. Student subsidies provided by the national government will be used to cover these costs so that students do not face financial barriers to owning a laptop. The campus will also provide access to wireless networks, allowing students to make use of the university's ICT facilities.

This is not, however, the case at the other educational institutions such as the National University of Lesotho, Lesotho College of Education or the Technical and Vocational Education and Training (TVET). There was little evidence across the board of adequate computer facilities, much less Internet access to resources for students and staff. Of particular concern was the fact that student teachers at the Lesotho College of Education acquired minimal computer literacy skills unless they were registered for computer studies. This implied that new graduates would not have the critical ICT skills to pass onto their pupils, thus resulting in another generation of children who have not been exposed to new technologies to access wider knowledge resources.

2.2.2 *Human resources*

Interviews with key MCST staff give the perception that the DST is understaffed and unable to undertake the full implementation of the policy including the critical coordination and communications role, as clearly articulated in the S&T Policy. The DST has, it should be noted, initiated a review of its staffing requirements.

Although pinpointed in the S&T Policy as a critical element, STI-related training and education facilities seemed to be inadequate. Moreover, interviews at the National University of Lesotho and with private sector firms point to a general reluctance on the part of students

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to undertake further training in science and technology. This could be explained in part by the absence of incentives, in part by the relatively higher failure rates in this field that could jeopardize their government study grant and in part by the obsolete teaching methods and materials used in the science faculties.

The National University of Lesotho no longer has post-graduate programmes. Promising students must continue their post-graduate studies in South Africa or in other countries, and many subsequently choose to pursue employment opportunities abroad. The national university is struggling to recruit and retain qualified staff and appears unable to attract funding for special research projects.

The imbalance between supply and demand for well-qualified graduates has been exacerbated by Lesotho's proximity to South Africa's larger job markets and employment opportunities. Efforts to increase and enhance the pipeline of trainable workforce should be in tandem with enhancing the absorptive capacity and employment generation within government and industry. For example, although vital for their potential contribution to such sectors as ICT, tourism and other services, students graduating from Limkokwing University with STI-related degrees are unlikely to find employment in Lesotho. A similar situation exists for engineering graduates. Were the university able to produce a larger number of graduates, there are doubts that they would find employment opportunities in the domestic market, leaving them no option but to emigrate.

The extensive investments in these students may be lost to the country unless there are concerted efforts to upscale existing internship programmes or to build capacity within local industry and government to create more employment opportunities. At the same time, an STI component could be highlighted in a general scheme to strengthen linkages with the Basotho diaspora both within the region and beyond. Access to ICTs is a key element in this drive.

Building on the 2005 ICT Policy, the S&T Policy has as one of its key objectives the building of an information society (section 2.5.2), which would drive Lesotho toward becoming a knowledge-based economy. However, in the absence of sufficient ICT infrastructure in most of Lesotho's tertiary institutions, and the extremely low availability of public ICT access points such as SchoolNets, Internet cafes or tele-centres, it will be extremely difficult to achieve any level of ICT literacy.

With limited bandwidth, the research community finds itself unable to participate in global online forums or research efforts requiring the use of reliable, affordable and available bandwidth and computing ability. The continued absence of any assistance to institutions to accelerate their access to such knowledge resources, or linkages with other international research networks such as the European Community's Géant network or South Africa's TENET network,⁸ would increase the risk of the research community becoming isolated and marginalized, even within the African continent.

Statistical databases are essential for effective planning and decision-making. They enable the pinpointing of areas of need or of potentials, as well as of trends to be corrected or promoted. Conducting a thorough analysis of Lesotho's STI capacity has been restricted by the lack of data on key institutions engaged in STI research, training and policy setting. The DST has initiated a project in collaboration with the United Nations Educational,

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Scientific and Cultural Organization (UNESCO) to establish an STI database. The availability of data on key science and technology indicators will be the basis for monitoring and evaluating future science and technology initiatives.

2.2.3 *Institutional resources*

An effective and functional structure within the MCST is critical for it to drive the recommendations of the S&T Policy. Such a structure would underpin its fundamental functions of coordination and collaboration as well as support its task of galvanizing STI resources – human, financial, institutional – for the benefit of the key sectors. Specifically, the policy document states that: “The department, which acts as a coordinating body, a focal point for government and a liaison point for various public and private S&T stakeholders, will also review, assess and monitor S&T policy issues of national interest.”⁹

Section (6) of this review provides a recommended set of mechanisms and a structure devised to facilitate and support collaboration across ministries and sectors with a view to ensuring the effective diffusion of science and technology throughout government, industry and society.

The MCST Department of Science and Technology has been mandated “to formulate and implement policies and programmes that will promote growth of science and technology and create an enabling environment in which technological development will make a meaningful contribution to a better quality of life of Basotho”.¹⁰

An important challenge for the department is to avoid becoming so enmeshed in the day-to-day management of technology-related activities that it loses sight of its fundamental role of creating an enabling environment for STI growth. For example, its involvement in the Tissue Culture Lab might be limited to that of STI coordinator rather than hands-on institution-builder.

The need to address critical issues such as health, job creation and poverty alleviation are addressed in the S&T Policy. The cross-cutting and underpinning role of science and technology in the broader development planning context has been highlighted in the policy with the following statement: “*Lesotho has a new development planning system that will implement, among other things, new policies such as Poverty Reduction Strategy Paper, programmes and projects to address the issues of sustainable development, wealth creation, poverty and disease eradication, human development, food security, environmental security, rural and social balance and gender equity.*”¹¹ There is an urgent need for a well-defined plan of action with a well-defined role for STI in this system.

Discussions with various government departments reveal a discouraging trend away from science and technology research. Due to the lack of research capacity and of management to carry out research agendas, critical activities are being decentralized. An example is the research division of the Department of Forestry: once a functioning research unit, it is no longer operational. The transfer of the Director of Research rendered the division personnel insufficient in both numbers and competence to maintain its research capacity. Interviewed sources point to the loss of research standards and with it, valuable information and statistics critical to forest management and erosion prevention. On the other hand, the Department of Forestry has been handing over the management of forests to

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resident farming communities. While this policy might relieve forestry personnel of certain maintenance tasks, R&D remains critical for safeguarding the health of the forest and guarding against soil erosion and deforestation, as well as discovering new and improved products and processes that could enhance forest-based livelihood.

Another example of an institution for which service delivery could be made more effective with better technology is the Department of Meteorology. This department is staffed with a small but committed team. Weather reports are generally relayed by radio, which is time-consuming, susceptible to human error and sensitive to weather conditions. Timely warning of inclement weather is key to saving lives and protecting property, and there have in fact been disasters that could have been prevented. Low cost ICTs could, in addition to serving as an early warning device, also function as a communication channel for isolated villages. Family-sized farms in these villages could better access farming advice as well as long-term weather forecasts.

The few large companies present in Lesotho are mostly South African subsidiaries in telecommunications (Vodacom) and banking (Standard, Nedbank, ABSA), or joint ventures with South Africa such as the Lesotho Highlands Development Authority (LHDA). Most of the technology used in these companies is imported from South Africa or sourced from Europe or the United States.

Few enterprises are in manufacturing, and the STIP Team's inquiries yield the perception that innovations and technologies are either low level or non-existent. In order to promote STI in the production sector, sustainable leadership, a broader base of potential markets and a competent workforce equipped with entrepreneurial and STI key skills are vital. Moreover, new technologies need to be introduced, maintained and continuously upgraded.

Numerous ad hoc projects, as cited by the Lesotho Chamber of Commerce, BEDCO and the SMME Network, point to an expansion of the industrial base. These include a cannery, aloe-based products, furniture manufacture, sandstone products, weaving and garment making. None, except for garment making, appear to have any significant levels of production. The success of the garment industry came about as the result of a number of influential policies and factors, such as the AGOA. However, once these agreements come to an end in 2013, there is a strong risk that the sector will collapse.

Working with multinationals is one way to upgrade the industrial base and technological capacity. Corporations usually enter the country with a ready market, immediate employment, equipment and training. If entry conditions for FDIs are right, firms could bring in more advanced technology in the form of machinery and equipment into a country, undertake skills training and establish supply linkages with local firms. Investors such as Philips have set a positive example in this area.

a. Large to small companies

The experience of countries that have successfully transitioned from a resource-based or agrarian economy to a manufacturing economy points to strong linkages for knowledge flows and technology transfer from large to small companies. At this time, given the relatively small corporate manufacturing sector and the still nascent entrepreneurial

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class, such linkages are weak or virtually non-existent in Lesotho. On the other hand, without intervention to strengthen linkages and to build a critical mass of activity, it would be hard for the SMME sector on its own to evolve to a position where it could adopt new innovations and technologies.

b. Business organizations

Feedback from the Lesotho Chamber of Commerce, the SMME Network and BEDCO indicates that few SMMEs request science and technology-related assistance. Again, a concerted effort is needed to update SMMEs on the role of science and technology in business and expansion and to set up a mechanism to capture their STI needs both present and projected. There has been interest expressed in the acquisition of ICT skills and training, but these have remained mainly unmet.

As a principal function, the Lesotho Chamber of Commerce mentions the facilitation of conflict resolution, particularly between the private sector and the government. While this undertaking could be a critical element in private sector growth and development, it could detract from its potential as a forum for innovation, advocacy and entrepreneurialism. It seems that at this time, the chamber's function as a business development forum has been relegated to the back burner in favour of dispute resolution. Further, it lacks the capacity to actively engage in technology and innovation promotions. Interviews with contacts at the chamber indicate that there have virtually been no requests in this area from its members.

Box 2.4 TEMO Holdings, an example of community ownership

There are a few private initiatives in the agricultural sector aimed at improving farming practices, upgrading the quality of livestock and enhancing sanitation practices. TEMO Holdings is an example of a private initiative, with 2,500 farmers claiming 60 per cent ownership of the company. Each farmer vested M 250 (about \$30) for their shares, a sure indication of their interest on improved farming techniques. Owing to difficulties in raising capital, only a few projects have been initiated. They have had success in small projects in animal husbandry, particularly with pigs. There are, however, very serious concerns about the way in which animals are slaughtered, the quality of livestock and hygiene conditions in dairies. These food processing shortfalls represent a serious health risk to consumers.

Mature technologies and simple practices are available, but there is no adequate mechanism to access technology and to tap knowledge sources. Also, farmers lack the capital needed to invest in more efficient farm equipment and machinery.

There are, however, other effective business organizations that have taken on the function of strengthening collaboration within industry. The non-governmental organization (NGO) Commark has been assisting the textile industry in skills transfer and upgrading the sector in anticipation of the challenges that will come with the expiry of the preferential trade agreements. Follow-up information is still to be collected regarding the success of this entity in responding to the STI-related needs of firms, entrepreneurs and others engaged in the industry but initial interviews suggest that Commark has had an excellent demonstration impact in the country. An example of a community ownership initiative in the agriculture is shown in box 2.4.

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Another agent for facilitating and underwriting growth in industry is the Lesotho National Development Corporation (LNDC). Both the LNDC and Commark have demonstrated the capacity to facilitate and underwrite industry growth in Lesotho, and are therefore well positioned to play an active role in the introduction and diffusion of new technologies and processes in Lesotho.

Table 2.1 Official development assistance for Lesotho, 2006-2008

Receipts	2006	2007	2008	TOP 10 DONORS OF GROSS ODA (2007.2008 av)	USDm
Net ODA (US\$m)	71	129	143	1. EC	22
Bilateral share (gross ODA)	53%	48%	46%	2. IDA	22
Net ODA/GNI	3.7%	6.2%	7.0%	3. Ireland	20
Net Private flows (US\$m)	-3	-9	-5	4. United States	17
<i>For reference</i>				5. Global Fund	14
Population (m)	2.0	2.0	2.0	6. AfDF	9
GNI per capital (Atlas US\$)	960	1 040	1 080	7. Japan	9
				8. United Kingdom	8
				9. Arab agencies	8
				10. Germany	7

Sources: OECD, World Bank. www.oecd.org/dac/stats

c. Official development assistance (ODA)

Donor support may have been artificially high due to the desire of the international community to assist Lesotho in reducing its dependence on South Africa during the years of apartheid. With the first democratic elections in South Africa in 1994, development assistance to Lesotho slowed to a trickle. The year 2007 saw a significant increase in ODA, as revealed in table 2.1. This surge is likely to decline, however, as the current global financial crisis will have a major impact on available aid funding to developing countries.

Of the areas that elicit donor support, STI-related activities have received relatively low support. Technical assistance in this area has been made available by UNESCO, which has been active in assisting Lesotho in articulating its science and technology policies and in conducting an STI Review in 2006.

d. Funding needs

As pointed out previously, even with increased budgetary allocation the MCST would most likely still be unable to fully implement its mandate and would have to seek supplementary funding. This entails identifying and collaborating with key stakeholders and external funding agencies, as well as with other government ministries and the private sector. This would place a heavy burden and responsibility on the DST and require a specific

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budget allocation. Box 2.5 illustrates a three-in-one funding mechanism as an example to consider.

Box 2.5 Funding mechanisms: the case of Mexico

During the 1990s, Mexico's National Council on Science and Technology (CONACYT) noted that funding mechanisms neither encouraged cross-sectoral partnership nor linked key sectors for a common support. Consequently, it introduced the *fondos sectoriales*, *fondos mixtos* and AVANCE:

Fondos sectoriales are created with matching funds from CONACYT and collaborating ministries. The funds currently in operation are SEMARNAT (environment), SAGARPA (agriculture and rural), SEMAR (marine), SEDESOL (social development), Economía (mostly for private development projects), CONAFOVI (housing), CONAFOR (forestry), Salud (health), SEP (education), SENER (energy), SCT (communications), SEGOB (government) and ASA (airports). These earmarked funds replace the science support programme that covered all research projects. Research for pure science is now supported by the SEP-CONACYT sectoral fund.; **Fondos mixtos** are joint funds with a Mexican state, instead of a ministry. Each state defines its own research priorities. Of the 32 state governments (including the Distrito Federal), 25 have already set up a fund and their first set of projects. The promptness with which the 25 *fondos* were set up attests to the growing awareness of the importance of S&T at the state level. This programme has the additional benefit of decentralizing research activities from Mexico City, specifically at the Universidad Nacional Autónoma de México (UNAM) and the Instituto Politécnico Nacional (IPN) into the different state research facilities.; and **Programa AVANCE** (Alto Valor Agregado en Negocios con Conocimiento y Empresarios) provides "last mile" financing to help move newly developed products, processes and services from the laboratory to the marketplace. This fund underwrites the engineering of products and processes, construction and testing of prototypes, and market testing. The fund also provides financial and technical support for patent registration. Lab-to-market innovations in Mexico have been very few, and this programme is aimed at creating a critical mass of successful cases. To produce a significant effect, however, a profound reform is needed to enhance research organizations' incentive to cooperate with industry.

Through these three programmes, CONACYT is able to respond to the specific needs and priorities of the sectors and the states and ultimately is able to bring science and technology into industry. They allow for the transformation of a supply-based science system into a demand-driven technology base. A World Bank assessment of these three programmes finds that "the sectoral and regional funds ... help ensure that innovation is relevant to the private and public sectors ... help users identify their research needs and create teams of evaluators who understand the needs of researchers and knowledge users". Further, it argues that: *strategically, (it) ... allocate(s) public funds on a demand-driven, decentralized basis while improving the design and implementation of the funds. Stronger incentives are needed to engage international players, bring specialized expertise in project design (the Argentina Technology Fund provides up to \$20,000 to SMEs to enhance the quality of their funding applications; the Uganda Millennium Science Initiative also includes a "Better Research" programme that sponsors proposal writing workshops), and learn from successes and failures, which implies a need for early and continuous evaluation.*

Over the medium term, these funds would be consolidated with clearly specified priorities and operating procedures. Inter-organizational and private-public projects should also be encouraged, as exemplified by Tekes, the National Innovation Agency of Finland which supports industrial projects as well as innovative projects in research institutes.

Source: Kuznetsov and Dahlman (2008). *Mexico's Transition to a Knowledge Based Economy*. World Bank.

2.2.4 Networking, collaboration and communications resources

Interviews with industry representatives, government and business support organizations indicate little evidence of technology transfer. Further, firms express only minimal expectation that science and technology can play a significant role in providing them with a competitive edge. Likewise, there is little evidence of interaction beyond that of conflict resolution and negotiation on key policy issues. An overriding comment in interviews with industry was a desire to have more interaction with government and that specific mechanisms need to be established to create a proactive and positive environment for these types of interactions to occur. The S&T Policy sector strategy on industry and commerce does reflect intent on the part of government but does not appear to have any significant perspective from an industry point of view. This points to the need to strengthen collaboration between public research and industry, particularly for a mechanism through which STI would flow in both directions.

The absence of linkages among the research community, higher education and industry perpetuates the mismatch between academic curricular and research agendas, between industry needs and technology capacity, between skills and job market requirements. A situational analysis that addressed this issue was carried out in 1999 but there has been little activity since that time. There is as yet no mechanism to ensure the relevance and effectiveness of the STI component in the education system, nor has concerted action been taken to modify the academic curricula in line with private sector needs. For example, in the ICT sector the general perception is that graduates from NUL are less market-ready than those from the Polytechnic. Unfortunately, neither institution seems to be equipping graduates with adequate and relevant skills for the workplace. This situation is symptomatic of a disconnect between supply and demand.

Research apparently is not systematically integrated into training. While there are a few exceptions such as at the Health Training Centre outside Maseru, hands-on laboratory experience or research exposure or research skills training are not part of the post-secondary coursework of STI-related curricula. The implication is that without study abroad in an institution that integrates research and training, Lesotho's science and technology graduates are ill prepared to respond to the research requirements needed to achieve the national development goals.

Consultation and communication are not new concepts. In fact, the S&T Policy itself is the product of extensive consultations and workshops with a wide range of stakeholders across many sectors. This is strongly reflected in the depth of thought and range of the sector strategies presented in chapter 3. Linkages to other ministries and sectors are well articulated. The sector strategies include options for interventions and could be used as a springboard for roadmaps on priority sectors. To this end, the DST has consulted a number of models including those of India, Jamaica, Malaysia, South Africa and the United Kingdom. The policy document provides an objective picture of the state of science and technology, and offers a comprehensive strategic framework for policy implementation.

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The consultative element in the formulation of the S&T Policy raised the levels of awareness and expectations among stakeholders in the impact of STI. But while useful for public officials familiar with technical official language, the policy as a document has not been prepared for a broader audience. An example might be taken of the Food Security Policy, which has been simplified into a pamphlet and widely distributed as part of an awareness-raising campaign.

The S&T Policy proposes an institutional framework for implementation that acknowledges the ministry's key role in communicating and/or cooperating with other ministries and institutions. The proposed structure (section 5.4) does not provide detail how this is to be achieved, however, nor does it indicate how the proposed National Centre for Innovation and Research and on how the Science and Technology Information Centre would interact with other institutions. In deciding its future course of action in this regard, examples might be taken of successful mechanisms in the region that ensure cross-ministerial dialogue. Box 2.6 on Uganda provides one such example.

Existing linkages between institutions could be strengthened to further science and technology capacity. For instance, the University of Lesotho maintains linkages with other institutions providing opportunities for collaboration on identified projects. These linkages are few, however. More collaboration is required to strengthen linkages between educational institutions and the private sector. For example, mechanisms could be created to allow large companies such as Vodacom, the LHDA and Philips – potential employers of science and technology graduates – to provide input into curriculum development and future skills needs. Closer linkages between industry, government and the university would ensure the efficient deployment of resources.

At the international and regional fronts, the MCST/DST is active in science and technology-related committees that serve to enhance collaboration and undertake networking activities. It has been an active participant in NEPAD's STI activities. Recent activities include collaboration with the Southern African Network for Biosciences (SANBio Network), out of which areas for collaboration were identified. These include aquaculture, fish biodiversity, antimicrobial bioassays for HIV/AIDS and the conservation of plant genetic research.¹² Lesotho also participates in various STI forums and ratified the NEPAD ICT Broadband Infrastructure Network for Eastern and Southern Africa.

Another regional resource for STI collaboration is the African Ministerial Conference on Science and Technology of the African Union. Lesotho actively participates in conference and recently used the forums to explore the possibility of participating in alternative energy sources exploration and development. The DST also participated in a UNESCO S&T Policy workshop in Botswana for SADC countries. Lesotho is also one of the participants in the pilot NEPAD e-schools project, in which ICTs have been introduced into schools to provide Internet access and to integrate ICTs into the teaching of curricula. The Lesotho pilot was the first of the NEPAD e-schools in southern Africa.

Box 2.6 Cross-sectoral dialogue: the case of Uganda

Despite its impressive gains toward human development and economic growth, Uganda still faces substantial challenges in food security, health, infrastructure and private sector development. In order to meet these challenges, the Government of Uganda has turned to harnessing science, technology and innovation.

A 2005 World Bank situation analysis of the STI capacity of Uganda pinpointed the lack of cross-sectoral collaboration as the principal source of lost opportunities in mitigating limited funding for research and innovation-related activities, and in overcoming cross-sectoral, institutional, bureaucratic and cultural divides among lead sectors. Through its Millennium Science Initiative (MSI), Uganda equipped its STI governance and financing system with a cross-sectoral priority setting and funding mechanism that allocates resources for research, technology development and support for policy setting, analysis, monitoring and evaluation, and other urgently needed STI activities.

The MSI is governed by an Executive Committee of the Uganda National Council on Science and Technology, a multi-sectoral entity charged with overseeing the implementation of the MSI project in accordance with project documents. The Executive Committee also provides policy guidance, based on the national Poverty Eradication Action Plan and other key national development policies wherein a number of sectoral priorities with STI inputs and outputs are defined. These include research, new technology, innovative partnerships and trained personnel. The Executive Committee also articulates the national priority and government policies in science and technology and communicates these to the other project-implementing entities.

A technical committee of distinguished scientists in key sectors – health, agriculture, engineering, social science, etc. – from both Uganda and elsewhere adjudicates the process of fund allocation through a process of merit-based, peer review. Now in its second year of implementation, the MSI selects roughly 15 highly promising research, training and institutional strengthening projects annually from 10 times as many applications. Science and technology activities being performed tie directly to the most important national development goals of the country and underpin the attainment of a number of sector strategies.

See MSI website for more detail: <http://uncst.go.ug>.

2.2.5 Knowledge resources

The S&T Policy states that one of the core S&T policy issues is to: *“Facilitate access and flow of up-to-date trade and market-related S&T information across all sectors of the economy. S&T research institutions should be a central resource for science and technology information and provide appropriate links and gateway for citizens and researchers to connect to other S&T networks and databases in the region and outside.”*¹³

In addition, the policy states that to enhance the performance of S&T investments there needs to be an instrument to: *“...operate Technical Information Systems and*

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Interactive Database[s] countrywide, disseminate and facilitate Internet and direct access to S&T Databases.”¹⁴

More specifically, it states that the following databases should be created:

- Science and technology personnel and science and technology institutional database;
- Approved and appropriate science and technology equipment, technologies, their sources, suppliers and local technical support that are of specific interest to SMEs, community and commercial farmers, and the educational, agricultural, industrial, health, metrological and environmental sectors;
- Niche markets, active traders, trading standards and entry requirements for existing and potential Lesotho products;
- Technologies for health, agricultural and agro-industrial production, water and waste management.
- Banned, abandoned, expired and doubtful technologies;
- National, regional and international science and technology and R&D institutions, R&D funding organizations, science and technology database and networks;
- Periodic publication of scientific papers, articles, journals, formation of science and technology associations, technical forums for science and technology academics, practitioners, professionals and students.¹⁵

Such a database would enable the DST to play one of its key roles, which is to monitor S&T Policy targets, performance and impact. As well, it would help it promote and disseminate information about science and technology to the R&D community or to the broader public at large. To this end, the DST has launched a project to create a national databank, but at the time of this review the Basotho R&D/ science and technology statistics are still at an early stage. UNESCO supports a project to build a database of science and technology-related information that will aid in this effort.

Research constitutes one of the most critical knowledge resources available to firms, universities, the government and institutions and yet it is neither being adequately tapped nor sufficiently prioritized. This limits its potential to contribute to the knowledge base or access and benefit from the knowledge base existing elsewhere. With few researchers, an inadequate research component within its training institutions and weak research institutions, Lesotho's capacity to seek out useful information from the mass of knowledge available at the internet, and to adapt and diffuse this information to meet national development challenges such as the MDGs is heavily undermined. This observation is consistent across sectors from agriculture and health, to the environment and industry. For example:

- In a country with less than 6 per cent arable land, soil degradation is a critical issue, yet there appears to be little data on the extent of the problem nor research to assess the major causes;

There is inadequate data on the water infrastructure in rural areas, yet the provision of clean water is a key element in improving quality of life;

There has been no environmental research as yet;

Use of alternative energy sources, particularly for higher and colder altitudes, should be promoted;

The need to create an information society has been identified as a priority, yet no research or technology scanning has been carried out to assess the availability of low cost, easy-to-maintain ICT infrastructure, an area with tremendous opportunities for leapfrogging.

Although certain target areas for the application of STI resources are identified in the policy, others are not specified adequately to orient research, training or functional capacity-building. The key sectors and lead products identified in section 1.3 (box 3) of the policy are as follows:

- Water, medicine, scents and cosmetics;
- Birds, bees, fish and game;
- Animal products – wool, mohair, meat, bones, skin;
- Fruits, roots, tree crops and horticulture;
- Tertiary manufacturing, including electronic assemblies;
- Semi-precious gems, stone works and carvings;
- Renewable energy: hydro, solar, wind and biomass;
- Traditional and indigenous technologies; and
- ICT programmes and biotechnology.

A constantly evolving knowledge base, built on indigenous wisdom and deepened with ever-unfolding intelligence garnered both at home and abroad, is a key element towards an information society.

Box 2.7 Key STI challenges and related policy options

STI components	Key challenges	Policy options
Technology	<ul style="list-style-type: none"> ▪ Lack of resources; ▪ Limited technology flow in public–private partnerships; ▪ Inadequate ICT in key institutions. 	<ul style="list-style-type: none"> » Optimize resources through resource sharing, prioritizing, etc.; » Study lessons learned from other countries and experiences.
Human capital	<ul style="list-style-type: none"> ▪ Inadequate staffing within the MCST/DST; ▪ Lack of technical training facilities; ▪ General disinterest in sciences and technology studies; ▪ Brain drain; ▪ Lack of STI database; ▪ Gender not clearly addressed in STI Policy. 	<ul style="list-style-type: none"> » Set up science and technology database; » Match skills supply to market demand; » Build a critical mass of ICT-literate teachers, researchers and graduates.
Institutions	<ul style="list-style-type: none"> ▪ Ill-defined MCST role; ▪ A development strategy with STI as the underpinning element needs to be in place; ▪ Research agenda generally too broad and no training programme for personnel in specialized but critical areas; ▪ Network of functional science and technology institutions inadequate; ▪ No technology transfer mechanism among actors and sectors; ▪ No explicit measure to build critical mass and enhance STI absorptive capacity within the private sector; ▪ Inadequate resources for STI activities such as R&D, technology scanning, outreach, training, etc. 	<ul style="list-style-type: none"> » Prioritize STI database; » Set sector-specific targets, including well-defined goals, objectives, outputs, outcomes and timelines; » Integrate “quality of life” issues such as poverty reduction and job creation; » Showcase the underpinning role of STI in the drive to national development.
Networking/collaboration	<ul style="list-style-type: none"> ▪ No tangible link between public research and private industry; ▪ Weak link between curriculum planning and industry needs. 	<ul style="list-style-type: none"> » Establish mechanisms to systematically ensure collaboration among main actors and sectors.
Knowledge base	<ul style="list-style-type: none"> ▪ STI data not yet available; ▪ Indigenous knowledge and practices need to be sufficiently documented; ▪ Research not sufficiently prioritized; ▪ No depository for knowledge that is accessible to all. 	<ul style="list-style-type: none"> » Assess STI strengths and opportunities; » Focus STI resources on areas selected on the basis of comparative advantage, urgent need, etc.; » Build research capacity; » Create knowledge partnerships at home and abroad.

2.3 Conclusions

Box 2.7 is a summary of the principal challenges that need to be surmounted in the areas of technology, human capital, institutions, networking and collaboration, as well as knowledge base, in order to create a framework that is conducive to the STI growth. It also includes options for policymakers to consider in addressing the challenges.

The key challenges could be categorized into lack of resources both human and material, and lack of linkages among the key sectors and principal actors. These issues could be addressed broadly through resource- and knowledge- sharing, as recommended in the policy options. An STI database could serve as a platform for facilitating both the coordination of projects and activities, and the collaboration of their managers.

In addition to resource sharing, the capacity for technology acquisition and for innovation would be enhanced and strengthened with an STI advisory services that would be accessible to all users from all sectors. Such a facility would also promote and foster the cross-fertilization of initiatives and ideas from the different sectors and users.

Although the role of STI in the development process is set out in the National Science and Technology Policy, there is still a need for a road map with functions such as goal setting and priority selection, monitoring and adjusting, as well as for forecasting technology needs and foreseeing STI direction.

The policy options in box 2.7 respond directly to the specific challenges identified in each of the STI components. The following chapter offers an in-depth evaluation of the STI-related challenges in the key sectors of the economy, and provides more detailed policy options for government decision-makers to consider. In the latter part of this review, a mechanism will be proposed that would address these issues in a coordinated and comprehensive method.

Chapter 3. INTEGRATING SECTORAL STRATEGIES INTO AN IMPLEMENTATION FRAMEWORK

The essential elements for building STI capacity – namely technology, human capital, institutions, networking and collaboration and the knowledge base – need to be assessed not only in terms of policy statements and dialogue as in the previous chapter, but also in terms of actual conditions and national aspirations. The analysis in this chapter seeks to evaluate the conditions and roles of these elements in the present situation of key sectors of the economy. The strengths and weaknesses of these elements are identified, and policy options are offered at the sectoral level. With a view to ensuring coherence and building collaboration among the sectors, sectors have been further grouped in accordance to the complementariness of their respective functions. The details of the “THICK” framework, by sector and by sector grouping, are set forth in annex I.

3.1 The analytical framework

Various tools enable analysts and decision-makers to examine STI capacity. Some of these focus upon the stocks and flows of knowledge, such as the Knowledge Assessment Methodology of the World Bank Institute. Others take a sectoral orientation, focusing on a particular set of key actors, such as firms, to measure how dynamic a system is in terms of knowledge production, use and distribution. An example of this is the World Economic Forum’s Global Competitiveness Index. Still others have been designed and used in developed countries, notably the National Innovation Systems approach.

A methodology has been developed recently to capture the science and technology situation of developing countries. Known as “THICK”,¹⁶ an acronym for technology, human resources, institutions, collaboration/communication, and the knowledge base, the methodology has been successfully used in analysing the STI situation and potential of Mozambique and Uganda. Because of the similarities of Lesotho’s STI-related conditions and development priorities with those of Mozambique and Uganda, this methodology has been selected as the basis for analysis in the present review.

Information from the policy document itself, supplemented with desk research and interviews with key actors, was used to construct a matrix for each of the key sectors. Entries in THICK are further categorized into strengths and weaknesses, and finally actions

for each sector are proposed. The full matrices by sector and by sectoral grouping are in annex 1. The picture that emerges from the matrix has been the basis for in-depth analysis and policy options for harnessing STI to underpin the national development objectives of increased productive capacity, trade competitiveness and poverty reduction.

Specifically, the S&T Sector Strategies proposed in the policy that correlate with each of the principal science and technology-relevant sectors were keyed into the THICK matrix. These recommended sector strategies are included under the “Suggested Actions” for the multi-sectoral cluster that includes environment. The key science and technology-relevant sectors addressed in the S&T Policy – agriculture, environment, meteorology, water, industry, telecommunications, energy, education, culture and human development, information society, and health and sanitation – were then clustered as follows:

- Agriculture, environment, meteorology and water;
- Industry, telecommunications and ICTs, and energy;
- Education, culture and human development, health and sanitation, information society.

3.2 Overview of the analysis

“Technology” encompasses technological means, such as machinery and equipment, and technological information, such as instructions and blueprints, as well as technological understanding, or know-how. From the agriculture and health sectors to the transport and telecommunications sector, the infusion of technology is inadequate. And yet, experience has shown that technological progress is a critical source of economic growth. Technological change increases the productivity of land, labour and capital, reducing costs of production and improving the quality of outputs. In Lesotho, this could occur initially through learning – that is, the acquisition, diffusion and upgrading of technologies that already exist elsewhere, rather than frontier-breaking research. Further, ICT infrastructure and Internet access, which in their present condition seriously hinder the formation of partnerships within and outside the country, could be upgraded and made more accessible for public and private users.

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. The acute shortage in Lesotho of technically trained workers able to diagnose and solve STI-related problems is pervasive in all sectors. Proactive measures are urgently needed to break the vicious cycle of an untrained, unskilled labour force and weak businesses. Ongoing initiatives to connect academic curricula with the changing needs of the job market should be supported. The brain drain problem, so common among developing countries, could be turned into “brain gain” through partnership with the Basotho diaspora and through incentives to encourage repatriation. It should be noted, however, that many of the positive brain gain effects occur only when home countries have reached a certain level

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of development and income growth. A measure that might be taken in the near term is the inclusion of a skills transfer provisions in FDI contracts.

There a number of institutions that undertake STI-related activities, including R&D. However, institutional capacity for R&D seems to be extremely limited by unskilled personnel and inadequate budget. Another factor is the absence of an institutional framework that encourages collaboration, priority setting and implementation. The costs of working in isolation from other actors in the field have yet to be assessed and addressed. At the same time, certain critical STI-related functions to promote industrial development and growth are not adequately provided for in the current institutional setting, such as those related to metrology, standards, testing and quality or technology scanning, outreach or information dissemination. Despite industry's need for better and improved technology and researchers' need for laboratory and scientific equipment, low levels of technology usage pervade both the private sector and public research facilities. This could be attributed to the absence of a service unit that would undertake critical functions.

Its compact size and the geographical concentration of its principal economic activities have not facilitated networking, communication and collaboration among stakeholders. Initiatives to promote networking and foster collaboration could be better served with an adequate ICT infrastructure as well as a clearing house facility for services and market intelligence. On the other hand, collaboration through international and regional networking seems to be functioning. Lesotho actively contributes to and fully benefits from its bilateral cooperative agreement with South Africa for the transfer of knowledge and know-how on a range of STI-related areas, for instance. At the subregional level, it is a member of SANBio.

The knowledge base is the underpinning element to STI growth. Domestic knowledge systems are important in that they enable – or constrain – the creation, accumulation, use and sharing of knowledge. It is these systems that underpin effective the effective acquisition, diffusion and improvement of imported technologies. The MCST/DST has taken steps to build a science and technology database, and national experts have been trained at NEPAD and at the UNESCO Institute for Statistics. Already, it has submitted preliminary R&D data for 2002–2004 to the regular UNESCO survey. However, the database is still a work in progress and there are still large knowledge gaps that need for be filled to allow for effective planning and business support.

These observations lead to the conclusion that the major, if not the main, role of the Department of Science and Technology is to facilitate and coordinate collaboration between stakeholders, within and across sectors, and provide information and knowledge to the right people at the right time.

3.3 Summary of analysis

There are a number of traits that run across each sector and clusters. The most significant and consistent are highlighted below:

3.3.1 *Technology*

The sectors generally considered as engines of economic growth share a common characteristic with regards to technology; they all have relatively low levels of technology usage. Except for small ad hoc projects, there is no clear indication that STI has been employed to any significant level to make an impact on any of the sectors. For example, there are a number of small initiatives in agriculture to introduce best practices through various extension and outreach initiatives sponsored by government, NGOs and the university. Despite the long-term nature of several of these programmes, few farmers adopt the technologies or practices deployed.

In spite of the overarching need to infuse industry with better technology, no institution in Lesotho is charged with and systematically undertakes the critical function of technology scanning. Projects appear to have been initiated in isolation, based on the initiatives of individuals or organizations with or without their own agendas or interests. For example, donor organizations may have a focus on a specific area of technology and seek to create a project for this purpose, but without equipping it with technology and skill transfer components nor with measures to include a wider range of beneficiaries and participants.

3.3.2 *Human resources*

Lesotho's need for STI-skilled and STI-trainable human resources to help drive the development process, whether in terms of shaping an STI-conducive policy framework or leading from within the private sector, is largely unmet. The lack of skills among Basotho workers is a problem that is repeatedly raised in the trading and manufacturing sectors.¹⁷ The framework above shows the shortage of technically trained people, partly due to the lack of educational institutions and training facilities to produce them. A vicious circle is formed with students expecting to have to look for employment outside Lesotho after graduating, grounded on the perceived incapacity of the country's public and private sectors to absorb technically trained graduates.

Moreover, the sciences and engineering fields are generally more academically demanding and therefore have a higher attrition rate than other fields of study. This is a big risk factor for students on government study grants. A proactive measure is needed to make the sciences and engineering fields a student-friendly choice. Some measures that might be considered, for instance, would be an attractive career path starting with apprenticeship programmes for senior students, study grants abroad and mentoring.

It is imperative that importation of machineries and equipment be coupled with skills training. Already in 2003, UNCTAD noted in its *Investment Policy Review of Lesotho* major deficiencies in employee training for manufacturing, with services sectors such as banks and

hotels having more extensive training programmes. It also noted the absence of institutions for skill formation in industrial activities, even while there was a dearth in skills such as machining, supervision, maintenance or marketing. Whatever training took place was essentially on-the-job, but then only enough to launch “cut make trim” operations. The review, however, pointed to the increasing awareness on the part of the investors to upgrade skills. South African firms seemed to be investing more in training workers in Lesotho than their Asian counterparts, and sending those with managerial potential among them to their headquarters for more training. At the same time, they pressed the need for policy support for worker training.

The need for upgrading the skills profile of Lesotho cannot be underestimated. The deepening of the apparel industry into textiles, a more capital-intensive and complex activity, will call for more advanced skills. The expiration of trade preferential status will only intensify this need. If the industry is to narrow its productivity gap as it diversifies its industrial base and move up the technology and quality ladder, it must have the production skills – industrial engineering, management, local design, marketing – to source its growth.

Lesotho’s Labour Code Order of 1992 regulates terms of employment and conditions and for worker health, safety and welfare. As well, the National S&T Policy addresses the issue of brain drain, stipulating that private businesses are expected to apply affirmative action wherever possible, and that Lesotho will be facilitating, training and retaining local S&T personnel. The policy also addresses gender equality and stipulates that enterprises will be encouraged to proactively facilitate women’s access and mobility into occupations requiring mathematics, natural sciences, engineering and technology management. The Ministry of Education has reviewed and started the integration of a science curriculum at the secondary and tertiary levels, even while free primary education was implemented in 2000.

3.3.3 *Institutions*

NUL’s multidisciplinary science facility provides an ideal structure for spearheading Lesotho’s science teaching and research efforts. It has reasonably equipped laboratory facilities, but science and technology personnel need to be substantially augmented if it is to effectively undertake both full-time teaching and research in an ongoing manner. Plans are being developed to launch a multidisciplinary research unit comprising intrafaculty teams in science, technology, social, political and economic sciences to integrate these two sets of research outputs.

Lerotholi Polytechnic is an autonomous institution and is a main science and technology institution with the special mandate of training and developing Lesotho’s technical, commercial and vocational skills base in technical and professional competencies. As such, its programmes have direct functionality to workplace requirements as well as for research and innovations. This requires it to work closely with industry, commerce and the government. TVET is a leading agency on technical and vocational training within the Ministry of Education. It is charged with the development of training of persons for skilled occupations to meet poverty alleviation and socio-economic development needs. A list of R&D institutes, together with their respective agenda and research outputs, is presented in box 3.1.

Box 3.1 Agenda for research-oriented science and technology institutes

R&D institutes	Primary research objectives	Specific research outputs	Main providers/supplier of R&D services
National Centre for Innovation & Research	R&D and innovation	Research, product innovation and science and technology advice	All R&D institutes receiving/using public funds
National University of Lesotho	Teaching, research, material and product development	Management and science and technology skills, technical publications and advice, laboratory support, new materials and process innovations	Science and Education Faculty, Agriculture Faculty, Social Sciences and Health
Lerotholi Polytechnic	Process and product improvement; training, extension service and technical advice	Technical and vocational skills, technical publications, outreach services and appropriate technology	Science and Engineering Schools, Agriculture, Domestic Sciences and Arts
Ministry of Agriculture	Increased on-farm productivity, better marketing facilities and higher value added output and income	New processes, new products, uses, appropriate technologies and improved farm practices	Research divisions in the ministry and all outstations and extension offices
Ministry of Education and Training	Enhanced occupational skills; business, vocational and entrepreneurial training	Effective educational policy and programmes, certification, curricula and materials, methodology	All tertiary level teaching and research institutions, technical, trades and vocational training centres
Appropriate Technology Services (ATS)	Higher rate of acquisition, use transfer and popularization of appropriate technologies for steady SME growth	Procurement, development and demonstration of appropriate technology choices, designs and prototypes. Skills upgrading and technical advice	Ministries dealing with labour and community-related activities. All ATS divisions and RIC/RDC attached
Ministry of Tourism, Culture and Environment	Management of natural and environmental resources; science and technology and environmental information	Stronger domestic linkages, value added output, more trade and market intelligence information. Daily forecasts and recording of science and technology information, environmental impact and risk assessments	All divisions and outreach offices of the ministry. All divisions dealing with environment and all meteorology divisions and outstations
Regional Innovation Centres (RIC)	Better use of local plants, materials and indigenous skills and technologies	Practical workshops, demonstration and training sessions for rural-based SMEs	All established RIC and RDC offices

Source: Lesotho Science and Technology Policy.

INTEGRATING SECTORAL STRATEGIES

The total number of articles published in Lesotho as indexed in the international database ISI between 2001 and 2007 was 75, which means an average output of only 7.5 papers per year. The only institution that produces scientific publications is the National University of Lesotho.

Institutional capacity for research and development seems to be extremely limited. Even the University of Lesotho is limited in this regard, lacking any post-graduate programmes. The bulk of NUL's research output comes from three institutes. The university's budgeted research funds, disbursed by the Research and Conferences Committee, can be accessed by any member of staff who submits a solid proposal. The fact that this fund has never been exhausted in any given year indicates that staff members are not undertaking as much research as they could.¹⁸ To encourage publishing by its staff, NUL has helped establish several journals, some of which are departmental, faculty and general university journals.

The research institutes, on the other hand, are severely handicapped from the lack of funding resources. This has translated into lack of high-level scientists and obsolete, non-functioning equipment, which render these institutions unable to perform their mandates.

3.3.4 *Networking, communication and collaboration*

Lesotho culture is endowed with the spirit of "*letsema*" – a partnership wherein every one, including the weakest in society, would benefit from a common goal. Its geographically compact size could lend easily to close networking and collaboration, such as in Switzerland. There is also the concentration of most economic activities within a small geographical area. All these factors, however, have not led to close networking, communication and collaboration among the key development actors, both public and private. There are presently a number of initiatives to promote strong ties and cooperation, but these could be better served with adequate ICT capacity and accessibility. As it is, opportunities for collaboration are still being lost because of lack of information. In the area of food security, for instance, relevant institutions could have a clearer picture of how crop production may be improved through their participation and through partnerships with the private and NGO sectors. Improving farm productivity through block farming and partnerships with the South African farmers has been considered, although there is also concern that mechanisation might impact negatively on labour in rural areas. On the other hand, collaboration through international and regional networking seems to be functioning. The countries involved in collaboration include African, Asian and European countries, and the United States. The International Scientific Networking is a pragmatic strategy for building the capacity of the LDCs such as Lesotho. The scientific network would not only strengthen technology, innovation, research and development but would enhance the timely advisory role that science has to play, as well as build the human resource base in the process of scientific and technological development.

Lesotho also has a bilateral cooperative agreement with South Africa, signed on 6 June 2005, for the transfer of knowledge and know-how on the following areas: technology business incubation of SMMEs; a National Science Centre for Promotion of Public Understanding of Science, Engineering and Technology; biotechnology for health and food security; indigenous knowledge systems and advocacy for indigenous technological

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capability; Square Kilometre Array; and tissue culture to improve potato seed and other local crops.

SANBio is one of the four regional networks in Africa. It was established with the regional hub being hosted by the Council for Scientific and Industrial Research in South Africa. The network covers 12 countries in the subregion: Angola, Botswana, Malawi, Mauritius, Mozambique, Namibia, Lesotho, Swaziland, Seychelles, South Africa, Zambia and Zimbabwe. The SANBio work programme is focussed on the following areas: plant biotechnology; livestock production; health; anthropogenic activities on freshwater ecosystems; mushroom production; indigenous knowledge systems; and enhancement of capabilities of the gene banking facilities in Southern Africa.¹⁹

3.3.5 Knowledge base

Without a benchmarking system on the development of STI, improvement on the knowledge base would be difficult to monitor and promote. To this end, the MCST/DST has taken steps to build a science and technology database, along the broad UNESCO definitions of science and technological activities. Basotho experts have also been receiving training at NEPAD and at the UNESCO Institute for Statistics workshops and seminars. Lesotho has already submitted some preliminary R&D data for 2002–2004 to the regular UNESCO survey. The database is still a work in progress.

Currently, there is no directory of scientists, technologies, institutions and projects operating in the country. Such a database would afford opportunities for collaboration and partnership, and would be instrumental in stimulating the growth of business and services. There are, for instance, many small projects underway all over Lesotho, but the absence of a directory together with limited Internet access make knowledge sharing difficult.

Knowledge gaps could also be found in the diffusion of STI into the economy and society. There does not seem to be a systematic information-gathering mechanism that would signal the needs of small fledging self-owned enterprises that do not have the capital to access high-end technology and that would have benefited from shared facilities or outsourcing. For example, small-scale but viable agro-industrial enterprises might benefit from alternative energy sources such as solar for food processing and storage. A dynamic private sector could hold the key to food security and job generation. Addressing their STI needs and facilitating technological upgrading could only be carried out effectively on the basis of a firm knowledge base.

3.4 Summary of strengths and weaknesses by sector

The sectors included in the present analysis have been selected on the basis of their actual or potential contribution to the economy (industry and agriculture), their impact on the quality of life (energy and the environment) or their importance to national security (meteorology). As in the overall analysis above, there are distinctive similarities that run

across sectors for which a response might be consolidated and coordinated to make the most impact at minimal cost.

3.4.1 Cluster 1: Agriculture, environment, meteorology and water

In agriculture, there have been a number of technologies that proved feasible in pilot projects and that have been deployed successfully by the extension programme. The diffusion of new agriculture practices and technologies will be supplemented with a new Asian Development Bank project in the near future. Capacity built on the Tissue Culture Lab's current research on potato seed could conceivably be expanded to other lines, even while the draft legislation on genetically modified organisms could represent a working platform for industry and research partnership. Opportunities upstream could be had through collaboration between the International Maize and Wheat Improvement Centre (CIMMYT) and the Centro de Investigación en Alimentación y Desarrollo (CIAD), which could open synergies in research, while midstream an expanded knowledge base could be had with a small network of research stations and substations. Downstream, a weekly radio programme has been conveying farming-related information. It should also be noted that at NUL there is a bioinformatics programme for cataloguing plant species.

However, the agriculture sector is still characterized by the pervasive use of obsolete techniques and machinery, as well as severely limited post-harvest facilities. The Department of Agriculture Research does not have the resources to fully support R&D, including the lack of a microbiology laboratory. Moreover, it is administratively separate from the extension service, which hinders coherence and synergy. The extension officers carry a triple workload: agriculture, forestry and environment, but are underpaid and out-performed by NGO-assisted farmers. As in other disciplines, the sector is seriously affected by the emigration of experienced and educated elite.

In the areas of environment, Lesotho has a unique ecology system that could be used to advantage. Although the Law on Environment has not yet been enacted, the Environment Directorate is already in operation with the Bureau of Statistics maintaining a meta-database and the Maloti Drakensberg Project documenting indigenous flora and fauna. The Steering Committee on Biosafety covers environment, agriculture and health. There is also a national spatial data infrastructure that could be used for environment, forestry, meteorology and other sectors. However, there are still knowledge gaps on critical issues such as soil degradation, for which there is no clear-cut strategy and action plan. Opportunities to collaborate with regional initiatives such as the United Nations Environment Programme database and the African Environmental Information Network have not been fully exploited.

In the field of meteorology, a satellite reception centre monitors soil degradation, flood vulnerability, agriculture and water management. Daily weather forecasts are provided to both national and international data centres. Potential areas for collaboration exist in agriculture, food safety, health, soil conservation, etc. Competence, however, is seriously compromised by insufficient programme funding, obsolete equipment and not enough personnel. This situation also undermines LMS capacity to collaborate with other departments.

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The LHWP is one of the world's largest development projects and has attracted high level of expertise in the area of water management. The Water Resources Management Policy is aimed at improving management and coordination of water resources, while the Commissioner of Water is tasked with addressing local water needs. While water is an abundant resource, there are not enough boreholes and the distribution system inadequate to meet rising water demand. There is no water system in most rural areas.

3.4.2 Cluster 2: Industry, telecommunications and energy

To strengthen industry, various measures have been taken notably by the LNDC to facilitate FDI and local investment, support links with neighbouring countries especially South Africa, and to coordinate and promote science and technology. Other agents of change are the Lesotho Chamber of Commerce and BEDCO. An example of success is the electronic firm Phillips' decision to expand its investment and to further invest in training and technology transfer. Commark also has a capacity-building project aimed at assisting nationals to rise to management positions in textile and garment factories. There is a vast potential for synergy in the work of the SMME Network, BEDCO and the Chamber of Commerce, as well as the LNDC. The latter has an extensive information base on projects, feasibility studies, contacts and current events that could be of use sector-wide.

The Philips and Commark examples are noteworthy because in general, there is little evidence of systematic skills and technology transfer from foreign firms. Local firms are small with limited capacity to purchase and use technology. There do not seem to be any significant backward or forward linkages for technological learning and innovation between the large foreign-owned corporations and the smaller local ones, nor are there any clearing house facilities on available technology and innovative processes, machinery and equipment register, or projects involving skills and technology transfer.

Telecommunications and ICTs have made great strides since the beginning of millennium, particularly in terms of mobile telephony. The government is the largest ICT purchaser and employer. There is a highly developed telecommunications infrastructure, and a Telecommunications Act was to be presented to the cabinet in 2009. There is also a Communications Policy drafted in 2009 that addresses the need for a converged regulatory regime for telecommunications, broadcasting and postal services. The MCST has been charged with taking over the government's financial management system from the Ministry of Finance, and to make recommendations for ICT investments within government.

There is, however, still a serious digital gap in terms of limited access to landlines, wireless and the Internet, with almost no reach in rural areas. The ICT skills base is not in keeping with industry needs, and there are no local training opportunities in this area. Furthermore, it seems that national ICT projects are generally uncoordinated, which makes collaboration and synergy building difficult.

Lesotho is basically energy sufficient, except in winter months when it sometimes needs to repurchase from South Africa to meet local demand for heating. Energy needs are expected to augment with increased industrialization and urbanization.

3.4.3 Cluster 3: Education and the information society

Lesotho has one of the highest literacy rates in sub-Saharan Africa. The government has continued its policy of prioritizing education with compulsory primary schooling as well as incentive programmes such as student exchange, industry internships and opening up the school system to private and foreign institutions. There are initiatives to address the skills gaps, increase computer literacy and enhance collaboration with partners abroad. There remain, however, many challenges to be met, ranging from the lack of physical equipment and capital, to lack of employment opportunities, and to lack of structure to ensure inter-ministerial collaboration on science and technology-related programming, planning and priority setting.

3.5 Summary of policy options by sector

To enhance the agriculture sector, measures such as diffusion of improved planting materials and innovative practices including post-harvest storage might be taken in addition to building research capacity for improving indigenous stocks and for biotechnology. Extension officers should be periodically trained in new techniques, perhaps with the collaboration of NGOs. Formal linkages might be forged with complementary ministries such as environment, meteorology and water.

To safeguard the environment, soil degradation needs to be monitored closely. Technologies and practices successfully used in other countries under similar circumstances should be looked into for adaptation, as well as traditional farming practices and tools to determine which are beneficial and need to be promoted, and which are harmful and need to be discarded. An Environment Policy should be formulated to officialize the need to protect and preserve flora and fauna, as well as to set up measures for mitigating the impact of climate change.

Meteorology could become even more critical as weather conditions are expected to become more unpredictable and more severe in the coming years. Facilities need to be expanded and upgraded, and meteorology's mandate broadened to service agriculture, environment and food safety.

Although water supply is not a critical issue at this time, current shortfalls in distribution could worsen if measures are not taken to improve management and monitoring, including supply levels, sanitation conditions and rural distribution.

For the industry sector to become more dynamic, there has to be a facility that would provide basic technology service such as scanning and equipment servicing. There would need to be closer public-private partnerships that would guide skills training and entrepreneurial guidance, as well as analysis of lessons from other countries. The STI component has to be explicitly included in industrial development policies. Furthermore, measures must be taken to facilitate forward and backward linkages in key sectors such as

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textiles and manufactures, and raise awareness of the need of technological upgrading, as well as encourage and stimulate innovativeness among local entrepreneurs.

Telecommunications and ICT services could be further expanded through use of low cost, wireless mesh networks in underserved areas. In tandem with aligning school curriculum to industry needs, work must also be carried out to improve public service delivery such as rural health care facilities through ICT use.

Energy is an indispensable ingredient in technological upgrading and measures should be taken to improve and expand its availability through improved expanded power grid as well as use of alternative sources such as biomass, solar and wind.

Education is the driver of the information society. Besides measures to improve formal education and technical training, including the integration of sciences and mathematics as core courses, action is needed to raise technology awareness and technical competence to acquire novel technologies. As well, indigenous and traditional technologies should be documented for scientific validation and where feasible, their use promoted, including through commercial marketing. Options for broadening ICT access in terms of affordability and geographic coverage should be considered.



Chapter 4. IMPLEMENTING THE S&T POLICY: A structural proposal

A key expected outcome that was included in the terms reference of the STIP Review Team was the drafting of a proposal for an implementation mechanism for the National Science and Technology Policy. This mechanism should encompass the Department of Science and Technology and any new bodies proposed in the policy. In previous sections of this *STIP Review*, a series of options for future action by Basotho authorities was put forward. These covered interagency coordination, reform of public science and technology institutions, training of scientists and engineers, and private sector innovation. Proposed in the present section is a structure designed to facilitate the implementation of the Science and Technology Policy, with a view to promoting the establishment and development of an effective national innovation system (NIS) in Lesotho.

There are many available definitions of the concept of the NIS. For the purposes of this STIP Review, the definition provided in Metcalfe (1995) is particularly relevant.²⁰ This refers to the NIS as:

...that set of distinct institutions which jointly and individually contributes to the development or diffusion of new technologies and which provides a framework within which governments form and implement policies to influence the innovation process. As such it is a system of interconnected institutions to create, store and transfer the knowledge and skills and artifacts which define new technologies.

The focus of the proposals is therefore on designing a STI policy implementation structure that (1) supports the generation and diffusion of knowledge on which technological development and innovation can draw and (2) includes a set of players, rules and processes that facilitate the formation and operation of collaborative efforts among the STI stakeholders to enable them address specific development problems through the application of STI. The emphasis should be on capabilities rather than resource endowments, on knowledge as a pivotal development factor and on institutions as basic sources of development. The importance of facilitating the use of local knowledge, and of adapting technologies from the technological lead countries is also recognized.

A major challenge for the Department of Science and Technology in the current institutional arrangements for STI policymaking in Lesotho is that it forms part of a ministry



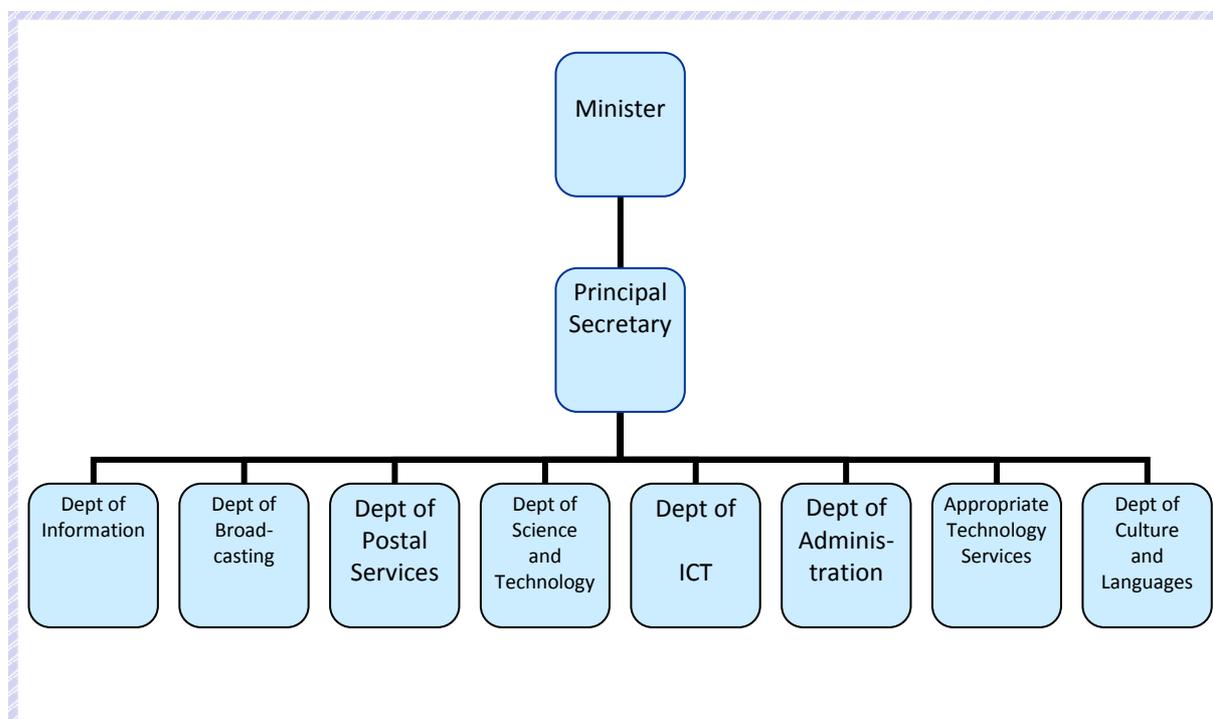
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that includes the very dominant communications sector. Science and technology are a junior entity in this ministry in terms of size, influence and priority.

Currently, the Department of Science and Technology is one of eight departments of the Ministry of Communications, Science and Technology (see figure 4.1). The other departments in the ministry are: information, broadcasting, postal services, ICT, administration, appropriate technology services, and culture and languages. Apart from the Department of Administration, the work programme of the ministry might be divided into two broad categories as its name suggests: (a) communications and (b) science and technology. The first category, communications, consists of five departments. The second, science and technology, has two: the Department of Science and Technology, and Appropriate Technology Services (ATS).

The present structure indicates that the science and technology component, consisting of the Department of Science and the ATS, is eclipsed by the communications-related category by sheer number of departments. Moreover, given the dominance of the communications sector in terms of the interest and support at the global level, the science and technology component is under a permanent threat of relegation to a weaker and secondary role.

Figure 4.1 Current structure of the Ministry of Communications, Science and Technology



The effective development of Lesotho's NIS will require a multipart structure that would facilitate the provision of advice to the government as well as an operational arm to implement initiatives and policies. The structure must be a mechanism for action, including a means of information gathering, priority setting, needs identification and facilitation of funding. This must involve a process of collaboration across sectors and institutions.

The proposal made in this report for the formation of the Ministerial Committee on Science and Technology, and the National Commission on Science and Technology (referred to as the Lesotho Advisory Commission on Science and Technology in the policy) provide the department with the means to significantly raise the profile of science and technology policymaking in terms of the country's development priorities. The chances of success of this new arrangement hinge critically on the status and capacity of the operational entities to carry out and implement the decisions made through these bodies.

4.1 Proposed science, technology and innovation governance structure

The effective implementation of the S&T Policy 2006–2011 will require a significant reinforcement of the capacity at the STI policymaking level. A first important step in this direction would be to increase the visibility of the government's commitment to improving capacity and resources for STI governance and to STI as an important element of the country's development strategy. To this end, it is proposed that the position of Principal Secretary for Science Technology and Innovation be created as soon as possible.

A short-term decision to create the post of Principal Secretary for Science Technology and Innovation within the ministry would be crucial to enable the establishment and development of the remainder elements of the NSI governance structures proposed by this *STIP Review*. The full proposed STI governance structure would therefore include the following:

- (a) STI Ministerial Council,
- (b) STI Steering Committee,
- (c) Permanent Secretary for Science, Technology and Innovation;
- (d) The STI Hub, including:

Specialist directorates/units (addressing STI needs of productive sectors, sectors covering key development priorities, indigenous knowledge systems and other technology issues);

Support directorates/units (including information services, STI promotion, applied technology services);

STI Secretariat;

- (e) The Innovation Fund.

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Two of these bodies, the Lesotho Commission on Science and Technology (whose name it is suggested to change to STI Steering Committee) and the Lesotho Innovation Trust Fund, were already recommended in chapter 4 of the National Science and Technology Policy. The newly proposed STI Ministerial Council is intended to provide guidance at the highest level of government, while the proposed STI Hub would function at the operational level as the country's main STI service provider.

The reasoning behind transforming the current structure into a higher status one with a broader capacity is to raise the profile of science and technology and to provide the newly formed STI Steering Committee with operational means. The proposed structure would provide a mechanism for action with the highest mandate possible. It would promote activities and actions at the policy level as well as facilitate project funding, initiation and implementation. With this mechanism, Lesotho will be in a position to focus efforts on critical and important STI initiatives that have impact on the national scale. Appropriate support and resources can be applied, and funding from the various role players such as development partners can be better channelled and utilized. It would replace the current ad hoc approach to STI-related projects with more sustainable and coordinated system for bringing about a greater and broader STI impact and growth to all sectors of the economy.

Figure 4.2 Proposed structure for an STI mechanism

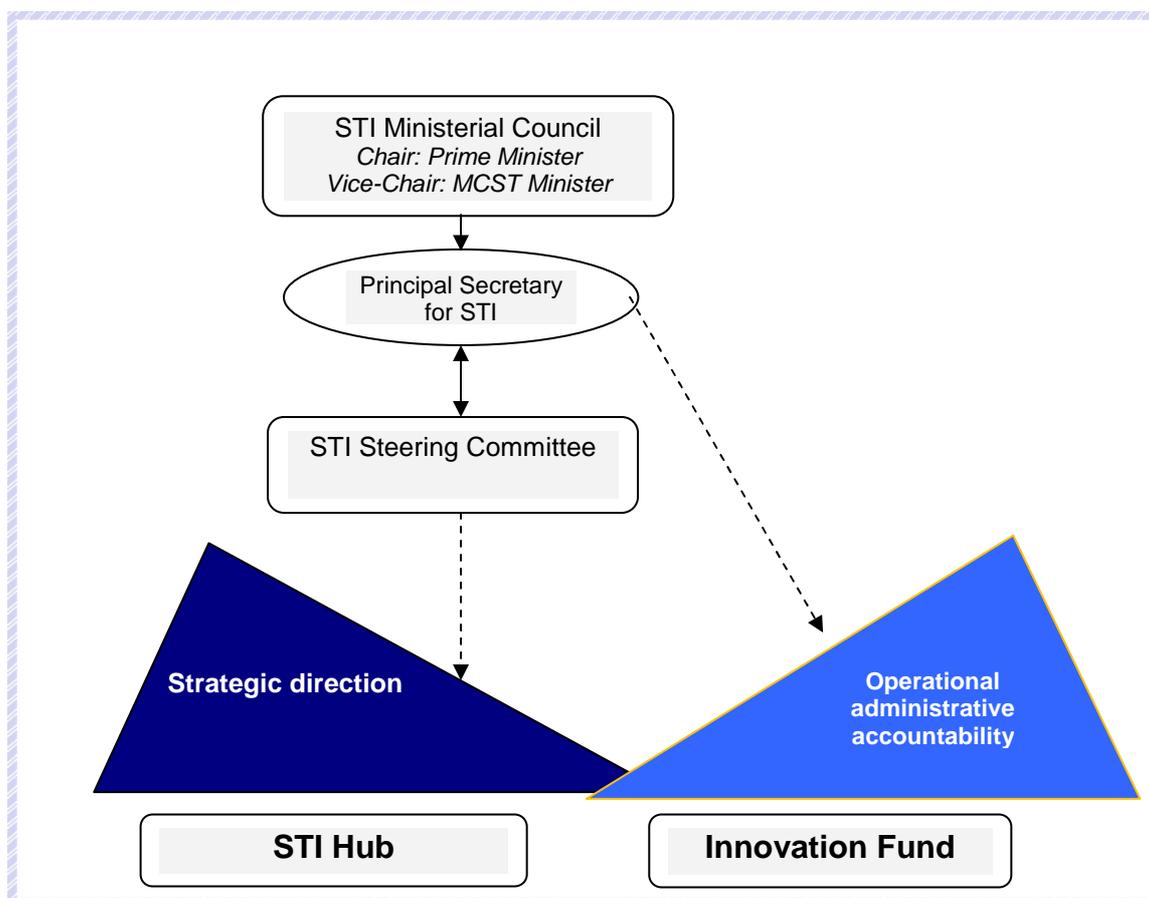


Figure 4.2 shows the operational relationship between the proposed components. Although there is a strong focus on policy advice at the commission level, the structure also provides operational capacity as well as budgetary and administrative accountability. The STI Hub and the Innovation Fund receive directives from the STI Steering Committee, but report to the Principal Secretary on administrative and budgetary matters.

It may be advantageous that in the medium term, and following a learning phase, some of these entities, in particular the Innovation Fund and the proposed secretariat of the STI Steering Committee, eventually become autonomous bodies. This step may be important to create a greater sense of ownership and participation from the wider stakeholder community in the national system of innovation, and to provide the NCST with a necessary independence

In the medium to long term, and as policy experience and capacities accumulate and demand grows for an enhanced contribution of STI policies and processes to national development strategies, the creation of a full-fledged Ministry of Science, Technology and Innovation should be considered. This could help sustain the political commitment and focus on STI policy issues. It would also be in line with a growing trend among countries in the Southern African subregion towards raising the political visibility of STI through the establishment of independent ministries and, in this regard, could facilitate Lesotho's participation in regional and subregional processes of collaboration and knowledge sharing.

4.2 The STI Ministerial Council

In order to provide a national STI governance structure with a high-level focus and mandate, it is proposed that an STI Ministerial Council be formed. The council should be chaired by the Prime Minister, with the Minister of Communications, Science and Technology as Vice-Chair, responsible for the secretariat and coordination.

Components. The council should be a subcommittee of the Cabinet. The other members of the council would be ministers whose portfolios include science and technology components, actual or potential, such as the Ministers of Trade and Industry, Education, Health, Agriculture, Natural Resources and National Treasury.

The STI Steering Committee should advise the council on substantive matters. Successful interaction with other ministers and the Cabinet will raise STI as a priority on the national agenda and ensure a front and centre place for STI in the drive for national development.

Functions. The council will meet several times per year to discuss policy related to science, technology and innovation, based primarily on advice received from the STI Steering Committee. These policies can be cross-cutting, amongst different ministers in the government. Their discussion at the committee would mitigate risks of duplication and enable the building of synergies among different sectors and related undertakings. It would also allow for a more realistic assessment of implementation challenges and their solutions.

The council can also request the STI Steering Committee to perform tasks that could benefit discussions around policy formulation in the area of science, technology and innovation.

Expected outcomes and benefits. The main benefit to be derived from the council is the mandate to promote, fund and place STI high on the agenda of every ministry and institution. It will provide a mechanism to advise the Cabinet on the formation of components and allocation of budgets.

4.3 The STI Steering Committee

According to the National Science and Technology Policy, the STI Steering Committee (referred to as the LACST in the policy) will “be an overarching, high-level STI advisory body reporting to the minister. It will manage the STI policy and innovation process, provide STI advice to government and oversee the STI policy implementation”.²¹ It would also establish and supervise the proposed Innovation Fund.

The main role of the steering committee is to provide independent advice to the Council. The role and responsibility of the Ministry of Communications, Science and Technology is to execute the government’s policies. The policy itself is typically a political decision for which the minister is politically accountable. In order to preserve its autonomy and independence, especially in its advisory role, the steering committee needs to be a legal entity with its own budget and staff, with the Ministry of Communications, Science and Technology as the accounting authority. The committee should have its own programme and should submit an annual report for Parliament.

The call for nominations to the steering committee should be officially and widely published in the national newspapers and other media. At the same time, efforts will be made to encourage high-profile leaders, whether in industry, academia or civil society, to express interest. The nominees will be vetted and final selection made by the Cabinet. Members will be appointed by the Prime Minister for an initial period of four years, renewable for a second term, for a maximum period of eight years or two terms.

The steering committee should use an evidence-based methodology in advising the council. It should hold quarterly meetings but could for operational purposes form sub (working) committees that can meet during the year.

Components. The steering committee would include:

A *chairperson*, who will provide the intellectual leadership, take ownership of the steering committee’s strategic plans and intent, and ensure that useful and timely advice is provided to the council. The chairperson, being a part-time external member, will be subjected to severe time constraints, and hence the issue of availability should be accounted for in the selection of the

chairperson. The chairperson should have direct access to the Minister of Communications, Science and Technology, and should also be a permanent invitee to the council;

Not more than 12 members (excluding the chairperson) and preferably should have adequate representation from the different sectors (business, higher education, non-profit organizations, etc.). It is recommended that the members be chosen on the basis of exceptional stature, experience and qualification, as well as their demonstrable ability to contribute and add value to the steering committee's work. It is critical that before accepting the appointment, prospective members be briefed on the expectations of their contribution. Furthermore, these members should be aware of national and international trends, events and developments in the area of science, technology and innovation;

A strong, efficient and effective secretariat. This unit will have substantial professional, technical and analysis capability. In addition to taking care of administrative aspects, the secretariat should have a strong ability to support the STI Steering Committee on technical matters of its deliberations, including policy analysis and development, management of contract research and report writing.

Functions. The steering committee would advise on:

- » National strategies for the promotion and development of STI and technology transfer;
- » Coordination and the promotion of STI activities, including the alignment of policies throughout the government impacting the science, technology and innovation environment;
- » A framework of research focus for the Innovation Fund;
- » The development of appropriate human resources for the national system of innovation to operate effectively;
- » Developments in the areas of STI that may require new legislation;
- » International liaison and cooperation;
- » The structuring and governance of the national system of innovation of Lesotho; and
- » Any other matter relating to science, technology and innovation, which the committee may refer to the council, or in respect of which the steering committee may deem necessary to advise the council.

Expected benefits. The steering committee will be constituted at a high enough level to have the necessary impact on government thinking and policy, with a direct line of communication to the line ministries and to the Office of the Prime Minister. Benefits of the steering committee would include:

- ✓ Coordination of all STI-related efforts in the country;
- ✓ Greater involvement in and ownership of STI policy by relevant sectors and stakeholders;
- ✓ Strategic orientation, coordination and rationalization for STI activities;
- ✓ Focal point for STI initiatives, partnerships and proposals from within and outside of the country; and
- ✓ Forum for cross-sectoral dialogue, such as between academia and the private sector.

4.4 The Principal Secretary for Science, Technology and Innovation

In order to initiate the establishment of the proposed STI governance structure and to oversee its functioning, the Ministry of Communications, Science and Technology would need, as a first step, an official who has both the level and the authority to take action. It is recommended therefore that the post of Principal Secretary within the Ministry of Communications, Science and Technology should be created as a matter of priority.

Under the minister, the Principal Secretary for STI will be charged with all STI-related responsibilities within the Ministry of Communications, Science and Technology. In effect this will mean that in the short term, the ministry will have two Principal Secretaries, one focusing on communications, the other focussing on STI. This newly formed position is critical in order to jumpstart the building of a national system for innovation, both within the ministry and outside, and to facilitate the necessary level of budgetary allocations. It may also be a step towards the establishment of a full-fledged Ministry of Science, Technology and Innovation should that decision emerge as necessary in the medium to long term. The Principal Secretary will be responsible and accountable for the STI Steering Committee and the Innovation Fund. S/he will also oversee the STI Hub.

In order to develop the necessary capabilities to fast track the establishment of the STI Hub specialized in supporting STI services, it is proposed that external technical assistance be provided to the principal secretary. The areas needing expertise would be operating procedures, human resource training for the specialist and support STI units, as well as in skills in facilitation, coordination, communications and information management. Further assistance would be needed in terms of full-time and ad hoc consultants, with principal functions as special advisors to the principal secretary and through training interventions.

4.5 The STI Hub

It is proposed that the current Department of Science and Technology be replaced by a STI Hub that will comprise initially a limited number of units for which the title of “directorate” is suggested. The key role of the STI Hub is to provide operational, as well as administrative/secretarial support to the STI Steering Committee and to STI stakeholders in general. The STI Hub is the main operational entity for the implementation of STI policies. It includes directorates with a specialist focus and support-orientated directorates. It is important that the configuration of the various service providers that make up the STI Hub be established in such a way (including in terms of denomination and administrative rank) that it will be attractive to highly skilled, motivated individuals whose performance potential will be key for the success of the STI Hubs.

The constituent directorates of the STI Hub should be designed and capacitated to coordinate, mobilize, inform, assist and support stakeholders in the various disciplines in taking advantage of STI opportunities. Catalysers or “cross-pollinators” are critical. The STI Hub would have a number of responsibilities, but its chief responsibility would relate to the connecting of stakeholders to the resources they need and steering the processes related to STI needs identification, partnership creation, funding and project implementation. Conceptually, the STI Hub is the focal point where individuals or groups from the sectors (be they other ministries, NGOs, firms, universities, institutes, entrepreneurs, etc.) could express their needs, present opportunities and associate with one another.

The STI Hub would take direction and guidance from the STI Steering Committee, with a view to mobilizing resources within the government and to facilitate joint STI initiatives between the government the private sector, NGOs and donors. Through its role as coordinator and facilitator, acting on the direction provided from the STI Steering Committee, the STI Hub should aim at creating a STI community in Lesotho representing a variety of distinct constituencies. These include: research institutions, producers, users, researchers, universities, NGOs, firms and many others.

Specialist directorates within the STI Hub should support focus areas of the national STI policy. These could include the STI needs of productive sectors (such as agriculture, trade and industry), those of key sectors for national development (health or education) and issues related to specific technologies (biotechnology) and/or indigenous knowledge systems. The exact number and configuration of the specialist directorates should be determined on the basis of the identified technical and managerial skills and capabilities, and levels of resources available to the STI Hub. A modest number of directorates should be envisaged at the initial stages, with the number increasing as capacity and demand for STI-specialized services grows.

A number of supporting directorates will need to be formed in order to provide support to the specialist directorates and to the STI stakeholder community as a whole. These may include directorates addressing issues such as (a) STI promotion (public information and awareness activities such as Science Week, marketing of the STI Hub’s services, etc.); (b) information services (including statistics and information for monitoring and evaluation purposes), a directorate that will service the information requests of the STI

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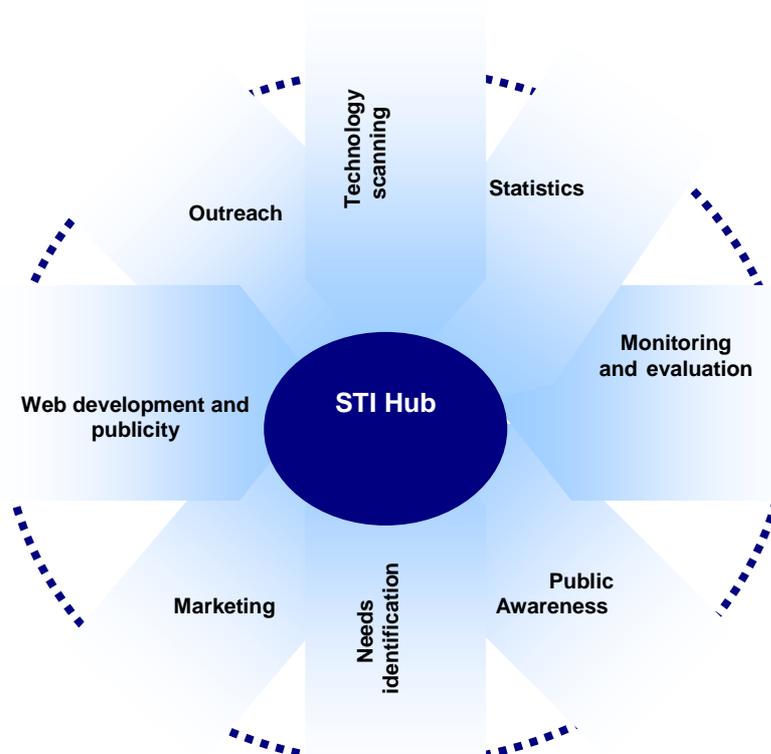
Steering Committee; and (c) the Applied Technology Services currently under the Ministry of Land Resources.

The same considerations made above about the need to start with a reasonable number of directorates and to scale up activities in a progressive manner apply to the supporting directorates.

The STI Hub would include an STI Secretariat to provide logistics, administrative support and secretariat services to the STI Steering Committee and the Innovation Fund. It would organize meetings, including drafting meeting agendas, preparing supporting documents, making logistic arrangements and issuing meeting reports. It would also assist the chairman in follow-up activities. This unit will also function as a conduit between the committee and the rest of the STI Hub, channelling all information, needs, advice, etc.

An important function of the STI Hub is that of quantifying, monitoring and evaluating the contribution of STI to the development process. This information would enable decision-makers to modify the strategy to better address emerging issues and needs, and to better exchange experiences with other countries.

Figure 4.3 Areas of impact of the STI Hub



Expected benefits. One of the key observations of the *STIP Review* has been the ad hoc and insulated character of STI initiatives, and the lack of an underpinning strategy that would coordinate these. The STI Hub will function on STI-centred collaboration, coordination and synergy. It would provide a physical space and technical support for key stakeholders to seek assistance and partnerships in overcoming STI-related obstacles. More specifically, the services provided by the STI Hub would bring about:

- ✓ Enhanced coordination of STI initiatives within and among sectors;
- ✓ Improved facility for gathering, managing and disseminating information;
- ✓ Stronger linkages among STI stakeholders;
- ✓ Tangible and responsive focal point for initiatives and propositions;
- ✓ Assistance in fund-raising for well-structured and viable STI projects.

Moreover, the STI Hub would:

- ✓ Strengthen linkages between the STI community (researchers, public research institutions, NGOs, universities, firms, etc.) and the users of new technologies, innovations and scientific knowledge (e.g., farmers, health care professionals, teachers, parents, etc.);
- ✓ Provide framework for organization and system management;
- ✓ Compile STI-related data and information, and monitor development in this area;
- ✓ Build and use to advantage an institutional memory on lessons learned in the process of shaping a dynamic national system of innovation.

Figure 4.4 shows how a specialist directorate forms linkages with stakeholders. The directorates may form task teams that might include persons/institutions external to the STI Hub. The idea of developing these linkages is to both provide a service to the stakeholders, and also to draw on information and expertise from these institutions. The directorates function as conduits for knowledge so that technology development and exchange can flourish.

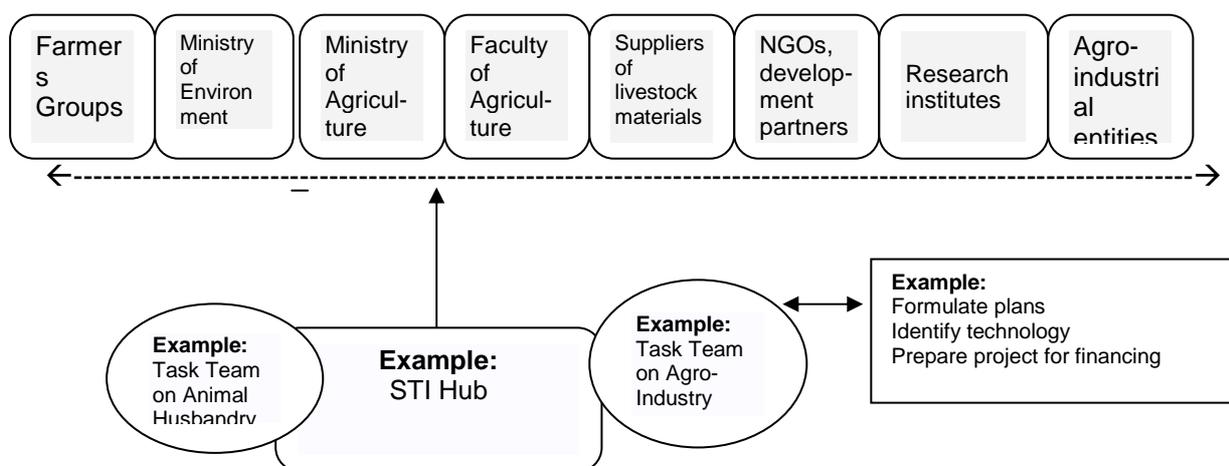
The directorate will provide the necessary venues to cater for meetings and a budget to pay consultants, procure information or fund fact-finding visits, etc. It will also assist in preparing funding proposals to the Innovation Fund. The specialist directorate leans on the support units: Information Services, STI Promotion and Applied Technology Services.

Staffing. The STI Hub directorates should be headed by “coordination and information management specialists” with expertise in their respective areas of research and technology development. Another important qualification would be their capacity to connect people, spot opportunities and link STI users to information and financial resources. For example, the head of the directorate delivering services to the agriculture sector must have

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experience and expertise in the field and must have demonstrated an aptitude for applying new technology in agriculture.

Figure 4.4 An example of the work dynamics between an STI Hub directorate and its stakeholders



Specifically, directorate heads would:

- ✓ Organize, initiate and manage gatherings of stakeholders;
- ✓ Prepare agendas and other documents for meetings;
- ✓ Identify and arrange for expert interventions as required;
- ✓ Provide support to stakeholders to establish linkages with external parties;
- ✓ Identify opportunities and resources of interest;
- ✓ Keep records of meetings and provide follow-up support;
- ✓ Assist in preparing proposals for funding and/or partnerships;
- ✓ Report relevant activities, and/or request assistance from the STI Steering Committee where and when necessary; and
- ✓ Receive directives from the STI Steering Committee.

Functions. The following is an indication of the full range of services that STI Hub directorates should be able to provide once they are fully deployed and operational. It should be expected that at their initial stages their catalogue of services would be more limited.

A specialized directorate would:

- ✓ Coordinate and integrate the activities of the various sectors to ensure synergies, effectiveness and efficiencies in STI;
- ✓ Bring together relevant stakeholders of specific sectors to collaborate such that action is prioritized over bureaucracy;
- ✓ Provide a focal point for NGOs, development partners, business sector and the government to liaise, collaborate and initiate STI-related opportunities;
- ✓ Identify needs, such as assistance in pinpointing common STI priorities among sectors or users with a view of pooling resources;
- ✓ Assist in scanning and identifying technologies to match specific needs. This expertise requires research capacity, knowledge resources, connectivity and experience;
- ✓ Promote new projects or products, ideas, partnerships, financing schemes, opportunities for collaboration and learning, etc;
- ✓ Reach out to other sectors (agriculture, health, ICT, etc.) and domains (private, public, academic, etc.), or across national boundaries to promote partnership;
- ✓ Provide statistics as basis for business decisions, policy dialogue and reform and funding requests, as well as partnership formation;
- ✓ Provide platform where researchers and inventors can promote their work to potential users and sponsors;
- ✓ Assist in the preparation of proposals/projects and in the fund-raising process.

An STI Promotion Directorate would:

- ✓ Develop and manage the STI Hub website. The website will present the hub's initiatives and services, provide online assistance and feature STI-related developments and opportunities. From web page development to online marketing, the web development and publicity functions are essential to help broadcast the accomplishments and the needs of Lesotho's STI community;
- ✓ Undertake public information drives, including Science Week and other awareness-raising activities; and

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- ✓ Promote the activities of the other directorates and the STI Steering Committee.

An Information Services Directorate would:

- ✓ Monitor and evaluate, given that the process of innovation is one based on multiple learning and feedback loops. The monitoring and evaluation function will be system-wide in that the information services directorate would be charged with measuring, tracking and documenting the progress of individual projects as well as the performance of the whole STI system. It would serve as a repository of experiences to share and learn from;
- ✓ Supervise the gathering, dissemination and promotion of STI-related information, with a view to promoting an STI culture, linkages and infrastructure; and
- ✓ Provide information and external expertise through representations, site visits and demonstrations, and create linkages between committee members and relevant institutions and other interested parties regarding STI.

An Applied Technology Services Directorate would:

- ✓ Provide technical support to SMMEs, including indigenous enterprises, and publicize appropriate technologies to the general community to address their needs;
- ✓ Research and develop appropriate technology for its identified research areas as follows: irrigation and agricultural implements; renewable energy including biomass; food technology; and product commercialization;
- ✓ Acquire, adapt and disseminate information and technologies from other research and technology organizations worldwide;
- ✓ Establish and operate a technology-based business incubation unit;
- ✓ Provide an environment for scholars to research and develop useable technologies;
- ✓ Activities of the directorate in relation to other STI directorates include:
 - *Providing advisory services on the availability and appropriateness of technologies;*
 - *Reviewing the technological aspects of funding proposals to the Innovation Fund;*

- *Developing linkages with technological institutions inside and outside of Lesotho;*
- *Assisting with technology transfers;*
- *As the directorate develops more credibility and stability, it could migrate into a separate entity and become a fully fledged research institute where its mandate could be expanded.*

The role of the STI Secretariat would include:

- ✓ Providing logistical support to the STI Steering Committee including the arranging of meetings, arranging of venues and catering;
- ✓ Assisting in gathering of supporting information, preparing members for meetings and assisting in minute-taking, dissemination of information to members and follow-up activities;
- ✓ Referring requests for assistance or information to the other directorates in the secretariat. These may include requests for information on stakeholder views, a situational analysis, opportunities, project reports, funding requests, etc;
- ✓ Assisting in the preparation of an annual report to Parliament; and
- ✓ Providing secretariat assistance to the Innovation Fund.

The activities and involvement of the STI Hub would be continually reviewed to ensure that they meet the changing needs of its stakeholders.

4.6 The Innovation Fund

The objective of the fund is to advance research and research capacity development in all fields of science, technology and innovation. Under the guidance of the STI Steering Committee, the fund would identify specific STI areas for research priority and then open a call for proposals therein. These will be reviewed and vetted by STI Hub specialist directorates and/or the Applied Technology Services Directorate (where applicable) in terms of substantive merits, technical viability and funding requirements in line with an established set of criteria designed to guide the evaluation process and ensure impartiality. A mechanism must also be set up to monitor the implementation and output of selected projects.

The goals of the Innovation Fund are pursued through:

- Investing, on a competitive basis, in knowledge and people;
- Developing research capacity to unlock the full creative potential of researchers;
- Facilitating strategic partnerships and knowledge networks;
- Promotion of business development, based on a strong technology support.

In order for the Innovation Fund to be effective, it must identify broad areas for investment. The STI Steering Committee should provide guidance in these areas. It should then operate on an open call basis and consider proposals in the identified areas.

Components. The following organizational structure is proposed:

The Innovation Fund should not be part of the STI Steering Committee. The fund is an operational activity, whereas the STI Steering Committee deals with strategic issues;

Initially, the Innovation Fund should report to the Principal Secretary for Science, Technology and Innovation, and be housed within the Ministry of Communications, Science and Technology, with a specific budget allocation;

The Innovation Fund must have an accountable officer, who will manage the budget allocation as a line item of the Ministry of Communications, Science and Technology;

As the fund develops more credibility and stability, it should migrate into a separate entity, where its mandate can be expanded;

The fund needs to identify research and development focus areas for investment;

The Innovation Fund should be marketed/communicated to its stakeholders, and should have an open call for proposals;

The specialist STI directorates and/or the Applied Technology Services Directorate (where applicable) will evaluate funding proposals and make recommendations on the technical aspects and funding requirements. The members of such a review must have the necessary technical background, research experience and credibility in the science and technology domain;

It is important that a set of criteria be established to determine successful applications/proposals; and

A mechanism must also be derived to evaluate and monitor the output of the research and technology development, once financial allocations are made.

IMPLEMENTING THE S&T POLICY

A budget of 5 million Maloti is recommended for the first year of operation of the fund. Over time, as the Innovation Fund fulfils its mandate of overseeing and promoting STI research and capacity-building, consideration might be given to its expansion and autonomy.

Chapter 5. TOWARDS A NATIONAL SYSTEM OF INNOVATION (NSI)

The mechanism proposed in chapter 4 was designed to promote the emergence of a national system of innovation that will enable the public sector to enhance service delivery and the private sector to improve products and services, as well as nurture a virtuous cycle of capacity-building and technological upgrading. The effectiveness of the proposed structure rests on a number of conditions, for which constant monitoring and management is required. The present chapter highlights the conditions, both enabling and disabling to the functioning and growth of the system, as well as the financial and management resources that would be required for its establishment and continuation.

5.1 Enabling and disabling conditions

The main sine qua non for the functioning of the STI mechanism are:

Government buy-in: The government's high-level buy-in and unequivocal support of the structure and its objectives is fundamental. The mechanism should not be perceived as being in competition with development initiatives, but rather as an underpinning element for growth and progress;

Stakeholder outreach: The mechanism, especially its STI Hub component, must be brought to the attention of STI stakeholders and potential users, including private sector firms, entrepreneurs, NGOs, business organizations such as manufacturers' associations and the SMME Support Network, universities and STI-related public institutions such as the Department of Standards and Quality Assurance. Inclusiveness is key in cross-cutting and multidisciplinary issues. Experience in countries that have successfully harnessed STI for growth and development has underlined the importance of collaboration among disciplines and sectors in bringing about a structural change;

Staff calibre: Staff must have the necessary professional qualifications and personal commitment. They must be able to respond to requests for technological advice and assistance, and to undertake services such as facilitation and coordination, meeting management, communication and strategic planning. Moreover, they must be capable of detecting opportunities and prioritizing common objectives;

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Quality of services: A corollary to staff calibre is the quality of the STI Hub services. If the STI Hub is not able to respond to requests promptly and satisfactorily, its credibility would be seriously compromised. Moreover, because the STI Hub would inevitably be perceived by the public at large as the embodiment of STI, its failure would impact the national drive for technological upgrading and innovation capacity-building. Ad hoc consultancy arrangements, such as for training needs and specialized activities like road mapping and foresight exercises, might be considered;

Adequacy of funding: Funding at an adequate level for a reasonable period of time must be secured for the mechanism, especially the STI Hub, to take root and flourish. In order to ensure government ownership and sustainability, the basic budget should be regular government allocation, which might be supplemented with other funding sources. A plan might also be in place for a fee-for-service arrangement, probably subsidized during the defined weaning period and eventually towards fully self-sufficient operation.

The action-oriented model proposed herein entails funding requirements and a radical shift in the organizational paradigm, particularly in terms of closer inter-ministerial collaboration and stronger cross-sectoral linkages. It could be argued however that, in view of increasing globalization and heavier STI investments in countries in the subregion and elsewhere, that disregarding these challenges is no longer an option. Inaction could result in:

- Continued lack of critical STI services such as technology needs identification, technology acquisition, novel product development and marketing, monitoring and evaluation. These services transform ideas into reality, and in their absence, science will remain a classroom concept, technology will remain dormant and innovation a dream;
- Lost opportunities for synergies and savings as the STI needs of the different ministries and sectors continue to be met in a piecemeal fashion. A system-wide approach, as offered in the proposed mechanism, would result in a more optimal use of human and financial resources and in a more potent multiplier impact of STI use;
- Increasing ineffective public service delivery;
- Diminishing absorptive capacity for technological learning;
- Increased marginalization in terms of production capacity, which would result in lower export competitiveness and higher import dependency.

5.2 Description of costs

The funding implications might be categorized as follow:

1. *Staffing costs.* Post of Principal Secretary; technical advisors for the first two years and as needed thereafter; STI Hub directorate staff; and office staff.

2. *Training costs.* Staff will need specialized training in research, information management, meeting management, facilitation skills, presentation skills, etc. Refresher courses might be needed periodically in order to update skills and train incoming staff

3. *Secretariat costs.* These will cover recurrent expenses such as office stationery and supplies, office computer software and hardware, communications, subscriptions, etc.

4. *Promotion and marketing.* This key function of the STI Hub requires the organization of events, participation in related fairs, outreach activities, workshops, task team servicing, etc.

5.3 Action plan

The implementation structure proposed herein would engage STI stakeholders, both at the public and private sectors, in integrating STI into the national development framework. At the heart of the strategy proposed in this report are the actors on the ground. One is a cadre of committed advocates to work with the STI Hub, mobilize stakeholders, users and resources. The motivational impact of these catalysing agents and the demonstration effect of their activities spell the difference between success and failure of STI drives, as shown in the experiences of many countries.

Another important element in the strategy is political will. Only with unambiguous support and involvement at the highest level would visibility and sustainability of the drive be ensured. This point has been proven in the case of Rwanda, where the President himself incessantly stressed the importance of science and technology as the instrument of his country's social and economic development, and spearheaded the rapid adoption of a national STI policy. A high-placed champion in government who is a confirmed believer in the role of STI in development would be needed to drive the proposed strategy.

The recommended course of action is presented below as short-, medium- and long-term action plans, and in box 5.1.

5.3.1 Immediate

The Ministry of Communications, Science and Technology would examine, adapt and present the proposal to the Cabinet. Approval by the Cabinet would lead to the formation of the following:

- (a) STI Ministerial Council;
- (b) STI Steering Committee;
- (c) Principal Secretary for Science, Technology and Innovation;
- (d) STI Hub;
- (e) The Innovation Fund.

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The groundwork for the establishment of these entities, particularly the National Council and the Innovation Fund, has already been laid in the National Science and Technology Policy 2006–2011. As emphasized above, the strategy must be driven by actors who are convinced of and believe in the promise of STI. This qualification must figure in the call for membership to the STI Steering Committee and in the recruitment to the STI Hub.

At the first meeting of the STI Steering Committee, to be held soon after its membership is formed, the STI agenda will be set and priority areas identified. Strategic inputs might also be made on the STI Hub activities.

Putting the STI Hub into operation would request an inventory of the basic STI functions that are missing in key government ministries and agencies such as technology scanning, STI-based networking, skills formation, resource sharing and general awareness of STI. Staffing at the present Department of Science and Technology would have to be reorganized in line with the new structure, which would require deployment and retraining. There would need to be a temporary placement of an expert charged with overseeing reorientation of services and staff training, even while recruitment of additional staff might be necessary.

At the same time, actions must be taken to develop a clientele for the STI Hub. Even on the basis of inclusiveness, the participation of key stakeholders might be actively encouraged in order to kick-start the facility and to build a demonstration effect. Other measures to raise awareness of the new facility might also be undertaken.

5.3.2 Medium-term plan

At this point, the STI Ministerial Council and the STI Steering Committee will be in full operation, and demand for the services of the STI Hub greater and more sophisticated. The new STI mechanism will have begun to bring about more coordinated STI-related decision-making at the policy level as well as more innovative and technologically-laden production processes at the business sector. In order to ensure that the growth is on the right track, an overall technology needs assessment must be undertaken. The services of the STI Hub might also be expanded in line with increasing, more diversified and more advanced demand from a broader range of users. This could be met through the recruitment of additional staff and/or use of services available elsewhere in the region.

It is also at this time that measures could be taken to institutionalize the other components of the STI mechanism. Greater autonomy and permanent status might be given to the Innovation Fund and the STI Steering Committee, while the Applied Technology Services Directorate might be turned into a fully fledged Applied Research Institute. Also, STI educational issues might be addressed at school and tertiary institutions with greater emphasis on teaching approaches, training of science and engineering teachers/professors, adequate equipment and supplies and appropriate curriculum.

At this stage, when the mechanism is in full operation and the results are beginning to show, steps might be taken to establish a separate Ministry for Science Technology and Innovation to ensure the continuing growth of STI contribution to the development process.

5.3.3 Long-term plan

The National System of Innovation will have been deeply entrenched in the national landscape. Its STI Ministerial Council will ensure policy coordination and coherence, its STI Steering Committee providing advice and direction and its STI Hub offering vital services to users from all sectors. Among the services that a dynamic STI Hub would be providing in the long term are scanning and technology acquisition, matching technology partners, stimulating innovation in education and business, creating opportunities for technology learning (e.g. from foreign affiliates, hands-on apprenticeship and study tours), maintaining directories (on skills, artisans, etc.) and statistical dates (for planning, benchmarking, projection purposes, etc.).

Box 5.1 STI Action Plan

Immediate	<ol style="list-style-type: none">1. Establishment of the STI Ministerial Council2. Formation of the STI Steering Committee3. Creation of post of Principal Secretary for STI4. Launching of the STI Hub5. Creation of the Innovation Fund
Medium term	<ol style="list-style-type: none">1. Technology needs assessment (and foresight exercise)2. Expansion of STI Hub services3. Permanent status of the Innovation Fund and the STI Steering Committee4. Conversion of the Applied Technology Services Directorate into a research institution5. More STI in school curricula and facilities6. Initial steps to establish separate Ministry of Science, Technology and Innovation
Long term	<ol style="list-style-type: none">1. Establishment of a Ministry of Science, Technology and Innovation2. Network of R&D institutions

The benefits of the system would have multiple spillover effects across the country. Among the measures that might be taken at this point would be the establishment of more local STI research facilities that would underpin a growing R&D capacity. They would facilitate technological acquisition and support home-grown innovations, which in turn would reinforce the national system of innovation.

5.4 Outcomes and conclusions

Provided that the structures proposed in this document are set up, the necessary financial resources obtained, required capacity built and the cooperation and collaboration of stakeholders acquired, the following outcomes may be expected.

5.4.1 Short-term objectives

A more effective, more dynamic, more responsive STI structure. The proposed structure would underpin the implementation of the STI Policy and its objectives, with the STI Hub facilitating, promoting, organizing and coordinating STI initiatives across the sectors and industries;

Improved coordination and collaboration. The proposed structure would provide a platform for coordination and collaboration among stakeholders, both from the public and private sectors as well as key development partners. It would underpin coordination between projects, enhance selection of technologies and enable savings through more effective and efficient spending. It would also foster priority-setting beyond ministerial priorities and into national needs, thereby enabling a more providing a consolidated approach and effective impact, including the formation of a critical mass of STI-oriented human capital;

An STI focal point and platform for collaboration. All stakeholders wanting to initiate, fund, implement or simply learn about projects involving STI will have a point of contact where they can interact. The STI Hub will provide the dual service of raising the visibility of STI in society and opening access to STI services and information;

STI services. Stakeholders will have access to a broad range of STI-related services, including information on technology opportunities, technology scanning, STI activities within Lesotho and the subregion, linkages with external resources, and directory of locally available experts, technologies and funding resources. It would also enable the building of an institutional memory that would guide future decision-making processes.

5.4.2 Medium-term goals

Increased awareness and demand for STI. Government services, manufacturers and entrepreneurs will become more aware of and enthusiastic about the opportunities and advantages that STI can bring. Together with the rising expectations for better product quality and improved food safety on the part of consumers, this will build the demand for the services of the STI Hub;

Monitoring mechanism for STI needs. This assessment will enable decision-makers to address the needs of various sectors as they arise in a timely and cost-effective manner, through collaboration and cooperation;

TOWARDS A NATIONAL SYSTEM OF INNOVATION

Enhanced measurement of STI performance. This information will provide the basis for decision-making and for needs forecasting. It will also allow for comparative analysis, in terms of time series or with other countries;

Stronger linkages. With the STI Hub as platform, collaboration and coordination will be facilitated among government agencies, research institutions and academia as well as the private sector;

STI-oriented human capital. Sciences and engineering subjects will be introduced early on in the education system so that more students will specialize in the field at the tertiary level;

Improved business support. Organizations such as BEDCO and the SMME Network will be able to assist their members through, for instance, enhanced capacity to recognize emerging opportunities and to diffuse new technologies and processes;

Sharpened capacity for technological learning. Firms and individuals would be better equipped and disposed to seek improved technology and processes from each other and from abroad;

Higher export revenue. This could be brought about with higher value added exports, and in line with the specifications of importing countries.

Medium-term expectations at the sectoral level

Improved practices, in farming, sanitation and hygiene, as well as better food safety, crop yields, quality of livestock and income levels;

Agro-industrial growth based on STI capacity and country-specific comparative advantage such as geographic/climatic location, which allows for the production of disease-free plants and animals;

Improved environmental management to combat soil degradation and to conserve natural resources;

Improved access to water for drinking and for farm irrigation;

Improved meteorological services to mitigate weather-related disasters and assist farmers and pastors, public health service, etc., as well as to track climate change;

A broader industrial and export base, as for example, electronic assembly is promoted due to enhanced linkages between companies such as Philips and educational institutions to ensure a steady supply of well-trained graduates.

5.4.3 Long-term expectations

Enhanced R&D capacity as a result of cross-sectoral dialogue, priority-setting and funding. Research results, novel technologies, improved services and innovation are rapidly and efficiently absorbed and assimilated by institutions, firms and other productive entities;

A critical mass of skilled STI human resources emerges capable of producing local technologies and innovations and of acquiring and adapting imported ones, as needed to fuel and sustain national development;

A virtuous cycle of STI capacity and development emerges as technologies and innovations take root and flourish at the national level. Commercialization and international dissemination of “made in Lesotho” technologies and innovations will raise the profile of Lesotho in the STI field, and elicit the interest of new partners and investors.

Annex I. THICK tables and definition of components

RESOURCES FOR INNOVATION		FUNCTIONS REQUIRED FOR SUCCESSFUL IMPLEMENTATION
T	Technology	Locally available and in actual use
		Transfer opportunities
		Adequate infrastructure
H	Human resources	Scientists and engineers
		Technical workers
		Technical training opportunities
		University students in S&T fields
		Management and entrepreneurship training
I	Institutional	S&T ministry and departments
		Standards-setting bodies
		Meteorology testing centre
		Educational and training facilities
		R&D institutions
		Incubators and/or science parks
		Extension services
		Financial institutions/risk capital
		Donor/partnership network
C	Collaboration and Networking	Professional societies
		Producer associations
		Conferences/demonstration/hands-on learning opportunities
		ICT access and online technical resources
K	Knowledge	Technical data and reports
		Research funds
		Laws and policies
		Indigenous knowledge

AGRICULTURE					
	Technology Resources	Human Resources	Institutional Capability	Collaboration/Networking	Knowledge Base
Strengths	<ul style="list-style-type: none"> • Technologies proven feasible in pilot projects; • Successful technology deployment by Ministry of Agriculture; • New Asian Development Bank project to facilitate tech. dissemination; SABO-NET, a bio-informatics project at NUL. 	<p>A cadre of extension officers serving the agricultural sector.</p>	<ul style="list-style-type: none"> • Draft legislation on GMOs: a platform for partnership with industry and research; • The Tissue Culture Lab could be useful for other lines of research outside of potato seed; Access to South African labs for fertilizers, etc., to bridge domestic shortfalls. 	<ul style="list-style-type: none"> • Extension corps the focal point among stakeholders; • A weekly radio programme on farming-related issues including new techniques, etc.; • Collaboration with CIMMYT and CIAD opens research opportunities and improves synergies. 	<ul style="list-style-type: none"> • A small network of research stations and substations offers potential for expanded knowledge base; The extension services corps and the faculty of Agriculture/NUL..
Weaknesses	<ul style="list-style-type: none"> • Predominantly small-scale; • Obsolete techniques and machineries; • Limited post-harvest technology and facilities. 	<ul style="list-style-type: none"> • Agriculture extension officers multi-tasking with forestry and environment work; • Underpaid, over-worked and often outperformed by NGO-assisted farmers; • PhD-level agricultural scientists emigrating outside; • Most incoming agriculture researchers have limited work experience. 	<ul style="list-style-type: none"> • Department of Agriculture Research does not have adequate resources; • 2/3 of dept budget for payroll, little left for research or technology upgrade; • No up-to-date strategic planning for sector; • Separate divisions for research and for extension hinders integration and synergy. 	<ul style="list-style-type: none"> • Add-on environment and forestry tasks to extension services, but no apparent programme to coordinate or collaborate; • Weak links between research and extension officers. 	<ul style="list-style-type: none"> • Local research activities are often weakly focused and poorly funded; • Lack of a microbiology lab for product testing.

AGRICULTURE					
	Technology Resources	Human Resources	Institutional Capability	Collaboration/Networking	Knowledge Base
A C T I O N S t o C O N S I D E R	<ul style="list-style-type: none"> • Identify viable and useful technologies and best practices; • Acquire, adapt and disseminate technologies and techniques for commercial, community, family farming; • Build research capacity for biotechnology; • Determine merits of indigenous plant stock; • Explore options for genetic resources, materials, and germplasm; • Address post-harvest issues like storage and agro-processing; • Promote technologies that add value and shelf life to agricultural products. 	<ul style="list-style-type: none"> • Enhance number and capacity of extension corps to diffuse new technologies and practices in agriculture, forestry and environment. 	<ul style="list-style-type: none"> • Create an ongoing programme for skills enhancement and technology development for extension officers; • Identify activities that can best be outsourced to NGOs and private firms; • Promote and strengthen agricultural research facilities; • Encourage staff mobility; • Promote technical and managerial competencies to extend advisory services to family, communities and commercial farms. 	<ul style="list-style-type: none"> • Provide technical support, incentives and advice on environmentally sound and effective farming practices, on management techniques and internal standards of compliance; • Create formal linkages among agriculture, environment, meteorology and water through a Science and Technology Action Committee; 	<ul style="list-style-type: none"> • Promote and manage the flow of knowledge and information between the Department of Agriculture Research, NUL and other partners; • Set up knowledge repository for stakeholders to assess current activities, outputs, technologies and challenges.

ENVIRONMENT					
	Technology Resources	Human Resources	Institutional Capability	Collaboration/ Networking	Knowledge Base
S t r e n g t h s	<ul style="list-style-type: none"> • Unique geography and landmass could be an advantage; Existing national Spatial Data Infrastructure could be used for environment, forestry, meteorology, and other sectors. 	<p>26-strong staff at the Environment Directorate, most in the Environmental Planning Unit.</p>	<p>Law on Environment exists, although not been enacted.</p>	<ul style="list-style-type: none"> • With Bureau of Statistics to maintain a meta-database; • Committee on environmental data management; Steering Committee on Biosafety incl. environment, agriculture and health; 	<p>The Maloti Drakensberg Project documents indigenous flora and fauna.</p>
W e a k n e s s e s	<ul style="list-style-type: none"> • No clear-cut strategy and action to address soil degradation. 	<p>Not enough adequately trained personnel to perform certain functions such as air quality testing.</p>	<p>Need for a comprehensive strategy that includes all environment-related entities</p>	<p>Opportunities to collaborate with various regional initiatives not fully exploited, e.g. UNEP database and the African Environmental Information Network.</p>	<ul style="list-style-type: none"> • Limited knowledge and data on important issues such as soil degradation; No research on the environment.
A c t i o n s t o c o n s i d e r	<ul style="list-style-type: none"> • Set up database to monitor soil quality; • Draw a soil conservation strategy; • Scan for tried-and-proven technologies and practices; • Promote indigenous technologies and knowledge systems. 	<ul style="list-style-type: none"> • Promote soil conservation awareness at the community level. 	<ul style="list-style-type: none"> • Enact a comprehensive environmental policy; 	<ul style="list-style-type: none"> • Adopt laws to protect and preserve fauna and flora; • Participate actively in regional and international forums. 	<ul style="list-style-type: none"> • Devise mechanisms to better monitor soil degradation; • Undertake research in areas such as biodiversity, CFC reduction, environmental impact, conservation.

METEOROLOGY					
	Technology Resources	Human Resources	Institutional Capability	Collaboration/ Networking	Knowledge Base
S t r e n g t h s	<ul style="list-style-type: none"> • A satellite reception centre to monitor soil conservation, flood prevention, agriculture and water management. 	<ul style="list-style-type: none"> • Small, well-qualified and dedicated team. 	<ul style="list-style-type: none"> • LMS provides daily forecasts at the national level and shares data with the international data centre. 	<ul style="list-style-type: none"> • Room for collaboration with various parties in agriculture, food safety, health, soil conservation, etc. 	<ul style="list-style-type: none"> • Data on weather conditions, rainfall, temperatures, etc.
W e a k n e s s	<ul style="list-style-type: none"> • Very few automated weather stations, inadequate equipment and technologies. 	<ul style="list-style-type: none"> • LMS severely under-staffed. 	<ul style="list-style-type: none"> • Competence compromised by insufficient funding, obsolete equipment and not enough personnel. 	<ul style="list-style-type: none"> • Limited capacity and equipment hinder LMS communication and collaboration with other departments. 	<ul style="list-style-type: none"> • Knowledge and use of equipment limited to certain level staff; Instruments read manually leading to more chances of error and faulty reporting.
A C T I O N S T O C O N S I D E R	<ul style="list-style-type: none"> • Improve meteorological facilities in key areas and regions; Provide research assistance and S&T information to the various Ministry of Education and Training services facilities. 	<ul style="list-style-type: none"> • Allocate more personnel and equipment to the LMS; • Provide continuous training of technical personnel. 	<ul style="list-style-type: none"> • Provide the LMS with a broader mandate to service agriculture, environment and food safety. 	<ul style="list-style-type: none"> • Provide LMS with automated weather stations; • Plan for more diversified use of LMS facilities to collect data on other sectors. 	<ul style="list-style-type: none"> • Establish an information database to help identify trends, forecast crops, farm activity planning, flood and snow risks, etc.

WATER					
	Technology Resources	Human Resources	Institutional Capability	Collaboration/ Networking	Knowledge Base
S t r e n g t h s	<ul style="list-style-type: none"> • The LHWP, one of the largest development projects in the world in the 1980s. 	<ul style="list-style-type: none"> • High level of expertise exists at the LHWP. 	<ul style="list-style-type: none"> • The LHWA manages the Highlands Water Scheme; • The Commissioner of Water tasked to address local water needs; • Water Resources Management Policy aimed at improving management and coordination of water resources. 	<ul style="list-style-type: none"> • Potential collaboration with COW; • A Directorate of Water being planned to coordinate water sector. 	<ul style="list-style-type: none"> • An integrated water sector management information system (LWSHMIS) with the U. of Kwazulu Natal, So. Africa; • Linked via a VSAT network, with remote monitoring through the Netherlands in collaboration with Comnet Lesotho.
W e a k n e s s	<ul style="list-style-type: none"> • Inadequate distribution system, insufficient boreholes; • No water system in most rural areas; • Uncoordinated approach to sanitation. 	<ul style="list-style-type: none"> • LWHS well funded but downstream agencies do not have resources to implement. 	<ul style="list-style-type: none"> • COW appears under-resourced; 	<ul style="list-style-type: none"> • Need for a comprehensive water-management strategy. 	Limited knowledge of the state of water infrastructure in rural areas.
A C T N S t O C O N S I D E R	<ul style="list-style-type: none"> • Build and maintain reservoirs in rural areas; • Research applied technologies in water capture and management. 	<ul style="list-style-type: none"> • Provide training in water management, including reservoirs monitoring. 	<ul style="list-style-type: none"> • Provide the Commission of Water with the necessary resources to carry out its mandate. 		Gather information on water supply levels, sanitation conditions and rural water; this could be linked to the setting up of rural wireless networks.

INDUSTRY					
	Technology Resources	Human Resources	Institutional Capability	Collaboration/Networking	Knowledge Base
Strengths	<ul style="list-style-type: none"> • The LNDC is actively promoting Lesotho as an investment destination for electronic assembly; • Philips has to expand its present investment; • The textile and garment sector, the largest industrial employer, mostly foreign owned and imported capital equipment. 	<ul style="list-style-type: none"> • Philips to further invest in labour force through training cum technology transfer; • Commark's capacity building project to assist Basothos to mid-level management positions in textile and garment factories. 	<ul style="list-style-type: none"> • LNDC effective in facilitating FDI and local investment, actively promotes S&T; • "One-stop shop" has reduced paperwork to start a business from three to one month; • The Lesotho Chamber of Commerce could also help build business interest in S&T; • BEDCO has incubation facilities. 	<ul style="list-style-type: none"> • Potential for synergy in the work of the SMME network, BEDCO, the Lesotho Chamber and the LNDC. 	<ul style="list-style-type: none"> • The LNDC has extensive information base on projects, feasibility studies, contacts and current activities.
Weaknesses	<ul style="list-style-type: none"> • FDI-dominated with little evidence of systematic skills and technology transfer; • Local capacity to purchase/use technology is limited. 	<ul style="list-style-type: none"> • Limited career prospects for local staff; Technical labour pool is small, hampering the companies' capacity to operate and maintain machinery and equipment.. 	<ul style="list-style-type: none"> • Most of the large industries are foreign-owned and in the service sector, e.g., the banking sector, business associations are not geared toward the promotion of S&T. 	<ul style="list-style-type: none"> • Limited linkages with other sectors (i.e. educational institutions) around science and technology; No backward/forward linkages between large corporations and smaller ones for technological learning and innovation. 	<ul style="list-style-type: none"> • No clearinghouse facilities on available technology and innovation, machinery and equipment register, or projects involving technology transfer.

INDUSTRY					
	Technology Resources	Human Resources	Institutional Capability	Collaboration/ Networking	Knowledge Base
A C T I O N S t o C O N S I D E R	<ul style="list-style-type: none"> • Build technology scanning facility to better access new technologies, improved processes. 	<p>Establish public–private partnerships to guide training that should cover a wide range of areas, from management to technical formation to operate and maintain equipment.</p>	<ul style="list-style-type: none"> • Integrate science and technology component into industrial development policies; Analyse public–private partnerships to identify success factors that could be replicated elsewhere. 	<ul style="list-style-type: none"> • Facilitate forward and backward linkages in key sectors; • Identify priority areas jointly (government and industry) and form a corresponding labour force; • Raise awareness of advantages from e.g. technology scanning, new business ideas, improved equipment and processes, and innovative technologies; Encourage and stimulate local entrepreneurship, particularly for women and rural communities. 	<p>Develop intellectual property rights and systems for patent and quality. This is important when developing and commercializing indigenous knowledge and community-based knowledge systems.</p>

ICT AND TELECOMMUNICATIONS					
	Technology Resources	Human Resources	Institutional Capability	Collaboration/ Networking	Knowledge Base
S t r e n g t h s	<ul style="list-style-type: none"> • The government is the largest purchaser of ICT equipment; • ICT access improving, particularly mobile telephones; • Broadband available but usage is still low; • The Lesotho Communications Authority work with EASSY cable project to lower costs and improve connectivity; • Most government offices equipped with computers. 	<ul style="list-style-type: none"> • The government is the largest ICT employer; • NUL produces ICT graduates who often opt to go abroad to seek employment. 	<ul style="list-style-type: none"> • There are two mobile operators, one national operator; • Privatization underway; • A Communications Policy drafted in 2008, on need for comprehensive regime for telecom, broadcasting and postal services; • A Telecommunications Act to be presented to cabinet in 2009; • An independent telecommunications regulator in place. 	<ul style="list-style-type: none"> • MCST has mandate to coordinate the MIS project, taking over from the Ministry of Finance; MCST charged with making recommendations for ICT investments within the government. 	<ul style="list-style-type: none"> • Control over IFMIS has been turned over to the MCST from the Ministry of Finance; Substantive financial assistance with service management specialists over a five-year period.
W e a k n e s s e s	<ul style="list-style-type: none"> • Lack of competition; • Limited access to fixed, wireless and Internet, with almost no access in rural areas; • High cost of telecoms against low GDP per capita. 	<ul style="list-style-type: none"> • The ICT skills base not in keeping with industry needs; • No telecoms training available in Lesotho, students need to go abroad; • Tight job market for new graduates; • A lack of absorptive capacity within the country; • Generally insufficient ICT skills in government. 	<ul style="list-style-type: none"> • Present budget has no separate line item for ICT purchasing. 	<ul style="list-style-type: none"> • National ICT projects generally uncoordinated, making collaboration across sectors difficult; • Not enough government–industry dialogue nor mechanisms for government–private sector linkages. 	<ul style="list-style-type: none"> • No existing inventory of available ICT infrastructure within the government.

ICT AND TELECOMMUNICATIONS					
	Technology Resources	Human Resources	Institutional Capability	Collaboration/ Networking	Knowledge Base
A C T I O N S t o C O N S I D E R	<ul style="list-style-type: none"> • Equip key facilities such as health centres, post offices, police stations and schools; • Explore use of low-cost, rural wireless mesh networks in underserved areas; • Look into alternative energy sources for more remote areas not on the electricity grid. 	<ul style="list-style-type: none"> • Develop ICT curricula jointly among NUL, government and industry; • Adopt retention strategies to attract ICT students from NUL, Limkokwing University, TVET institutions and other higher education institutions. 	<ul style="list-style-type: none"> • Improve ICT access, particularly in smaller centres and at local government offices. This will assist in providing better services to citizens; A separate budget line item is required for ICT infrastructure. 	<ul style="list-style-type: none"> • Work with NUL for an effective curricula; • Bridge the digital divide through inter-ministerial collaboration ; • MCST to coordinate ICT matters to ensure optimal use of limited resources; this applies to ministries as well as educational and research institutions; Ensure coherence among ICT policy directives, the science and technology policy, and other sectors, such as agriculture, water, health, tourism, industry and commerce. 	<ul style="list-style-type: none"> • Set up an inventory system to assess the ICT infrastructure within the government.

ENERGY					
	Technology Resources	Human Resources	Institutional Capability	Collaboration/ Networking	Knowledge Base
S t r e n g t h s	Lesotho is basically energy sufficient.				
W e a k n e s s e s	<ul style="list-style-type: none"> • During the winter months, Lesotho cannot meet local peak demand for energy and has to repurchase it from South Africa. 				
A C T I O N S t o C O N S I D E R	<ul style="list-style-type: none"> • Study feasibility of alternative energy sources such as solar and wind energy; • Improve and expand the power grid, including the use of alternative sources. 	<ul style="list-style-type: none"> • Set up training for maintenance and management of viable alternative energy sources, especially for rural isolated areas. 	<ul style="list-style-type: none"> • The sector strategy recommends commitment to power sector reforms. 	<ul style="list-style-type: none"> • Undertake a broad information campaign on energy-related topics such as more affordable energy options, thermal insulation and construction materials, energy efficiency, biomass, etc. 	<ul style="list-style-type: none"> • Prioritize dissemination of information on alternative energy sources for rural areas; • Explore use of mobile technologies in public awareness campaigns; • Collect data on biomass availability and potentials for use.

EDUCATION AND THE INFORMATION SOCIETY					
	Technology Resources	Human Resources	Institutional Capability	Collaboration/ Networking	Knowledge Base
S t r e n g t h s	<ul style="list-style-type: none"> • Acquisition of 80 computers for ICT skills training centers; • Vodacom donation of 300 computers to NUL, 40 with free Internet access; • Each Limkokwing U student equipped with a laptop; • NUL engineering faculty requires apprenticeship in industry. 	<ul style="list-style-type: none"> • One of highest literacy rates in the SSA; • Student exchange programmes at LCE; • Internships e.g., one year at Vodacom, LHDA; • Government commitment to promote entrepreneurship; • Emergence of private tertiary education institutions offering business-oriented curricula.; • The “global professoriate” model used at Limkokwing University enables faculty retention and skills upgrading; • Free tuition at MA/MSc level to encourage higher education; • Postgraduate STI programs in southern Africa region that could be tapped; 	<ul style="list-style-type: none"> • TVET draft policy of closer alliance with industry as in “Sector Skills Committees” to address the skills gaps; • The matching grants facility to scale up skills training to meet industry needs; • Commark program on textile sector; • Two nursing schools; • The Health training college to introduce a research unit and ICT use in service delivery; • Proposed African Quality Rating Mechanism and strategy for harmonization; • The Lesotho College of Education to set up a Science Education Center; • The Universal Service Fund established to enhance ICT access in rural areas. 	<ul style="list-style-type: none"> • Proposed NEPAD platform for STI collaboration; • Southern African Regional Universities Association to promote system articulation and student mobility among member countries; • The AU has chosen tertiary education as priority for its 2nd Decade of Education for Africa (2006-2015); • NUL to collaborate with institutions abroad e.g. with Brazil on joint R&D; • a Scottish University on health education; • The arrangements for training Lesotho MDs in South Africa and Nigeria, offset lack of a medical school; • Integrated industrial attachment and overseas study as part of student training at Limkokwing leads to cross-sectoral collaboration. 	<ul style="list-style-type: none"> • UNESCO database of information on STI

<p>W E a k n e s s e s</p>	<ul style="list-style-type: none"> • Equipment at the Lesotho College of Education inadequate for technical training; • ICT facilities obsolete and/or too few; • No systematic technology scanning by any one institution; • Technologies for deploying telemedicine units still not available; • No interest/support for investment in health technologies; • Massive emigration of trained health workers; • No functional computer network at NUL, leading to lost opportunities for external collaboration and virtual learning; • No computer access to non-computer science students at the Lesotho College of Education, so teachers are generally not computer literate; • Too few Internet cafés and like facilities to broaden access; • Few schools have ICT access; • Absence of tele-centre facilities. 	<ul style="list-style-type: none"> • Few students major in sciences due to higher probability of failure which leads to loss of study grants; • Too few lecturers on science and computer skills at the LCE; • Graduates perceived as requiring skills upgrading in S&T key skills, a serious deterrent for would-be employers; • No effective mechanism for matching curricula to changing job market; • Percentage of tertiary level S&T students only half of regional average of 31 %; • Education not cost-competitive: \$7,742 per student is over 50% more than the regional average; • Research not integral part of graduate work; • Emigration of professionals and educated; • Too few PhD-level full professors in the tertiary education system; • Staff to student ratio (1:50) at NUL too high for effective mentoring. 	<ul style="list-style-type: none"> • No systematic matching of curriculum to changing job market; • The science education centre at LCE is under-resourced; • No child-oriented S&T programme; • No mechanism in the education sector to promote innovation, foster exchange of experiences; • Technical, vocational and education institutions often over-looked in upgrading exercises (e.g. few inservices); • TVET Board and institutions not serving as platform for dialogue; • TVET Curriculum Advisory Committee acts only when curriculum falls beneath a set threshold, not proactively; • Inadequate metrology, standards, testing, and quality functions; • Draft Standards Bills, and Metrology legislation have stalled; • Identified priorities such as food security and soil conservation not matched with funding for research and training. 	<ul style="list-style-type: none"> • No mechanism to ensure employability of S&T training and to reorient curriculum in line with job market needs; • No Internet connection at the health training college, leading to lost opportunities for collaboration via open and distance learning; • Presently no structure for inter-ministerial collaboration on S&T policy, planning, and priority-setting; • No mechanisms to attract investments on inter-ministerial S&T mechanism and equipment; • Visiting professor programmes not used but could vastly improve health training; • The health training college is a department within the ministry and subject to bureaucracy and red tapes; • Opportunities for teacher staff exchange through AAU, NEPAD, CAU and NUL are not taken up. 	<ul style="list-style-type: none"> • Research capacity within NUL is generally weak; • Limited STI analysis, with insufficient statistical database to monitor, evaluate and make time-series studies; • Ministry of Education statistics compendium not sufficiently not comprehensive nor accessible; knowledge gaps lead to faulty measures and policies that could be detrimental to the sector; • Research is not an integral part of health training programme; • Research findings of the health training college are not published and disseminated; • No significant e-government activity and low demand for such services from the public, due to low awareness, and lack of ICT access points; • Heavy teaching load of tertiary level professors does not allow for research work and student mentoring.
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EDUCATION AND THE INFORMATION SOCIETY					
	Technology Resources	Human Resources	Institutional Capability	Collaboration/ Networking	Knowledge Base
A C T I O N S t o C O N S I D E R	<ul style="list-style-type: none"> • Explore opportunities to leverage the Tissue Culture Laboratory at NUL for collaboration in promising lines of research; • Maintain and modernize existing medical technologies, equipment and treatment practices; • Raise technology awareness and technical competencies to use, adapt and develop indigenous practices and medicines; • Investigate indigenous and traditional technologies, submit documentation for scientific validation and diffuse their applications and uses including commercial marketing; • Assess linkage to 	<ul style="list-style-type: none"> • Enhance training and facilitate deployment of technical personnel in all related fields of health and sanitation; • Promote interest in S&T through the classroom, laboratory practice, apprenticeships, and community outreach; • Integrate ICTs in the classroom, especially in science courses; • Provide incentives to increase enrolment in S&T fields and engineering; • Expand and improve S&T education programmes, eliminating distance and age barriers; • Improve training especially in health and sanitation; • Regularly update 	<ul style="list-style-type: none"> • Ensure effectiveness of science education curriculum, teaching materials and programmes; • Strengthen science education outreach activities through attractive and user-friendly materials; • Support implementation of a national qualification and certification system to attract young minds and ensure career satisfaction among S&T professionals; • Keep abreast with discussions on public policy and policy reform to integrate and harmonize S&T education programmes and delivery strategies. 	<ul style="list-style-type: none"> • Foster <i>Indabas</i> – collaboration between government, industry and private sector, to foster partnership in education and health; • Set up mechanism to strengthen industry–academia linkages (for industrial attachment opportunities, curricula reform, etc.); • Establish partnerships with other countries to increase pool of resources; • Promote innovative processes that are based on links between education, culture, heritage and community-based knowledge systems; • Explore opportunities for participating in the Global Business School Network of 	<ul style="list-style-type: none"> • Provide technical and advisory support to professional journals for the health services sector; • Implement plan to create a Virtual Campus, in collaboration with UNESCO; • Undertake studies in national priority areas to increase community benefits and add to the pool of local and scientific knowledge; • Enhance research capability and undertake scientific research on traditional medical practices, herbs and treatments with a view to integrating these with conventional medicine; • Facilitate the acquisition and maintenance of S&T instruments

<p>international research networks by collaborating with initiatives such as the Geant network and TENET;</p> <ul style="list-style-type: none"> • Evaluate options for achieving low-cost rural access to ICTs, using alternative energy sources. 	<p>and upgrade S&T teaching programme and materials at all levels;</p> <ul style="list-style-type: none"> • Support teachers trained in S&T, math, computer literacy and facilitate their equitable spread throughout the country's education system; • Set up a ICT training programme for rural youth. 		<p>Africa;</p> <ul style="list-style-type: none"> • Work with the Ministry of Education to set up a mobile science education programme, including the use of broadband. 	<p>and pedagogic facilities;</p> <ul style="list-style-type: none"> • Provide technical and financial support for S&T teaching materials, books, etc.; • Undertake research in language, culture and Basotho tradition and prepare S&T teaching materials in Sesotho.
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Annex II. Round-table Meeting on the draft *STIP Review*

On 14 July 2009, the Ministry of Communications, Science and Technology organized a round-table meeting among its stakeholders to discuss the draft *STIP Review*. Together with the Secretary-General of the Lesotho National Commission for UNESCO and a senior UNDP official, about 150 stakeholders representing a broad cross-sector of Lesotho's social and economic fabric reviewed and discussed the draft, and offered opinions and recommendations. In addition to the organizing ministry's staff, the government services represented included the Senate; the Ministry of Finance and Development Planning; the Ministry of Trade and Industry, Cooperatives and Marketing; the Ministry of Education and Training; as well as the National University of Lesotho and the Agriculture College; the Ministry of Agriculture and Food Security as well as the Department of Livestock Services and the Agricultural Fisheries; the National Environmental Secretariat; the National Climatic Data Centre and the Lesotho Meteorological Services; the Highlands Development Authority; the Ministry of Public Works and Transport; the Ministry of Forestry and Land Reclamation and its Engineering Department; the Ministry of Land Resources and its Department of Mines and Geology; the Lesotho Communication Authority; the Lesotho Electric Company; and the Basotho Enterprise Development Corporation (BEDCO), the parastatal mandated with the establishment and development of Basotho-owned business enterprises with particular emphasis on the promotion of indigenous entrepreneurial skills. A number of DAs were also represented.

Also represented in addition to the national university were the National Health Training Centre, a polytechnical school and three nursing schools. Private sector representation was led by the SMME Network and included diverse groups such as Organic Adem, Lesotho Flour Mills, Serumula, Lesotho Post Bank and STD Les Bank. Key groups were also present, such as the National Farmers' Union, Thinking Ahead, Young Christian Students, as well as NGOs such as the World Vision Lesotho, LIFE, LEMA, TED-LCN, DAR and the Malealea Development Trust. There was a delegation from the African Technology Policy Studies Network, likewise from key media such as the Lesotho Times and Radio Lesotho.

The UNCTAD delegation was headed by the Chief of the Policy Section/Science, Technology and ICT Branch of the Division on Technology and Logistics, who briefed the meeting on the background and main objectives underpinning UNCTAD's STIP REVIEW series. Also presented were the findings of the review, in terms of the strengths, weaknesses and opportunities of the key sectors as well as recommendations for leveraging STI to the benefit of specific sectors and the country in general. The proposed mechanism within the government system that would underpin the technological growth and the development of innovation was likewise explained in detail.

It was decided that discussion groups would be formed in order to enable a more in-depth and focused discussion. Group 1 included stakeholders affiliated with the sectors of agriculture, environment, meteorology and water; Group 2 with industry, communications and energy; and Group 3 with education, health and sanitation, culture and human resources, and the information society.

Group 1 (agriculture, environment, meteorology and water) identified sector goals for which STI was indispensable: increased agricultural production, management of natural resources, timely and reliable weather information, equitable and sustainable water supplies. In agriculture, for instance, STI was needed in the entire value chain, from improved agriculture inputs and enhanced practices such as irrigation, to value adding processing and marketing. Soil erosion was underlined as the most serious threat in the environment sector, followed by the need for programmes to conserve biodiversity and control pollution. The group also stressed the importance of improved national capacity to respond to climate change, specifically through vulnerability assessment, adaptation and mitigation. On the more immediate timescale, the need for technologies to improve capacities of weather stations and to setup early warning systems was pointed out. Although water has been an abundant national resource, its distribution has not been equitable. As water is forecasted to become increasingly scarce in the near future, even as certain areas of the country have been experiencing severe drought, the group proposed the modern technologies should be exploited to address this increasingly pressing issue.

Group 2 (industry, communications and energy) underlined the need for STI in all aspects of industry, communications and energy sectors. Besides technological growth, innovation was necessary to enhance entrepreneurship especially among SMMEs as well as in the marketing and diversification of the industrial base. Public R&D support would become even more critical as the industry sector evolves. While noting the rapid diffusion of mobile phone technology, the group pointed out that Internet accessibility was still rather limited. It was through this technology that a vast wealth of knowledge could be retrieved and long-distance partnerships could be forged, and it was therefore important that this should be made more available. Stressing the need for energy security and conservation, the group recommended support for renewable and stand-alone sources such as solar and wind for areas outside the current grid system. The group also discussed improvement of national road network, as well as the use of STI in enhancing the service and quality of the public transport system.

Group 3 (education, health and sanitation, culture and human resources, and the information society) recommended an overall review of the curriculum, from primary to tertiary, to ensure the inclusion of STI to promote innovation and enhance responsiveness to development needs. In addition to strengthening the teaching faculty, it also suggested the use of multimedia such as in distance learning as well as in improved access to current medical knowledge for health practitioners. STI would also be used to document, preserve and diffuse indigenous knowledge and practices. Making the Internet more affordable and accessible was a sine qua non for building an information society.

With regard to the proposed STI mechanism, Group 1 suggested that the committee should aim at formulating an integrated development plan that should be continuously monitored and periodically evaluated. It approved the proposed composition of the committee, that is, cross-cutting representation of key sectors including important groups such as farmers, local government representatives, academia, civil society and the private sector. A challenge for the committee would be to ensure that information is filtered to their respective constituents. Group 2 was of the opinion that the principal role of the committee was to oversee the development of national R&D capacity. For Group 3, the principal role of the committee was advocacy. Its mandate and composition should be such that it can push the STI agenda forward. The stakeholders unanimously agreed that the stated functions of the proposed STI mechanism, from resource mobilization, monitoring and evaluation, documentation and publicity, technology scanning as well as policy harmonization, were indeed critical in stimulating and underpinning technological growth and promoting innovation.

The recommendations of the stakeholders have been reflected in this review.

Annex III. NOTES

- ¹ UNCTAD (2007). *Least Developed Countries Report 2007: Knowledge, Technological Learning and Innovation for Development*. United Nations publication. New York and Geneva
- ² UNCTAD (2003). *Investment Policy Review of Lesotho*. United Nations publication. New York and Geneva.
- ³ BOS (2001). Demography Survey.
- ⁴ UNDP (2006). *Lesotho National Human Development Report 2006*.
- ⁵ UNCTAD (2007). *The Least Developed Countries Report 2007: Knowledge, Technological Learning and Innovation for Development*. United Nations publication. New York and Geneva.
- ⁶ SARUA (2008). www.sarua.org/?q=Lesotho
- ⁷ National S&T Policy, sections 3.4 and 3.4.1.
- ⁸ TENET serves tertiary institutions and negotiates bulk discounts on ICT infrastructure and knowledge resources on behalf of these institutions.
- ⁹ S&T Policy, section 3.6.2.
- ¹⁰ Ibid.
- ¹¹ S&T Policy, section 2.1.
- ¹² http://www.nepadst.org/sanbio/pdfs/sanbio_lesotho_2008.pdf.
- ¹³ S&T Policy, section 2.5.4.
- ¹⁴ S&T Policy, section 2.5.4, box 14.
- ¹⁵ S&T Policy, section 2.5.5, box 16.
- ¹⁶ Developed by Sara Farley and Caroline Wagner for the World Bank and SRI International (Wagner and Farley, 2009).
- ¹⁷ Global Development Solutions GDL-LLC 2004, MTICM aide memoir 2005.
- ¹⁸ Ntimo-Makara M (2003). *African Higher Education: An International Reference Handbook*. Indiana University Press: 372–380.
- ¹⁹ CREST & High Impact Innovation (2007).
- ²⁰ Metcalfe J (1995). The economic foundations of technology policy: equilibrium and evolutionary perspectives. In Stoneman P, ed. *Handbook of Economics and Innovation and Technology Change*. Oxford, Blackwell.
- ²¹ Chapter 4.1 of the National Science and Technology Policy, on the Lesotho Advisory Commission on Science and Technology (LACST).

Annex IV. SELECTED UNCTAD PUBLICATIONS IN THE AREA OF SCIENCE, TECHNOLOGY AND ICT FOR DEVELOPMENT

(For more information, please visit our website at <http://stdev.unctad.org>)

A. Flagship Reports

Technology and Innovation Report 2010: Enhancing food security in Africa through science, technology and innovation (April 2010). United Nations publication. New York and Geneva.

Information Economy Report 2009: Trends and Outlook in Turbulent Times (September 2009). United Nations publication. New York and Geneva.

Information Economy Report 2007-2008 – Science and technology for development: the new paradigm of ICT. United Nations publication. Sales No. E.07.II.D.13. New York and Geneva.

Information Economy report 2006: the Development perspective. United Nations publication. Sales No. E.06.II.D.8. New York and Geneva.

Information economy Report 2005: E-commerce and Development. United Nations publication. Sales No. E.05.II.D.19. New York and Geneva.

E-Commerce and Development Report 2004. United Nations publication. New York and Geneva.

E-Commerce and Development Report 2003. United Nations publication. Sales No. E.03.II.D.30. New York and Geneva.

E-Commerce and Development Report 2002. United Nations publication. New York and Geneva.

E-Commerce and Development Report 2001. United Nations publication. Sales No. E.01.II.D.30. New York and Geneva.

B. Science, Technology and Innovation Policy Reviews

Science, Technology and Innovation Policy Review Ghana. United Nations publication. UNCTAD/DTL/STICT/2009/8. New York and Geneva. *Coming soon*

Science, Technology and Innovation Policy Review Mauritania. United Nations publication. UNCTAD/DTL/STICT/2009/6. New York and Geneva.

Science, Technology and Innovation Policy Review Lesotho. United Nations publication. UNCTAD/DTL/STICT/2009/7. New York and Geneva.

Science, Technology and Innovation Policy Review of Angola. United Nations publication. UNCTAD/SDTE/STICT/2008/1. New York and Geneva.

Science, Technology and Innovation Policy Review. The Islamic Republic of Iran. United Nations publication. UNCTAD/ITE/IPC/2005/7. New York and Geneva.

Investment and Innovation Policy Review of Ethiopia. United Nations publication. UNCTAD/ITE/IPC/Misc.4. New York and Geneva.

Science, Technology and Innovation Policy Review: Colombia. United Nations publication. Sales No. E.99.II.D.13. New York and Geneva.

Science, Technology and Innovation Policy Review: Jamaica. United Nations publication. Sales No. E.98.II.D.7. New York and Geneva.

C. Technology for Development Series

Green and renewable energy technologies for rural development. United Nations publication. UNCTAD/DTL/STICT/2009/4. New York and Geneva.

Financing ICT for development. United Nations publication. UNCTAD/DTL/STICT/2009/5. New York and Geneva.

Investment and Technology Policies for Competitiveness: review of Successful Country Experiences. United Nations publication. UNCTAD/ITE/IPC/2003/2. New York and Geneva.

Electronic Commerce and Music Business Development in Jamaica: A portal to the new Economy? United Nations publication. Sales No. E.02.II.D.17. New York and Geneva.

Changing Dynamics of Global Computer Software and Services industry: implications for Developing Countries. United Nations publication. Sales No. E.02.II.D.3. New York and Geneva.

Partnerships and Networking in Science and Technology for Development. United Nations publication. Sales No. E.02.II.D.5. New York and Geneva.

Do Environmental Imperatives Present Novel Problems and Opportunities for the International Transfer of Technology? United Nations publication. Sales No. E.95.II.D.11. New York and Geneva.

Emerging Forms of Technological Cooperation: The Case for Technology Partnership. United Nations publication. Sales No. E.96.II.D.1. New York and Geneva.

New Technologies and Technological Capability-Building at the Enterprise level: Some Policy Implications. United Nations publication. Sales No. E.95.II.D.24. New York and Geneva,

Promoting the Transfer and Use of Environmentally Sound Technology: A review of Policies. United Nations publication. UNCTAD/DST/12. New York and Geneva.

Science and technology in the new Global Environment: Implications for Developing Countries. United Nations publication. Sales No. E.95.II.D.14. New York and Geneva.

D. Other publications

Division on Technology and Logistics Activity report 2009. United Nations publication. UNCTAD/DTL/2010/1. New York and Geneva.

- Estudio sobre las perspectivas de la armonización de la ciberlegislación en Centroamérica y el Caribe.* United Nations publication. UNCTAD/DTL/STICT/2009/3. New York and Geneva
- Study on prospects for harmonizing cyberlegislation in Latin America.* United Nations publication. UNCTAD/DTL/STICT/2009/1. New York and Geneva.
- Manual for the Production of Statistics on the information Economy 2009 Revised Edition.* United Nations publication. New York and Geneva.
- Division on Technology and Logistics Activity report 2008.* United Nations publication. UNCTAD/DTL/2009/1. New York and Geneva.
- The Global Information Society: a Statistical View 2008.* United Nations publication. Santiago.
- Measuring ICT: the Global Status of ICT Indicators Partnership on measuring ICT for Development.* United Nations ICT Task Force. New York.
- Core ICT Indicators.* UNESCWA. Beirut.
- WSIS follow-up Report 2008.* United Nations publication. UNCTAD/DTL/STICT/2008/1. New York and Geneva.
- Measuring the Impact of ICT Use in Business: the Case of manufacturing in Thailand.* United Nations publication. Sales No. E.08.II.D.13. New York and Geneva.
- World Information Society Report 2007: Beyond WSIS.* Joint United Nations and ITU publication. Geneva.
- Manual for the production of Statistics on the Information Economy.* United Nations publication. UNCTAD/SDTE/ECB/2007/2. New York and Geneva.
- World Information Society Report 2006.* Joint United Nations and ITU publication. Geneva.
- The Digital Divide: ICT Diffusion Index 2005.* United Nations publication. New York and Geneva.
- The Digital Divide: ICT Development Indices 2004.* United Nations publication. New York and Geneva.
- Africa's Technology Gap: Case studies on Kenya, Ghana, Tanzania and Uganda.* United Nations publication. UNCTAD/ITE/IPC/Misc.13. New York and Geneva.
- The Biotechnology promise: Capacity-Building for Participation of Developing Countries in the Bioeconomy.* United Nations publication. UNCTAD/ITE/IPC/2004/2. New York and Geneva.
- Information and Communication Technology Development Indices.* United Nations publication. Sales No. E.03.II.D.14. New York and Geneva.
- Investment and Technology Policies for Competitiveness: Review of Successful Country Experiences.* United Nations publication. UNCTAD/ITE/IPC/2003/2. New York and Geneva,
- Transfer of Technology for Successful Integration into the Global Economy: a Case Study of Embraer in Brazil.* United Nations publication. UNCTAD/ITE/IPC/Misc.20. New York and Geneva.
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Transfer of Technology for Successful Integration into the Global Economy: a Case Study of the South African Automotive industry. United Nations publication. UNCTAD/ITE/IPC/Misc.21. New York and Geneva.

Transfer of Technology for the Successful Integration into the Global Economy: a Case Study of the Pharmaceutical industry in India. United Nations publication. UNCTAD/ITE/IPC/Misc.2.. New York and Geneva.

Coalition of Resources for Information and Communication Technologies. United Nations publication. UNCTAD/ITE/TEB/13. New York and Geneva.

Key issues in biotechnology. United Nations publication. UNCTAD/ITE/TEB/10. New York and Geneva.

An Assault on poverty: Basic Human Needs, Science and Technology. Joint publication with IDRC. ISBN 0-88936-800-7.

Compendium of international Arrangements on Transfer of Technology: Selected Instruments. United Nations publication. Sales No. E.01.II.D.28. New York and Geneva.

E. Issues in Brief

Measuring the information Economy: How ICT Contributes to Development. Issues in Brief No. 7. UNCTAD/IAOS/MISC/2005/13

E-Tourism in Developing Countries: More Links, Fewer leaks. Issues in Brief No. 6. UNCTAD/IAOS/MISC/2005/11.

ICT and E-Commerce: an Opportunity for Developing Countries. Issues in Brief No 1. UNCTAD/ISS/MISC/2003/6.
