The Republic of Rwanda's Policy on Science, Technology and Innovation

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UNU-IAS Report

The Republic of Rwanda
Policy on Science, Technology and Innovation

Acknowledgements

The Vision 2020 for Rwanda highlights the crucial role that Science and Technology will play for Rwanda's development. This Policy document has been written to build on the immense work that has been done since 1994 to develop Rwanda, in order to enhance the Science, Technology and Research capacity, and to reinforce the development pillars of Vision 2020, across all sectors of the Rwandan economy.

His Excellency, Paul Kagame, The President of Rwanda has acknowledged the extreme importance of not working in isolation but learning from the experiences of other countries both from our neighbours in the region and also internationally. It is in this respect that I am delighted to acknowledge the many people both at home, regionally and internationally who have worked with us to ensure that this document comprehensively embraces all areas of science and technology that we need to strengthen and reinforce in order to meet the aims of our vision.

International Support has been given from experts on Science, Technology and Research Policy, including: Dr Vijoleta Braach–Maksvytis – former Global Director, Commonwealth Science Industrial Research Organisation (CSIRO), Australia, Dr Fiona Clouder–Richards - Head of Science and Innovation at the Foreign Commonwealth Office, UK, Dr Richard Hall - Deputy Director, International Foundation for Science, Sweden, Dr Eamon Kelly - Tulane University and former Chairman National Science Foundation, US.

Regional and National Support has been given from, among many others: Prof Brig. Gen. Yadou M.Kohi - Director General Tanzania Commission for Science and Technology, Prof. Zerababel Nyiira - Executive Secretary Uganda National Council for Science and Technology, Prof. Mannaseh NSHUTI – (then) Rwandan Minister of Commerce, Industry, Investment Promotion, Tourism and Cooperatives, Dr Jeanne d'Arc Mujawamariya – Rwandan Minister of Education.

Our National Science, Technology and Innovation Policy was developed with the help of considerable support from our development partners, in particular I would like to highlight the following key events:

September 2004, with support of the World Bank
- Advisor Science and Technology Appointed;

November 2004, with support of DFID / UNESCO
 - Concept paper CSIRO – Preparatory National Integrated Innovation Framework for Rwanda;

December 2004 – April 2005
- Drafting of initial policy document with extensive consultation with key stakeholders

May 2005, with support of DFID
- National Science and Technology Conference in Butare to review draft Policy Document. This was opened by His Excellency Paul KAGAME, President of the Republic of Rwanda, and, on behalf of our development partners, Jeremie Macadie, the UK Ambassador.

July 2005,
- Approval of the National Policy on Science, Technology and Innovation by the Rwandan Cabinet.

August 2006, with support from UNECO and United Nations University
 - Publishing of the Policy on Science, Technology and Innovation

The above national science and technology conference was also attended and supported by Ambassadors and Heads of Mission of our development partners in Education, Science, Technology and Scientific Research, including: UK, USA, Netherlands, Sweden, Germany, Belgium, South Africa, France, Japan, Canada, China, Kenya, Uganda, Tanzania, Russia, UNDP, DFID, World Bank, and many others. All of these have continued to support Rwanda throughout the past decade in the development of science and technology, either through technical on the ground support in Rwanda, or through scholarships in their countries to Rwandan students of Sciences.

The conference and policy development was also supported by many Rwandan Cabinet Ministers whose sectors are related to Science, Technology and Research, including: Professor Manasseh Nshuti, (then) Minister of Commerce, Industry, Investment Promotion, Tourism and Cooperatives, Dr Patrick Habamenshi, (then) Minister of Agriculture and Animal Resources, Mrs Drocella Mugorewera, (then) Minister of Lands, Environment, Forestry, Water, and Mines, Mr Evariste Bizimana, (then) Minister of Infrastructure, Dr Jean Damascene Ntawukuliryayo, Minister of Health, and Ministers of State: Eng Albert Butare; Professor Bikoro Munyanganizi; Mrs Patricia Hajabakiga; Dr Daphrose Gahakwa; and Dr Innocent Nyaruhirira. Plus many other key stakeholders from both academia and private industry in Rwanda, including the rectors of Rwanda's institutes of Higher Learning, (National University, Kigali Institute of Science and Technology, Institute of Agriculture and Animal Husbandry, Kigali Health Institute and Kigali Institute of Education), together with representatives of the Rwanda Private Sector Federation.

Following extensive discussion and debate on the draft policy document an eight person drafting committee, drawn from senior members of academia, civil society and private sector, was formed to fine tune the policy document using both the feedback from the conference and further consultation with key stakeholders. I acknowledge the support of this drafting committee which comprised as follows:

Prof. Silas Lwakabamba, (Chairman)
Prof. Chrysologue Karangwa, (Vice Chairman)
Dr Rose Mukankomeje, (Secretary)
Mike Hughes, (Coordinator)
Prof. Kalisa Mbanda,
Leopold Mukama,
Claver Yisa,
Emma Rubagumya,.

On July 7th 2005 - Letter from Professor Chrysologue Karangwa on behalf of Drafting Committee: "I am pleased to inform you that the Committee you appointed, following the Science and Technology Policy Conference of 5th and 6th May 2005, to oversee the revisions to the draft National Science and Technology Policy document has now completed its task."

I am very grateful to the support of Professor Joseph Massaquoi (UNESCO) and Dr M. Taeb and the United Nations University Institute of Advanced Studies (UNU-IAS) for all their support in the publishing of this document.

I know there were many others who also participated and supported in the process and for you and all the above mentioned I gratefully acknowledge your support.

I look forward to seeing the words in this policy document converted into solid actions that will help transform Rwanda into the technology led, knowledge based economy envisioned for our future.

Professor Romain Murenzi
Minister in the President's Office in Charge of Science, Technology and Scientific Research

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Preface

As we launch in Rwanda our National Policy on Science, Technology and Innovation, let me state at the outset that the application of science and technology is fundamental, and indeed, indispensable in the social and economic transformation of our countries. Productive capacities in modern economies are not based merely on capital, land, and labour. They are also dependent on scientific knowledge and sustained technological advances.

The National Policy on Science, Technology and Innovation is signal to us in Rwanda that we have begun to give science and technology their due importance in our development processes. But where are we starting in applying scientific knowledge to address our development challenges?

Educational and training patterns in post-colonial Rwanda do not significantly differ from those in the rest of Africa, especially with regard to the centrality of science and technology or research and development. Scientific knowledge is under-utilised generally, while our knowledge centres which were never strong in the first place, have been in decline over the past several decades. Rwandan situation was exacerbated by the 1994 genocide, which led to the loss of our meagre human and infrastructural resources in our science base.

But we now have a vision on science and technology, which we believe is the surest route to developing our nation. Our Vision 2020 envisages Rwanda as "a modern nation, able to generate and disseminate technological knowledge and innovation", and as "a centre of excellence at a regional level in the area of technologies, particularly with ICT."

Building on that Vision, we now have a National Policy on Science, Technology and Innovation. The principle objective of this policy is: "To integrate Science, Technology, Scientific Research and Innovation in the context of the issues facing Rwanda."

In this policy, we are now ready to embark on an ambitious, but actionable plan, for the strengthening of science and technology across all sectors of our economy. These measures we take must include the establishment of a legal and regulatory framework governing Science, Technology and Research, together with numerous proposed interventions within education and across all sectors to strengthen the capacity for science, technology, and research.

We are not starting from a total vacuum. On the contrary, we have a number of institutions that together provides a foundation for applying science and technology for development. The following institutions, for example, should redouble their efforts in terms of concreting on their core businesses:

• The National University of Rwanda, should continue to carry out High Level Education in Applied Sciences and develop research programmes appropriate to our development needs;

• The Agricultural Sciences Institute of Rwanda should carry out agricultural research, and most importantly, ensure the transfer of technology to our agricultural producers;

• The Science and Technology Research Institute (IRST) should continue to conduct fundamental and applied research;

• The Kigali Institute of Science and Technology should focus on its core vision of Science and Technology, and it is our ambition that KIST becomes increasingly recognised as a centre of excellence for the region in this field;

• A Centre for Innovation and Technology Transfer (CITT) has already been set up, building on the success of the Kigali Institute of Science and Technology should innovate and internalise technologies from outside the country;

• The Kigali Health Institute should train health staff, inculcating in them the use of scientific and technological processes in their profession;

• The Institute of Agriculture and Animal Husbandry should develop programmes for scientific training in agriculture and animal husbandry;

• The Kigali Institute of Education should lead in the training of high calibre teachers at all levels of our school system, capable of promoting awareness of the role of science and technology in a nation's socio-economic development;

These knowledge institutions will continue to be supplemented by our Private Sector Institutions, which, together, should help to adopt science and technology as a recognised tool in our national development strategies.

Let me emphasize, however, that we in Rwanda are embarking on our scientific and technological course from a particularly challenging position. But if we begin on this journey on a sure footing by implementing the National Policy on Science, Technology and Innovation vigorously, and learn from those that have travelled this path ahead of us, we can leapfrog at least the mistakes others made, while drawing good practices, as opposed to "reinventing" the technological wheel.

His Excellency Paul Kagame
President of the Republic of Rwanda

Foreword

This publication is about the will of a nation that is determined to leave behind the horrific memory of the genocide in 1994, and build a prosperous society, and a country that would be proud of its achievements. Undoubtedly, knowledge , planning and determination would be the core spirits that would lead the country's reconstruction, however, that is not enough, technology is needed to enable courage and determination to bear results.

The importance of technology in economic development is well understood, but what is less understood is how to put knowledge, creativity, market, politics, and resources together in a manner that they contribute to economic growth and rise in productivity. This document is intended to guide the Government agencies in Rwanda just how to do that. It is the product of tireless and continuous efforts by the Government of Rwanda and a large number of individuals who have contributed to its development, the United Nations University Institute of Advanced Studies (UNU-IAS) is pleased to contribute to these efforts by publishing this document.

Adopting the right policies is a critical and an important issue in creating an enabling environment for science and technology development in developing countries. UNU-IAS is committed to enhance the capacity of developing countries in this regard. Policy research and human capacity development in policy matters related to science and technology are important contributions by the UNU-IAS in building the policy making capacity of developing countries.

I sincerely hope that the present policy document will assist the Government of Rwanda in its efforts to employ science and technology as a core element in its socio-economic development.

A.H. Zakri,
Director,
United Nations University
Institute of Advanced Studies

1 Introduction

1.1 Overview

In 1997-98 the Office of the President of the Republic of Rwanda took the initiative to organise discussion sessions on the future of Rwanda. On the basis of the ideas agreed at the discussions the Vision 2020 document was born and further developed to become a high level vision of the future of Rwanda. In short this vision for Rwanda's future looks towards the achievement of "a modern and Prosperous Nation, strong and united, worthy and proud of its fundamental principals"

The development of Science and Technology capacity in Rwanda shall support the development of the people of Rwanda within a prosperous knowledge-based, technology-led economy.

The science and technological knowledge attained shall contribute to the desire for, healthy, educated citizens, professionally qualified, who are eager to be informed and constituting real wealth for the country.

The development of Science and Technology shall be in partnership with the growth of an innovative, modern and competitive Private Sector geared towards revival of industry and the service sector.

In particular the developed Science and Technology sector shall:

• **Stimulate a steady growth in GDP**

• **Advance the quality of life for all the citizens of Rwanda**

• **Improve Skills and Knowledge among the population**

• **And integrate Technical Education with commerce, industry and the private sector in general.**

This policy document on the development of Science, Technology and Innovation focuses on the many challenges that need to be overcome in order to meet "Vision 2020".

In order to maintain the focus the following diagram illustrates how a strong foundation in Science and Technology can support the vision of the future of Rwanda.

| The reconstruction of the nation; | An efficient State, capable of uniting and mobilizing 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. | Vision 2020 Pillars |

Science, Technology & Research – National Integrated Innovation & Enabling Framework

Ministry & Institution Policies, Plans and S&T Strategies

Main Implementing Institutions

Capability Building

Science and Technology in Support of Vision 2020

Figure 1 - How a strong foundation of Science and Technology can support the development of Rwanda towards Vision 2020

1.2 Rural Transformation

One key consideration is to maintain viability of rural areas to prevent burdens associated with rapid urbanisation experienced by many developing countries. In these countries as rural livelihoods declined they were not replaced by employment opportunities in other sectors. The rural population had no choice but to shift to urban areas to seek their livelihood. Rwanda is well positioned to strategically choose to enhance opportunities for growth in its rural areas, and avoid urban slum issues. Rwanda's advantage of small size makes connectivity viable in terms of ICT, transport, multiple service including hubs.

The following diagram illustrates the role of Science and Technology, and the rural school in particular, to address cross-sector needs in rural communities and, rather than shut down rural opportunities turn the rural location of the population into an advantage.
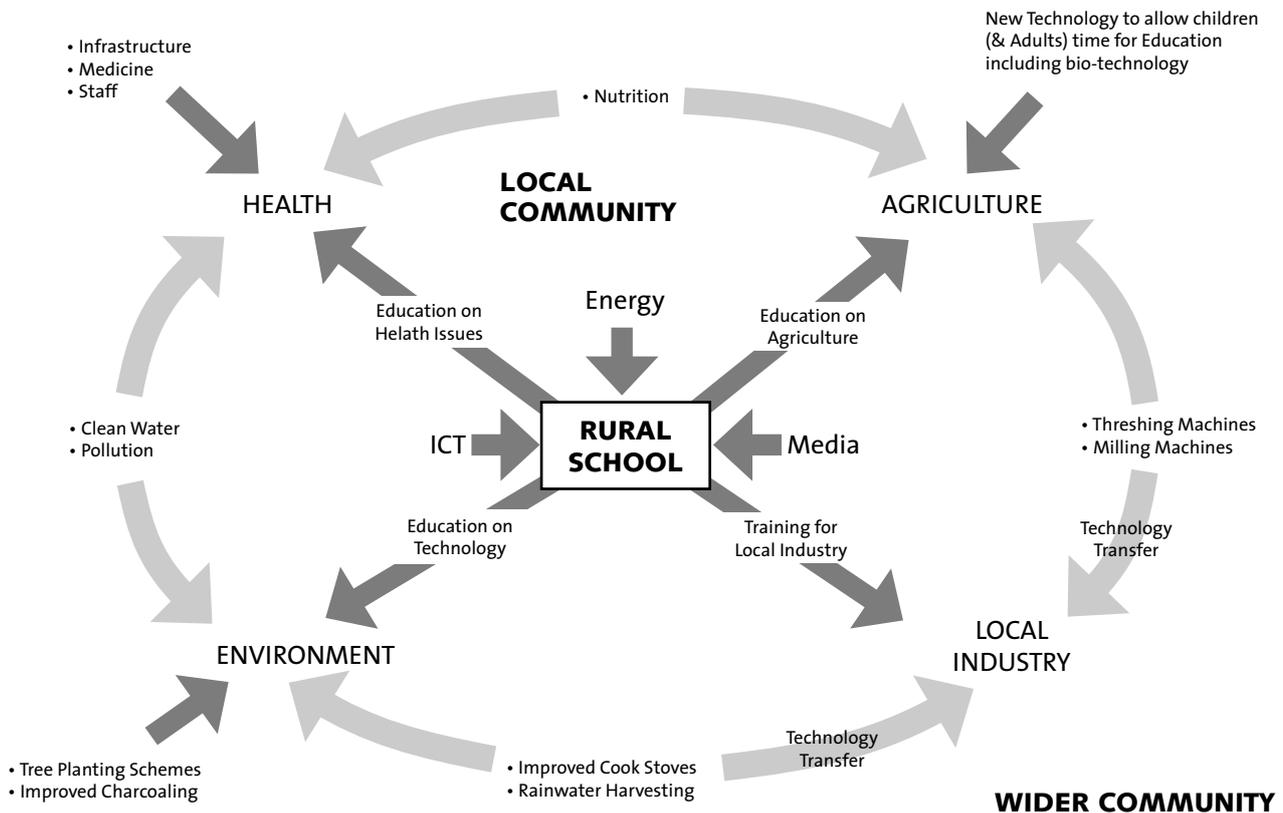
Figure 2 – Education for Technology Access to Rural Rwanda

1.3 Economic Transformation

Science, Technology and Innovation is increasingly recognised internationally as important factors in the economic transformation of developing countries.

There is a very strong awareness within all the sectors of Rwanda's economy of the interventions that need to be taken to develop the country in line with Vision 2020. This policy document reviews the policy and strategies in place in various sectors and details the science and technology policies and strategies that can enable science and technology to be strengthened to support transformation and growth of all sectors of Rwanda's economy.

2 Background

The recent history of Rwanda, which culminated in the genocide of 1994, devastated the Rwandan economy and destroyed much of the infrastructure. Tragically the loss of up to one million people left the human resource base, in particular of trained personnel in a desperate situation.

Ten years on the new Government has succeeded in re-habilitating infrastructure, restoring public services and re-establishing a credible government in the eyes of both the people of Rwanda and the international community. Rwanda has no appreciable natural resource mineral base. The Government of Rwanda has realised therefore that, in order to develop the country, it needs to develop the human resource base in particular in the areas of science and technology. The starting point is very low as historically the development of science and technology has at best been marginalised.

There is a strong recognition of the importance of Science and Technology in the development of Rwanda. The words of Rwanda's President, His Excellency Paul Kagame:

"Rwanda's development shall ultimately depend on the development of our human resource base and that of the people, with whom we share our destiny."

"We shall continue to invest in our people and we shall strive to open up the frontiers of science, technology and research as we broaden our trade links with our neighbouring countries and beyond."

The current population of Rwanda is estimated at 8,128,553 (08/2002) inhabitants. 49% of the population are under 14 years old with 60% less than 20 years old. There is an es-timated 400,000 orphans with 20% of these as head of their household. The ratio between men and women is male - 46%, and female: 54%, with an estimated 42% widowed. 35% of all households are headed by women

Landlocked between Uganda, Burundi, Tanzania and the Democratic Republic of Congo (DRC), Rwanda is situated in the central part of Africa. It has an area of 2.6 millions hectares of which 1.4 are suitable for cultivation. The country is characterised by an uneven mountainous land with an average height of 1,500 m above the sea level. This topography has led Rwanda to be given the name "Land of a Thousand Hills". The country lies at latitude between 1° and 3° South and at longitude 29 –31° East and has a mountainous tropical climate. Despite its proximity to the Equator, the climate in Rwanda is cooled by the high altitude. It is warm throughout most of the country and cooler in the mountains. There are two rainy seasons: February to May and mid-September to December.

Rwanda is one of the poorest countries in the world. In 2000 there were greater than 64% of the population below the poverty line of 1US$/day/person. Its economy is mainly agricultural and over 90% of the population live on subsistence agriculture in rural areas. The industrial sector is still in its early stages and consists of factories which mainly transform imported semi-manufactured products.

The constitution mandates that women hold at least 30 percent of all positions in government and other decision-making positions. The 2003 elections trumped even this ambitious goal, swearing in a new legislature that was 48 percent female. In 2005 out of the 28 cabinet ministers, 36 percent were women.

Table 1 Rwanda Statistics

Area	
Total Area, km2	26,337
% farmed	46
% in natural and planted forests	19
Demographics	
Total population, 2002	8,162,175
% Overall population growth	2.9
% of population living in urban areas	10
% of population living in rural areas	90
Population density per km2	310
Life expectancy, 2002	49
% Population engaged in agriculture	90
Daily calorie supply, % of requirement	82
% Adult Literacy (> 5 years)	52
- Female	48
- Male	58
Key macroeconomic indicators	
Total GDP, 2002 (million FRW)	812,268
Per capita GNP (US$)	263
Poverty (%<1US$/Day) (Situation in 2000)	64
Agriculture as %of GDP	47
Industry as % of GDP	18
Gross domestic savings as % of GDP	3.6
Total exports, $US million	47
Exports, coffee, $US million	14.1
Exports, tea, $US million	13
Total imports, $US millions	253.3
Imports, food, $US million	46.1
Imports, energy products, $US million	49.2
Key energy use indicators	
Traditional energy consumption as % of total (firewood & charcoal)	94
% of population using electricity	6

Source: Rwanda Development Indicators 2003 Poverty Reduction Strategy Paper National Forests Policy Agriculture Policy

3 Science and Technology Policy Objectives

3.1 Principal Policy Objective

"To integrate Science, Technology, Scientific Research and Innovation in a framework that shall include capability building, technical transfer initiatives, and the promotion of innovation, in the context of the issues facing Rwanda. Science, Technology and Scientific Research shall be catalyst to underpin all public and private sector activities to enable Rwanda's Vision 2020 to be realised."

3.2 Specific Policy Objectives

Science and Technology statement in Vision 2020

"Rwanda becomes a modern nation, able to generate and disseminate technological knowledge and innovation. The Rwandan nation has integrated these with its fundamental cultural values in its socio-economic development, as factors of creativity, productivity, job creation and well being. The country then becomes a centre of excellence at a regional level in the area of technologies, particularly with ICT."

One of the key objectives of the Science and Technology Policy is to help overcome the challenges and problems across all sectors of the economy.

The overriding objectives of this policy are as follows:

• 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.

Capability building in Science and technology 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.

3.2.1 Knowledge Acquisition
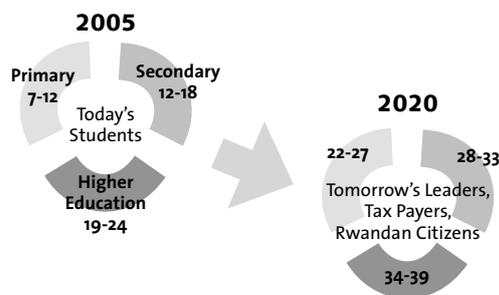
Figure 3 – Students in today's education system will be the citizens of year 2020

The principal areas for knowledge acquisition start at Primary level and move up through Secondary to Vocational, Technical, and Higher Institutions of learning as illustrated in the following diagram:

Objectives		Interventions / Enhancements
Cultivate Interest in Science and Technology	Pre-Primary & Primary Schools	Quality of Teaching Quality of learning environment Quality of teaching aids
Retain Interest in Science and Technology	Lower Secondary Schools Upper Secondary Schools	Laboratories & Lab. Equipment Quality of Science & Technology Teaching
Train competent artisans to give high quality support to the development needs of Rwanda	Vocational Training Institutions	Quality of Teaching & Curriculum Inst. Infrastructure Technical Equipment
Train high level technicians to give high quality support to he development needs of Rwanda	Technical Training Schools	Quality of Teaching & Curriculum Inst. Infrastructure Technical Equipment
High level theoretical and practical training for medical practitioners, technologists in various fields, agriculturalists, scientists, engineers, doctors etc.	Higher Academic, Technical & Professional Institutions NUR, KIST, IRST, ISAR, KHI, ISAE, KIE	Quality of Teaching & Curriculum Inst. Infrastructure Technical Equipment

Figure 4 – Objectives and interventions at all levels of Science and Technology Education and Training

3.2.3 Knowledge Creation

Research Capability shall be developed in all priority sectors of the economy

• The strategy includes the establishment of a National Council/Commission for Science, Technology and Innovation to direct and guide the national plan of research.

• Also the investment in training and development of international partnerships in high quality Research to meet the development needs of Rwanda.

• The strategy includes the high level equipping of all research institutions also to provide high level theoretical and practical training to produce high calibre scientists, engineers, doctors etc. These shall take the lead in developing high quality scientific and technological research relevant to all the priority needs of Rwanda that shall assist in Rwanda's development.

3.2.4 Knowledge Transfer

Science and Technology Capability shall be reinforced in all priority sectors of the economy.

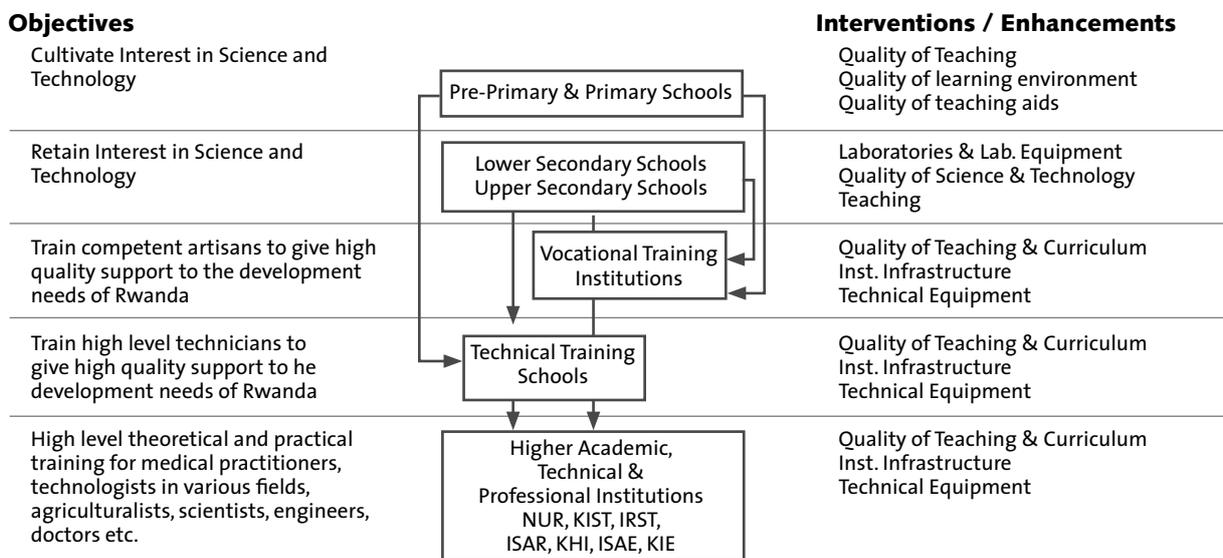• The strategy includes the establishment of links between research and technological development and the many and varied needs of industry, economy and community Including technological hubs to ensure widespread access to the latest technology

• The strategy also includes the establishment of Technology Consultation Centres, Demonstration Units and Science and Technology Parks

3.2.5 Innovation Culture

Innovation shall be encouraged at all levels to help stimulate economic growth.

• The strategy includes the establishment of business enterprise centres nationally, especially within technological institutions as outlined above.

• The strategy also includes the establishment of District Innovation Centres and to encourage private sector partnership as a key part of every sector.

4 Strategies and Framework to achieve Policy Objectives

4.1 National Integrated Innovation Framework

Innovation is the successful exploitation of new ideas. Incorporating new technologies, design and best practice is the key business process that enables businesses to compete effectively in the global environment.

The National Integrated Innovation Framework for Rwanda as summarised below creates 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 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.
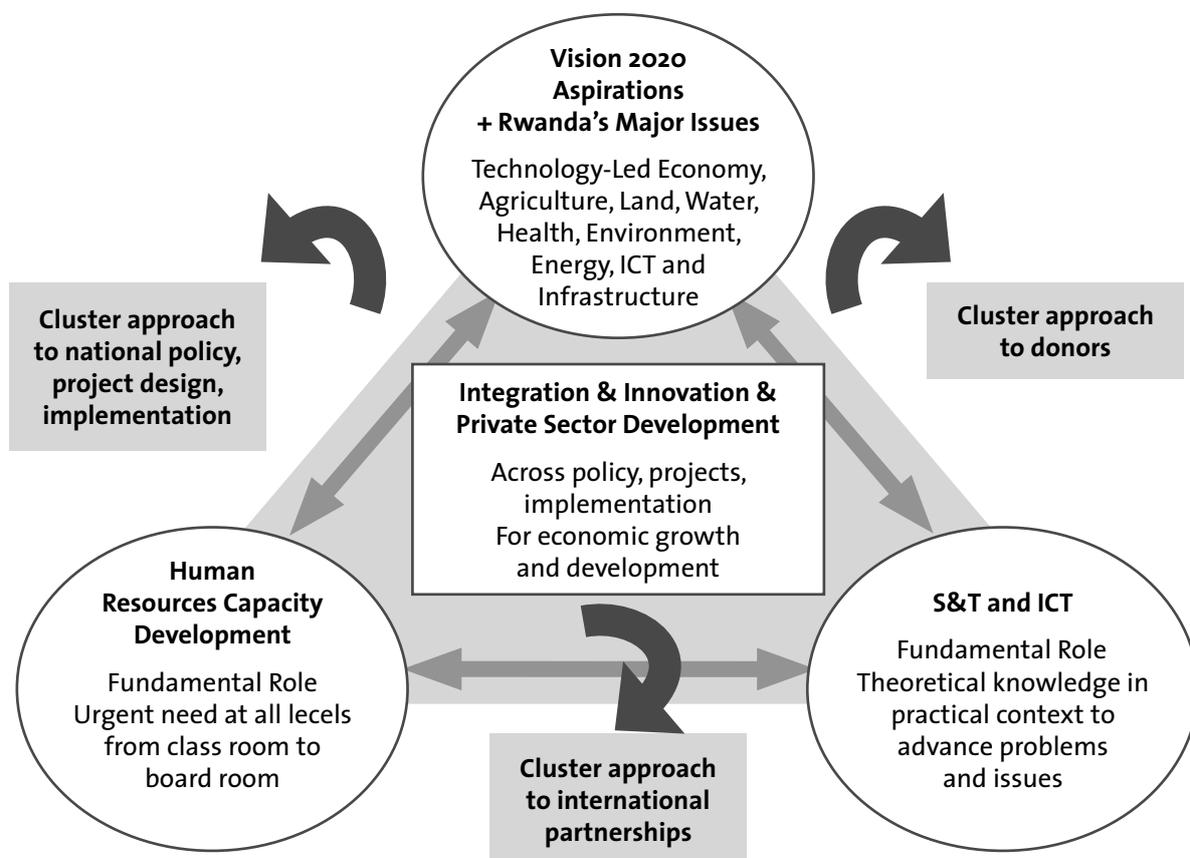
Figure 5 - *Overview of Integrated Innovation Framework Linkages*

The National Innovation Framework incorporates:

• the 'Vision 2020' priorities, and in particular:

  o Pillar 3: Human Resource development;

  o Pillar 5: Development of Entrepreneurship and the Private sector;

  o Pillar 6: Modernisation of Agriculture and Animal Husbandry;

Science and technology needs strong development to provide the knowledge base for all sectors of the country. It is recognised that low standards of knowledge in these areas is reflected in the weakness of these areas in education, and needs to be strongly addressed.

Infrastructure demands across all sectors form an important part of the way forward for the country, including ICT which has been targeted as a necessary tool for enabling broader access and connectivity both across the country in multiple sectors, and also internationally.

4.2 Government reforms

4.2.1 General Principles

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 added value 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 know-how needed by the society for efficient management of our S&T resources and assets.

Every effort shall be made by government to support and motivate private sector development and innovation in S&T.

Micro, small and medium scale enterprises are of particular interest for employment creation to develop indigenous entrepreneurs and advance inter-sectoral linkages. Private sector entities undertaking activities in these areas shall be supported by scientific, teaching and research institutes.

Micro and small enterprises shall have access to Innovation Centres, established through-out the country, to demonstrate appropriate technologies, either developed locally or imported and adapted to local needs

4.2.2 Public Sector Reform and Adjustments

In order to support the above S&T Policy initiatives Government shall introduce reforms in the public sector:

Policies and Enabling Legislation shall be developed to achieve the following:

• Government shall evolve sound and conducive public policy and appropriate legislation to encourage national capacity to innovate and generate new competitive products, services and intellectual properties;

• A core of well qualified and competent S&T personnel shall be established in each ministry and throughout each economic sector;

• Women shall be empowered to participate fully in S&T development and management.

• The use, advancement and integration of science, mathematics, communication, informatics and computer technologies shall be facilitated in industry, commerce and education;

• Priority treatment shall be given for the procurement and use of appropriate technologies, products and services intended for use in schools in training, re-training and skills upgrading;

• Efforts shall be made to ensure S&T is fully integrated into national and sectoral policies and across the education system;

• Greater emphasis shall be placed in the education system on science and mathematics including full integration in curricula at all levels of education;

• Quality teaching shall be encouraged and experiments introduced both in and after school;

• Research activities shall be encouraged;

• Sound and environmentally friendly technologies shall be promoted in industry and commerce

• National capacity shall be strengthened in the assessment of skill levels, achievements, technical qualifications and to establish and monitor set standards;

• Measures shall be taken to promote and preserve Rwanda's rich culture and heritage, its fragile ecology, environment, indigenous and traditional technologies, and community based knowledge systems;

• Indigenous small and medium enterprises shall be advanced to the extent possible, including the encouragement of traditional and home grown technologies;

• An up-to-date S&T information exchange shall be established and operated.

4.2.3 Science and Technology Outreach

Science and technology outreach programmes shall be established through:

• Technology Consultation Centres shall be established;

• Technology Incubators and Demonstration Units shall be set up;

• Science and Technology Parks shall be introduced, essentially to target rural communities;

• Steps shall be taken to generate local and community awareness in science and technology.

4.2.4 Incentives for S&T Policy Implementation

The Government shall introduce incentive schemes and systems such as:

• Government recruitment and internal promotion policy shall facilitate S&T development by ensuring compensation packages to reward technical achievers;

• Skills that are in high demand shall attract special premium until shortage is relieved;

• Individuals and organisations shall be rewarded for outstanding achievement in science and technology;

• Equipment and material imported for R&D activities shall be exempted from all taxes. In addition, tax incentives shall

be provided for the resources committed by the private sector to S&T development, and in particular R&D.

Specific Incentive schemes to include the following:

Science Olympiad: Presidential Order No 11/01 of 7th March 2005 establishes "The Prize of Excellence for best performing Pupils and Students"

The above prize is designed to motivate young people to excel in Science and Technological studies and shall be granted annually to pupils and students who have achieved the best results at national level in mathematics and science.

Promotion of Innovation and Entrepreneurship: In order to provide incentive schemes for the promotion of innovative, entrepreneurial activities, with special emphasis on the rural areas, a national competition shall be set up to link rural entrepreneurs with counterparts in the Diaspora. The details are as follows:

• The competition shall be announced in a high-visibility event;

• There shall be clear, results-oriented criteria for selection of winners;

• The submissions shall be in the form of business proposals;

• The awards shall be in the form of support (e.g. equity grant, start-up loan program, etc.) for the business venture;

• Links shall be set up with the Diaspora;

• Subcategories shall be included such as ICT, agriculture, rural, women, etc.

4.3 Public-Private Partnerships in Research and Development

Public Sector Research Institution

Primary focus: Research, Development, Education and Training

Research, Development and Innovation

Private Sector Business Enterprise

Primary focus: maximise value for shareholders, understand consuemer needs, compete in the market place to increase customer base.
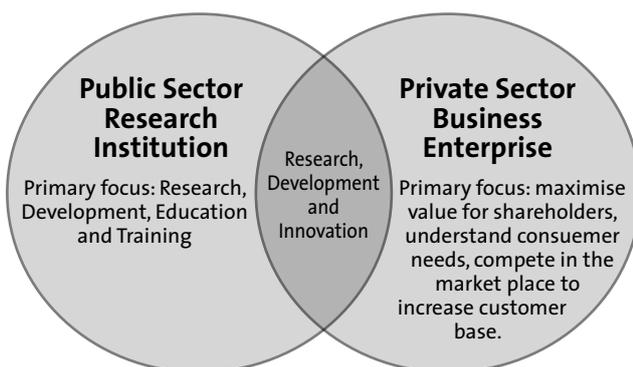
Figure 6 - Relationship between publicly funded institutions and private enterprise

The challenge for companies is to bring to the market a stream of new and improved, added-value, products and services that enable the business to achieve higher margins and thus profits to re-invest in the business.

The Public and Private sector have different strengths such as the research skills of the public institution and the entrepreneurial, marketing and business skills of the private

enterprise. It is important to recognise and reinforce these complementary strengths and ensure a link to bridge the gap between the public research institution and private enterprise through the engagement in scientific research and development specific to fulfill the needs of the private enterprise.

4.4 Intellectual Property

A feature of globalisation and liberalisation which can have a substantial impact on scientific and technological developments concerns the available capacity at national level to process scientific and/or technological innovations or inventions that can lead to acquisition of Intellectual Property Ownership (IPO).

Intellectual property refers to creations of the mind and is divided in two categories:

• Industrial Property which includes:

 - inventions in all fields of human endeavour (patents);

 - scientific discoveries;

 - trademarks, service marks, commercial names and designations;

 - industrial designs, and

 - all other rights resulting from intellectual discourse;

• and Copyright, which includes:

 - literary and artistic works such as novels, poems and plays, films, musical works;

 - artistic works such as drawings, paintings, photographs and sculptures; and

 - architectural designs.

Higher and technical education and research institutions can play a decisive role in training candidates who ultimately end up being globally active in Rwanda's "knowledge based economy" if their scientific and technological research and development is of high levels.

An effective intellectual property management framework shall be established in Science and Technology Research and Development institutions and firms so as to create the capacity to support local researchers in protecting their Intellectual Property Rights (IPR). If this is not done, research and technological developments will be at risk of premature disclosure which could prejudice the rights of the inventor and invalidate a patent.

A legal framework shall also be established to protect Science and Technology Intellectual Property Rights.

Areas of Intellectual Property become especially pertinent in the arena of biodiversity research in Rwanda. ORTPN have developed a system of research clearance and material transfer agreements which seek to regulate the research studies carried out, in particular by outside individuals and organisations, and also the outflow of genetic material.

Systems shall be developed to harmonise working arrangements, with particular regard to the above proposed legal framework, to safeguard Rwanda's natural heritage.

5 Sector Policy Statements and Strategies

Rwanda has many strengths that will support the development of the necessary capacity and infrastructure throughout all the sectors of the economy. Strengths such as:

- *Know what the problems are: limitations; needs;*

- *Know what expertise is needed*

- *Determination to absorb and link to expertise to build capacity and solve problems*

All this knowledge and ideas has been converted into policies, plans and strategies by the various ministries and institutions charged with the responsibility of forging a way through all the stumbling blocks and obstacles.

Under pinning all of the above is the science and technology development to provide knowledge base for all sectors of the country coupled with the foundation of the capability building in Science and Technology to equip the population with the knowledge and skills to put the Science and Technology into practice.

The following details the Science and Technology strategies to be pursued against all sectors of the economy.

5.1 Education

An Education Sector Policy has been developed by the Ministry of Educatio. This policy was published in 2002. Subsequently an Education Sector Strategic Plan was also developed and published, in July 2003, covering the period from 2003 to 2008, this is updated year on year to reflect the changing situation as regards targets and strategies.

5.1.1 Science and Technology Policy in Education

The importance of science and technology at every level of human resource development shall be emphasised including primary, secondary and tertiary education.

5.1.2 Science and Technology Strategies in Education

As outlined in the introduction to this 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.

Specific strategies as follows:

- **Primary Schools:**
The strategy at Primary level includes the provision of a Science Corner in every Primary School to cultivate the interest in mathematics, science and technology at an early age and help provide good grounding in scientific think-

ing. It shall also require a review and implementation of improved teaching methods for primary science.

- **Secondary Schools:**
The strategy includes the provision of a high quality science and technology education, in schools equipped to also undertake practical lessons. This shall ensure that students retain an interest and gain a solid foundation in Mathematics, Science and Technology that shall prepare them for further education and equip them with the scientific skills to assist in Rwanda's development.

- **Vocational Schools:**
The strategy includes maximising the availability of access to vocational training through the provision of a high quality Vocational Training Centre (VTC) in each of the districts of Rwanda. The VTC shall also include a business enterprise unit to match the students of the school with employment opportunities, and also to work in partnership with local business enterprises.

- **Technical Schools:**
In order to maximise the availability of access to high level technical school training the strategy is to construct a high level technical School in each of the provinces of Rwanda. Again the Technical Schools shall include business enterprise units to develop entrepreneurship and innovation skills, match the students of the school with employment opportunities. Also to work in partnership with local business enterprises.

- **Higher Level Technical and Professional Institutions:**
The two principal objectives for the Higher Technical and Professional Institutions are to: train the teachers and lecturers that shall support in the development of Science, Mathematics, Vocational and Technical school training as detailed above; and also to train high level professional technicians, engineers, architects, medical professionals, veterinary professionals, agricultural professionals etc. These shall take a lead in the ongoing development of Rwanda towards the goals of Vision 2020.

The strategy shall also include the development of links with "best in field" technical and professional institutions internationally to ensure that Rwanda stays abreast of latest technology and thinking.

5.2 Health

The Health Sector comprises a public, private and traditional Health System, which are supported by the Government, Development Partners, Non Governmental Organisations and Civil Society.

The Ministry of Health has been designated as the principal Government Agency responsible for Health Sector Development; more specifically, it is in charge of defining policy, setting standards, regulating and monitoring activities in the sector.

5.2.1 Science and Technology Policy in Health

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

5.2.2 Science and Technology Strategies in Health

• A telemedicine system shall be implemented at District, and Hospital level;

• A national nutrition and epidemic surveillance information system shall be developed;

• Indicators shall be developed to monitor and evaluate quality of Health services delivery in Health centres, districts and Hospitals;

• Operational research shall be carried out in environmental Health (latrines, waste management etc.) ;

• Technical training schools shall be supported in environmental health;

• A food quality surveillance system shall be put in place;

• Standards for eye care services shall be established at Health centres, districts and Hospital levels;

• A protocol of standards and guidelines shall be developed and disseminated for the integration of mental Health into primary Health care;

• Health professionals shall be trained in severe malnutrition case management, good feeding practices and control of iron deficiencies;

• An operational plan for prevention of HIV/AIDS shall be developed;

• Research shall be carried out on drug resistance and resistance of insecticides for "malaria" vector control;

• Laboratory norms and standards shall be developed and adopted.

5.3 Agriculture and Animal Husbandry

Agriculture and animal husbandry is the single most important sector in Rwanda. Food crops represent 92% of cultivated land, with banana the most predominant product with 28% of cultivated land followed by beans (21%), sweet potatoes (12%), sorghum (10%), and cassava (8%). Export crops (coffee and tea), come last with respectively 6.3% and 1.6% of cultivated land.

The sector has been affected by poor productivity due mainly to low use of agricultural inputs, such as seeds, fertiliser, etc. Changes in weather, particularly reduced rainfall, have also adversely affected crop production together with crop diseases such as in the banana crop, cassava-mosaic virus, and diseases affecting passion fruit and coffee crops.

Raising cattle or small ruminants is done in a non professional way. Local cows yield low production, while poor farmers lack the farming systems to provide manure to improve soil structure.

5.3.1 Science and Technology Policies in Agriculture and Animal Husbandry

Rwanda's population is mainly subsistence based rural agriculture and animal husbandry. 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, will 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. Specific policy statements as follows:

Scientific techniques shall be used to improve land yield and productivity which is key to optimising the use of Rwanda's limited land resource;

Scientific techniques shall be applied for the promotion and development of specific commodities with a view to transformation of agriculture and animal husbandry with particular emphasis on the promotion of exports.

5.3.2 Science and Technology Strategies in Agriculture and Animal Husbandry

Scientific and Technological techniques shall be applied in order to:

• improve irrigation technologies;

• increase the of fertilisers and mechanisation in Agriculture;

• improve food security;

• enable transformation and competitivity of agricultural & animal products;

• promote the use of Research for Agriculture and Animal Husbandry development;

• reinforce rural infrastructures in support of producers;

• support university services based extension service in agriculture;

• create a conducive environment for the promotion of entrepreneurship;

• develop information system for trade of agricultural product;

• strengthen quality control to reinforce competitivity in markets.

5.4 Biotechnology

The report commissioned by the UN Millennium Project Task Force examining how Science and Technology can contribute to achieving the Millennium Development Goals highlights that Biotechnology has emerged as one of the tools that can be used to address development challenges. These biotechnologies include: molecular diagnostics; recombinant vaccines; vaccine and drug delivery; bioremediation; sequencing pathogen genomes; female controlled protection against sexually transmitted infections; bio-informatics; nutritionally enriched genetically modified crops; recombinant therapeutic proteins; and combinatorial chemistry.

5.4.1 Science and Technology Policy in Biotechnology

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

5.4.2 Science and Technology Strategies in Biotechnology

- Undertake research to develop disease and pest resistant crops, plants and trees, and breeding plants and animals for high yields;

- Undertake soil research to optimise use of fertilisers (e.g. expansion of pyrethrum cultivation);

- Strengthen research on disease and pest control, genetic technology (tissue culture, molecular biology), biodiversity, land degradation, environment and ecosystem problems;

- Strengthen research in molecular diagnostics, vaccine and drug delivery, recombinant vaccines and bioremediation in order to support reduction in child mortality, improvement in maternal health and the combat of HIV, malaria and other diseases;

- Upgrade agricultural research facilities and equipment;

- Invest in training of biotechnologists and agricultural scientists;

- Identify more productive breeds, cross breed with Rwandan cows and expand;

- Strengthen the use of GIS on soil & climate in order to determine which crops to grow where;

- Use of post-harvest technologies to reduce loss and add value;

- Investment in research capacity in institutions such as the Agricultural Sciences Institute of Rwanda (ISAR) and the National University of Rwanda (NUR).

5.5 Environment

The importance of preserving the environment has been recognised and Environmental policies have been put in place. Areas of focus in the policy include:

- Sustainability, security and equitable use of resources;

- To prevent degradation of land, water, vegetation, deforestation and air;

- To conserve and enhance biological diversity of the ecosystem of Rwanda;

- To recognise the importance of public awareness and understanding on the essential linkages between environment and development, thus promoting individual and community participation in environmental action.

5.5.1 Science and Technology Policy in Environment

Scientific techniques shall be applied for the sustainable management of natural resources including biodiversity, water and soil conservation, marshlands improvement and issues related to climate change.

5.5.2 Science and Technology Strategies in Environment

Scientific techniques for sustainable management of natural resources including biodiversity, water and soil conservation, and marshlands improvement shall be applied to the following:

- Public awareness, Public participation & Education programs;

- Environmental, land use policy and planning;

- Technology improvement / alternative Energy sources;

- Reforestation programs;

- Capacity Building and human resource development to develop local Rwandan capacity in all areas of the environment such as environmental impact assessment, forestry, etc.;

- Conservation programmes including: bio-diversity; ecology; species, habitat and wildlife management;

- Issues related to climate change.

5.6 Water and Sanitation

The combination of safe drinking water and hygienic sanitation facilities is central to health and the fight against poverty, hunger, child deaths and gender inequality. In adopting the Millennium Development Goals, Rwanda pledged to reduce by half the proportion of people without access to safe drinking water and basic sanitation.

Improved access to safe water supplies not only generates immediate benefits in terms of significant reductions in morbidity and mortality rates but also frees up a substantial proportion of time for women and children in particular for more productive work. Improved sanitation brings benefits in terms of both public health and the environment.

The problems of clean water and sanitation are prevalent in all provinces of Rwanda. In the countryside many people have no water at all leaving people to walk for hours in search of water. In addition, in rural areas only o.8% of pit latrines satisfy hygienic norms.

5.6.1 Science and Technology Policies in Water and Sanitation

Science and technology interventions to achieve sustainable and integrated water resources development and management to enable access nationally to effective sanitation systems and clean drinking water.

5.6.2 Science and Technology Strategies in Water and Sanitation

The core science and technology strategies for the water supply and sanitation sector are:

• To develop capacity in the design and implementation of the provision of water and extension of the water supply network;

• To develop capacity to support the increase in access to sanitation services;

• To encourage and develop community participation and capability in the installation and management of water and sanitation infrastructure. This will include the application and use of appropriate technologies and rainwater harvesting techniques;

• To promote technically and financially viable projects based on strong community participation;

• To strengthen technical capacity at both central government and district level in the management of water supply and sanitation systems. This will include the monitoring of resources and quality, quality data collection and planning and forecast;

• To develop community awareness and education in water supply and sanitation issues including focussed community communications programmes.

5.7 Energy

The National Policy goal is to meet the Energy challenges and needs of the Rwandan population for economic and social development in an environmentally sound and sustainable manner.

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.

5.7.1 Science and Technology Policy in Energy

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.

5.7.2 Science and Technology Strategies in Energy

• Research and development shall be carried out in renewable and Energy alternatives: solar, wind, geothermal, including equipment and best practise applications;

• Research and development shall be carried out in Energy use & conservation practices;

• Research & Analysis of waste and recycling options and system of management shall developed;

• Exploration shall be conducted in the extraction of methane gas from lake Kivu including and best practise technologies;

• Capacity Building and human resource development shall be carried out to develop local Rwandan capacity in all areas of engineering and technical fields, including expertise in the field of renewable energy technologies, etc.

5.8 Transport

Rwanda faces many deficiencies in terms of both national and international transportation, the landlocked nature of the country and mountainous terrain exacerbate these problems. The lack of transport infrastructure adds to the cost across all sectors and creates difficulties, especially with the inadequate rural roads, for rural communities to access services such as education and health and hence impacts on the poverty of these communities. The high transport costs add significantly to the cost of exports. Regional Cooperation is currently being sought for the development of improved transport routes through the North, East and South corridors through a combination of improved roads, potential rail extensions and water transport.

5.8.1 Science and Technology Policy in Transport

To develop local Rwandan capacity in the design and construction of transport infrastructure, including bridges, viaducts and culverts.

5.8.2 Science and Technology Strategies in Transport

Science and technology strategies in the transport sector are as follows:

• Research and development shall be carried out into

infrastructure design and construction including best practise;

- To develop design and maintenance standards for paved, gravel, unpaved roads, and for bridges, viaducts and culverts;

- To develop environmental guidelines for road and bridge construction and maintenance;

- Measures shall be undertaken to develop Rwandan public and private sector capabilities in road construction and maintenance techniques;

- To develop the capacity of rural communities in maintaining the rural road network;

- To develop national capability in the design, construction and maintenance of all forms of transport including air, water and potentially rail;

- Integration of modern tools to manage the transport of goods through all key routes to reduce transit time and manage follow-up etc.

5.9 ICT

ICT (information and communications technology - or technologies) is an umbrella term that includes any communication device or application, encompassing: radio, television, cellular phones, computer and network hardware and software, satellite systems, as well as the various services and applications associated with them, such as videoconferencing and distance learning.

The importance of ICTs lies less in the technology itself than in its ability to create greater access to information and communication in underserved populations. Many countries around the world have established organisations for the promotion of ICTs, because it is feared that unless less technologically advanced areas have a chance to catch up, the increasing technological advances in developed nations shall only serve to exacerbate the already-existing economic gap between technological "have" and "have not" areas.

Rwanda has in place an "Integrated ICT-led Socio-Economic Development Policy and Plan for Rwanda". Many ICT initiatives have been established in Rwanda, including:

- Cellular Communications Network;

- Rural Communications Network;

- Fibre Network;

- International Telecommunications;

- ATM Card Introduction.

5.9.1 Science and Technology Policy in ICT

A focus shall be applied to information technology, especially in the fields of intelligence systems and decision making.

5.9.2 Science and Technology Strategies in ICT

- The use and integration of science, computer literacy

shall be promoted and popularised in schools and in our various workplaces;

- Training efforts shall be intensified especially in technical and scientific fields to advance absorption and understanding of the technologies. This initiative must proactively influence Rwanda's local capacity to use, adapt, service, apply and to introduce new programmes, products and services;

- Publications, studies, investigations and reports shall be promoted in the ICT sector;

- 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.

5.10 Geo-Information

It is recognised that, especially in a highly populated country such as Rwanda, it is vital to manage all the resources of the country in the most efficient way possible.

5.10.1 Science and Technology Policy in Geo-Information

Advanced Geographical Information / Remote Sensing Systems (GIS/RS) shall be developed, covering the whole country, to enable spatial databases to be developed and maintained to maximise knowledge and understanding of the country.

5.10.2 Science and Technology Strategies in Geo-Information

- In view of the urgent and immediate need to manage all GIS/RS functions, to the overall benefit of Rwanda, the Centre for Geographic Information Systems and Remote Sensing (CGIS/RS) shall establish a Central Clearing House function to coordinate and harmonise all the GIS/RS activity;

- A Coordinating Body shall be set up, with membership representing all the users of GIS/RS in Rwanda, to oversee the development of GIS/RS in Rwanda;

- A National Geographic Institute shall be establised with the function to manage all the functions of Geo-Information in Rwanda in one Central location. The National Geographic Institute shall take on the responsibility for delivering common services to Government Departments and Public and Private Institutions. The Institute shall be independent to ensure that it can give equitable access across all the different Ministries and Public and Private Institutions.

5.11 Tourism

Rwanda enjoys a moderate tropical climate with an average temperature of 19°C and is subdivided in three different altitude zones:

- A low altitude zone less than 1500m covering east of

Rwanda through Akagera National park, Umutara, Bugesera to Gisaka;

- A medium altitude zone (1500m-1900m) in the centre and east;

- A high altitude zone more than 1900m in the north, volcano regions and Buberuka.

The emphasis on tourism in Rwanda is in the development and diversification of: Cultural; Historical; and Natural tourism attractions.

5.11.1 Science and Technology Policy in Tourism

Scientific and Technological processes shall be developed in support of the application of science to eco-environmental tourism with a view to supporting the development of the tourism sector in Rwanda.

5.11.2 Science and Technology Strategies in Tourism

- Capacity Building and human resource development shall be carried out to develop local Rwandan capacity in all areas of research related to cultural, historical and natural tourist attractions. This shall include tourist impact assessment in tourism areas, and socio-economic studies on populations living in the tourist sites;

- Capacity shall be developed to carry out tourism development research associated with the development of tourism products in Rwanda;

- Karisoke Research Centre, in the Virunga National Park, shall be developed as a Centre of Excellence in research associated with the mountain gorillas and their associated habitat and conservation in the Virunga Park;

- To support the development of the Gorilla Interpretive Centre as a centre of education on the Mountain Gorillas;

- To support research programmes in the development and conservation of all forms of tourism products.

5.12 Industry

More than 73% of the industrial enterprises are Small and Medium Enterprises (SMEs) employing less than 100 people. 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 added value, to create more jobs and to improve living conditions of households. All the strategies are oriented towards improvement of competitivity of Rwanda's industry on national, regional and international markets and towards production of high quality goods and services.

5.12.1 Science and Technology Policy in Industry

The application of Science and Technology shall be promoted in support of the growth of the Industrial sector with a focus on light industry within a diversified economy, competitive and oriented towards exports.

5.12.2 Science and Technology Strategies in Industry

Training of professional & technical personnel shall be undertaken in the areas of technology, engineering and management.

A focus shall be applied on the promotion of products with high added value including the use and exploitation of information & communication technologies to collect new technical information, create opportunities and develop market predictions.

Complex technology processes shall be simplified for small & medium scale enterprises;

Use of locally available materials shall be promoted including the manufacture of large scale building materials (cement, bricks) in order to raise the quality and competitiveness of locally manufactured products;

Technology advice and support shall be provided to improve farming and industrial systems and to link agriculture with industrial processing and markets;

Export of semi finished or finished minerals shall be promoted;

Pyrethrum Refinery shall be developed in order to make available on export market a finished product with high added value;

Laboratory testing services shall be provided to monitor standards and quality of in-coming goods and materials, including those that are locally produced, giving special attention to those intended for the export markets;

5.13 Private Sector

In the 40 years of its post colonial existence the Rwandan economy was only able to generate 200,000 jobs outside agriculture.

The role of the Private Sector as the engine of economic development of Rwanda has been made clear by the government. Many initiatives and interventions are ongoing to reform the public sector in areas such as:

- industrial development;

- investment promotion;

- national investment strategy;

- improvements in the financial sector, including microfinance systems;

- partnership public – private sector; and

- trade.

5.13.1 Science and Technology Policy in the Private Sector

The Science and Technology policy objective for the private sector is to focus on technological and innovative advancements in support of the emergence of a healthy private sector that will lead economic growth in Rwanda.

5.13.2 Science and Technology Strategies in the Private Sector

• A core of qualified & experienced scientists, technologists and skilled technicians shall be maintained;

• Public research shall be engaged including innovation and transfer to local businesses;

• Technical and Scientific Information centre shall be maintained for product technology and market research;

• Waste management techniques and recycling technologies shall be managed and promoted;

• High quality packaging processes shall be developed, suitable for export quality: Tea; coffee; and other produce;

• Science and technology interventions to promote value addition in various export commodities including: tea; coffee; horticulture; aquaculture; leather goods and other agricultural produce;

• A cold chain shall be implemented at all levels from production to exportation;

• New fruits & vegetables transformation units shall be promoted in order to increase added value;

• Existing dairies and new milk transformation units shall be supported to increase production and commercialisation of manufactured products;

• Conservation units and / or transformation of tubers (irish potatoes, cassava, sweet potatoes) shall be promoted in order to stabilize prices on local markets and exportation of transformed products;

• Cereals (wheat, maize) transformation and storage units shall be promoted to increase quality and availability for both internal and export consumption.

6 Implementation Framework

6.1 Coordination Mechanisms

The Ministry with responsibility for Science, Technology and Scientific Research shall be the main government agency responsible for science, technology and research policy.

6.2 Coordinating institution with the role of facilitation

Government Ministries and Public Agencies - establishment and promotion of Science and Technology programmes require the commitment and cooperation of ministries, parastatals, 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 /Commission for Science, Technology and Innovation with resources to facilitate their coordinating roles and establish appropriate links with private sector.

6.3 Executing and Implementing Organisations

National Council/Commission for Science, Technology and Innovation (NCSTI) – This Council 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.

The NCSTI shall have an Executive Secretary and such core staff as shall be provided in the relevant legislation. The NCSTI shall also be composed of not less than 15 members appointed as indicated in the Statute.

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.

Sectoral Science and Technology Committees – These sectoral 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.

Chief Scientific Advisor (CSA) – A Chief Scientific Advisor shall be appointed with responsibility for providing independent expert advice on any aspect of science, technology and innovation as required by the Government. He will have a special role to play in advising on science issues in the context of NEPAD and internationally. One of the key functions will be to oversee a system of independent evaluation of science policy and programmes across a range of issues. Advice on the matching of resources to expected performance is of particular importance. The post can be an independent post under the President's Office or could also be a function of the Chairman of the Board of the NCSTI.

6.4 District Innovation Centres

District Innovation Centres (DICs) shall be established by the NCSTI at District locations throughout Rwanda to support small enterprises and manufacturing efforts in rural communities.

Prior to their establishment, NCSTI shall undertake scoping studies of existing institutions and propose the focus for each DIC. In general, DICs shall focus research based on local needs and on the use of District resources and materials on cost-recovery basis.

6.5 Sustained S&T Funding

There is a need to develop ways and means and special programmes to fund science and facilitate good public research. This shall ensure a predictable stream of both public and private funds. Public – private sector co-operation is essential to ensure funds are used effectively and achieve specific S&T objectives.

One of the Working committees of the NCSTI shall be the National Research Fund (NRF). The Government shall allocate annually 0.5% of the total budget to the NRF to be managed by the NCSTI for research and development activities oriented towards the development goals of Rwanda.

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.

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.

The NRF shall enable the government to support and promote a well managed and focused "public good" research programme.

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.
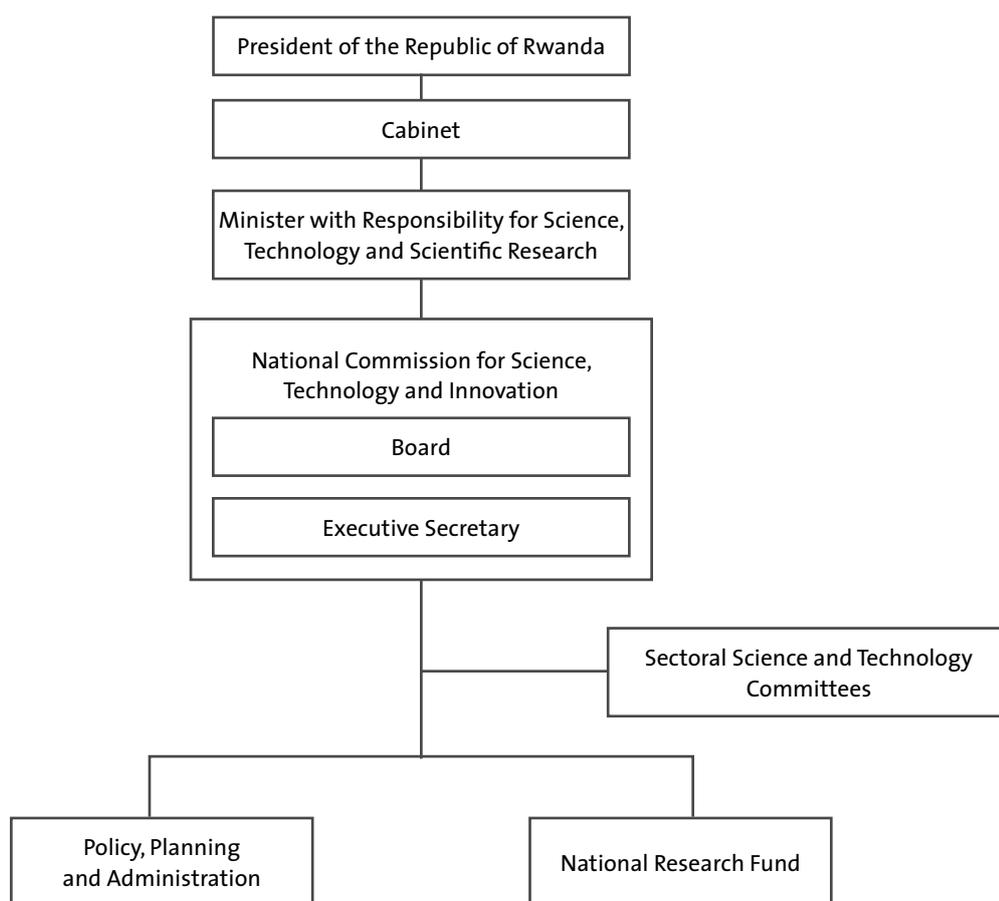
Figure 7 - *Structure of Science & Technology System in Rwanda*

Abbreviations and Acronyms

ATM	Automatic Teller Machine
CGIS	Centre for Geographic Information System
CSA	Chief Scientific Advisor
DIC	District Innovation Centre
GDP	Gross Domestic Product
GIS	Geographic Information System
GNP	Gross National Product
HIV/AIDS	Human Immunodeficiency Virus/ Acquired Immune Deficiency Syndrome
ICT	Information Communication Technology
IPO	Intellectual Property Ownership
IPR	Intellectual Property Rights
IRST	Science and Technology Research Institute
ISAE	Institute of Agriculture and Animal Husbandry
ISAR	Agricultural Sciences Institute of Rwanda
KHI	Kigali Health Institute
KIE	Kigali Institute of Education
KIST	Kigali Institute of Science and Technology
Km	Kilometre
MDGs	Millennium Development Goals
MINEDUC	Ministry of Education , Science , Technology and Scientific Research
NCSTI	National Council/Commission for Science, Technology and Innovation
NEPAD	New Partnership for Africa Development
NICI	National Information and Communication Infrastructure
NRF	National Research Fund
NUR	National University of Rwanda
R&D	Research and Development
RS	Remote Sensing
S&T	Science and Technology
SMES	Small and Medium Enterprises
UN	United Nations
VTC	Vocational Training Centre

United Nations University Global Reach

Programmes at UNU Centre, Tokyo, Japan

Peace and Governance Programme
Environment and Sustainable Development Programme
Capacity Development and Fellowships
Online Learning
Email: mbox@hq.unu.edu, URL http://www.unu.edu

UNU Research and Training Centres or Programmes

UNU Institute of Advanced Studies (UNU-IAS), Yokohama, Japan
Focus: strategic approaches to sustainable development
Email: unuias@ias.unu.edu; http://www.ias.unu.edu/index.cfm

UNU World Institute for Development Economics Research (UNU-WIDER), Helsinki, Finland
Focus: development economics
Email: wider@wider.unu.edu; http://www.wider.unu.edu

UNU Maastricht Economic and Social Research
and Training Centre on Innovation and Technology (UNU-MERIT), Maastricht, The Netherlands
Focus: socio-economic impacts of new technologies
Email: postmaster@intech.unu.edu; http://www.intech.unu.edu

UNU Institute for Natural Resources in Africa (UNU-INRA), Accra, Ghana
Focus: natural resources management
Email: unuinra@inra.unu.edu.gh, URL http://www.inra.unu.edu

UNU International Institute for Software Technology (UNU-IIST), Macau, China
Focus: software technologies for development
Email: iist@iist.unu.edu, URL http://www.iist.unu.edu

UNU Programme for Biotechnology in Latin America and the Caribbean (UNU-BIOLAC), Caracas, Venezuela
Focus: biotechnology and society
Email: unu@reacciun.ve, URL http://www.biolac.unu.edu

UNU International Leadership Institute (UNU-ILI), Amman, Jordan
Focus: leadership development
Email: mbox@la.unu.edu, URL http://www.la.unu.edu

UNU International Network on Water, Environment and Health (UNU-INWEH), Hamilton, Canada
Focus: water, environment and human health
Email: contact@inweh.unu.edu, URL http://www.inweh.unu.edu

UNU Programme on Comparative Regional Integration Studies (UNU-CRIS), Bruges, Belgium
Focus: local/global governance and regional integration
Email: info@cris.unu.edu, URL http://www.cris.unu.edu

UNU Food and Nutrition Programme for Human and Social Development (UNU-FNP), Cornell University, USA
Focus: food and nutrition capacity building
Email: cg30@cornell.edu; http://www.unu.edu/capacitybuilding/foodnutrition/cornell.html

UNU Institute for Environment and Human Security (UNU-EHS), Bonn, Germany
Focus: environment and human security
Email: info@ehs.unu.edu; http://www.ehs.unu.edu

UNU Iceland-based Training Programmes, Reykjavik, Iceland:
UNU Geothermal Training Programme (UNU-GTP)
Focus: geothermal research, exploration and development
Email: unugtp@os.is; http://www.os.is/id/472
and
UNU Fisheries Training Programme (UNU-FTP)
Focus: postgraduate fisheries research and development
Email: unu@hafro.is; http://www.unuftp.is

UNU International Institute for Global Health (UNU-IIGH), Kuala Lumpur, Malaysia
Focus: global health, including public health related particularly to developing countries' needs
Email and URL will be available shortly.

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