

THE REPUBLIC OF RWANDA

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Introduction

This report looks at the science, technology and innovation system of Rwanda and is structured in three main parts. Section 1 briefly deals with the national political environment; Section 2 looks at the key country characteristics including the economic, demographic and health, education and, information and communication technology infrastructure. Finally, Section 3, which forms the main part of the report, gives an overview and analysis of the science and technology system. This section is subdivided into seven thematic subsections covering the governance of the science and technology, science and technology landscape, S&T human resources, funding, research outputs, technological innovation and lastly international co-operation and networks activities.



Section 1: The political environment

Rwanda is a small, landlocked country in Central Africa. Rwanda is bordered by Uganda to the north, Tanzania to the east, Burundi to the south and the Democratic Republic of Congo to the west. It became independent in 1962 after colonization by Germany (1899) and Belgium (1919). In 1961, its monarchical government was formally abolished by a referendum, and the first parliamentary elections were held.

Ethnic polarization has been the curse of Rwanda since independence in 1960. Political turmoil over the sharing of power and explosions of ethnic violence has marked the recent history of the country. A low-intensity civil conflict pitting the government against the Rwanda Patriotic Front (RPF), a Tutsi-led rebel movement, culminated in genocide, between April and June 1994. About 800,000 people were massacred (Tutsis and moderate Hutus), by the army and the extremist Interahamwe militia. The RPF overthrew the regime in June 1994. (World Bank)

The impact of the genocide on the social fabric of Rwandan society is very deep and healing will take many years. Most people went through horrendous experiences and the events haunt the memories of the survivors. The country is now at peace, and the establishment of a national police force has helped to improve the security situation. The majority of suspects of genocide remain in jail. Faced with the difficulties of handling such a large number of cases, the government has decided to rely on a traditional arbitration mechanism (Gacaca) to expedite the judgment of local executives in the genocide. (World Bank) A new constitution was enacted in June 2003. The first multi-party presidential and parliamentary elections since independence were held in August and September 2003, resulting in the election of President Kagame.

Section 2: Country characteristics

2.1 Basic economic outlook

With a per capita gross domestic product (GDP) of only US\$242 in 2000, Rwanda is one of the poorest countries in the world. Coffee and tea continue to be the country's principal exports. The manufacturing sector accounts for 20 percent of GDP and is dominated by import-substituting industries. GDP declined sharply during the four years of civil war that culminated in the genocide of 1994. Recently, GDP has again been growing steadily under a program of improved tax collection, accelerated privatisation of state enterprises, and continued improvements in export crop and food production. (World Bank Study, 2004)

Table 1: Economic Indicators

Rwanda	1995	2000	2002
GDP per capita (constant 1995 US\$)	227.08	267.29	294.66
Agriculture as share of GDP, %	44.00	41.41	41.41

Source: World Bank Africa Database 2004

When looking at Rwanda's share of agriculture to GDP at about 41%, and take it as an indicator of development, it is clear that Rwanda is far behind Sub-Saharan African countries. (Bigsten, A & Yanagizawa, D, 2006).

The macroeconomic situation in 2003 was extremely disappointing when compared to the 9.4% growth experienced in 2002. The Rwf¹ 17 billion reduction in real agricultural output in 2003 is largely responsible and tells the story of a severe climatic shock, hampering progress against poverty reduction and affecting heavily on economic growth. Severe as this shock was, it would have been difficult in any circumstances to replicate the progress of 2002, a particularly good year for weather. A more accurate medium-term picture may be obtained by examining agricultural growth from 2001, which averages at 5.1% per year to 2003. (MINECOFIN, 2004)

Growth in agricultural output (value terms) dropped from 15% growth in 2002 to -4.1% in 2003. This was due mainly to the considerable decline in the growth of food crop production (from 31.5% in 2002 to -4.5% in 2003). Total export crop production also decreased despite improved commodity prices on international markets. Rwandan export crop growth (coffee + tea) in volume and value terms was of -15.5% and -1.4% respectively. This poor performance was mainly due to the considerable decrease in coffee productivity, from 648 tons/ha in 2002 to 464 tons/ha in 2003. (MINECOFIN, 2004)

The industrial sector accounts for almost 20% of GDP, within which construction, food, drink and tobacco manufacturing are the largest components. The 7.1% industrial growth in 2003 was led almost solely by the construction sector, which registered a 15.6% growth. The production of other major components decreased, except for tea production. The poor performance of the other industries is the result of continual depreciation of the Rwandan Franc against both the dollar and the Euro. (MINECOFIN, 2004)

In 2003, a net growth across the service sectors was noted. In the financial sector, real growth was 10.4%, and in transport, storage and communications 2.3%. Wholesale and retail trade

¹ Rwandan Franc (Rwf) is the official currency. Exchange Rate: \$ 1 = 550 Rwf as at November 2006

grew the slowest, at 0.3% growth. The growth in the financial sector was largely due to both the buoyant credit market in 2003, which acted to increase revenues for commercial banks from interest payments and a reduction in inter-bank interest charges for the commercial banks. Tourism is one of the sectors that the Government is trying to develop as a means of attracting foreign currency and, in addition, in November 2003, Rwanda sought further to promote itself as a tourist destination by having a stand at the International Tourism Exhibition. The results of these efforts are promising, since the sector has developed beyond expectations, achieving better results than targeted in the tourism development strategy. (MINECOFIN, 2004)

2.2 Demographic profile incorporating health, education and ICT indicators

Table 2: Summary of various demographic statistics for Rwanda

Indicator	Statistic	Year	Source
<i>General demographical</i>			
Total Population (millions)	8.9	2004	World Development Indicators database
Annual population growth (%)	1.4	2004	World Development Indicators database
<i>Health</i>			
Life expectancy at birth (years)	38.3	2004	Health Sector Policy, Ministry of Health
Infant mortality rate (per 1000)	107	2004	Health Sector Policy, Ministry of Health
Adults aged 15-49 with HIV/AIDS (%)	5.3	2003	World Development Indicators database
Doctors	168	2003	Ministry of Economics and Finance
Nurses	2157	2003	Ministry of Economics and Finance
<i>Education</i>			
Number of Primary learners	1534510	2001/02	Ministry of Education
Primary: Pupil to Teacher Ratio	59:1	2001/02	Ministry of Education
Number of Secondary learners	157289	2001/02	Ministry of Education
Secondary: Pupil to Teacher Ratio	25:1	2001/02	Ministry of Education
Number of Tertiary learners	12674	2001/02	Ministry of Education

Table 2 Continued

Indicator	Statistic	Year	Source
<i>Information & Communication Technology (ICT)</i>			
Cost of a local call for 5hrs (US\$) as % of monthly GDP per capita	51.22%	2002	ITU World Telecommunications Indicators 2003
Cellular mobile telephone subscribers per 100 inhabitants	1.3556	2002	ITU World Telecommunications Indicators 2003
Cellular subscribers per capita	0.0136	2002	ITU World Telecommunications Indicators 2003
Internet users per capita	0.0031	2002	ITU World Telecommunications Indicators 2003
Main lines per capita	0.0028	2002	ITU World Telecommunications Indicators 2003
Telephone subscribers per 100 inhabitants	1.64	2002	ITU World Telecommunications Indicators 2003

Section 3: Science and technology system

Almost all of Rwanda's policy documents and strategies make mention of the Government of Rwanda's Vision for 2020. Vision 2020 is the governments all encompassing plan of where the country as a whole should be in year 2020 in all sectors.

The Rwanda 2020 Vision is centred upon "Human resources development and a prosperous knowledge-based economy, through literacy and basic education for all, gender equity, science and technology, professional and managerial training" is seen as the way for Rwanda to achieve all its developmental goals. It is the wish of Rwanda to have a population with a slower demographic growth, for all to have social security, be well fed, healthy, educated citizens, who are eager to be informed and trained on a continual basis, and who are professionally qualified, capable of using time efficiently and constituting real wealth for the country. (GoR, 2002)

The aim is also for fast development of entrepreneurship and a modern, competitive Private Sector, based on a culture of initiative and creativity and centred on a solid class of business executives and entrepreneurs, geared towards capital formation through the revitalisation of industry and service sectors. (GoR, 2002)

The future of Rwanda by the year 2020 is based upon the following six pillars and four crosscutting areas:

Pillars of the 2020 Vision	Crosscutting domains of the 2020 Vision
<ul style="list-style-type: none"> • The reconstruction of the Nation • An efficient State, capable of uniting and mobilising its population • Human resources development • Town and country planning and development of Basic Infrastructures • Development of Entrepreneurship and the Private Sector • Modernisation of Agriculture and Animal Husbandry 	<ul style="list-style-type: none"> • Gender issues • Environment protection • Science and technologies, including ICT • Regional and international integration

The development of science and technology capacity in Rwanda is designed to support the development of the population in a prosperous knowledge-based, technology-led economy. In particular, a developed science and technology sector will:

- Stimulate a steady growth in GDP
- Advance the quality of life for all citizen
- Improve the skills and knowledge among the population, and
- Integrate technical education with commerce, industry and the private sector in general (Murenzi, R & Hughes, M; 2005)

The principal objective of the National Science, Technology and Innovation Policy is “To integrate Science, Technology, Scientific Research and Innovation in a framework that shall include capacity building, technical transfer initiatives, and the promotion of innovation in the context of the various issues which face Rwanda. Science, Technology, Scientific Research shall be catalyst to underpin all public and private sector activities to enable Rwanda’s Vision 2020 to be realised”. (National Science, Technology and Innovation Policy, 2005) Another key objective is to help overcome the challenges and problems across all sectors of the economy.

The overriding objectives of the policy are to support the growth of the economy of Rwanda, specifically to support the Vision 2020 targets of a steady growth in GDP – 8% per year from 2010 to 2020; advance the quality of life for all the citizens of Rwanda, specifically to support the Vision 2020 target of a GDP per inhabitant of 900\$ by 2020; improve skills and knowledge among the population, specifically to create a “knowledge-based” economy; Maintain viability and strategically choose to enhance opportunities for growth in rural areas; and integrate Technical Education with commerce, industry and the private sector in general. (National Science, Technology and Innovation Policy, 2005)

Capability building in the Science and Technology policy is founded on the following specific objectives:

- Knowledge Acquisition;
- Knowledge Creation;
- Knowledge Transfer;
- Innovation Culture.

All of the above objectives need to be fulfilled to achieve science and technology capability building to underpin Rwanda's development needs. (National Science, Technology and Innovation Policy, 2005)

Strategies and framework to achieve policy objectives:

- *National Integrated Innovation Framework.* The National Integrated Innovation Framework for Rwanda is to create linkages between policy, capacity, and major country issues, and emphasises a cluster approach, not only to national policy and projects, but also to external relationships with the donor community and the international community. The strength for Rwanda lies in clear articulation of integrated issues and priorities, and how these are then reflected in identified needs to build up the knowledge base through human resource capacity building, underpinned by well identified science and technology needs. This then creates a need for cluster approach to donors and strategic development of international partnerships to address national integrated issues. (National Science, Technology and Innovation Policy, 2005)
- *Government reforms.* The Government shall endeavour to foster a culture of partnership and strategic purpose among S&T training, research and employer institutions, and to link their service to S&T providers, purchasers, users and consumers for meaningful benefit goods and services. This is with the intention to provide greater job opportunities, sustainable earnings and rising living standards.

The Government shall promote a sense of commitment in public and private sector institutions and individuals toward research and technological innovation as basis for human development, business success, national wealth creation and international competitiveness.

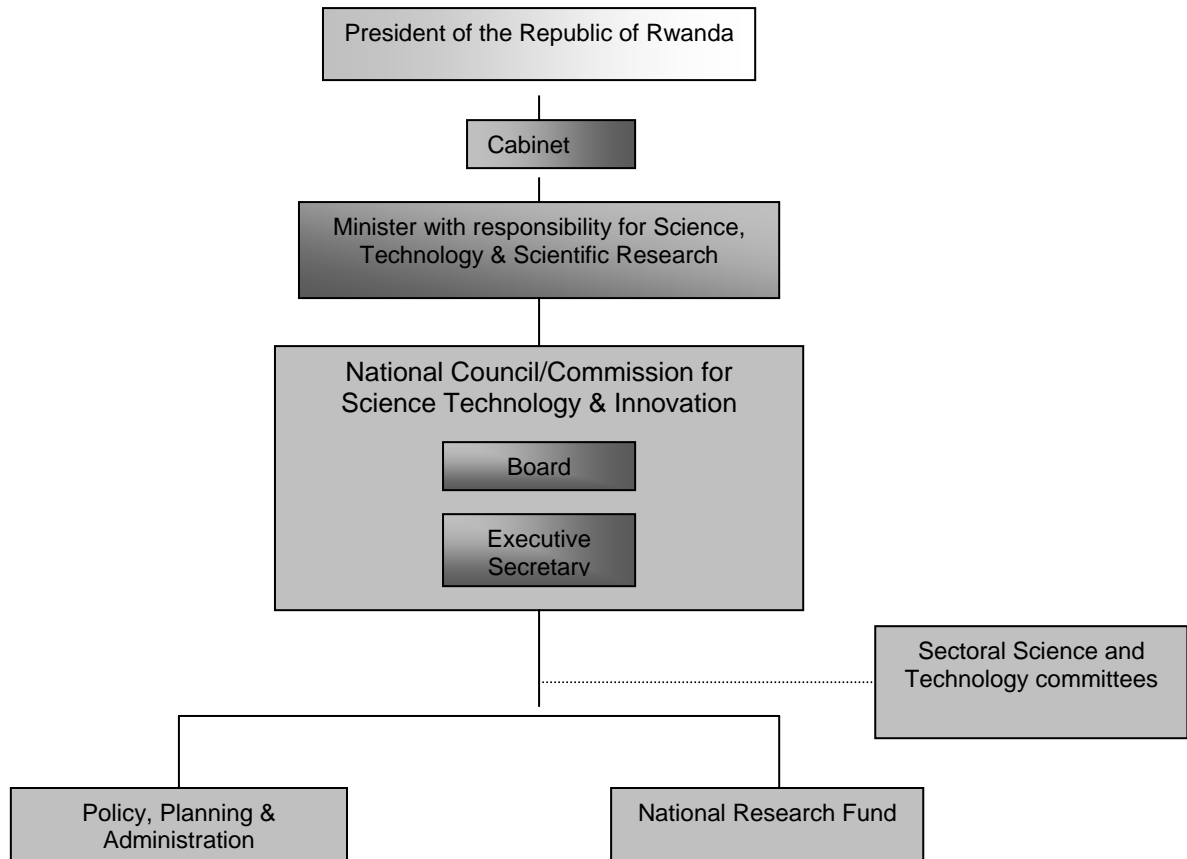
The Government shall secure an appropriate mix of resources and ensure that steady funding and priority are devoted to research, and for the engagement of science and technology in both public and private sectors.

The Government shall facilitate the development of Rwandan citizens and enterprises through the provision of up-to-date technical advice, business support, S&T extension services and maintenance of a critical core of technical competencies in country, with the skills and expertise needed by the society for efficient management of the S&T resources and assets.

3.1 Governance of science and technology

Science and Technology as a directorate was under the auspices of The Ministry of Education, Science, Technology and Scientific Research, until the directorate was moved, and the ministry restructured. The ministry was split into Education and Science & Technology separately. The minister of Education, Science, Technology and Scientific Research, Prof Murenzi, became minister of Science and Technology within the Office of the Prime Minister, and Prof Judith () became the minister of education. The current Ministry of Science and Technology is still in its infancy and policies and initiatives have only just been implemented or are in the process of doing so. The following diagram illustrates the current structure of S&T in Rwanda, and institutions such as the National Council/Commission for Science Technology & Innovation & National Research Fund still need to be established.

Figure 1: Proposed new structure of the Science & Technology system in Rwanda



The Ministry with responsibility for Science, Technology and Scientific Research shall be the main government agency responsible for science, technology and research policy. The establishment and promotion of Science and Technology programmes require the commitment and cooperation of ministries, para-statal, public as well as non-governmental, non-profit and private sector institutions. Priority activities are to be undertaken by public funded science and technology based organisations through appropriate public funds, and government shall provide the responsible Ministry and the National Council for Science, Technology and Innovation with resources to facilitate their coordinating roles and establish appropriate links with private sector. (National Science, Technology and Innovation Policy, 2005)

The National Council/Commission for Science, Technology and Innovation (NCSTI) shall be responsible to the Minister with responsibility for Science, Technology and Scientific Research, and other organs of government, for the development, promotion and coordination of Rwanda's Science, Technology and Innovation Policy. (National Science, Technology and Innovation Policy, 2005)

NCSTI will also have the responsibility as an independent advisory board to the Minister and other organs of government to direct and guide the national plan for research, which includes planning, organisation, capacity planning, quality assurance and fund raising in all research areas. (National Science, Technology and Innovation Policy, 2005)

Sectoral Science and Technology Committees shall, among other members, comprise of Science and Technology Representatives, appointed within each relevant Ministry and Institution, as a link between NCSTI and the Sectoral Ministries. These Science and

Technology Representatives shall have the overall responsibility of coordinating S&T issues within their respective Ministries. (National Science, Technology and Innovation Policy, 2005)

3.1.1 *Ministry of Agriculture*

The Government of Rwanda's long-term development revolves around the framework of the 'Vision 2020', the Millennium Development Goals and adopts the Poverty Reduction Strategy Plan (PRSP) for effective achievement of people-centred sustainable development through good governance and democratic decentralisation. The implementation of the PRSP is elaborated through sector policies and strategies, a process recently completed by the Ministry of Agriculture and Animal Resources (MINAGRI). In 2004, MINAGRI revised the National Agricultural Policy (NAP), and for its operationalisation, it adopted the Strategic Plan for Agricultural Transformation (PSTA – Plan Stratégique de Transformation de l'Agriculture) in early 2005.² Through the implementation of PSTA's four programs, Rwanda's agriculture sector shall be transformed into a modern, professionally operated and market oriented economic undertaking, through the promotion of professionalism, specialization, technological innovations, and public-private partnerships. (International Fund for Agricultural Development, 2005)

For over a decade, agricultural productivity has been declining, impoverishing the country, in particular the rural population. The major causes of the decline include the exhaustion, fragmentation, and overexploitation of available agricultural lands, owing to rapid rural population growth; the degradation of the soil and the environment; and the lack of use of modern inputs and weak research and extension services. Most of the agricultural sector is composed of fairly unproductive subsistence farming carried out on small plots (with an average size of 6 000 m²) located on steep slopes, with no protection against erosion, rudimentary cropping practices and insufficient inputs of fertilizing elements to compensate for those removed by crops. The break-up of farms is also a result of the land fragmentation caused by population pressure on arable land. The ongoing reduction in the average area of farms is combined with the suppression of fallow periods and the settling of marginal or environmental land reserves (marshland and forests). (International Fund for Agricultural Development, 2005)

MINAGRI was one of the first ministries to develop a sector strategy. The first step was the formulation of the National Agriculture Policy (NAP) during the last two months of 2003 and the first half of 2004 (the NAP was officially endorsed by the Government in October 2004). The NAP gives the central role to producers and focuses on promoting a modern and competitive agricultural sector, based on priority commodity chains, entrepreneurship and sustainable management of natural resources. Based on the policy orientations provided by the NAP, a Strategic Plan for Agricultural Transformation (PSTA) was then prepared in the period July-October 2004 with IFAD, Royal Netherlands Embassy (RNE) and DFID support, and then officially endorsed in January 2005. (International Fund for Agricultural Development, 2005)

The Strategic Plan aims at transforming current subsistence farming into a market-oriented agriculture, while ensuring food security and preserving the resource base, through a concerted pro-poor approach associating the administration, producers, support services, civil society and the private sector. While centred on the promotion of commercial agriculture and on the development of commodity chains, the Strategy is also meant to address the needs of poorer smallholders, by supporting enhanced productivity of food crops and by targeting most vulnerable areas and groups. (International Fund for Agricultural Development, 2005)

² The Council of Ministers adopted the Strategic Plan for Agricultural Transformation on 12 January 2005.

3.1.2 *Science and technology priorities*

The following priority areas are mentioned in the Science, Technology and Innovation Policy document, which are to be pursued in all sectors of the economy.

3.1.2.1 *Education*

As outlined in the introduction to the Education Sector policy an essential component of building Science and Technology capacity in Rwanda is the education of the citizens of Rwanda in science and technology. The skills range from fundamental level through to advanced skills that shall enable Rwandans to take the lead in high-level research aimed at Rwanda's development.

3.1.2.2 *Health*

A scientific approach to health issues shall be promoted, focussing heavily on infectious disease vaccines and clinical treatments

3.1.2.3 *Agriculture and Animal Husbandry*

Rwanda's population is mainly subsistence based rural agriculture and animal husbandry farmers . Any improvement, therefore, in the yield and quality of existing crops and livestock, as well as the introduction of new value added crops and processes for income generation would have a wide-ranging and immediate effect on the health and poverty levels of the population. These can be introduced in ways that make the best use of regional land, water, and environmental issues.

3.1.2.4 *Biotechnology*

The development of biotechnology shall be supported to increase productivity in terms of both crop yield and animal husbandry and to assist with the achievement of the Millennium Development Goals.

3.1.2.5 *Environment*

The importance of preserving the environment has been recognised and environmental policies have been put in place. An environment policy was developed and adopted by Cabinet and the Environment organic law voted on by Parliament in June 2003. In 2004, Cabinet adopted a draft law establishing the Rwanda Environment Management Authority (REMA). Policies on the management of plastic wastes have been adopted and studies on bio-diversity and an environmental information system are in progress. (MINECOFIN, 2004)

A national forestry policy has been developed and a national forest protection agency and funds have been established. In 2003, the Rwandan Forestry Management Support Project (PAFOR) opened a line of credit of Rwf 500 million to promote private investment in the forestry sector. A Higher Forest and Wood Products School will be opened in collaboration with the Ministry of Education. (MINECOFIN, 2004)

3.1.2.6 *Water and Sanitation*

The problems of clean water and sanitation are prevalent in all provinces of Rwanda. In the rural areas, many people have no water at all leaving people to walk for hours in search of water. In addition, in rural areas only 0.8% of pit latrines satisfy hygienic norms.

3.1.2.7 *Energy*

Rwanda is currently facing an energy crisis in that the installed capacity of its generating plant is unable to meet the needs of country, particularly in the face of increased energy demands as the country continues on its development path. It is planned to promote scientific and technological activities that will increase access to electricity and provide good quality, cost-effective service, including the development of capacity in all areas of energy research, development and implementation, with particular regard to renewable energy and the protection of the environment.

In gas exploitation, the Government of Rwanda has initiated some negotiations with two private companies (Dane and Cogelgas). UPEGAZ and RURA are in place, and the Electrogaz management contract was signed between the Government of Rwanda and Lahmeyer International (LI). (MINECOFIN, 2004)

3.1.2.8 *Transport*

The ministries aim is to develop local Rwandan capacity in the design and construction of transport infrastructure, including bridges, viaducts and culverts.

3.1.2.9 *Information and Communications Technologies*

A network of Science and Technology resource centres, with supported libraries, shall be established at strategic locations throughout the country to provide access to students, teachers and researchers; they shall be linked with other Science and Technology information sources such as Government departments, colleges and secondary schools.

Since 1998, the Rwandan government has worked on a national framework for the development of an ICT sector, resulting in the ICT policy for Rwanda, adopted by the Cabinet at the beginning of 2000. The policy states the vision and strategies for transforming Rwanda's predominantly agricultural economy into a knowledge-based economy, through the adoption and development of ICTs and their applications. The principal policy instrument for this transformation is Rwanda's National Information and Communications Infrastructure (NICI) plan, which is supplemented by a blueprint of specific initiatives for achieving the policy objectives, in line with Rwanda's Vision 2020. Rwanda has established the Rwanda Information Technology Authority (RITA), responsible for catalysing and facilitating national and sectoral ICT strategies. (Nsengiyumva, A; Mutabazi, J-B & Okech, J, Page 17, 2003)

In addition, reform has resulted in the establishment of a multi-sector regulatory body, the Rwanda Utilities Regulatory Agency (RURA), in January 2003, with jurisdiction over several market sectors including energy, transport, communications and waste management. A key task for the agency will be to address the issue of universal access to all essential services, given that much of the population lives in rural areas where basic infrastructure such as water, electricity, telecommunication facilities and roads are still lacking. (Nsengiyumva, A; Mutabazi, J-B & Okech, J, Page 17, 2003)

A number of policies have been adopted by the government of Rwanda to ensure access to telecommunications facilities especially to underprivileged areas. The universal access Fund will be supported from 2.5% of the telecom companies' annual revenue and a certain percentage to be allocated from the government annual budget. The target that the government is working on is that within the five coming years the average distance to access a public phone will decrease from 15 to 3kms. (Nsengiyumva, A; Mutabazi, J-B & Okech, J, Page 17, 2003)

3.2 Science and technology landscape

Science, Technology and Research are key elements in the Government's Poverty Reduction Strategy and 2020 Vision, and are tools for economic and social progress and a means towards sustainable development through wealth creation.

3.2.1 S&T agencies

The institutional landscape defining the Science and Technology (S&T) set-up of the country is comprised of research funding, training, performing and utilizing organizations.

Table 3: Summary of key S&T agencies and functions

Agency	Established	Function
National Research Fund	Still to be established	Support and promote a well-managed and focused "public good" research programme.
National Council/Commission for Science, Technology and Innovation (NCSTI)	Still to be established	Independent advisory board

Both of the agencies mentioned are yet to be established by the Ministry of Science and Technology within the Office of the President. The Science, Technology and Innovation Policy created has been in existence for less than a year, and many of the strategies and organs mentioned are still to be established.

3.2.2 R& D Performing Institutes

The R&D performing institutions in Rwanda may be categorized in the higher education sector institutions, public sector research and technology institutes as well as private sector research institutes.

3.2.2.1 Higher Education Sector

The government recognises the need to develop the higher education sector in order to meet work force needs for nation building. To compensate for losses during the genocide and to address problems existing after 1994 several new institutions had to be created (in 1995/6 there was only one public Higher Learning Institution with less than 4,000 students), plus a number of private *Grands Séminaires*. Despite this, there are still relatively insufficient tertiary students (in 2001/2 academic year, only 15,940, of whom just 34.1% are female, for both public and private institutions: for public institutions only, 10,226 students, only 24.8% of whom are women). A cadre of university staff that is generally under-qualified is teaching these students. This has necessitated recruiting expensive expatriate lecturers, while simultaneously pursuing staff development abroad for local lecturers. The challenge for the sub-sector during the plan period will be to increase student numbers and improve quality while reducing costs. This will largely be achieved through efficiency measures including the introduction of formula funding, a cost-recovery student loan scheme and by widening the resource base, with encouragement for public Higher Learning Institutions (HLIs) to seek private funding. Bills, already drafted, will pave the way for this. Meanwhile scholarships will be awarded to enable higher education lecturers to undertake international masters and doctoral studies. (ESSP, MINEDUC, 2003)

The private institutions in operation in 1980–81 were as follows: Institut Africain et Mauricien de statistiques et d'économie appliquée, Grand séminaire de Nyakibanda, Faculté de théologie de Butare, Grand séminaire de Kabgayi, and Centre d'enseignement supérieur de Kigali.

Some private institutions that existed in earlier years have closed or have merged with other institutions; these include the Institut Africain et Mauricien de statistiques et d'économie appliquée, Institut supérieur catholique de pédagogie appliquée de Nkumba, and Ecole supérieure de gestion et d'information. (Education in Rwanda, World Bank 2004)

The institutions that currently exist are as follows:

- Public institutions
 - Université Nationale du Rwanda,
 - Kigali Institute of Science, Technology and Management,
 - Kigali Institute of Education,
 - Kigali Health Institute,
 - Institut supérieur d'agronomie et d'élevage, and
 - Institut supérieur des finances publiques.
- Private institutions:
 - Université libre de Kigali,
 - Université laïque de Kigali,
 - Institut supérieur de pédagogie de Gitwe,
 - Université adventiste d'Afrique centrale,
 - Grand séminaire de Nyakibanda,
 - Faculté de théologie de Butaré,
 - Grand séminaire de Kabgayi, and
 - Centre d'enseignement supérieur de Kigali.

Higher education in Rwanda expanded rapidly in the post-genocide years. Since 1997, three new public institutions have been created, the number of government-sponsored students has risen nearly 250 percent, and the public budget for the sub-sector has grown by a massive 340 percent, to a current level of almost Rwf 12 billion (nearly US\$27 million). The sub-sector currently serves a small population but absorbs almost 40 percent of the country's current spending on education. Given the obvious imbalance, it is no surprise that the future development of higher education has been the subject of recent policy documents tabled for discussion by the Cabinet. (Education in Rwanda, World Bank 2004)

Overall, the number of private institutions dropped from seven before the genocide to six afterward. The number of students and their distribution between public and private schools tracked the changes in the number of institutions. In the 1960s, the system as a whole enrolled perhaps 100 students; the UNR, for example, began with only about 50 students. In the 1970s, total enrolment stood at about 1,000, but by the end of the 1980s, it had risen to 3,000. Mainly the establishment of private institutions fuelled growth within the education sector during the 1980's, and the share of students in the private sector grew during the decade from 8 percent to 28 percent. Further expansion of the system in the early 1990s saw public and private enrolment rising to about 5,000. The private sector's share rose to about 35 percent just before the 1994 genocide. In the post-genocide 1990s, total enrolments more than doubled, reaching 11,000 by the end of the decade. The private sector share of enrolments fell in the years immediately following the genocide, when several institutions closed, but began

recovering as new institutions were established. In the early 2000's enrolments continued to grow throughout the system, reaching nearly 17,000 by 2001-02. The private sector grew even faster; its share of enrolments in that year was a historical high of 38 percent. (Education in Rwanda, World Bank 2004)

Table 4: Enrolment in public and private higher education Institutions by gender 2000-2001

Sector and name of institution	Male	Female	Total
<i>Public institutions</i>			
Universite Nationale du Rwanda (NUR)	3705	1135	4840
Kigali Institute of Science, Technology and Management (KIST)	1169	423	1592
Kigali Institute of Education (KIE)	689	270	959
Kigali Health Institute (KHI)	377	313	690
Institut superieur d'agronomie et d'elevage (ISAE)	420	106	526
Institut superieur des finances publiques (ISFP) ^a	85	36	121
All Public Institutions	6445	2283	8728
<i>Private institutions</i>			
Universite libre de Kigali (ULK)	1658	1592	3250
Universite laïque de Kigali (UNILAK)	117	163	280
Institut superieur de pédagogie de Gitwe (ISPG)	22	32	54
Universite adventiste d'Afrique centrale (UAAC)	208	237	445
All private institutions	2005	2024	4029
Total	8450	4307	12757

Source: Education in Rwanda, World Bank Study, 2004

3.2.2.1.1 Public Universities

Over the course of late July and early August 2006, the National University of Rwanda (NUR) and the Presidency jointly developed a "contract" based on the His Excellency Paul Kagame's vision of rejuvenating the University so that it can provide more relevant knowledge and skills for Rwanda's development needs. (Office of the President, 2006)

A detailed and time-bound work schedule of rebuilding NUR, beginning with a comprehensive needs assessment through various stages of scaling up the reinforcement of the different aspects of the University was developed. The university is now seen as the "engine of social and economic development" in terms of innovations and the commercialization of ideas

^a Now the Institute of Finance and Banking (IFB)

that lead to entrepreneurial activities and the formation of business enterprises. (Office of the President, 2006)

Clear milestones and indicators were identified within the time-bound work schedule, so that all measurable actions were achieved. In addition, every Faculty, School and Centre at NUR will be tasked to analyze how their programs and courses can more actively contribute to the nation's social and economic development and especially the challenges of:

- Skills development
- Agricultural output
- Entrepreneurial and business development
- ICT development
- HIV-Aids
- Secondary and university education, especially for girls
- Poverty alleviation
- Achievement of the Millennium Development Goals

The NUR Library consists of one main library and nine faculty libraries, all facing many problems: outdated books and a lack of funds to subscribe to journals, only four trained librarians and users of the library without experience of how to use search tools and online resources. To handle these problems SIDA is supporting a co-operative project between NUR and Makerere University in Uganda, where the appropriate training can be offered.

Internet connectivity still needs to improve, and the Government of Rwanda is in the process of providing a subsidy to the University for Internet connectivity. The computer to student ratio is currently 1:15, and the aim to decrease this figure.

Out of the total student population of 8072, 2307 students (including Masters level) are studying within the different fields of Science and Technology.

In 2001, National University of Rwanda - Centre for GIS and Remote Sensing was created as an inter-faculty unit aimed at:

- Developing a GIS and RS curriculum for instruction
- Assisting governmental and non-governmental institutions by providing training in the application of GIS and RS tools
- Developing research in various topics of national interest
- Assisting in GIS-based conservation research in conjunction with its main partner, Dian Fossey Gorilla Fund International
- Serving as a regional or central clearinghouse for all Rwanda geographic databases
- Serving as a mapping unit to respond to the needs of the community.

The centre has created many national, regional and international networks such as:

- *National:*
 - MINEDUC, ORTPN, KIST, ISAR, Rwanda Development Gateway Group, PEARL Project and many others
- *Regional:*
 - RCMRD Kenya, UCLAS Tanzania, CEAD South Africa, UNDP Nairobi
- *International:*
 - Dian Fossey Gorilla Fund International, Georgia Tech Institute, Development Gateway Foundation, International Institute for Geo-Information Science and Earth Observation (ITC)

The higher Institute of Agriculture and Animal Husbandry (ISAE) was created in 1989 in Busogo, and by February 2006, it had registered 619 A1 Advanced diploma engineers in the following areas: Soil Sciences, Agricultural Engineering, Animal Production and Crop Production.

Currently ISAE has 1057 students and produces approximately 250 graduates every year. Behind continued human resources development, ISAE wants, according to its Development Strategic Plan, to reach progressively to the number of 2200 students of Advanced Diploma level by the year 2010 without reducing its educational quality. This will lead to 600 graduates per year, which is in line with the need of the country as a whole.

Priority Departments to be launched from 2006:

<ul style="list-style-type: none"> • Soil management • Water resources management • Crop protection • Agroforestry • Agricultural mechanisation 	<ul style="list-style-type: none"> • Nutrition and animal feeding • Animal medicine • Extension • Rural development and Agribusiness
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Table 5: Teachers of ISAE

Level	Present situation 2006	Local	Expatriate
Degree	28	24	4*
MSc.	27	18	9
PhD	5	3	2
Total	60	45	15

* Degree level expatriates in 2006 are volunteers from Nigeria Source: ISAE Development Strategic Plan

The expatriate staff of ISAE comes from a variety of different countries: India, Nigeria, Burundi and the Democratic Republic of Congo (DRC). As the years progress it is part of ISAE's plan to slowly decrease and eventually have no expatriate staff members by the year 2015.

The institution's main source of funding is from the Government of Rwanda. The funds acquired from external sources are being utilized to increase training facilities i.e. Computers and Laboratory equipment and for research purposes in the areas of milk production and sustainable agriculture. The two countries providing these funds are the Netherlands and Canada, with the African Network of Agro forestry also contributing.

Since its inception in November 1997 as a project of the UN Development Programme, Kigali Institute of Science and Technology (KIST) have grown in strength with many international supporters. Its establishment was made possible by the combined efforts of the Government of Rwanda as the main stakeholder, UNDP (Rwanda) as the executor of the project and the German Agency for Technical Co-operation (GTZ) as the implementing agency. The initial funding for starting the institute came from UNDP core funding and a UNDP Trust Fund obtained from generous contributions by the Governments of Japan and the Netherlands.

It has introduced courses in computer and information technology, automotive, mechanical and electronics technology as well as electrical, civil and environmental engineering. KIST has forged collaborations with numerous institutions of higher learning throughout the world – in particular the Kaiserslautern University of Technology in Germany – to develop it into a renowned centre of excellence. (Murenzi, R & Hughes, M; 2005)

In 2001, KIST received the Ashden Award for sustainable energy, for developing an energy-efficient oven that uses 25% of the fuel required by traditional ovens. KIST subsequently established the Centre for Innovation and Technology Transfer to develop appropriate technology solutions for rural areas, including renewable energy. One area of focus for the centre is the development of biogas digesters that are installed in prisons and schools. (Murenzi, R & Hughes, M; 2005)

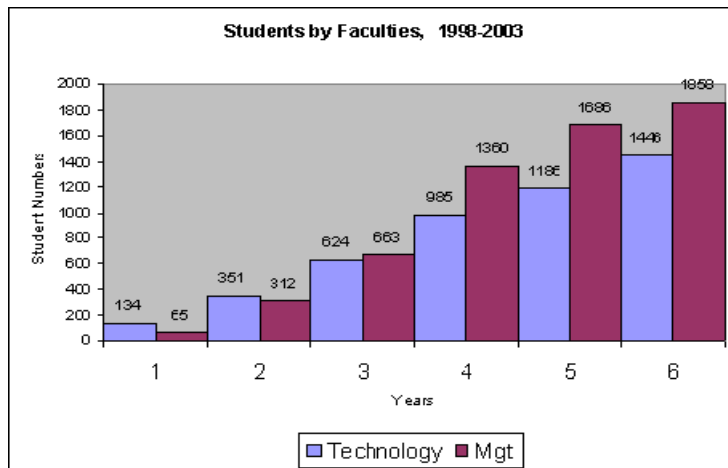
In July 2002, it held its first graduation, awarding 403 diplomas and 62 degrees to its 465 proud pioneers in management and compute science disciplines. Despite many challenges, KIST boasts a highly motivated and trilingual student population of 3247, enrolled in both regular and part-time undergraduate programmes. Students choose from wide variety of engineering and management course. KIST recently introduced a postgraduate diploma in demography and statistics. (Murenzi, R & Hughes, M; 2005)

Table 6: KIST Graduations

Date	Diplomas	Degrees	Total
2002	401	62	463
2004	355	428	783
2005	104	515	619

The student population grew from 209 in 1998 to 3,304 in 2003, an increase that went in tandem with the increase in the number of faculties and departments. Full-time students constitute 73% of the student population. More than 90% of part-time students enrolled in the Faculty of Management. The corporate target is an annual full-time intake of 600 students from 2002 onward: 360 in the Faculty of Technology and 240 in the Faculty of Management.

Figure 2: Student numbers by Faculties, 1998-2003



KIST has been admitted to membership in the Association of African Universities (AAU) and the International Association of Universities (IAU). KIST is also the African centre for Engineering and Technology Education, the first to be established in African with a second centre in Algeria (NACETE). Its mission is to facilitate the transfer of information and research on engineering education in the Eastern and Central African region. (KIST, 2005)

KIST has collaborated with many universities nationally, regionally and internationally in terms of curriculum development, external examining, joint research and consultancies.

Kigali Institute of Education (KIE) is a relatively new public institution of higher learning that started operating in 1999 and was legally established under KIE statute law NO. 49/2001 of 27/12/2001. The establishment and operation of KIE were made possible mainly through Rwandan government funding and some assistance of various donors. These donors include the World Bank, Swiss Co-Operation, DFID, USAID, UNESCO, German Cooperation, the French Cooperation and the Netherlands Government. (<http://www.kie.ac.rw>)

Kigali Institute of Education (KIE) held its second graduation in January 2007 that saw 956 students awarded with degrees and diplomas in various disciplines. Male graduates were 644 constituting 67 percent of the total graduates, who completed their studies in the Faculty of Science (BSc) and that of the Arts and Social Sciences. In the Faculty of Science, 237 graduates were awarded with Bachelors' degrees in Science while 166 graduated with diplomas in education. The diploma graduates are pioneers of KIE's distance learning programme. (www.kie.ac.rw.)

Even before the war and genocide of 1994, Rwanda had an inadequate supply of health workers both in number and in quality. This situation worsened due to the genocide that took place. To address the problem of insufficient health workers, the government then established the Kigali Health Institute (KHI) in June 1996.

The institute's mission is to train and develop human resources for Rwanda's health sector, proficient in most modern knowledge and skills, and committed to serving the health needs of Rwandans of all lifestyles.

The first three departments to be established were Anaesthesia, Physiotherapy and Nursing/Midwifery. As the institution progressively grew, more departments were introduced

such as Mental Health Nursing, Dentistry, Medical Laboratory Technology, Radiography, Environmental Health Sciences and an ophthalmic clinical officers program. The Centre for Continuing Medical Education was established in 2001.

The student population has grown from 96 enrolments in 1196 to 1020 in 2005, with a male to female ratio of 3:2. The majority of the students are government sponsored secondary school leavers who have majored in science or the equivalent. KHI also admits a small number of international students who come from neighbouring countries.

For the past ten years, the institute has only been able to award students with Higher National Diplomas (A1); however, from this year (2006) degree programs were introduced. The degree programs are in the fields of Nursing sciences, Midwifery and Physiotherapy.

The institute collaborates and is affiliated to many international universities such as: University of Makerere, University of KwaZulu-Natal, University of Cape Town, University of Witwatersrand, University of Western Ontario, University of Ottawa, Dundee University, to name but a few.

3.2.2.2 *Public Research Institutes*

Institute of Scientific and Technological Research (IRST) is a Rwandan Public Institute of Scientific and Technological Research based at Butare and created by the Organic Law in 1989. It is a multidisciplinary research institution. Its research centres handle research in several domains such as: Energy, Environment, Applied Mathematics, Phytomedicines, Rwandan flora, Essential oils, Biotechnology, Linguistics, Rwandan Literature and History as well as Psycho-Sociology.

Objectives:

- To handle fundamental and applied research orientated towards the applied sciences, phytomedicines, life and human sciences domains
- To contribute towards the research results valorisation
- Promote the development of relevant technologies
- Contribute to the administrative, scientific and technological training of staff
- To publish and disseminate the research results

IRST research is conducted in three Research Centres:

- Phytomedicines and Life Sciences Research Centre,
- Applied Sciences Research Centre and the Arts and
- Humanities Research Centre.

The institution faces challenges in terms of human capacity development, due to limited funds. ISRT also has infrastructural capacity problems with a need for more offices, laboratories, a new library and improved IT facilities.

Table 7: IRST Human Resources

	PhD	Masters	Bachelor's degree	Diploma	Total
Researchers	1 Rwandan 6 Expatriates	11	25		43
Research technicians			14	5	19
Admin / Technical Staff			21	10	31

The institute acknowledges that there are many limitations including that 80% of the staff is monolingual (Francophone) which then affects the kinds of research interactions that take place. There are no monetary incentives for staff that publish or excel in their field. Many of the researchers are young and new to the institute (70% recruited in June 2006) and therefore do not have the experience required manage large research projects.

IRST obtains 93% of its funds from the Government of Rwanda, and only 7% from internal resources and donor funds. Its dependence on the government for funding limits the institute's research activities. IRST is in the process of reinforcing their Resource Mobilization system (internal, donors & GoR) in order to upgrade the facilities and equipment.

The *Institute des Sciences Agronomiques du Rwanda (ISAR)* was established on 22 June 1962 through legislation. It replaced the former *Institute National pour l'Etude Agronomique au Congo (INEAC)*, which had mandates for research in Congo, Burundi and Rwanda during the colonial period. The ISAR mandate was established to promote the scientific and technical development of agriculture and livestock in Rwanda. The *Rwandan Institute of Science in Agriculture* has 12 research stations in different parts of Rwanda.

The inadequate link between research and technology transfer has been realized. For this reason, ISAR, the institute responsible for adaptive research is being restructured to better serve the needs of farmers. The major extension strategy has consisted of addressing the most crucial needs of training in the sector. (PRS, MINECOFIN, 2004)

3.2.2.3 *Private Research Institutes*

Dr. Fossey founded "The Dian Fossey Gorilla Fund International³ (DFGFI)" in 1978 to preserve and protect the world's last mountain gorillas. Dr. Fossey established the organization's flagship project, the *Karisoke Research Centre*, in 1967, between the *Karisimbe* and *Visoke* volcanoes (thus "Kari-soke") in the Rwandan sector of the *Virunga Volcanoes*.

Karisoke has generated a body of scientific literature on mountain gorillas, and served as training station for many currently active conservationists and primatologists who had their first field experiences there. Many of the Rwandan staff have more than 20 years of experience, and now participate heavily in scientific data collection. The centre has been able to develop a 30 year-record of data collection and analysis because of their continued dedication and expertise, particularly during Rwanda's devastating civil war and genocide, when they were the only ones capable of monitoring the mountain gorillas.

³ DFGF International is a completely separate organization from "The Dian Fossey Gorilla Fund – Europe", which is based in the United Kingdom.

Karisoke operates with a staff of more than 65 personnel. It maintains an office building, a housing complex for its field workers and trackers, two residences for its scientific staff, and a residence that houses student researchers from the University of Rwanda.

Karisoke continues to maintain databases on gorilla behaviour, demography, group compositions, and group ranging activities first begun by Dian Fossey in the late 1960's. Together, these form one of the longest running set of databases on primates in the world.

In addition to gorilla studies, through DFGFI staff and with Rwandan students from the National University, Karisoke supports a number of other key studies on Grauer's Rush Warbler, Golden monkeys, Buffalo, and the distribution and use of bamboo in the Volcanoes National Park of Rwanda, PNV (see "Karisoke Annual Report 2004"). The Karisoke-developed biodiversity manual, available on DVD, is a database with key descriptions for 1000 plants and animals in the Virungas, and is utilised in the two national parks in Rwanda. Karisoke maintains a herbarium of more than 600 plant species, and through another Rwandan institution, IRST, is building links to study medicinal plants in this region.

In partnership with the National University of Rwanda, Karisoke Research Centre has continued to encourage young students to develop their theoretical and practical training in biodiversity studies, conservation, and primatology through field courses and research projects in and around the PNV. During 2004, KRC provided scientific supervision and financial support for 45 students involved in field courses, and supported fully paid internships for three students from the Biology and Geography departments of the National University preparing their dissertations.

Karisoke also serves as important regional training centre. It has an active training program for the staff from the Rwandan wildlife authority, and has trained a number of field workers from the DRC. Karisoke also maintains strong links with the DFGFI-supported GIS centre at the National University of Rwanda.

3.3 *Human capital for S&T*

The Ministry of Public Service, Skills Development and Labour (MIFOTRA) is the primary custodian of the PRS objectives in line with the human resource development and institutional capacity building. The current Human Resource Development Agency (HRDA) will be reformed into the HIDA (Human Resource Institutional Development Agency). A proposed set-up of HIDA is currently discussed by Cabinet and will be submitted to Parliament. The HIDA will be the key institutional arrangement to implement the Multi-sector Capacity Building Programme (MSCBP). (PRS, MINECOFIN, 2004)

The MSCBP will improve co-ordination of key capacity building interventions and will facilitate efforts to strengthen institutional capacity building. This has been a significant development, which should enhance the management of capacity building initiatives in the future and lead to reduced poverty. The first part of the MSCBP will focus on the public sector, and is to commence in November 2004. Further strengthening of capacity for undertaking policy analysis and formulation will be achieved through the Institute for Policy Analysis & Research (IPAR). Further, Cabinet adopted a draft document on social security funds. (PRS, MINECOFIN, 2004)

Underemployment remains a significant challenge for Rwanda's development. It is however encouraging that labour-intensive public works related to non-agriculture employment such as construction and transport are growing fast. In 2003, one of Rwanda's ambitious programmes was set up with the aim of creating employment opportunities targeted at the poor. The stated

objective of PDL-HIMO (a multi-sectoral infrastructure labour intensive programme) is to create, within the 5 years of its duration, 322,000 direct jobs, and 564,000 induced jobs. This would then result in 65,000 permanent jobs being created. The 5-year budget for PDL-HIMO programme is estimated at US\$ 205 million. (PRS, MINECOFIN, 2004)

3.3.1 Size and structure of the R&D workforce

Rwanda's Science and Technology system is very young and therefore there are still huge gaps in the measurement of the size and structure of the R&D workforce. Initiatives are in the pipeline to assess the size of the research and development workforce, but the implementation of the new Science, Technology and Innovation Policy takes the fore now.

Table 8: Trends in enrolments and distribution by field, University of Rwanda, selected periods

Field of study	Average annual enrolments ^a			% Distribution of enrolments ^b		
	1980's	Post genocide 1990's	Early 2000's	1980's	Post genocide 1990's	Early 2000's
Humanities and social sciences	843	2467	2927	58.3	73.9	71.7
Law	126	573	366	14.9	23.2	12.5
Arts and human sciences	257	342	465	30.4	13.9	15.9
Education	153	310	727	18.2	12.6	24.8
Economics, social science and management	308	1180	1329	36.5	47.8	45.4
Journalism and communications	0	62	40	0.0	2.5	1.3
Applied and Natural sciences	602	870	1153	41.7	26.1	28.3
Medicine and health sciences	143	440	430	23.8	50.6	37.3
Science and technology	333	305	623	55.4	35.1	54.0
Agronomy	126	125	100	20.9	14.3	8.7
Total in specialized fields	1445	3337	4079	100.0	100.0	100.0

Source: Education in Rwanda, World Bank 2004

^a The three periods refer, respectively, to 1982-1986, 1994-1999 and 2000-02

^b Expressed as a percentage of total enrolments. The percentages of the two broad fields- humanities and social sciences, and applied and natural sciences – sum to 100%; the percentages for each individual field sum to 100 percent within each of these broad fields

The table above documents the evolution of enrolments and fields of study since the 1980's. One change is the large share of students enrolled in pre-specialized courses in the post-genocide era. A quarter of all students are enrolled in such courses, reflecting the new policy of requiring students to achieve bilingualism as part of their university studies. Setting aside these students, the pattern of enrolments shows dramatic shifts between the broad fields of the humanities and social sciences and the applied and natural sciences. In the 1980's, the distribution appeared reasonably balanced, with 58 percent of the students enrolled in the humanities and social sciences and 42 percent in the applied and natural sciences. In the post-genocide 1990's, enrolment shifted heavily in favour of the humanities and social sciences, raising the share of that field to 74 percent, a gain of 16 percentage points over the level in the 1980's. The concentration in humanities and social sciences has declined only marginally in the early 2000's, to 72 percent. Given the country's interest in linking into the global economy through increased capabilities in the hard sciences, it might be appropriate to evaluate the current patterns of enrolments across disciplines. (World Bank, 2004)

In particular, in view of the growth of the private sector, the question is whether the UNR is indeed offering courses that would not otherwise be available. Major shifts have also occurred within each of the two broad fields discussed above. The reorientation toward courses with an explicit labour market focus, to the detriment of more traditionally academic ones, is especially clear from the data for the humanities and social sciences. In the 1980's students studying arts and human sciences accounted for 30 percent of total enrolments in the humanities and social sciences, but their share fell to less than 16 percent in the early 2000's. By contrast, the proportion enrolled in economics and management rose from 37 to 45 percent. The share of enrolments in education fell in the post-genocide 1990's, perhaps reflecting a period of consolidation and reorientation in course content, but by the early 2000's the field had more than recovered, claiming nearly a quarter of total enrolments in the humanities and social sciences group. (World Bank, 2004)

The years following the genocide saw an influx of enrolments in law, to nearly a quarter of all students in the humanities and social sciences group, but the increase was short-lived. By the early 2000's, law students made up just over 12 percent of the total in the category, less than in the early 1980's. This seems to be one field where the number of enrolments declined as similar offerings have become available in the private sector. Within the applied and natural sciences, there is also evidence of major changes in the pattern of enrolment. Fewer students are studying agronomy; they made up less than 9 percent of all students in the hard sciences in the early 2000's, down from 21 percent in the early 1980's. The share of medicine and health sciences increased sharply in the post genocide 1990s, accounting for half of science enrolments during the period, but by the early 2000's it reduced to just over 37 percent of the total as the number of students stabilized at less than 450. Enrolments in science and technology picked up following a period of relative stagnation during the post genocide 1990's. The lull is similar to that in education enrolments, suggesting a pre-expansion period marked by consolidation and reorganization of course offerings in light of the evolution of the sector. (World Bank, 2004)

3.3.2 *Master and Doctoral qualifications*

It is difficult to establish precise categories of qualification. Part of the difficulty is that the same qualification label may refer to different levels of training, depending on when and where the training took place. To illustrate, the *licence* degree in the French system is awarded following a three-year course that is taken after passing the *baccalauréat* examination administered at the end of the secondary cycle. In earlier years, however, a four-year course was the norm. In the Belgian system, the *licence* degree may require four or five years of study. (World Bank, 2004)

At the UNR, the share of highly qualified staff has diminished since mid-1980, but the decline is surprisingly small, given the heavy losses in human capital during the genocide. In absolute

terms, only a quarter of faculty members (excluding medical doctors) currently hold doctorates, whereas nearly 44 percent have only a *licence* or a bachelor's degree (i.e., less than a *maîtrise* or a master's degree). The situation at the KIST at the top end of the qualification range is comparable to that of the UNR, but it is much worse at the ISAE. Among the public institutions, only the KIE has an impressively high stock of doctorate holders among its staff. In the private sector, faculty qualifications are generally not much better than at the UNR. For example, 40 percent of the ULK's full-time faculty lacks a postgraduate degree, and at UAAC 25 percent. (World Bank, 2004)

The overall picture, considering both public and private institutions, is one in which many faculty members in higher education are barely ahead of the students they teach. Given the high proportion of inadequately qualified staff, faculty upgrading is an obvious priority in staff development. At the UNR, one-third of the national full-time faculty in 2002 was pursuing additional training via overseas government scholarships. Of these, 55 percent was reading for a master's degree and 29 percent for a doctorate. These faculty members accounted for 14 percent of all students studying on overseas government scholarships but made up more than two-thirds of those pursuing studies at the postgraduate level. (World Bank, 2004)

3.3.3 *Human and institutional capacity development Strategies*

Currently only 20.5% (this figure is lower for girls) secondary school (second cycle) students are taking the various science combinations. MINEDUC plans to establish 12 secondary schools as centres of excellence in science and ICT. In 2003, the rehabilitation/extension of six schools through the Human Resources Development Project started, and four were completed. These schools will be provided with laboratory equipment and computers. MINEDUC has also started a project aimed at improving the teaching of science in the first secondary school cycle. (PRS MINECOFIN, 2004)

Meanwhile recent developments indicate that the National University of Rwanda (NUR) started the 2007 academic year, with the admission of 70 percent entrants into science studies. The sharp increase of students to enrol for Sciences at NUR is due to the Government's long-term strategy of turning the country into an Information and Communication Technology hub. According to the NUR vice Rector in charge of Academic affairs, Prof. Silas Mureramanzi, the increase of Science students is a magic bullet for Rwanda's envisioned development plan of Vision 2020. (The faculty of social sciences previously had high number of students at the national university for four decades of its existence). (The New Times, Kigali, 9 January 2007: <http://www.newtimes.co.rw/>).

Nearly, all university staff who talked to The New Times agreed that the 70 percent increase of science students is a good future strategy but very challenging in terms of human resource, infrastructure and equipment. "It is very challenging but the government is strongly behind us to turn these challenges into future opportunities. That is why we are not so worried," Mureramanzi said. According to information from the academic vice rector's office, an estimated 1000 students have been admitted on government sponsorship, with only 300 for social Science and arts faculties (The New Times, Kigali, 9 January 2007: <http://www.newtimes.cco.rw/>)

3.3.4 *Scientific mobility*

The lack of adequate skilled work force in Rwanda has created a formidable challenge in the country's efforts to embark on effective reconstruction and rehabilitation programmes that can help to open up avenues for social economic development. In that regard, the government of Rwanda believed that strengthening human and institutional capacity is fundamental in order to address such a challenge. Among the strategies opted for, was to use qualified expertise from the broad pool of Rwandan expatriate professionals living abroad. (www.toktenrwanda.org.)

The low quality and skill levels of Rwanda's institutions and the inadequate capacity of the government to attract and retain qualified Rwandans in the public sector have moreover been other barriers to poverty reduction programmes. Part of the solution to these problems is the use of TOKTEN Volunteer program to attract qualified Rwandan nationals living abroad in order to develop the human resource and strengthen the capacity of public and private sectors, civil society and NGOs that are involved in the socio-economic reconstruction development processes in the country. (www.toktenrwanda.org.)

The UNDP is a key actor in this program is working closely with the government of Rwanda to enhance national capacity through various development assistances. The TOKTEN program is an additional expansion of UNDP's scope of cooperation in developing Rwanda's work force and institutional capacity through its expatriate nationals. UNDP is responding to the pressing problem of the 'brain drain' with a highly development focused short term 'brain gain'. (www.toktenrwanda.org.)

3.4 *Financial resources (funding)*

Currently the Government of Rwanda, largely funds all of the higher education institutions and research institutions. All the institutions receive donor funding from various sources for small-scale research projects, but the majority of their funds are received from government. These funds cover administrative costs and staff salaries. Almost all of the institutions acknowledge that there is a need for greater involvement on their part in generating an income, to facilitate their research projects.

There are currently no figures available for the Government's expenditure on Research & Development within Rwanda. The only figures available are overall expenditure within each government department on recurrent and future expenditure, not specifically focused on Research & Development. However, there are plans to establish a research funding facility to promote science, technology and innovation.

As proposed in the 2005 National Science and Technology Policy, one of the committees of the National Council for Science, Technology and Innovation shall be the National Research Fund (NRF). The Government shall allocate annually 0.5% of the total budget to the NRF managed by the NCSTI for research and development activities oriented towards the development goals of Rwanda. (National Science, Technology and Innovation Policy, 2005)

Resources for R&D shall also be generated through participation in bilateral and multilateral research projects and through participation in regional and international scientific and technological programmes. (National Science, Technology and Innovation Policy, 2005)

S&T Institutions shall be encouraged to generate funds by commercialising their services and outputs for the promotion and expansion of their scientific and technological activities. (National Science, Technology and Innovation Policy, 2005)

The NRF shall enable the government to support and promote a well-managed and focused "public good" research programme. (National Science, Technology and Innovation Policy, 2005) The fund shall stimulate competition between researchers and research institutes. The fund shall also support scientific and technological research by giving seed money to innovative research, to the development of state of the art technology and equipment, and / or other contributions to the strategic and socio-economic development of the country. (National Science, Technology and Innovation Policy, 2005)

3.4.1 *International donor funding*

The United Kingdom (UK) and Belgium are Rwanda's first and second largest bilateral partners, followed by the Netherlands and the United States. Forty percent of the GoR's budget is donor-funded by grants or loans. Donors providing budget support includes the UK, Sweden, European Union (EU), the World Bank, and the African Development Bank (ADB). The active participation of the Ministry of Finance in donor co-ordination groups adds to their impact.

3.4.1.1 *Donor cluster groups*

Cluster groups within the donor sector include the Private Sector and the HIV/AIDS Cluster Groups, led by USAID. USAID works closely with Switzerland and the UK on governmental decentralization activities (Netherlands leads the cluster), and with Belgium on judicial reform and conflict management. Belgium is the lead on non-HIV health programs and gets strong policy support from USAID in that cluster. The United States is the lead donor on HIV/AIDS and works collaboratively with the World Bank and the Global Fund to Fight AIDS, Tuberculosis and Malaria. In rural economic growth and agriculture, USAID coordinates closely with the EU, the World Bank and the UK. USAID works with the UK, the lead donor in education, on girls' scholarships and the computerization of schools. Canada is the lead donor supporting the Ministry of Gender in charge of gender initiatives and USAID participates in the cluster to assure that gender considerations are part of its programs. Germany supports environmental programs and coordinates with CARPE.

Donor Agency	Focus	Funds
DFID in Rwanda	<p>The UK's development partnership with the Government of Rwanda focuses on poverty reduction and the achievement of the Millennium Development Goals, as well as the promotion of peace and stability in the Great Lakes region.</p> <p>In order to ensure that this funding has the best possible impact on the poor, we also provide targeted support for capacity building, with a focus on strategic planning and budgeting processes, civil service reform and strengthening statistical capacity. We have also provided substantial support in key areas including: education, helping to introduce fee-free primary education, land reform, agriculture and rural livelihoods.</p>	<p>Over the past 10 years, the UK has provided Rwanda with £200 million of development assistance, which has helped to fund Rwanda's remarkable recovery. DFID is currently Rwanda's main bilateral partner with an annual programme of £46 million in 2005/06, two-thirds of which is provided as budget support that we believe is the most effective way of funding the priorities set out in the Government of Rwanda's poverty reduction strategy. (Website)</p>
GTZ in Rwanda	<p>Since its foundation in 1975 GTZ has been working in Rwanda on behalf of the German Federal Government. In September 1994, GTZ was one of the first implementing organisations to resume its work in the country. Since 2000, Rwanda has been a priority country for German bilateral cooperation. (http://www.gtz.de/en/aktuell/595.htm)</p> <p>GTZ currently focuses on the following priority areas:</p> <p>Strengthening democracy, civil society and public administration with a focus on peacekeeping, health, family planning, HIV/AIDS prevention, Economic reform and development of the market system. GTZ contributes to these priority areas above all through advisory services in order to help the Rwandan population to build democratic structures and give them the opportunity to find their own way out of poverty. In Rwanda, GTZ works closely with the Centrum für internationale Migration und Entwicklung (CIM), the German Development Service (DED), InWEnt (Capacity Building International), KfW Entwicklungsbank (development bank) and the state of Rhineland-Palatinate. It coordinates closely with the European Commission and the World Bank. GTZ also manages refugee repatriation on behalf of the United Nations High Commissioner for Refugees (UNHCR). (http://www.gtz.de/en/aktuell/595.htm)</p>	
USAID in Rwanda	<p>The goal of USAID's assistance to Rwanda is to increase economic growth and improve the well-being of the population. The program focuses on three strategic objectives: improved governance and reconciliation, increased use of health services including HIV/AIDS care and prevention, and rural economic growth. (http://rwanda.usaid.gov/)</p> <p>All three programs use decentralization as a means of promoting change and improving livelihoods. USAID supports improved governance by increasing citizen participation, strengthening civil society, rebuilding the justice sector, and assisting the GOR with the implementation of decentralization. The health program focuses on building a decentralized health</p>	

	<p>system for family planning, reproductive health (RH), child health, malaria, HIV/AIDS and nutrition; improving access, quality and sustainability of basic health services; and empowering Rwandans to take responsibility for improving their health. USAID's economic growth program expands economic opportunities in rural areas by promoting value-added crops and increasing the diversity of off-farm productive enterprises. It focuses on agricultural productivity and the mobilization of financial resources for agriculture. (http://rwanda.usaid.gov/)</p>	
SIDA in Rwanda	<p>In an agreement signed in 2004, Sweden and Rwanda decided that cooperation should be targeted at: promoting peaceful and democratic governance and contributing to economic and social development based on the sustainable use of natural resources</p> <p>SIDA is supporting the operations of the Institute of Research and Dialogue for Peace (IRDP) in the country through War-Torn Societies Project International.</p>	<p>Its contribution for 2004 amounting to SKr 14 million. Research cooperation between Sweden and Rwanda is extensive and focuses mainly on capacity building at the National University of Rwanda in Butare. SIDA will be contributing SKr 78 million for the 2003-2005 period, money which will be invested in peace and conflict research, teaching methods, the environment, and other areas, all in cooperation with the technical institutes in Gothenburg, Linköping and Blekinge.</p>
CIDA in Rwanda	<p>Canada has been present in Rwanda since 1963 actively developing programs to improve the quality of life of the country's poor, as well as building infrastructure, justice, higher education and governance systems. (Website).</p> <p>Major program objectives include:</p> <ul style="list-style-type: none"> • Diversifying the rural economy; • Increasing agricultural production and productivity; • Reducing peasant farmers' vulnerability to the uncertainties of climate and market; and • Bolstering the capacities of decentralized local authorities and of rural associations to conceive and implement concrete local development plans. • Environmental protection, gender equality, and supporting the struggle against HIV/AIDS are crosscutting themes in all programming. 	<p>Since the civil war and genocide of 1994, the Canadian International Development Agency (CIDA) has contributed a total of \$219 million in aid to Rwanda, including \$10 million in 2003–2004</p>

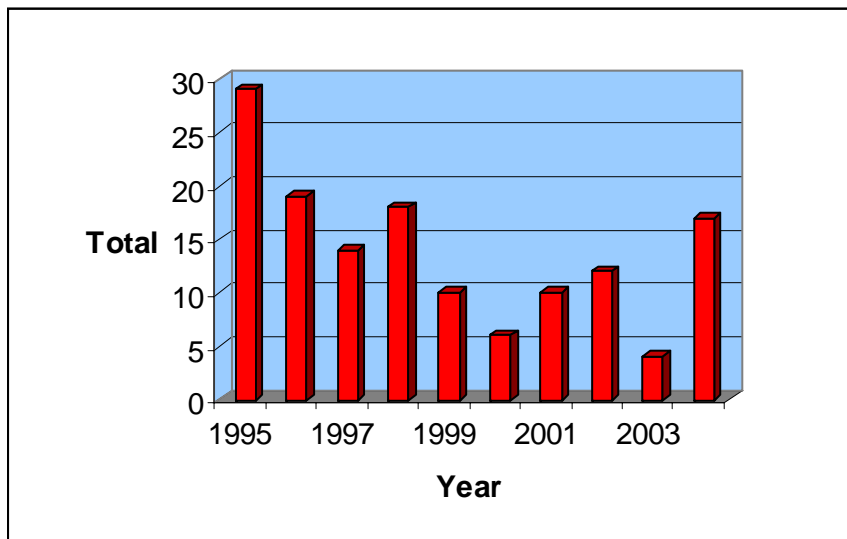
3.5. *Research outputs*

It is standard practice to measure research output in country studies in terms of peer-reviewed article output. Information on other forms of research outputs (books, conference proceedings, chapter in books and so on) is usually neither available in standard form nor always readily available at country level. In cross-country comparisons, it has also become standard practice to use output in one of the ISI-indexes (SCI, SSCI, or AHI) as sole source. This inevitably introduces various kinds of biases into such comparisons, as the ISI-indexes do not cover all countries, languages and disciplines equally well. It is a well-established fact that the coverage of those countries on the margin of world science, which is true for most if not all of Africa, is particularly poor.

While different databases provide different perspectives on trends in scientific publication output among African countries over the past decade, they agree at least on one point: in five years (1991-96), compared with Europe or with the rest of the world, Africa has lost 20-25% of its relative capacity to contribute to world science. (Gaillard, Hassan, Waast & Schaffer, 2005)

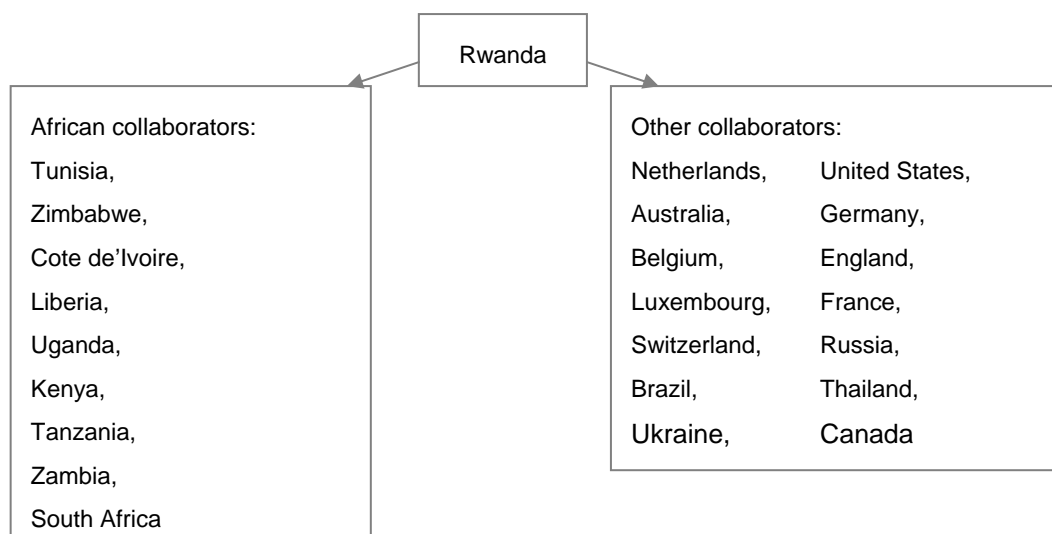
Where Rwanda's scientific publication output is concerned, there have not been many. When examining the Rwandan research output figures over the past nine years, they have only produced 139 research articles in total. When compared to a country like South Africa, which produced 2738 in 1998 alone the Rwandan publication output is extremely low.

Figure 3: Rwandan total publications per year from 1995 – 2004



It is evident that in almost all of the 139 cases Rwandan researchers collaborated with researchers from other institutions. Most Rwandan researchers collaborated with international researchers from other institutions, and not with their local counterparts. The different countries that Rwanda collaborates with are depicted in figure 4.

Figure 4: Country collaboration



3.6 Technological innovation

Business expenditure on R&D (BERD) and patent data are often used as a measure of a country's technological performance. This implies that indicators for technological innovation are useful for both input and output measurements. Similarly, the significance of technology in promoting human development led to the introduction of the Technology Achievement Index (TAI) by the United Nations Development Programme in its annual Human Development Report (HDR) in 2001. The TAI captures how well a country is creating and diffusing technology and building human skill base- reflecting capacity to participate in the technological innovation of the network age. This composite index measures achievements, not potential, efforts or inputs. The indicators selected relate to important technology policy objectives for all countries, regardless of their level of development. These are creation of technology measured by the number of patents granted to residents and by receipts of royalties and license fees from abroad (see technology balance of payments); diffusion of recent innovation measured by the number of internet host per capita; diffusion of old innovation (telephone per capita, electricity consumption per capita); and human skills as measured by mean years of schooling and gross tertiary science enrolment ratio. (UNDP, 2001:46)

Rwanda was not indexed according to the Technology Achievement Index due to lack of information.

3.6.1 Technology balance of payments

The external trade balance declined from a deficit of \$136.7 million in 2002 to \$153.7 million in 2003. On the export side, disappointing production of Rwanda's principal primary commodities in 2003, notably coffee, contributed to the worsening of the trade deficit along with a much weakened international market for columbite-tantalite. Higher consumption, especially non-food consumption contributed to around half the increase in imports, proving very inelastic in response to the exchange rate depreciation experienced throughout 2003.¹⁵ (PRS, MINECOFIN, 2004)

¹⁵ The continual depreciation of the Rwandan Franc against the dollar and the Euro is likely to have had an adverse effect on the trade deficit (measured in Rwf and relative to GDP), since many domestic manufacturers are reliant on foreign imports and may not have been able to adjust their consumption away from these increasingly expensive goods.

3.6.2 Patents

Table 9: Industrial property granted/registered

	Total	Residents	Non-residents
Patents granted, 1999	4	0	4
Marks registered, 1999	109	5	104

As can be seen from the table above, it is clear that Rwandan residents are not participating in the registration of patents and marks within their own country. In the case of the patents, those granted were to non-residents. It is therefore extremely important for the government to create a greater awareness amongst its residents regarding the benefits of registering their products.

3.6.3 Manufacturing sector

Rwanda has one of the smallest and most poorly developed manufacturing sectors in the region. Manufacturing accounts for about one-half of industrial output in value terms and less than 10% of total GDP. The sector is poorly developed and food, beverages and tobacco account for 80% of total manufacturing, a higher proportion than anywhere else in the region. Chemical industries account for 4% of total manufacturing, and textiles and clothing another 2%, which is the lowest share in the region. The private sector is in its infancy and the involvement of the state as producer and provider of economic essential services is widespread. (CRR, NEPAD, 2006)

There is no capital market in Rwanda in the conventional sense. Nine banks and six insurance companies in which the State is the dominant shareholder dominate the monetary and financial market. The state of the capitalisation of the economy is unknown, although it is clear that the State is the principal owner and the multinationals appear to come second while the SME's dominate in the informal sector. In the informal sector, family enterprises appear to dominate while public liabilities companies are present in the modern segment of the sector. (CRR, NEPAD, 2006)

It is estimated that there is a total of 60 businesses with annual turnover of Rwfr 100m or more registered in Rwanda, along with 5000 small and medium- sized enterprises. In recent years, service growth has been below that achieved in the economy as a whole, and appears to be the result of the termination of emergency relief programmes by most donor organisations. Rwanda has considerable tourist potential, but attracts only a small number of visitors, as it is geographically isolated. The country has been overcoming its history of political instability. (CRR, NEPAD, 2006)

The Government has taken steps to establish basic infrastructure through its Competitiveness and Enterprise Development Project funded by the World Bank. However, the country still lacks the key institutions of corporate governance, such as chambers of commerce and industry or genuine regulatory, supervisory bodies, including an institute of directors, association of accountants, association of auditors, association of brokers, association of dealers, association of investment advisers, association of notaries, and association of architects. Its Bar Association is very young and lacks sectoral and thematic expertise. (CRR, NEPAD, 2006)

More than 73% of the industrial enterprises are Small and Medium Enterprises (SMEs) employing less than 100 personnel. Industrial development is an effective source of growth creating interactions with other sectors such as agriculture and animal husbandry, transport, energy, information and communication technologies.

The Industrial Policy for Rwanda is designed to generate benefit, to create more jobs and to improve living conditions of households. All the strategies are oriented towards improvement of competition of Rwanda's industry on national, regional and international markets and towards production of high quality goods and services.

Privatisation of inefficient state enterprises has been identified as a major tool to lower business costs, improve quality and expand access to goods and services. Out of 69 firms to be privatised, 36 enterprises have been effectively sold to private entrepreneurs as of June 2004. In addition, nine state-owned companies are being liquidated. In 2003, privatisation receipts accounted for Rwf 367.5 million. To date, most of the proceeds from privatisation were used to repay the debts of the privatised companies and have been re-invested in other state-owned firms. (PRS, MINECOFIN, 2004)

3.7 International co-operation and networks

Rwanda joined the Common Market of Eastern and Southern Africa (COMESA) in 2004 and is one of the first four states on the continent to accept a peer review of governance under the auspices of the New Partnership for Africa's Development (NEPAD) and the African Union (AU).

The USA facilitated the signing of a Tripartite Agreement with Uganda and the Democratic Republic of Congo (DRC) in October 2004 to address regional border issues. Rwanda is also pursuing regional co-operation in infrastructure development through the northern, eastern and southern corridors. A variety of projects to improve the roads, extend the rail network and oil pipeline, and to develop water transport are either being implemented or explored. In particular, an on-going study is exploring the possible construction of a railway line between Tanzania and Kigali, which would give Rwanda a direct rail connection to Dar es Salaam.

There are also plans to extend the fibre-optic backbone network nationally and internationally, through the East African Submarine Cable System, which will provide the last loop to encircle African with a high-capacity telecommunications network. The East African coast currently has no direct links to the international fibre optic network, which is one of the main reasons why the region's connectivity is less reliable and costly. The East African Submarine Cable System (EASSy) therefore seeks to link Eastern and parts of Southern African to the international fibre optic system, which will lower costs of connectivity especially of the consortium members and cut on the substantial amounts of money that operators in this region pay to foreign carriers for routing their traffic. The countries involved in the consortium are Botswana, Burundi, Djibouti, Ethiopia, Kenya, Madagascar, Malawi, Mozambique, Rwanda, Somalia, South Africa, Sudan, Zanzibar, Tanzania and Uganda. (CIPESA, 2006)

The West African seaboard is serviced by SAT3/WASC and Atlantis-2 cable systems, while Flag and Sae-Me-We systems serve the North African seaboard. This makes the East African region exclusively reliant on satellite for communications, which makes Internet connectivity in the region more expensive and less reliant. This situation made East Africa one of the most "digitally excluded" regions in the world with just about 2% of the population connected to the Internet. Therefore, the proposed construction of the 9,900 km fibre optic system linking Mtunzini in South Africa to Port Sudan in Sudan was necessary to improve connectivity. Final commissioning of the network for commercial use is to be completed by the second quarter or 2007. (CIPESA, 2006)

3.8 Conclusion

Given its recent history, which culminated in the genocide in 1994, Rwanda is a very special case. The genocide devastated the Rwandan economy and destroyed much of the infrastructure. The loss of up to 1 million people and the emigration of many more obliterated the human resource base, especially trained personnel. Ten years on, the new government has succeeded in rehabilitating infrastructure, restoring public services, and re-establishing credibility. (Murenzi, R & Hughes, M. 2005)

Rwanda faces many challenges on its road to development, such as:

- Agriculture- the inability to meet the food and nutrition needs of the population
- Human resources- specifically science and technology education and research capacity, which is almost nonexistent at all levels of education
- Infrastructure- the need to improve access to infrastructure and basic services such as housing, energy, water and sanitation
- Health- improving nutrition and hygiene, and fighting malaria and HIV/AIDS; and
- Environment- the need to combat deforestation and soil erosion

These challenges together with its weak industrial base, weak purchasing power and land-locked nature, hinder development. Consequently, the Rwandan government recognised that it needed to develop the human resource base, particularly in science and technology, which has historically been marginalized.

However, Rwanda also boasts many advantages. These include the strength of its leadership, its small size, which means that development of infrastructure and interconnectivity is achievable more rapidly, a favourable climate; and increasing international visibility.

4. References

- An integrated Socio-Economic and ICT Policy and Strategies for Accelerated Development, February 2000, Government of Rwanda.
- Bigsten, A & Yanagizawa, D. (2006) Growth and Poverty Reduction: Evaluating Rwanda's First PRS Country Economic Report: 2005. SIDA
- Country Review Report of the Republic of Rwanda (2006). African Peer Review Mechanism. The New Partnership for Africa's Development (NEPAD)
- EDUCATION SECTOR STRATEGIC PLAN 2004 – 2008, October 2003, Ministry of Education, Science, Technology and Scientific Research
- Education in Rwanda: Rebalancing Resources to Accelerate Post-Conflict Development and Poverty Reduction (2004) World Bank Study, Washington D.C.
- Murenzi, R & Hughes, M (2005) Chapter 4: Africa in the global knowledge economy". In "Going for growth: Science, technology and innovation in Africa". Eds: Prof Calestous Juma. The Smith Institute
- National Science, Technology and Innovation Policy, August 2005, Ministry of Education, Science, Technology and Scientific Research. Republic of Rwanda
- Poverty Reduction Strategy: Annual Progress Report, MINECOFIN, 2004, Ministry of Finance and Economic Planning. Republic of Rwanda
- Rwanda's Health Sector Policy, February 2005, Government of Rwanda.
- The East African Submarine Cable System (EASSy): The Open Access challenges and debate. (2006) Collaboration on International ICT Policy for East and Southern Africa (CIPESA)
- 2020 Vision Draft 3: English version, November 2002, Ministry of Finance and Economic Planning. Republic of Rwanda
- The New Times, Kigali, 9 January 2007: <http://www.newtimes.co.rw/>
- Transfer of Knowledge Through Expatriate Nationals (TOKTEN) Project <http://www.toktenrwanda.org/>
- World Development Indicators database, April 2006
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Appendix 1

Table A: Highlights of Institutions' development

1936	The first institution of higher education, the diploma-granting Grand seminary de Nyakibanda (GSN), was established by the Roman Catholic Church specifically to train men for the priesthood
1962	The Institute des Sciences Agronomiques du Rwanda (ISAR) was established on 22 June 1962 through legislation.
1963	The founding of the Université nationale du Rwanda (UNR; in English, National University of Rwanda, NUR) under a joint agreement between the Rwandan government and the Dominican Fathers from Québec Province, Canada
1966	The Institut pédagogique national (IPN; in English, National Institute of Education) was established with support from the United Nations Development Programme (UNDP) and the United Nations Educational, Scientific, and Cultural Organization (UNESCO); its mission was to train secondary school teachers and conduct research in education.
1976	In the private sector the Institut Africain et Mauricien de statistiques et d'économie appliquée (IAMSEA) was established in
1981	The IPN was incorporated into the UNR
1984-1986	In the private sector, the number of institutions doubled, from three to six, with the addition of the Université adventiste d'Afrique centrale (UAAC) in 1984, the Ecole supérieure de gestion et d'information (ESGI) in 1985, and the Institut supérieur catholique de pédagogie appliquée de Nkumba (ISCPA) in 1986.
1986–87	The public institution: the Institut supérieur de finances publiques (ISFP) was established
1988–89	A year later another public institution: Institut supérieur d'agronomie et d'élevage (ISAE) was established
1993	In the private sector the Institut supérieur de pédagogie de Gitwe (ISPG) was established only to close the following year.
1994	After the 1994 genocide, three more private institutions—the IAMSEA, the ESGI, and the ISPCA—went out of existence.
1996	The FTB and the UAAC reopened in 1996
	A new private sector institutions was established, the Université libre de Kigali (ULK)
	The founding of the Kigali Health Institute (KHI)
1997	The ISPG was reopened
	A new private sector institution: The Université laïque de Kigali (UNILAK)
	The Kigali Institute of Science, Technology and Management (KIST) was established.
1999	The Kigali Institute of Education (KIE) in 1999

Table B: Summary of major policies driving research and institutional programmes

Policy/Act	Date
National Science, Technology and Innovation Policy	2005
Health Policy	2005
Agricultural Policy	2004
Organic Budget Bill	2004
Higher Education Bill	2003
Environment Organic Law	2003
Education Sector Strategic Plan (ESSP)	2003
Education for All Action Plan	2003
Rwandan Constitution	2003
Labour Law	2003
Poverty Reduction Strategy	2002
National Investment Strategy	2002
Education Policy	2002
Vision 2020	2002
ICT Policy	2000
