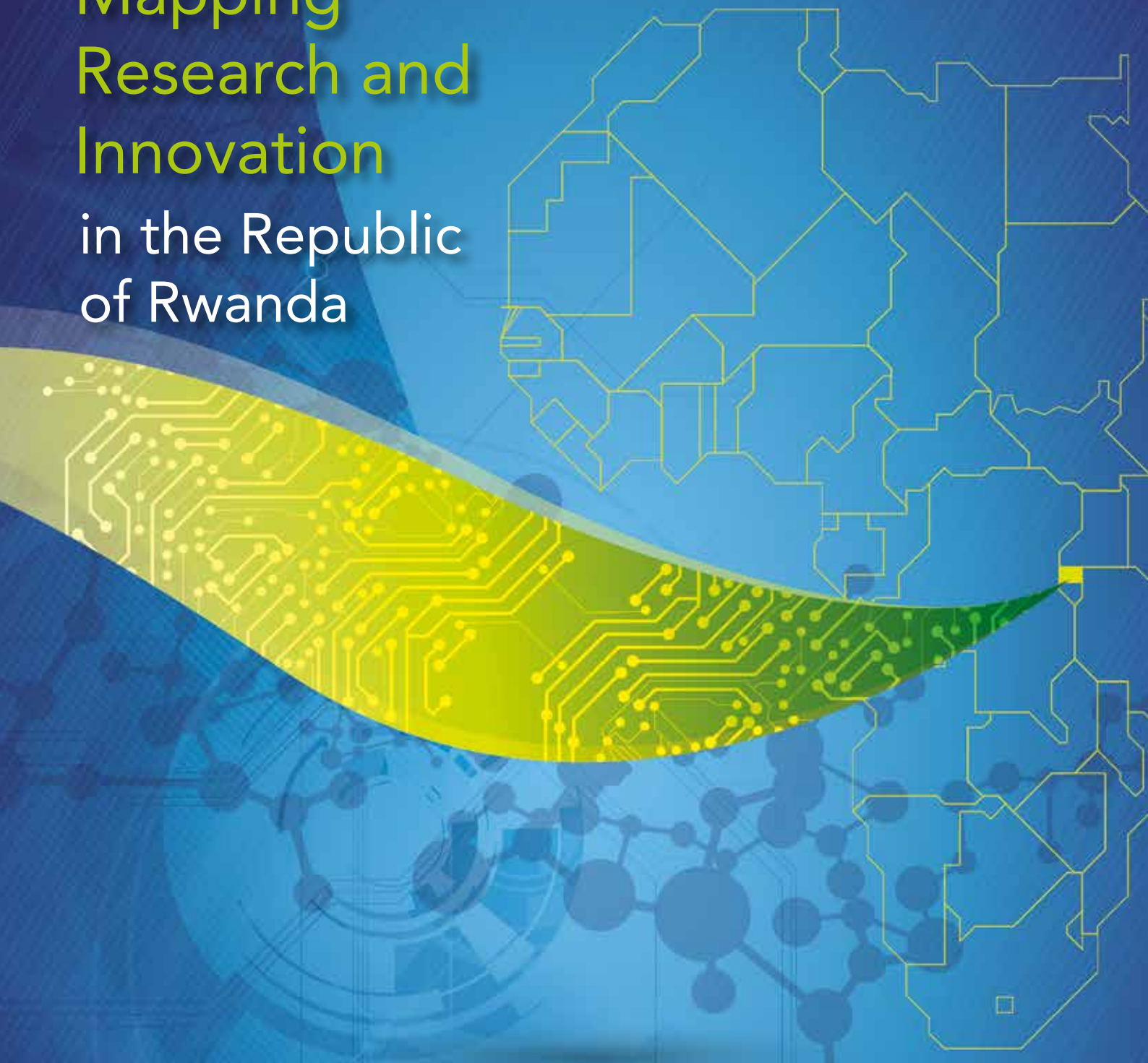
United Nations
Educational, Scientific and
Cultural Organization

GO SPIN
FOR SCIENCE POLICY
GLOBAL OBSERVATORY OF SCIENCE, TECHNOLOGY
AND INNOVATION POLICY INSTRUMENTS

Mapping Research and Innovation in the Republic of Rwanda



GO→SPIN Country Profiles in Science, Technology and Innovation Policy

Volume 4

Mapping Research and Innovation in the Republic of Rwanda

GO→SPIN Country Profiles in Science, Technology and Innovation Policy

Volume 4

In co-operation
with the Ministry of
Education of the
Republic of Rwanda

With the financial support of
the Government of Sweden

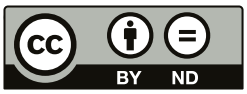
Published in 2015 by the United Nations Educational,
Scientific and Cultural Organization
7, place de Fontenoy, 75352 Paris 07 SP, France

ISBN 978-92-3-100126-0

Original title: *Mapping Research and Innovation in the Republic of Rwanda*

Suggested citation: UNESCO (2015) *Mapping Research and Innovation in the Republic of Rwanda.* G. A. Lemarchand and A. Tash, eds. GO→SPIN Country Profiles in Science, Technology and Innovation Policy, vol. 4. United Nations Educational, Scientific and Cultural Organization: Paris.

This study results from the contribution of Guillermo A. Lemarchand based on information provided by local authorities and the local consultants Verdiana Masanja and Charles Ndagije. The final edition was prepared by Guillermo A. Lemarchand and April Tash.



Countries interested in maintaining an inventory of their national research and innovation system within GO→SPIN are invited to contact:

Maciej Nalecz
Director, Division of Science Policy and Capacity-Building
Natural Sciences Sector
UNESCO
1, rue Miollis
75352 Paris Cedex 15, France
E-mail: m.nalecz@unesco.org or sc.stp@unesco.org
Website: www.unesco.org/news/en/natural-sciences/science-technology/sti-policy/

Layout: Mirian Quérol
Printed by: UNESCO
Printed in Paris, France

Acronyms and Abbreviations

ARIPO	African Regional Intellectual Property Organization
ASTI	Agriculture Science and Technology Indicators
ASTII	African STI Indicators Initiative (NEPAD)
AOSTI	African STI Observatory (African Union)
COMESA	Common Market for Eastern and Southern Africa
GDP	Gross domestic product
GO→SPIN	Global Observatory of Science, Technology and Innovation Policy Instruments (UNESCO)
EPO	European Patent Office
FDI	Foreign direct investment
EDPRS	Economic Development and Poverty Reduction Strategy
FTE	Full-time equivalent
HDI	Human Development Index (UNDP)
ICT	Information and communication technologies
IDRC	International Development Research Centre (Canada)
IFPRI	International Food Policy Research Institute
IPR	Intellectual property rights
ISCED	International Standard Classification of Education
KIST	Kigali Institute of Science and Technology
MDG	Millennium Development Goals
NEPAD	New Partnership for Africa's Development (African Union)
NUR	National University of Rwanda
OECD	Organisation for Economic Co-operation and Development
PPP	Purchasing power parity
R&D	Research and development
REIF	Rwanda Innovation Endowment Fund
RWF	Rwandan Franc
S&T	Science and technology
SETI	Science, engineering, technology and innovation
SME	Small and medium enterprises
STI	Science, technology and innovation
STPI	Science and Technology Policy Instruments
STR	Science, Technology and Research
TVET	Technical and Vocational Education and Training
UNCT	United Nations Country Team
UNCTAD	United Nations Conference on Trade and Development
UNDAP	United Nations Development Assistance Plan
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNIDO	United Nations Industrial Development Organization
UIS	UNESCO Institute for Statistics (Montreal)
USPTO	United States Patents and Trademark Office
WIPO	World Intellectual Property Organization

Glossary of Kinyarwanda terms

Abunzi	mediators
Agaciro	dignity
Akagari	cell (administrative unit)
Gacaca	truth and reconciliation traditional courts
Girinka	one cow per poor family programme
Imihigo	performance contracts
Inteko z'Abaturage	citizen forums
Ubudehe	community-based and participatory effort towards problem solving
mUbuzima	mobile phone application to link community health-workers to a national management information system
Umudugudu	village
Umuganda	community work
Umurenge	sector (administrative)

Contents

List of Illustrations

TABLES

FIGURES

BOXES

Foreword by Irina Bokova

Science, engineering, technology and innovation hold key answers to the new, complex challenges facing governments. These cannot be stand-alone processes but rather should be integrated into societies through partnerships, through strong links between science, policy and society, through effective national policies and robust systems of governance and through science education. Innovation is not a decision but an ecosystem that is a foundation for knowledge societies and sustainable development.

Governments need tools to map the landscape of science, technology and innovation (STI) in their countries, in order to strengthen national frameworks and take sharper decisions. This is the importance of UNESCO's Global Observatory of Science, Technology and Innovation Policy Instruments (GO→SPIN), which allows governments to review their country's performance against established indicators while exploring best practices from other countries. GO→SPIN provides key information on a range of levels, from STI policies, operational instruments and legal frameworks to STI national systems and data – all in order to improve policy-making, implementation and evaluation.

GO→SPIN is a core part of UNESCO's strategy to support the development of science policy initiatives, working with governments and other partners. Reliable information is vital for integrating research and innovation as cross-cutting policies into national development strategies and for catalysing greater investment by governments in the sciences for sustainable development.

I am confident that this new online series of country profiles by UNESCO will provide Member States and the global scientific community with a useful tool as we seek to build more inclusive knowledge societies.

Irina Bokova

Introduction

The growing complexity of science and innovation systems and the interface with society have been accompanied by a more complex policy environment. This results in a need for better co-ordination and coherence at national level. One of the most crucial factors is the increasingly global nature of the issues with which national policy-makers are confronted. In a whole series of areas, such as the environment, telecommunications, health, energy, education and intellectual property, it no longer makes much sense to construe problems in purely sectoral and national terms. In a world that is becoming daily more interdependent, policy-making is inevitably assuming an increasingly transversal and global dimension. In this context, science, technology and innovation (STI) policy systems have emerged as interconnections between knowledge, values, national and international socio-economic, environmental, technological and organizational components.

UNESCO has a long tradition of supporting Member States in policy development. With the convergence of S&T fields, the need to harness science, engineering, technology and innovation (SETI) for human and economic development and the transnational nature of today's challenges, STI policy processes have become a much more complex undertaking.

It is our vision that STI policies are transversal, cross-cutting policies that support and build the structural pillars for sustainable development. Therefore, UNESCO is conscious that monitoring and evaluating the impact of explicit and implicit policies and instruments is part of our work in supporting the design and implementation of STI frameworks in our Member States.

Mapping Research and Innovation in the Republic of Rwanda is the fourth in a series of a series of country profiles prepared by the Global Observatory of Science, Technology and Innovation Policy Instruments (GO→SPIN), a new UNESCO initiative.

The GO→SPIN programme is helping Member States to reform and upgrade national science systems and governance, and to build capacity to monitor and evaluate performance through SETI and social indicators. In this way, the scope of standard SETI assessment can be widened, to take into account country-specific contexts, as well as emerging knowledge of technological advances that contribute to sustainable development. Complementing efforts to promote evidence-based SETI policy-making, GO→SPIN offers a good basis for the promotion of scientific and technological foresight studies.

Through the GO→SPIN programme, UNESCO's Division of Science Policy and Capacity Building is working as a standard-setter, assisting in the elaboration of guidelines for SETI policy formulation, review and reforms, including monitoring and evaluation of policies and programmes. In this context, scientific advisory systems for governments and parliaments are necessary, as well as the availability of a wide range of scientific assessments to inform policy- and decision-makers and to bridge the gap between science and policy.

The Division of Science Policy and Capacity building has been collaborating with the Ministry of Education of the Republic of Rwanda with the support of the Embassy of Sweden in Kigali and the Swedish International Development Cooperation Agency (SIDA) to produce this country profile.

After African countries expressed a common need to enhance capacities in the design and evaluation of SETI policies, policy instruments and governing bodies, five sub-regional workshops were organized by UNESCO between November 2012 and May 2015, in Harare (Zimbabwe), Dakar (Senegal), Maputo (Mozambique), Kigali (Rwanda) and Cairo (Egypt). We applied the methodological approach developed by GO→SPIN to train higher national officials in designing, implementing and monitoring different types of operational policy instrument. This training involved officials from Angola, Botswana, Burkina Faso, Burundi, Cape Verde, Cote D'Ivoire, Egypt, Gabon, Malawi, Mozambique, Niger, Rwanda, Senegal, Zambia and Zimbabwe. There are plans to extend this training to other sub-Saharan countries and Arab States.

In November 2012, during the African Ministerial Conference on Science and Technology (AMCOST V), it was recommended that the African Observatory on STI (AOSTI), the African STI Indicators Initiative (ASTII) and UNESCO's GO→SPIN programme improve co-ordination among their different surveys. Following this recommendation, an agreement between UNESCO and AOSTI was established in February 2013. The terms of this agreement place AOSTI in charge of following up each GO→SPIN survey for a group of West African countries. There are plans to extend this agreement to the entire continent.

The participating countries are currently completing a national GO→SPIN survey on SETI policies and policy instruments that will be part of both this new series of country profiles and the GO→SPIN online platform.

The present profile is based on the GO→SPIN survey conducted as follow-up to the Kigali National training workshop by the officers of the Ministry of Education, other line ministries, research centers, universities, and STI stakeholders of the Republic of Rwanda. The profile was further developed by local consultants working in tandem with an international counterpart. The latter travelled on a fact-finding mission and a second time to participate in the validation workshop for the profile in April 2015.

Acknowledgments

Mapping Research and Innovation in the Republic of Rwanda is the outcome of a GO→SPIN training workshop organized by the Division of Science Policy and Capacity Building with the Ministry of Education of the Republic of Rwanda in Kigali in November 2014 and the corresponding GO→SPIN Validation Workshop held in April 2015.

Our sincere thanks go to the Government of Sweden for their financial support. We would also like to express our gratitude to the senior officers of the Ministry of Education of the Republic of Rwanda who made this study possible: the Hon. Silas Lwakabamba (Minister), Hon. Marie-Christine Gasingirwa (Director General of Science, Technology and Research) and to the GO→SPIN survey team within the ministry's Directorate of Science, Technology and Research: Remy Twiringiyimana (Advisor to the Minister of Education), Oreste Niyonsaba (Director of Research, a.i.), Jean Damascene Nsengiyumva (STR Data Manager) and Mike Hughes (STI Advisor).

Special thanks go to: UNESCO consultants Verdiana Masanja and Charles Ndagije, who prepared part of the inventories and texts related with the GO→SPIN survey of Rwanda; Peggy Oti-boateng from the UNESCO Harare office; and the personnel of the Science Policy and Partnership Section at UNESCO: Sonia Bahri, Chief of Section, Juliana Chaves Chaparro, Sarah Colautti, Ahmed Fahmi, Sunday Fadina, and Kornelia Tzinova.

Last but not least, my grateful thanks to the editors of the present volume, UNESCO consultant Guillermo A. Lemarchand and to April Tash, Programme Specialist from UNESCO's Social Science Sector, who transformed the survey into an informative and readable study.

Maciej Nalecz,
Director
Division of Science Policy and Capacity Building
UNESCO

The methodological framework for this series

GO→SPIN Country Profiles in Science, Technology and Innovation Policy is a series of reports published by UNESCO within its Global Observatory of Science, Technology and Innovation Policy Instruments (GO→SPIN). The GO→SPIN programme is run by UNESCO's Division of Science Policy and Capacity-Building.

The aim of this new series is to generate reliable, relevant information about the different landscapes of science, engineering, technology and innovation (SETI) policies around the world. The published information is based on replies to the GO→SPIN surveys, combined with government reports and statistical data from the UNESCO Institute for Statistics and other international sources.

Each country profile represents a comprehensive study of all the SETI policies, which include:

1. a long-term description of the political, economic, social, cultural and educational contextual factors;
2. a standard content analysis of the explicit SETI policies, including those research and innovation policies implemented in other sectors, such as the agricultural, energy, health, industrial and mining sectors;
3. a study of R&D and innovation indicators;
4. a long-term scientometric analysis of scientific publications, patents, trademarks and utility models;
5. a description of the SETI policy cycle;
6. a complete analysis of the SETI organizational chart at five different levels (policy-making level; promotion level; research and innovation execution level; scientific and technological services level and evaluation level);
7. an inventory of all the SETI government bodies and organizations related both to research and innovation and to science and technology services;
8. an inventory of the SETI legal framework, including acts, bills, regulations and international agreements on SETI issues;
9. a standard inventory with 18 different analytic dimensions of all the SETI operational policy instruments in place;
10. a SWOT analysis of the country's research and innovation landscape.

THE GO→SPIN APPROACH

The strategy of the GO→SPIN programme is four-fold:

- **Capacity-building:** training high-ranking national officials in the design, implementation and evaluation of a variety of SETI policy instruments at national and regional levels;
- **Standard-setter:** providing a standard practice for surveys on SETI policies and operational policy instruments through the *Paris Manual*[1]
- **Data collection:** worldwide distribution of the GO→SPIN surveys, prioritizing Africa, Arab States, Asia–Pacific and Latin American and the Caribbean.
- **GO→SPIN platform:** creation of an online, open access platform for decision-makers, knowledge-brokers, specialists and general public, with a complete set of various information on SETI policies.

The online platform will provide an innovative cluster of databases equipped with powerful graphic and analytical tools. The platform has been devized for political leaders, planners, directors and administrators of S&T in government, parliament, universities, research institutions, productive enterprises concerned with innovation, international organizations working for development; research personnel and specialists whose field of study embraces S&T policies.

1 The *Paris Manual* is being drafted by an international committee of experts put together by UNESCO in 2011. Once completed, the manual will define the ontological and epistemological bases of a common paradigm for evaluating STI policies and policy instruments worldwide.

The platform will also be a useful tool for the democratization of decision-making and public accountability of SETI policies.

The GO→SPIN survey and the information generated are primarily intended for the use of specialists and governmental bodies responsible for national SETI policies. It is their function to analyse the results of the survey and draw appropriate conclusions when they are required to prepare decisions by political bodies in the field of science, engineering, technology and innovation. The survey is also of interest to national bureaux of statistics and international organizations for promoting scientific and technological cooperation among their member states. Collectively, these users are:

- the national developing planning agencies, more particularly the government bodies responsible for formulating and co-ordinating national SETI policies and other national bodies involved in the application of science and technology (S&T) to sustainable development;
- parliamentary groups especially concerned with STI policies;
- SETI information brokers, consulting groups and advisory bodies;
- teaching and research departments engaged in SETI policy studies;
- The governing bodies of R&D institutes and S&T services;
- The boards of management of productive enterprises heavily reliant on R&D or engaged in the transfer of technology and innovation;
- International governmental and non-governmental organizations concerned with SETI and their application to sustainable development;
- Other more peripheral users, such as university departments of political science, economics and social sciences and national and international documentation and information services;
- The mass media.

At individual level, the main groupings are:

- **Decision-makers:** i.e. those responsible for national SETI policies and the management of R&D (ministries of R&D or S&T, directors of bodies responsible for formulating national S&T policies, directors of R&D institutes, heads of productive enterprises heavily reliant on R&D, etc.)
- **Intermediate users:** i.e. those who serve as the link between decision makers referred to above and researchers in S&T policy; their function is to prepare decisions by the former using theories and methods put forward by the latter, this category is made up of experts, consultants, advisers, liaison officers, the staff of ministerial offices and of parliamentary committees, etc., and they usually require rapid access to factual data.
- **Researchers in SETI policies:** i.e. those who develop the theories and methods on which S&T policy is based (researchers in the philosophy, history, sociology and economics of science, engineering and innovation, in the transfer of technology and in the management of R&D.
- **The general public:** by making SETI information more accessible, the GO→SPIN approach introduces a new dimension to the democratization of SETI.

THE METHODOLOGICAL FRAMEWORK

Science, engineering, technology and innovation (SETI) are becoming increasingly important for socio-economic and sustainable development. During the past 60 years, both developed and developing countries have recognized this fact by increasing the number of SETI government bodies, establishing new SETI legal frameworks and implementing a diverse set of new SETI policy instruments. This has driven investment in scientific research, technological development and innovation (STI), led to an increase in the number of scientists and engineers and fostered exponential growth in the number of new scientific articles and patents worldwide (UNESCO, 2010a).

The information economy is one of the key concepts invented to explain structural changes to the modern economy (Godin, 2008). The infrastructure to manage SETI information has been largely considered the core resource of national competitiveness in research and innovation (Neelameghan and Tocatlian, 1985). With the globalization of SETI information infrastructure has come a need to implement comprehensive strategies to connect, share and trade both domestic and foreign information at the national level (Lee and Kim, 2009).

The formulation of adequate SETI policies is critical to tackling contemporary challenges that include mitigating the consequences of global climate change; exploring new energy sources; generating innovation to foster social inclusion; promoting the sustainable management and conservation of freshwater, terrestrial resources and biodiversity; disaster resilience; and fostering the eradication of extreme poverty and hunger. These policies also need to be designed to achieve the UN Millennium Development Goals.

Over the past five decades, operational definitions have been elaborated within the framework of multilateral organizations to measure R&D and the broader concept of S&T. Statistical techniques have been developed to estimate private and public resources invested in these areas. For the former the OECD has laid down a methodological framework in the *Frascati Manual*, the sixth edition of which was published in 2002 (OECD, 2002). For the latter, the Member States of UNESCO have adopted the *Recommendations concerning the International Standardisation of Statistics on Science and Technology* (UNESCO, 1978; 1982; 1984a; 1984b). Methodologies for generating data about R&D investment and human resources have been constantly upgraded and extended.

During the first African Ministerial Conference on Science and Technology[2] (AMCOST I), in 2003, countries committed themselves to developing and adopting a common sets of STI indicators. The New Partnership for African Development (NEPAD) established the African Science, Technology and Innovation Indicators Initiative (ASTII) with the objective of building Africa's capacity to develop and use STI indicators. More specifically, NEPAD aims to: (a) develop and promote the adoption of internationally compatible STI indicators; (b) build human and institutional capacities for STI indicators and related surveys; (c) enable African countries to participate in international programmes on STI indicators; and (d) Inform African countries on the state of STI in Africa. The first *African Innovation Outlook* was published in 2011, while the second volume is being published in 2013. The methodology employed – that suggested by ASTII officials – follows the recommendations of the *Frascati Manual* for R&D indicators and the *Oslo Manual* (OECD, 2005) for innovation indicators.

In 2009, the UNESCO Institute for Statistics organized an Expert Meeting on Measuring R&D in Developing Countries, in Windhoek (Namibia). During the meeting, the experts identified the difficulties and challenges faced by the majority of developing countries, which were not explicitly addressed in the *Frascati Manual* (UNESCO Institute for Statistics, 2010; see Box A). The UNESCO Institute for Statistics is working towards a global standardization of STI statistics, including those items which are not taken into account in the *Frascati Manual*.

The availability of input and output R&D indicators alone does not suffice to evaluate SETI policies. Much more important than the particular value of one specific indicator at a given time is the long-term rate of change that long temporal series of indicators show (Lemarchand, 2010: 27–28). For that reason, long-term temporal series of indicators are necessary to analyse the impact of specific public policies. Improving the reliability of this analysis requires new ways of standardizing information about public policies and the policy instruments designed to implement them. Owing to the complexity of these issues, the 'science of science policy' has emerged in recent years as a new discipline where new analytic paradigms can be tested.

2 The final declaration of the AMCOST meeting in 2012 recommended coordination between the African Observatory on STI (AOSTI), ASTII and UNESCO's GOSPIN. An agreement between UNESCO and AOSTI in February 2013 assigned AOSTI with responsability for following up GO→SPIN surveys with a group of West African countries.

BOX A – MEASURING R&D: CHALLENGES FACED BY DEVELOPING COUNTRIES

The methodology for measuring R&D is detailed in the *Frascati Manual* (OECD, 2002), which has been in use for more than 50 years. A revised edition is due out in 2015. Despite the manual's longevity, developing countries still face problems when trying to apply its standards to measuring the situation in their particular country.

The UNESO Institute for Statistics conducts a biennial data collection of R&D statistics and produces a methodology tailored to the needs of developing countries; it also holds training workshops and builds capacity through other means in developing countries.

In 2014, the UNESCO Institute for Statistics published a *Guide to Conducting an R&D Survey: for Countries starting to Measure R&D*. This guide presents the relevant R&D indicators, discusses the main issues facing each of the major sectors of performance, provides a simple project management template and proposes generic model questionnaires for the government, higher education, business and private non-profit sectors which countries can use and adapt to suit their needs.

In 2010, the UNESCO Institute for Statistics produced a technical paper on *Measuring R&D: Challenges faced by Developing Countries*. The OECD Working Party of National Experts on Science and Technology Indicators subsequently suggested that the paper serve as the basis for an annex to the *Frascati Manual: Proposed Standard Practice for Surveys of Research and Experimental Development (6th edition)*. This annex was adopted as an online adjunct to the *Frascati Manual* in March 2012 (OECD, 2012).

Measuring R&D: Challenges faced by Developing Countries provides guidance on a number of challenges that are relevant to developing countries and which may not be elaborated on clearly enough in the *Frascati Manual*. The following situations are addressed in the document, among others:

- Despite the increasing presence of developing countries in global R&D, there is still a marked lack of demand for science, technology and innovation (STI) indicators from policy-makers in developing countries. Even if the demand does exist, there are often significant problems with compiling the data due to a lack of coordination at the national level, a lack of cooperation by research institutions, universities and businesses, and a generally weak statistical system in the country.
- R&D used to be largely funded by the government but new sources of funds are emerging. Foundations, scientific associations, NGOs and particularly foreign organizations already play an important role. In addition, the contribution of private business is becoming more important and gaining more recognition in a wider range of developing countries. Many of these new sources of funding go directly to individuals and groups rather than to institutions and therefore remain unaccounted for, including for statistical purposes.
- Although the *Frascati Manual* recommends the collection of primary data through direct surveys, the use of secondary data from national budgets and budgetary records of public R&D performing units has been a widely adopted practice to obtain a rough estimate of gross expenditure on R&D (GERD). However, there is often a discrepancy between voted and allocated budgets. Furthermore, national research systems have a limited absorption capacity, which may leave funds unused in central accounts instead of being transferred to institutions performing R&D. Moreover, care needs to be taken to ensure that such transfers are not 'double counted' as expenditure of both the funding body and the institution performing R&D.
- The definitions used by finance ministries and other government institutions to establish S&T budgets may be *ad hoc* and fail to distinguish between broad S&T and narrower R&D activities. Furthermore, many institutions (universities in particular) do not compile a separate R&D budget, especially where research is a low institutional priority.
- R&D components in the national budget, especially capital expenditure, can be difficult to identify and may be aggregated under different headings. In addition, when R&D activities

stretch over more than one financial year, it may not be easy to estimate the amount of resources used each year. For example, work done to develop land and buildings used for research in a given year should be clearly earmarked and not recorded in subsequent years.

- A concentration of innovation activities by sector or in a small set of institutes may lead to volatility and inconsistencies in statistics. There is generally lower emphasis on R&D in the business sector, in part due to reduced competitive pressure in local markets.
- In the higher education sector, the increasing number of private universities makes it useful to distinguish between public and private higher education and to further break up private higher education into government-dependent and independent private institutions. Further disaggregation into private-for-profit and private-not-for-profit higher education institutions should also be considered to track where most research is carried out.
- Surveys that cover all R&D performers should in principle all report for the same period. This is difficult to achieve since, in many countries, higher education institutions and businesses do not necessarily report on the same period – the business sector's calendar tends to be the most problematic. Also, not all countries follow the same calendar. As a solution, the recommendation that R&D performers report on the financial year closest to the survey period may have to suffice.
- Information systems in government and higher education are often not set up to enable the extraction of data on R&D personnel and expenditure. Thus, accurate information on financial expenditure only becomes available a long time after completion of an activity. Unfortunately, ad hoc IT solutions to address these issues may also lead to errors and inconsistencies.
- The collection of data in full-time equivalents (FTE) for researchers provides useful information on the true volume of human resources devoted to R&D. This information is also essential for estimating R&D labour costs. Tallying the number of researchers in a given country presents further challenges. In some developing countries, salaried researchers may not have research budgets or unpaid researchers may undertake research. In other scenarios, academic staff may hold part-time contracts at more than one university. Even if academic staff have contracts that specify the amount of time to be spent on conducting research, it is difficult to enforce especially where there is a lack of resources. Estimating the time spent on research and hence the calculation of the FTE for research staff – particularly in the higher education sector – is fraught with difficulties. This directly impacts the calculation of R&D expenditure.

A number of special types of activity warrant attention when measuring R&D, as they are on the border of what is considered R&D. Three examples follow from the technical paper:

- In the case of traditional knowledge, it is important to set boundaries. Activities which establish an interface between traditional knowledge and R&D are considered R&D. However, the storage and communication of traditional knowledge in traditional ways is excluded.
- Clinical trials are an area of growth in some developing countries. Identifying research personnel in the extended clinical trials value chain may be difficult, as their involvement is occasional and harbours a risk of double counting (i.e. as personnel in the trial and as academic staff).
- Reverse engineering is important in many developing countries. However, this generally falls outside the scope of R&D. Only if reverse engineering is carried out within the framework of an R&D project to develop a new (and different) product, should it be considered R&D.

STI statistical systems are often weak in developing countries. To help strengthen these systems, the paper recommends that countries institutionalize R&D statistics, establish registers of R&D performers and document survey procedures and estimations.

Countries interested in embarking on R&D measurement are encouraged to contact the UNESCO Institute for Statistics.

Better ways of measuring evidence-based policies

SETI policy debates are not yet dominated by a thoughtful, evidence-based analysis of the likely merits of different investment options and policy decisions. The latter are strongly influenced by past practice or data trends that may be out of date (Husbands Fealing *et al.*, 2011). The evolution of new policies has been accompanied by more difficult challenges related to planning and evaluating these policies (see Box B); this indicates a need to improve the theoretical frameworks for policy formulation (Steinmueller, 2010).

Unfortunately, a number of factors prevent countries from reaching most of the objectives established by their own development plans: the lack of reliable information on SETI national potentialities; difficulties in coordinating the various SETI stakeholders; an absence of mechanisms for promoting a strong interaction between the *supply* and *demand* sectors in SETI, and; the absence of any explicit industrialization policy promoting endogenous innovation.

These difficulties mostly appear in small economies. For example, Flanagan *et al.* (2011) have explored the ways in which innovation policy studies treat actors, instruments, institutions and interactions, in order to arrive at a more useful conceptualization of the policy mix for innovation. They stress the need for a genuinely dynamic view of policy formulation and policy interaction. They conclude that 'despite the importance attached to "strategic policy intelligence" in recent innovation policy analysis, little empirical attention has been devoted to actual processes of policy learning.' In developing and exploiting technological opportunities, institutional competencies – namely, the governance of SETI decision-making bodies – are just as important as the SETI incentive instruments they promote (Pavitt, 1996). Path dependency emerges, as the cost of institutional changes to SETI is often higher than that of accommodating new instruments and policies in existing structures (Van der Meulen, 1998). For this reason, the design, analysis and monitoring of any national SETI policy will strongly depend on the adequate mapping of: the structure of the SETI governing bodies; the SETI national legal framework and; of the implicit and explicit operational SETI policy instruments which are implemented (Herrera, 1971; 1972; Sagasti and Aráoz, 1976).

BOX B – THE POLICY-MAKING CYCLE

A stylized presentation of the policy-making cycle typically involves five stages:

- *Agenda-setting*: refers to the process by which problems related to SETI and the linkages between SETI and both society and the economy come to the government's attention;
- *Policy formulation:* refers to the process by which SETI policy options are formulated by the government;
- *Decision-making:* refers to the process by which governments adopt a particular course of action or non-action;
- *Policy Implementation:* refers to the process by which governments put SETI policies into effect and;
- *Policy evaluation:* refers to the process by which the results of SETI policies are monitored by both the State and societal actors. The result may be a re-conceptualization of policy problems and solutions, in which the effectiveness, efficiency and continuing appropriateness of policies and policy instruments are assessed and the results fed back into another round of agenda-setting.

Responsible and accountable SETI governance entails developing capabilities at each of these five stages.

WHY TALK ABOUT SETI POLICIES?

The term 'science policy' was coined following publication in 1945 of Vannevar Bush's seminal article *Science – the Endless Frontier*, which laid the foundations for the first social contract for science. By 1950, UNESCO had initiated the first systematic studies on science policies in a dozen developed countries. Originally, this term referred to public policies related to scientific and technological research, experimental development, scientific and technological services and innovation. *Science policy* as a discipline evolved over the coming decades. Today, it is possible to distinguish specific operational policy instruments according to the different needs established by science policies, engineering policies, technology policies and innovation policies. As these four distinct types of public policy require different skills, major universities around the world have recently introduced specific postgraduate programmes targeting each of the four types of policy:

S*cience policy:* relates to those policies needed to: promote scientific research, determine and select scientific objectives and goals consistent with national plans or strategies, exercise judgment in fixing norms to govern the ways and means by which science is developed, transferred and applied; gather, organize and deploy resources required to pursue the selective objectives and; monitor and evaluate the results obtained from applying the policy. The following are therefore among the most important questions dealt with by policy-makers in the field of science policy: (a) establishing and strengthening government structures and mechanisms for planning, budgeting, co-ordinating, managing and promoting scientific research; (b) gathering, processing and analysing basic data concerning the national scientific potential, including data on ongoing research, monitoring national scientific development and ensuring the smooth growth of the institutional infrastructure for scientific research; (c) maintaining a proper balance between the various types of research (fundamental, applied, experimental development), supporting the development of a creative national scientific community and setting standards for the status of scientific researchers in conformity with their responsibilities and rights; (d) optimizing human, financial, institutional and informational resources to achieve the objectives established by the national SETI policy; (e) assessing and promoting productivity, relevance, quality effectiveness of national research and scientific and technological services in various sectors of performance (higher education, government institutions, business enterprise, private non-profit) and removing organizational and managerial difficulties encountered in the execution of scientific research; (f) initiating appropriate legislative action in relation to the impact on the individual, society as a whole or the natural environment of the application of discoveries and inventions; evaluating the economic profitability and social utility (or harmful effects) of the said discoveries and inventions. Although the aforementioned list is not exhaustive, it indicates the key areas for which government policy-makers are primarily responsible. Each individual issue requires the design of a particular operational policy instrument.

E*ngineering policy:* the role of engineers in public policy can be seen as a two-fold endeavour: (1) to help create public policy related to the utilization of technology to solve public problems as well as monitor and ensure compliance with such policies; and (2) to use engineering knowledge to assist in the construction of policy directives to help solve social problems. In many cases, the development and implementation of such regulations and laws requires both a technical understanding of the functioning of these artefacts and an understanding of how this technology interacts with social and natural systems and would benefit from the involvement of a technical expert. The issues addressed by engineering policies are vast and global in nature and include water conservation, energy, transportation, communication, food production, habitat protection, disaster risk reduction, technology assessment and the deterioration of infrastructure systems. These issues need to be addressed while respecting the rights and meeting the needs and desires of a growing world population [for a detailed list of issues and challenges addressed by engineering policies, see UNESCO (2010c).

T*echnology policy:* the fundamental premise of technological policies is that it is possible for governments to implement public policies to improve social welfare by influencing the rate and direction of technological change. The conventional entry point for economic analysis is to identify the conditions needed for such influence to be superior to the outcome of ordinary market competition. These conditions, in turn, direct further examination of the feasibility and methods for such intervention, including the question of whether government intervention is necessary to improve social welfare. Succinctly stated, government intervention would be necessary if profit-seeking actors underperformed or performed poorly in producing or exchanging technological knowledge from the perspective of social welfare.

I*nnovation policy*: innovation policy can be characterized in various ways, such as by distinguishing between 'supply-side' and 'demand-side' policy, or between 'mission-oriented' and 'diffusion oriented' policy. Policy instruments include financial instruments (e.g. R&D tax credits, export incentives, soft loans, etc.) and regulatory instruments such as laws and binding regulations (e.g. the use of safety equipment for children in cars). Innovation policy encompasses many types of innovation. Innovation may be characterized, *inter alia*, by: the type of innovation – technological (product and process) or non-technological (organizational and marketing); the mode of innovation – novel innovator (strategic and intermittent), technology modifier and technology adopters and; the socio-economic impact – incremental, disruptive or radical. The effectiveness of innovation policies requires a sufficiently stable framework, institutions and policies. Stability and predictability are particularly important for risky activities with a long time horizon such as R&D and innovation. Excessive instability may inhibit innovation by increasing uncertainty for innovators. It may lessen the effectiveness of policy instruments by weakening the incentives they provide. In addition, it reduces opportunities for learning and developing evidence-based policy practices. Whereas there are manifold sources of unwarranted discontinuities, political instability and fiscal problems – often related to policy cycles – are a common cause. In an increasingly complex innovation landscape, developing effective governance requires better co-ordination at, and among, the local, regional, national and international levels.

SETI projects normally occur within a larger temporal framework administered by an organization or a government policy-making body. The early stages of a new SETI policy usually appear as successive expansions of the group of agents and stakeholders whose endorsement is needed to launch the initiative, whereas the latter stages focus on programme management, with feedback as to its success or failure at the policy level (Marburger III, 2011). Consequently, in order to provide an accurate landscape of the SETI policies and policy instruments in a specific national context, it is imperative to understand the long-term evolution of the SETI organizational chart, SETI infrastructure and legal framework (i.e. explicit policies), as well as the type of funding mechanisms implemented. The latter dimensions must be contrasted with detailed analyses of the long-term behaviour of political, educational, economic, productive and social macrovariables (i.e. implicit policies).

It is impossible to describe the current status of SETI without accurate data. Moreover, these data should be presented in such a way as to allow decision-makers and experts to estimate whether the status of SETI meets societal needs or expectations. Policy-makers benefit from additional policy tools to assist them in deciding about budget allocations or in the design of new SETI policy instruments, especially if these are real-time tools or new innovative prospective methodologies. Recent empirical studies show the relevance and long-term impact of appropriate SETI information services on SETI policies designed to improve national competitiveness (Lee and Kim, 2009).

It is also important to note the availability of a large group of public and private databases. These can be most useful tools for evaluating the performance of the SETI policies and providing adequate technology intelligence studies. There are robust, accessible systems designed to make rapid analyses and apply mathematical models to identify critical points or levers triggered by policy changes that can directly affect the performance of innovation activities. For example, Zucker and Darby (2011) present a comprehensive survey of all available databases that may be used to analyse the impact of SETI policies (see Box C).

BOX C – USING MATHEMATICAL THEORY TO PROMOTE STRATEGIC NATIONAL INNOVATION

Recent developments in the mathematical theory of networks can be applied to formulating new SETI policies, in order to promote strategic innovation within national economies.

Hidalgo *et al.* (2007) found that 'economies grow by upgrading the products they produce and export. The technology, capital, institutions and skills needed to make newer products are more easily adapted from some products than from others. The study of this network of relatedness between products, or 'product space,' shows that more-sophisticated products are located in a densely connected core, whereas less sophisticated products occupy a less connected periphery. Empirically, countries move through the product space by developing goods close to those they currently produce. Most countries can reach the core only by traversing empirically infrequent distances, which may help to explain why poor countries have trouble developing more competitive exports and fail to converge to the income levels of rich countries.'

This type of analysis can be applied directly to formulating customized SETI policy instruments to foster the development of specific technologies, where the country has detected a potential new technological niche. The availability of access to new electronic international databases (Zucker and Darby, 2011), combined with the appropriate analytic software, might transform this type of analysis into a standard procedure for selecting national SETI priorities.

Access to appropriate, reliable data is also a prerequisite for responsible and accountable governance, which demands informed decision-making at the planning stage of SETI policy and foresight as to the possible short and long-term impact of policy decisions. Therefore, policy-makers not only need a clear picture of the national, regional and global situation. They also need to be able to estimate the impact of current SETI policies and plan on future policies. The analysis of any national or regional SETI policy strongly depends on the adequate mapping of the structure of SETI governing bodies, SETI national legal frameworks and the implicit and explicit operational SETI policy instruments. Gaps or blind spots in information can cause a specific field to be neglected, which can result in missed opportunities for socio-economic development.

POLICY INSTRUMENTS: LEVERS FOR IMPLEMENTING DECISIONS

A policy may remain a mere rhetorical statement if no means are provided for its implementation or to realize its potential effect. To do this, a number of things may be needed, which we will incorporate under the term of policy instrument. A policy instrument constitutes the set of ways and means used when putting a given policy into practice. It can be considered as the vehicle through which those in charge of formulating and implementing policies actualize their capability to influence decisions taken by others.

The study of public policy instruments in national settings has contributed significantly to the understanding of policy, political systems and relations between State and citizen. Research on policy implementation usually focuses principally on the effects of a specific instrument, within a wider reflection on whether the correct instrument has been chosen for the purpose. As far as new governance models is concerned, the search for suitable instruments is above all governed by pragmatism (Kassim and Le Gales, 2010).

Figure A: Instruments for ensuring a policy obtains the desired effect. Adapted from Sagasti and Aráoz (1976)

SETI operational policy instruments are the levers by which the organizational structure ultimately implements the decisions on a day-to-day basis and attempts to produce the desired effect on the variables the policy has set out to influence. Throughout the analysis of an instrument's effectiveness, it is important to bear in mind the 'actors' or key decision-makers who are directly involved in the design and use of a policy instrument. An instrument does not act on its own accord. Rather, it responds to the will of the policy-makers and decision-makers using it.

A related concept can be found in the problem of *Ordnungspolitik* stressed by the German Freiburg School in the 1930s. Here, the focus was how to devise a framework or set of rules (*Ordnungsrahmen*) for an economy that would define the operating space for individual and private activities. The challenge for SETI policy instruments can be interpreted as a problem of transformation, namely the question of choosing the best policy instrument in order to reach the set target.

A policy instrument attempts to make individuals and institutions take decisions following the rationality dictated by the collective objectives established by those in power. It is the connecting link between the purpose expressed in a policy and the effect that is sought in practice. An SETI policy instrument includes, as a significant component, the manipulation of SETI variables.

One of the first and more relevant studies on SETI policy instruments was conducted in the 1970s by the International Development Research Centre. The principal objective of the study was to devise ways and means of understanding how a country's investment in S&T could be most effectively related to its objectives for industrial development. Sagasti and Aráoz (1976) developed an interesting methodological framework for making a survey and analysing the policy instruments of ten countries in Latin America, the Middle East, Southern Europe and Asia.

UNESCO's Global Observatory of Science, Technology and Innovation Policy Instruments[3] (GO→SPIN) has adapted and expanded the theoretical framework of Sagasti and Aráoz (1976), in order to implement a systematic survey in Africa, Arab States, Asia and the Pacific and in Latin America and the Caribbean. The information in the present country profile has been organized according to this methodological approach. Figure A presents the basic analytical units around which the present report is organized.

All national SETI policies, be they *implicit* or *explicit* (Herrera, 1971; 1972), attempt to harness a country's creative potential to its socio-economic, environmental and cultural objectives. An *explicit* SETI policy is a statement by a high-level government official or institution, such as a ministry or the planning secretariat, that deals with activities related to STI. The policy expresses a purpose (effects according to SETI variables) and may set objectives, define desired outcomes and establish quantitative goals. Policies also contain criteria for choosing from among several alternatives to guide decision-makers as to how SETI works. SETI policies might also be formulated by representatives of the private sector. A number of factors impinge on the efficiency of SETI governance, namely, the extent to which policy processes have the greatest effect with a given use of resources. It must be acknowledged that overall efficiency is not easily defined and measured in a multi-objective, multi-actor world.

3 See www.unesco.org/new/en/natural-sciences/science-technology/sti-policy/global-observatory-on-policy-instruments

THE KEY ROLE OF THE SETI ORGANIZATIONAL STRUCTURE IN POLICY IMPLEMENTATION

The SETI organizational structure or chart usually shows the distribution of responsibility for implementing a given policy. Under the term 'organizational structure,' it is possible to distinguish at least five different levels: (1) policy planning level (policy design); (2) promotional level (i.e. funding and co-ordination of R&D, innovation and scientific and technological services); (3) implementation level (execution of R&D and innovation); (4) scientific and technological services and; (5) assessment or evaluation level.

1. *Policy planning level*: includes policy planning, budgeting, decision-making, interministerial co-ordination. The responsibility for the formulation of SETI policies generally rests with a special government department, ministry or statutory body, in some cases assisted by national councils of research and innovation. SETI policy formulation normally includes the preparation of the national development plan or strategy relating to SETI; it also includes the annual preparation of the functional state budget for SETI activities (mainly research, innovation and scientific and technological services). The decision-making function usually falls to the government, or to a committee of ministers more specifically concerned with SETI; it mainly involves the approval of the national SETI plan (or strategy), as well as the assignment of funding mechanisms. The interministerial co-ordination takes place during the formulation of policies and preparation of plans and budgets then at the various stages of the implementation of these policy documents, once approved by the government.
2. *Promotional level*: the promotion, financing and co-ordination of research, innovation and scientific and technological services in the various sectors of the economy and in society. The functions performed at this level begin with the policy decisions taken by the government and continue with the various government departments or ministries through traditional budgetary procedures along administrative budget lines or through programme budget procedures, as applied to the so-called management by objectives. Several funding mechanisms and SETI operational policy instruments of various kinds have been implemented over the years (i.e. research funds, innovation funds, sectorial funds, tax-incentives; competitive grants, scholarships, etc.). Most countries apply a combination of operational policy instruments to handle the financing of research, innovation and scientific and technological services according to well-defined programmes. The latter can be achieved either by responding to requests for the funding of specific projects submitted by external institutions, laboratories, research units, individual research scientists and high-tech enterprises, or by providing incentives for innovation, or by selectively entrusting the external bodies mentioned above with the execution of specific projects called for by certain development objectives according to the national SETI plan or strategy (normative method). At this particular level, several countries have special institutions (i.e. national research councils) which promote the advancement of scientific research and technological development with a view to improving the quantity and quality of new scientific knowledge to expand the country's potentialities, particularly through support for post-graduate education and research at universities and polytechnics.
3. *Implementation level*: this operational level concerns the actual performance of scientific research, technological development and innovation.
4. *Scientific and technological services (STS) level*: this represents a mixed group, including the institutions in charge of: (a) SETI information and documentation, (b) museums of science and technology, botanical and zoological parks and other SETI collections (anthropological, archaeological, geological, etc.), (c) general purpose data collections: all the activities comprising the routine systematic collection of data in all fields of SETI, such as topographical, geological and hydrological surveys, routine astronomical, meteorological and seismological observations, surveying of soils and plants, fish and wildlife resources, atmosphere and water testing, monitoring of radioactivity, UV and CO_2 levels, prospecting and related activities designed to locate and identify oil and mineral resources, gathering of information on human, social, economic and cultural phenomena, usually for the purpose of compiling routine statistics; testing, standardization, metrology and quality control, activities related to patents and licenses, as well as the production of scientific publications.

5. *Assessment or evaluation level*: this consists in government sectors and institutions monitoring the implementation of policy goals and measuring the societal impact of those policies. Their function also encompasses the conduct of an ongoing survey of a country's SETI potential at the level of research, innovation and scientific and technological service units, including ongoing research results and their practical application.

The GO→SPIN methodological approach introduced a normalized way of encoding the different types of organization and their functions. By representing each national SETI organizational chart and by using the same set of coding tools (Lemarchand, 2010: 310), it will be possible in future to associate these charts and tools with specific topological metrics to identify patterns in performance. The latter will be very useful for defining a new set of SETI policy indicators able to reveal the level of complexity and functionality of each STI organizational chart. Table A shows examples of how different countries structure SETI policy design.

Since its purpose is to guide decisions about the future that must be taken now, a SETI watch cannot seek to identify future developments in S&T independently of past and current developments, or independently of the material and human resources devoted to research and innovation. The prerequisites for any future is: knowledge of the present, knowledge of the current trends observed in a real world composed of different nations and institutions, and knowledge of the strength and weaknesses of the national SETI system in which the decisions informed by the GO→SPIN survey's methodological approach have to be taken.

Table A: Models of governing bodies heading SETI policy design

Argentina	Scientific and Technological Cabinet (GACTEC) Ministry of Science, Technology and Productive Innovation
Australia	Prime Minister's Science Engineering and Innovation Council Commonwealth State and Territory Advisory Council on Innovation Coordination Committee on Innovation
Chile	Inter-ministerial Committee for Innovation National Corporation for the Promotion of Production (Ministry of Economy) National Commission for Scientific and Technological Research (Ministry of Education)
Croatia	Ministry of Science, Education and Sports National Council for Science National Council for Higher Education
Czech Republic	Ministry of Industry and Trade Council for Research, Development and Innovation Ministry of Education, Youth and Sports
Finland	Research and Innovation Council Ministry of Employment and the Economy Ministry of Education and Culture
Ireland	Inter-Departmental Committee on STI Department of Jobs, Enterprise and Innovation
Malaysia	Ministry of International Trade and Industry Ministry of Science, Technology and Innovation Economic Planning Unit
Republic of Korea	National Science and Technology Council Ministry of Science and Technology
Singapore	Economic Development Board Research, Innovation and Enterprise Council National Research Foundation
South Africa	Department of Science and Technology Department of Trade and Industry Department of Higher Education and Training

Source: UNESCO

The diversity of institutions at the promotion level (funding) in a given country seems to be one of the most fundamental indicators of good practices. The GO→SPIN global database will provide empirical evidence to confirm or refute this and other hypotheses.

The so-called *legal framework* can also be considered as a set of legal instruments. This embodies the policy, or parts thereof, in the form of a law, decree or regulation. Formal agreements, contracts and international STI cooperation treaties may also be included in this category. A legal instrument goes one step beyond a policy by stipulating obligations, rights, rewards and penalties. The GO→SPIN systemic approach has developed a friendly platform offering direct access to the entire SETI legal framework, description and the full text of laws, acts, decrees and agreements adopted by each country. Table B shows different examples of the most important types of legal instrument.

Table B: Examples of SETI legal instruments

A law for the creation of national research labs, universities, national research councils, ministry of S&T, R&D Funds, etc., or a legal framework to regulate the organization of the national innovation system.
A law to regulate the imports/exports of high-tech products.
A law to regulate tax incentives to promote innovation within the private sector.
A law to regulate foreign direct investments promoting the establishment of new high-tech enterprises.
A law to regulate the protection of the national biodiversity and to establish norms on how foreign companies exploit the active substances available within each national territory (new rules for the protection of indigenous knowledge).
Laws to foster R&D activities within the private sector and the creation of technological funds associated with the most strategic sectors of the economy (energy, mining, agriculture, industry, communication, fishing, tourism, etc.).
National regulations and decrees to establish new national policies, creation of new funding mechanisms, import/export tariffs, etc.
Bilateral, regional and international agreements on SETI activities.
Contracts on technology transfer.

Source: UNESCO

GO→SPIN also includes a complete description of SETI operational policy instruments; these are the levers, or actual means, through which the organizational structure ultimately implements the decisions on a day to day basis and attempts to influence the behaviour of the various stakeholders targeted by the policy. Throughout the analysis of an instrument, it is important to keep in mind the actors or key decision-makers who are directly involved in the design and use of a policy instrument. An instrument does not act on its own accord. Rather, it responds to the will of the policy-makers and decision-makers using it. Table C shows different types of operational policy instrument, whereas Figure B shows various instruments that can be employed to effect at the different stages leading to market penetration of an innovation. Table D presents the taxonomic classification of SETI operational policy instruments employed by GO→SPIN according to its methodological approach, by objective and goal; the type of mechanism/mode of support and target groups/beneficiaries. By analysing the aggregated information for groups of countries employing these classification schemes, it is possible to detect development patterns.

Table C: Examples of operational SETI policy instruments

Programmes and objectives	Policy instrument	Strategic objectives	Beneficiaries	Mechanisms for allocating funding
Scientific research and technological development	Competitive grants	Promote the endogenous production of new scientific knowledge in the exact and natural sciences. Promote regional networking.	Research groups at national universities and national research centres associated with similar research groups from other countries in the region, within formal partnership agreements	Competitive grants selected on a peer review basis; national research groups must be associated with similar groups from countries in the region which provide matching funding
Promotion of science education	Public subsidies for projects establishing science laboratories at public secondary schools	Improve scientific knowledge; methodological approach and critical thinking for secondary school pupils	Public secondary schools in less developed parts of the country	Public subsidies to mount new science cabinets and laboratories and new posts for science professors
Promotion of gender equality in research and innovation	Scholarships	Promote the participation of women in high-tech research and innovation	Young women enrolled in a PhD programme in basic and engineering sciences	Scholarships of up to four years and small grants for participation in international conferences
Protection of indigenous knowledge	Intellectual property rights, public law–national legislation and public subsidies	Protection of traditional knowledge to confer exclusive ownership and rights on local communities when the object of protection is a product or domesticated animal, cultivated plant or any micro-organism, or a design or an object of a functional or aesthetic nature, including any element of handicrafts, the act prohibits third parties from making, using, stocking, offering for sale, selling, commercializing, importing, exporting or identifying the active substances for commercialization, without consent	A local traditional practitioner, a local community or its representative may apply to register traditional knowledge	Public subsidies and tax exemptions to defend the Intellectual property rights of holders of indigenous and traditional knowledge
Attraction and reinvestment of foreign direct investment	Public financing Tax incentives	Strategies vary from country to country, examples being: (a) an Industrial policy based on attracting export-oriented industries; (b) promotion of structural change; (c) capacity-building to improve competitiveness, focusing on sectors or market niches; (d) internationalization of enterprises, and promotion of innovation; (e) prioritizing the generation of higher-tech goods and services (f) attracting selective FDI oriented towards ICTs, biotechnology, nanotechnology and financial services; (g) improving the business climate by refining legislation and simplifying formalities to facilitate corporate operations.	National Infrastructure (buildings, technology corridors, technological cities) and training of labour and professionals for the industry in question SMEs with export capacity	Soft-loans, tax incentives, grants For specific periods: tax discounts, exemptions, preferential rates, rebates on machinery and equipment
	Attracting R&D firms		Endogenous entrepreneurs High-tech emerging sectors: biotechnology, nanotechnology, new materials, ICTs.	The same tax incentives plus special competitive funding
	Other services	Structural change within a large country offers more opportunities for the domestic market, small and medium-sized countries generally focus on schemes conducive to the development of exports	Strengthening exports of industries and services considered to have strong potential in the country	Creation of a "one-stop shop" with representatives from different ministries/ agencies to deal with problems concerning programmes, public regulations and post-investment services

Programmes and objectives	Policy instrument	Strategic objectives	Beneficiaries	Mechanisms for allocating funding
Technological development	Non-repayable contributions	Increased competitiveness through innovation in products, services and processes	Micro-, small and medium-sized enterprises and broader enterprises certified as having attained international standards	By public competition; up to 50% of project cost
	Loans for technological development projects	Finance for middle-income technology production projects	Micro-, small and medium-sized enterprises with R&D departments or teams, collaborating groups and technical linkage units underwritten by the enterprise	Compulsorily repayable loans; up to 80% of the total cost, allocated on an open window basis, with a maximum of $... for three years
Technological modernization (improvement of products and processes, training)	Fiscal credit programme	Assistance in executing R&D	Physical or juridical persons who own enterprises producing goods and services	Subsidies through fiscal credit certificates obtained via public competition; up to 50% of the total cost of the project
	Loans for modernization Projects	Technological adaptation and improvements to products and processes with a low level of technical and economic risk	Enterprises with R&D department or groups; collaboration groups, and technical linkage units underwritten by the enterprise	Special compulsorily repayable loans allocated on an open window basis. Up to 80% of the total cost of the project, with a maximum of $...in three years
	Loans to enterprises	To finance projects for the development of new production processes, products and modifications thereto	Enterprises, without any restriction on size or sector; no finance provided for projects with a rate of return of less than 12%	Compulsorily repayable loans allocated on an open window basis. Up to 80% of the total cost of the project, with a maximum of $...
Promotion of the technological services market (research institutes and business research centres)	Subsidies for projects to develop business plans	Finance for business development projects based on R&D	Micro-, small and medium-sized enterprises whose projects are executed by technical linkage units	Subsidies allocated on an open window basis. Up to 50% of the total project cost, with a maximum of $..., for up to one year
	Loans to institutions	To promote the establishment and strengthening of structures for the provision of technological services to R&D enterprises and institutions	Public or private institutions providing services to the private productive sector; projects may be presented on an individual or associated basis	Obligatorily repayable subsidies allocated on an open window basis, up to a maximum of $...
Training and technical assistance	Subsidies for training and retraining projects	Subsidies to support activities for training and retraining human resources in new technologies	Micro-, small and medium-sized enterprises whose projects are executed by technical linkage units	Subsidies allocated on an open window basis. Up to a maximum of 50% of the total cost of the project, or $... for up to six months
	Subsidies for project Formulation	Support for the formulation of R&D projects, technology transfer or technical assistance	Micro-, small and medium-sized enterprises whose projects are executed by technical linkage units	Subsidies allocated on an open window basis. Up to a maximum of 50% of the total cost of the project, or $... for up to six months
Technological advisory assistance programmes and those strengthening the performance of technical small and medium-sized enterprises	Technological advisory assistance programme	Support for the formulation of R&D projects, technology transfer or technical assistance	Micro-, small and medium-sized enterprises producing goods and services which incorporate technological added value	Subsidies allocated on an open window basis to individuals or groups, with a maximum of 50% of the total cost of the project, or $... and a maximum of $... per participating enterprise
Popularization and social appropriation of science	Competitive grants	Support for the organization of national exhibitions and science fairs	Science museums, educational institutions at primary, secondary and tertiary levels	Subsidies allocated on a competitive basis

Source: UNESCO, UN ECLAC, FONTAR (Argentina)

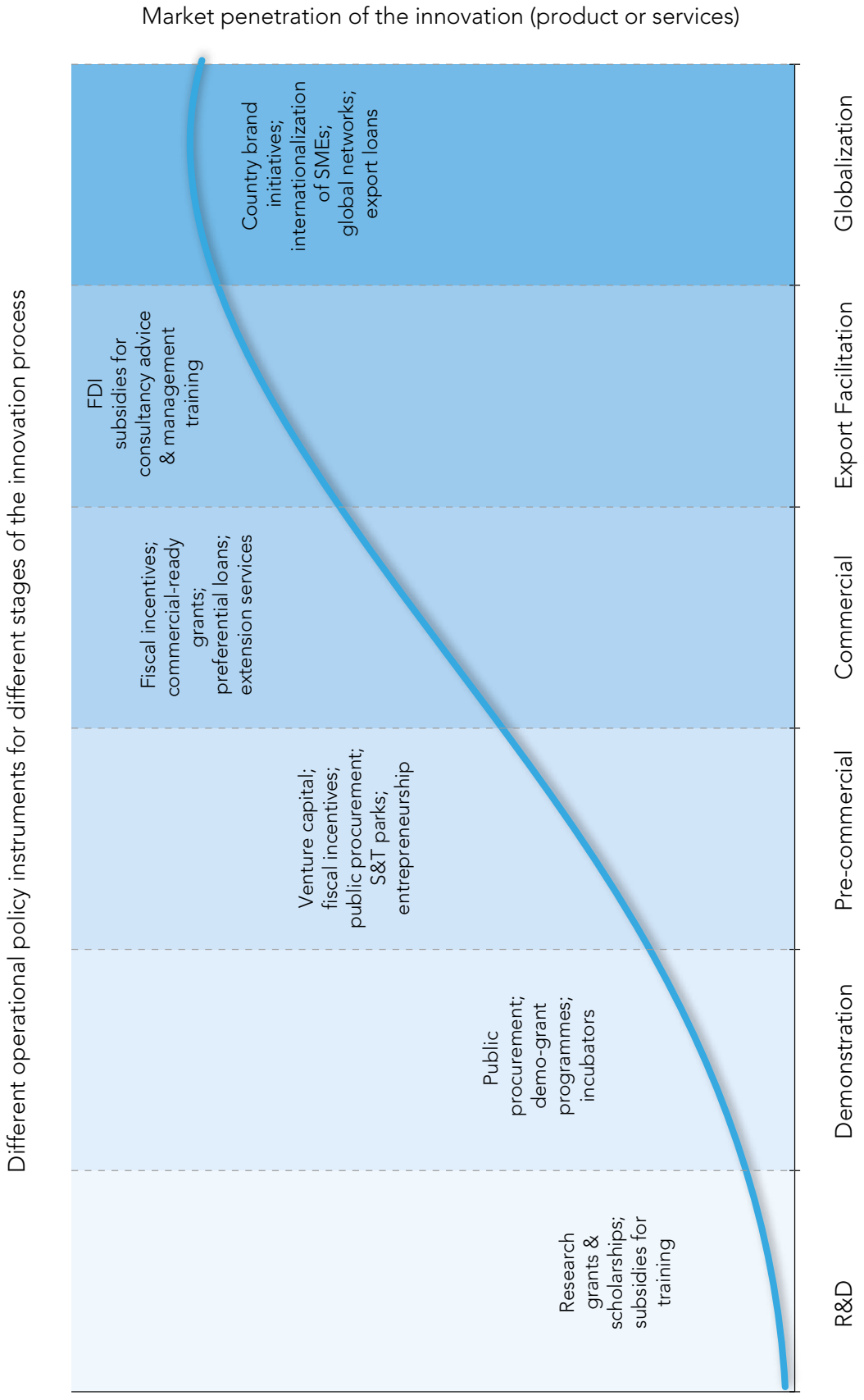


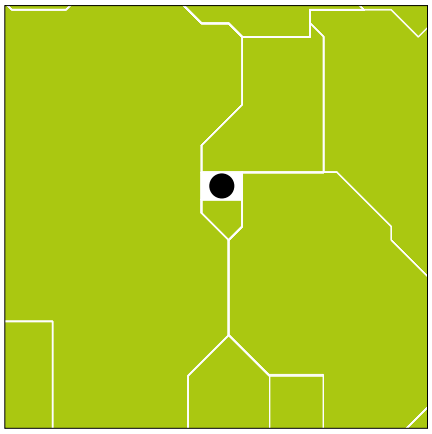
Figure B: Policy instruments for different stages of the innovation process and market penetration.
Source: UNESCO

Table D: Taxonomic classification of SETI operational policy instruments employed by GO→SPIN

Objectives and goals	Type of mechanism/ Mode of support	Target groups/Beneficiaries
Strengthen the production of new endogenous scientific knowledge	Grants (grant funds)	Technical and support staff at SETI
Strengthen the infrastructure of research laboratories in the public and private sectors	Donations (individuals/ companies)	Students
Human resources for research, innovation and strategic planning; capacity building, education and training of specialized human capital for (1) the production of new scientific knowledge, (2) development of new technologies, (3) promotion of innovation within the productive and services systems and (4) management of the knowledge society	Loans	Individual professionals / PhD holders
Strengthen gender equality for research and innovation	Creation of, and support for, technological poles and centres of excellence	Teachers/ Researchers
Strengthen the social appropriation of scientific knowledge and new technologies	Tax incentives	Universities
Development of strategic technological areas and new niche products and services with high added value; promotion and development of innovation in the production of goods and services; promotion of start-ups in areas of high technology	Technical assistance	Research centres
Strengthen science education programmes at all levels (from primary school to postgraduate)	Scholarships	Technical training centres
Promotion of the development of green technologies and social-inclusion technologies	Credit incentives and venture capital	Schools/ Colleges/ Institutes
Promotion of indigenous knowledge systems	Trust funds	Corporations/ Foundations
Research and innovation eco-system: strengthening co-ordination, networking and integration processes which promote synergies among the different actors of the national scientific, technological and productive innovation system (i.e. government, university and productive sectors)	Information services	Professional Institutes
Strengthen the quality of technology foresight studies to: assess the potential of high-value markets; develop business plans for high-tech companies; construct and analyse long-term scenarios and; provide consulting services and strategic intelligence	Others	SETI local groups (e.g. a group of independent researchers)
Strengthen regional and international co-operation, networking and promotion of SETI activities		Private companies
		Science and technology public or private non-profit organizations
		Ad hoc associations
		Individuals
		Small and medium-sized enterprises
		Public institutions
		Co-operatives
		Other

Source: UNESCO

Rwanda: mapping the landscape of a small-economy innovation system



OFFICIAL NAME: Republic of Rwanda

ABBREVIATION: RW

CAPITAL CITY: Kigali

CHIEF OF STATE: President, H.E. Paul Kagame (since 22 April 2000)

HEAD OF GOVERNMENT: Prime Minister, Right Honourable Anastase Murekezi (since 24 July 2014)

NATURE OF GOVERNMENT: republic; presidential, multiparty system

POPULATION: 10 515 973 (2012 census) and 11 406 000 (est. July 2015)

SURFACE AREA: 26 338 km2

LANGUAGES: By constitution, there are three official languages, Kinyarwanda, French and English, with English being the medium of instruction. Other languages include Kiswahili, commonly used in commercial centres

RELIGIONS: The greatest majority are Christians, including Roman Catholics, Protestants (including Adventists); others are Muslims, animists and some people practice unspecified religions

UNIT OF CURRENCY: Rwandan francs (RWF)

DATE OF INDEPENDENCE: 1 July 1962 (from Belgium-administered UN trusteeship)

DATE OF CONSTITUTION: several previous; latest adopted by referendum 26 May 2003, effective 4 June 2003; amended several times, last in 2010

HISTORY OF A PEOPLE

The territory of Rwanda today was inhabited as far back as 35 000 years ago. Anthropological research suggests that the first known inhabitants of the area were the *Twa*, a pygmy group that followed hunting and gathering subsistence patterns. Later, between the VII and X centuries AD, the Bantu-speaking *Hutu* people, who followed a settled, agricultural way of life, arrived, probably from the region of the Congo River basin (Gall and Hobby, 2007). During the XIV and XV centuries, the *Tutsi*, a pastoral people of Nilotic origin, arrived from the north, probably from the present-day countries of Somalia and Ethiopia, creating several small and independent chieftaincies. By the end of XV century, the chieftaincies merged to create a state, under the leadership of Ruganzu I Bwimba.

The history of Tutsi expansion falls into four separate phases. The initial step involved the formation of a small nuclear kingdom in the region of Buganza and Bwanacyambwe, under the reign of Ruganzu Bwimba in the XV century. A second phase, beginning in the XVI century, incorporated neighbouring areas into what is today the central region of Rwanda (Nduga-Marangara). With the accession of Ruganzu Ndoli to power, in the XVII century, a series of invasions were launched against formerly independent communities, which resulted in the creation of a unitary state. Finally, in the first half of the XIX century a group of independent states – the most powerful of which was the kingdom of Gisaka in the east – were forcefully incorporated into the national boundaries of Rwanda (Lemarchand, 1966).

In precolonial times, the territory of Rwanda was controlled by a highly centralized kingdom presided over by kings who hailed from one ruling clan. The king ruled through three categories of chiefs: cattle chiefs, land chiefs, and military chiefs. The chiefs were predominantly, but not exclusively, Tutsi, especially the cattle and military chiefs. While the relationship between the king and the rest of the population was unequal, the relationship among the ordinary Hutu, Tutsi, and Twa was one of mutual benefit mainly through the exchange of labour. A clientalist system called *ubuhake* permeated the entire society

(Kurien, 2007). This arrangement allowed leading Tutsi close to the king to thoroughly infiltrate the socio-political establishment, turning power to their exclusive advantage. Little by little, they took over control of the State institutions and at the same time built up a unification movement. The ownership of land was gradually transferred to the king, who became the supreme head and, in theory, absolute master of the country (Gall and Hobby, 2007).

European influence in East Africa began with the arrival of Catholic missionaries of the company of the White Fathers in 1879. In an attempt to mitigate the violence of the competition for the imperial sharing of Africa, in 1885, the Berlin Conference laid down the principles by which "spheres of influence" could be set up by colonizing powers. The conference placed the Kingdom of Rwanda together with Urundi (now Burundi) under German rule as part of *Deutsch Ostafrica* or German East Africa. However, not until nine years after the conference did the first European officials reach Rwanda. German rule was indirectly exercised through the king, who in turn used the German presence to strengthen his own authority and extend it throughout the territory. In those days, the German administration consisted of only five officials and about 166 soldiers (Kurien, 2007).

During the subsequent partition of Africa in 1910, much of Rwanda was annexed to neighbouring countries. This entailed the loss of a third of the Rwandan internal market and a large part of its natural resources (Rep. of Rwanda, 2000). Belgium, which had occupied the territory in 1916 during World War I, was afterward, in 1923, granted a League of Nations mandate that was known as *Ruanda-Urundi* (present-day Rwanda and Burundi). The Belgian Administration followed the German pattern by relying on the *mwami* and the Tutsi aristocracy.

In 1925, *Ruanda-Urundi*, was joined in an Administrative Union with the Belgian Congo. The Belgian colonial system was marked by a close alliance between the Administration and the missions that were responsible particularly for the educational system, in large part. In those days, very few Hutu were admitted to *Astrida*, the school that educated future administrators and government officials. In 1929, Hutu chiefs, often in charge of land allocation and management at the local level were removed from office and replaced by Tutsi chiefs. Because the latter already occupied chieftainships in cattle and military affairs, the balance of power fell completely in favour of Tutsi. The Hutu peasantry regarded the Tutsi – as a group – as their *de facto* rulers (Verwimp, 2013).

In 1946, Rwanda-Burundi was made a Trust Territory under the United Nations. Under pressure from the UN Trusteeship Council, the first representative political institutions were introduced in the country in 1952 (Kurien, 2007). The 1954 abolition of the *Ubuhake* by the Umwami Mutara III caused a divide between the local Administration made up of Tutsi, and the colonial administrators, who, sensitive to the context of African decolonization, supported the 1957 Hutu Manifesto.

In November 1959, a Hutu revolution began, continuing sporadically for the next few years. Many Tutsi either were killed or fled to neighbouring territories during the nationwide anti-Tutsi campaign named the "wind of destruction." The Belgian authorities, along with the Roman Catholic missionaries, provided crucial support to the Hutu during this troubled period. A provisional government, republican in tendency and composed predominantly of members of the Parmehutu Party, was set up in Rwanda in October 1960. Because the United Nations did not recognize the 1959 elections, on 25 September 1961, legislative elections and a referendum on retaining the institution and person of the *mwami* were held in Rwanda. The elections gave the Parmehutu, led by Grégoire Kayibanda, an overwhelming majority. In the referendum, about 95% of the electorate took part, voting 4 to 1 to abolish the monarchy.

Despite diplomatic pressure on both Rwanda and Burundi to come to independence united, the UN reluctantly accepted their separation. On 27 June 1962, the UN General Assembly passed a resolution providing for the independent states of Rwanda and Burundi, and on 1st July, Rwanda became an independent country.

Ideological tension (interpreted as racial by some scholars) continued after independence, with serious tribal warfare breaking out in 1963 when an incursion from Burundi of exiled Rwandan Tutsis resulted in the death of at least 15 000 Tutsis in hands of Hutu gangs. Parmehutu consolidated its position during

the decade, and in 1973 the existing constitution, which barred Kayibanda from seeking another term as president, was overthrown by a military coup led by army chief of staff Juvénal Habyarimana. There then ensued a period of military rule, until 1978, when a new constitution was promulgated and Habyarimana became president (Commonwealth Secretariat, 2014). Single party elections were held in 1981, 1983 and 1988, when Habyarimana won a fourth term as president.

Despite that some actions to promote national unity were implemented during this period, the discrimination against Tutsi continued. In October 1990, a new Hutu-Tutsi confrontation was triggered. Between 3 000 and 8 000 long-exiled Tutsi, calling themselves the Rwandese Patriotic Front (RPF), crossed the border from Uganda in an effort to topple Habyarimana's government. On June 8, 1991, the president signed a new constitution that provided for multiparty politics. After a long period of negotiations between the government of Rwanda and the RPF that took place in Arusha, Tanzania, the Arusha Peace Agreement was signed on August 4th, 1993. The agreement called for UN peacekeeping forces to be stationed in Rwanda. In April 1994, President Habyarimana and Burundian President Cyprien Ntaryamira were killed when their plane was shot down near Kigali; responsibility for the attack was never established.

In the three months following the assassinations, more than one million Rwandans, mainly Tutsi, were killed in what UN Secretary General Boutros Boutros-Ghali eventually called genocide against the Tutsi by the Hutu-dominated Rwandan Army (Gall and Hobby, 2007).

The RPF put an end to the 1994 Genocide and thereafter formed the Government of National Unity (GNU) and the Transitional National Assembly in coalition with other political parties to define a new future for Rwanda through democratic institutions (Rep. of Rwanda, 2000).

In 1995, the Transitional National Assembly adopted a constitution that included elements of the constitution of 1991, as well as provisions of the 1993 Arusha peace accord and the November 1994 multiparty protocol of understanding. The document created the post of Prime Minister, limited the president to two five-year terms in office, and provided for multiparty politics, freedom of the press, and separate executive, judicial, and legislative branches.

In 2003, voters overwhelmingly approved a new constitution that gave primacy to human rights, eliminated references to ethnicity, and included specific provisions to prevent genocide. Additionally, the document provided for a bicameral legislature, codified a system of checks and balances, and, in an effort to separate power, required that the prime minister and president be members of different political parties. It also offers specific provisions for parliamentary and presidential elections. Rwanda received the Millennium Challenge Account Compact in 2008 to support government's efforts to strengthen democracy. In 2011, the Rwanda Governance Board was established as the first institution of its type in Africa, to promote decentralisation of power, as well as, principles and practices of good governance in public institutions to promote accountability, transparency and integrity.

Rwanda was admitted to the United Nations on 18 September 1962, and is a member of UNECA and most of the non-regional specialized agencies, including the FAO, UNCTAD, UNESCO, UNIDO, WHO and the World Bank. It is also a member of the WTO, the African Development Bank, the ACP Group, the East African Community (EAC), the Common Market of East and Southern Africa (COMESA), G–77, the New Partnership for Africa's Development (NEPAD), and the African Union. In 1976, Rwanda joined Burundi and the Democratic Republic of the Congo (now the DRC) in the Economic Community of the Great Lakes Countries, formed to develop the economic potential of the basin of Lakes Kivu and Tanganyika; its headquarters are in Rubavu District (former Gisenyi). In 1977, Rwanda joined Burundi and Tanzania in forming an Economic Community for the Management and Development of the Kagera River Basin. Uganda became a part of the Community in 1980. Its headquarters are in Kigali.

Rwanda also joined the Commonwealth in late 2009. In January 2013, Rwanda assumed a non-permanent seat on the UN Security Council for the 2013–14 term. In environmental cooperation, Rwanda is part of the Convention on Biological Diversity, CITES, the Kyoto Protocol, the Montréal Protocol, the Comprehensive Nuclear Test Ban Treaty, the UN Framework Convention on Climate Change, and the UN Convention to Combat Desertification.

Table 1 presents a synthesis of the major characteristics of the Rwandan State's long-term evolution, which was originally developed for the foresight document *Vision 2020* (Rep. of Rwanda, 2000).

Table 1: The evolution of State in Rwanda from pre-colonial era to present

The role of the State	Pre-colonial era	Colonial era	From independence up to 1994	Post-genocide period
Internal peace and security	Generally well ensured by the King's authority. Periods of conflict expansion and relations with some neighbouring kingdoms.	Less regional wars, following the demarcation of colonial boundaries and the installation of the colonial administration.	Programmes caused by the ethnic and regionalist divisions Permanent climate of insecurity.	Fight against the 1996–2000 insurgency. High level of internal security. Pacification of the Great Lakes Region in process.
Nation unity	• No internal problems and everybody contributed to defend the nation. However, there used to be voluntary exile by individuals or groups who had defied the royal authority. • The Rucunshu succession war in 1896 that resulted in the weakening of the royal regime.	Cracks in the social fabric of the nation: Exclusive schools for the chiefs' children in Nyanza in 1918 and Astrida in 1929 operated by white Fathers. Destitution of Hutu modest Tutsi and Twa by Belgians in 1929.	Development of divisive ethnic ideologies. Total disintegration of the social fabric following the 1990 – 1994 Genocide.	Explicit political will and efforts for reconciliation. National Commission for Unity and Reconciliation. Anti-segregation legal framework including abolishment of ethnicity cards.
Justice				Efforts to separate the three powers. Gacaca reconciliatory justice.
Human rights	• Poorly respected.	• Poorly respected.	• Not respected.	Progress towards the rule of law.
Decentralization	• Hierarchical and centralised policies.	• Colonia power concentrated the political powers in his hands. • Beginning of the concentration of the national economy into the hands of the State.	• Highly centralized economic and political powers.	Progressive decentralization of the political and economic powers, promotion of the private sector. Establishment of a Common Development Fund for decentralisation.
Governance and democracy	• Low level of social equity. • All the leaders were nominated. • Possibility of expression and questioning the authority.	• Loss of a third of the national territory following the 1910 partition. • Low level of social equity. • No democracy but state control and coercion.	• Poor governance by the state party. • Poor level of social equity. • State party dictatorship.	Progressive improvement of popular participation. Strategy to fight poverty. Ombudsman institutionalised. Multiparty System institutionalised. Law liberalising the press. Consultation of National Constitution.

The role of the State	Pre-colonial era	Colonial era	From independence up to 1994	Post-genocide period
Regional and international integration	• Limited exchange with neighbouring Kingdoms. • No exchange with foreign countries (external world)	• Opening of the country's borders. • Contacts with the world via the colonial state Belgium. • Commodity products.	• Further opening to international cooperation. • Periodic problems with neighbouring countries due to personal relations between the ruling classes.	Free entry and exit of citizens. Efforts to pacify the Great Lakes Region and for the policy of good neighbourliness. Efforts towards multilingualism. Policy of regional integration and of openness.
Management of State (public) affairs	• Monarchy	• Efficient but coercive	• Progressive improvement. • High-level corruption.	Reforms and organs aimed at improving transparency. Fighting corruption.
Diaspora	• Limited	• Exacerbation of waves of emigrants running away from the colonial yoke and ruthless rule. • Close monitoring of indigenous administration.	• Negative role of the State in the forced emigration. • Destabilization of the Diaspora in host countries.	Double citizenship. Efforts towards good relations and contact. Easy entry and exit. Participatory approach and generalised consultation.

Source: Vision 2020

DEMOGRAPHIC PROFILE

The United Nations Development Assistance Framework (UNDAF) identified the high population density as one of the major challenges for sustainable development (United Nations Rwanda, 2012). At about 468 people per km^2, Rwanda has the highest population density in continental Africa. These values are over the human carrying capacity[1] of Rwanda. Population growth (2.6% c. 2013) and total fertility (4.6 children per woman c. 2014) remain high, constraining poverty reduction efforts.

Figure 1 shows the long-term evolution in the population of Rwanda (1960–2013). The percentage share of different age groups stabilizes after 1990. Figure 2 shows the population's growth rate over the same period. A high oscillation is observed during the Genocide period, but the growth rate remained very high over last fifty years.

The average annual population growth rate in Rwanda over the past 54 years has been 2.6%. This is similar to the value attained in 2013, which was the 23th-highest in the world. There are approximately 34.6 births/1 000 inhabitants (2014 est.) while the death rate is 9.18 deaths/1 000 inhabitants (2014 est.). The country's fertility rate is extremely high. Women in Rwanda who have little or no education have an average of 2.6 more children than those who have at least a secondary education.

United Nations' projections indicate that if the population continues to grow at its current rate of 2.6% a year, it could exceed 40 million by 2100, giving the nation a density five times that of Japan's today (Ruxin and Habinshuti, 2011).

1 Carrying capacity refers to the number of individuals who can be supported in a given land area over long term without degrading the physical, ecological, cultural and social environment, i.e. without reducing the ability of the environment to sustain the desired quality of life over time. For an extensive discussion on the human carrying capacity, see Cohen (1995).

This long-term trend compromises development gains. The population of a country influences all aspects of socio-economic development. Efforts to slow down population growth, reduce poverty, achieve economic progress and improve environmental protection are mutually interlinked. Slower population growth and sustainable fertility levels could have a very positive impact on long-term sustainable development and quality of life.

Rapid population growth, particularly in rural areas, has exacerbated migration to urban areas. The share of the urban population increased from 2.7 % during the independence (c. 1962) to 4.7 % in 1980, 5.4% in 1990, 14.9% in 2000 and 26.9% in 2013. The estimated annual urbanization rate for 2013 was 6.4%. Rapid urbanization is accompanied by a range of problems: poor access to a clean water and sanitation, the spread of disease, unemployment and growing crime rates, and environmental degradation.

High youth unemployment, another challenge facing the country, is also strongly linked to the rapid population growth. The economy suffers from an inexperienced workforce, skills mismatches, and its job creation rate lags behind the demand of youths eligible to enter the labour force each year.

Family planning and population policy needs to safeguard the progress made by Rwanda thus far in reaching the United Nations' Millennium Development Goals (MDG), to ensure that future success in reaching the MDGs does indeed lead to a net reduction in poverty ratios and increase social well-being. Young men and women, in particular, must be informed about their rights and responsibilities, given access to social services, training opportunities, health services (including a family planning element), social security, and social benefits.

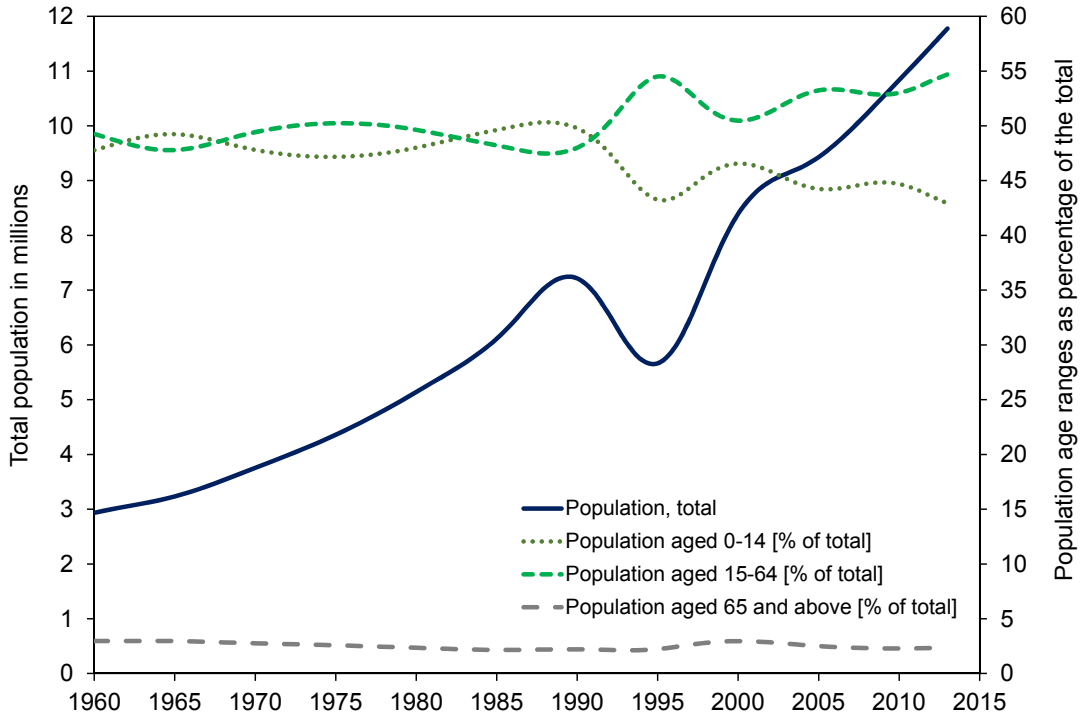


Figure 1: Evolution in the population of Rwanda, 1960–2013. Source: UNESCO, based on data provided by UN Statistics Division

Rapid population growth results in an increasing pressure on ecosystems, due to increasing demand for natural resources and living space with all the consequences (erosion, degradation, soil depletion, etc.). It also calls for increasing investment in education, health, energy and shelter despite the constraints of a non-diversified economy. For all these reasons, population growth presents one of the most serious challenges to Rwanda's meeting its target to become a middle income country by 2020.

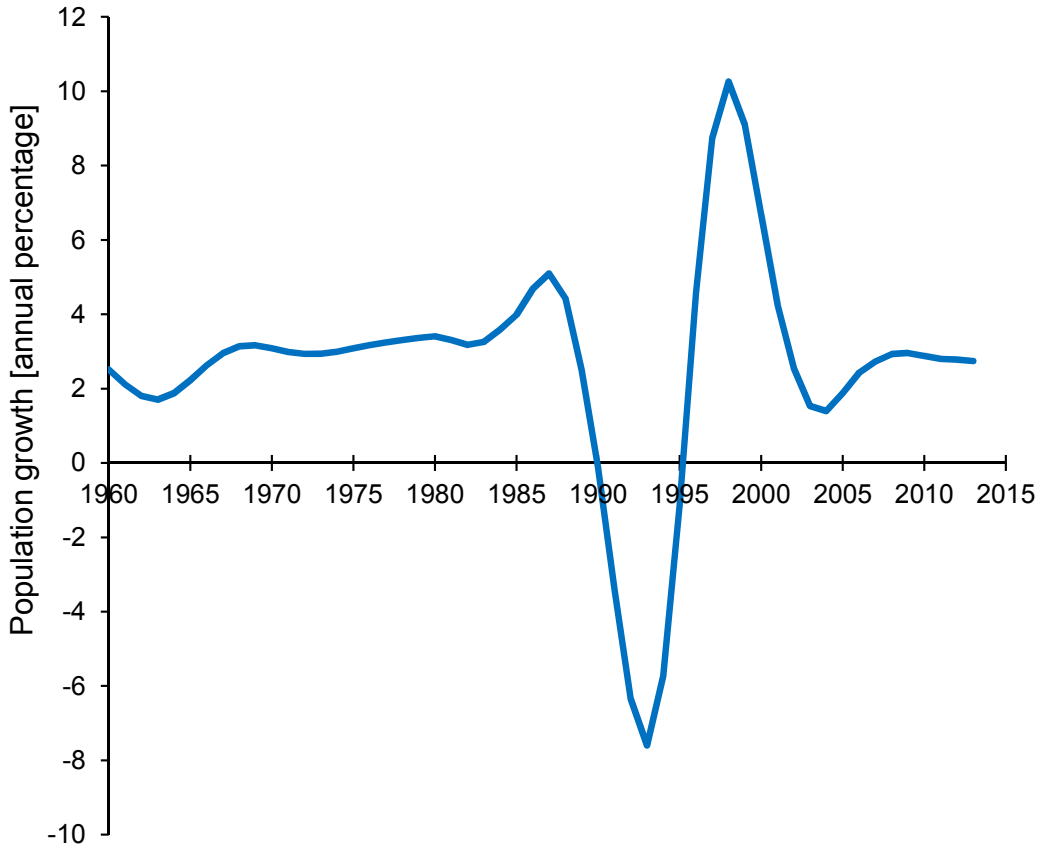


Figure 2: Evolution in the population's growth rate of Rwanda, 1960–2013. Source: UNESCO, based on data provided by UN Statistics Division

Rwandan culture, government and religious institutions have historically discouraged family planning (Ruxin and Habinshuti, 2011). As it was mentioned before, in 2000, the government developed a report proposing a long-term vision and strategy for the nation, identifying development goals and setting out steps for reaching those goals (Government of Rwanda, 2000). Known as *Vision 2020,* this long-term strategy recognized that the demographic trend of rapid population growth is a major cause of the depletion of natural resources, and thus a cause of poverty and hunger. According to *Vision 2020,* rapid population growth is the result of a number of factors: (1) the high fertility rate of women, itself linked to (2) a pro-birth culture (3) low child death rates and (4) the relatively low general mortality rate, due to a climate and topography unfavourable to diseases. *Vision 2020* proposed to reduce within 20 years the fertility rate from 6.5 to 4.5 children, and the population growth rate to 2.2% (Government of Rwanda, 2000: 14).

Bundervoet (2014) showed that fertility in Rwanda has declined between 2005 and 2010. While fertility dropped across all cohorts (except for the youngest cohort), the decline has in relative terms been most pronounced for younger cohorts. Between 2005 and 2010, cumulative fertility declined by 20% for the 20 to 29 age group, compared to 9% for the 35 to 49 age group. Bundervoet (2014) also found that increased levels of female education explain the largest part of the fertility decline, accounting for slightly over one fifth of the drop. Improved household living standards appear as a secondary driver of the fertility decline. The progressive roll out of the 12 years of basic education program is expected to substantially increase the educational attainment of young cohorts. Together with the progressive move off the farm, this suggests that further declines in fertility can be expected in the decade to come.

HUMAN DEVELOPMENT IN RWANDA

The concept of human development focuses on the result rather than the means of achieving development. This holistic approach puts people at the centre of the development process. Since 1989, the United Nations Development Programme (UNDP) has been measuring the Human Development Index (HDI). It describes in a summary way the achievements of a country in relation to three dimensions of human development: a long and healthy life, access to knowledge, and a decent standard of living. The HDI's country coverage is of course limited by data availability. The data for the three dimensions are normalised with the corresponding lowest and highest values obtained from a sample of 187 countries, then combined into a single index. Each country will have a HDI value situated between 0 and 1. The global rank of countries is obtained by representing each individual HDI value in descending order.

Countries are classified as being of very high, high, medium or low human development, according to their ranking. In 2013, Algeria (rank 95), Libya (rank 55), Mauritius (rank 63), Seychelles (rank 71) and Tunisia (rank 90) were attributed high human development, while eleven other African countries reached medium human development. The remaining 37 African countries fall in the low human development category, South Sudan being precluded from the study (UNDP, 2014).

Rwanda's HDI value for 2013 is 0.506 – in the low human development category – positioning the country in 151th place out of 187 countries and territories. Between 1975 and 2013, Rwanda's HDI value increased from 0.242 to 0.506, an increase of 109% or an average annual increase of about 2.87%.

Figure 3 shows the long-term evolution[2] of Rwanda's HDI, following the latest methodology for measuring HDI (UNDP, 2014).

The trends shown in Figure 3 can be best explained by disaggregating dimensions into their components. For example, one of the components of a long and healthy life is life expectancy at birth. In Rwanda, this has continuously increased between 1960 and 1984, peaking at 49.9 years. Beginning in 1985, life expectancy at birth trailed off, dipping to 26.8 years in 1993, then climbed steadily again to reach 64.1 years (2013).

The mean (average) income level, which helps constitute the measure for decent standard of living, has remained almost constant for the past five decades in Rwanda. For example, annual GDP per capita (in 2012 constant US$) remained steady from 1960 to 1993 at around US$300 (see Figure 5). In 1994 it suffered a drop to US$160; since then, the value has been increasing to reach US$442 (2013). The gap with the rest of sub–Saharan countries remained almost constant for more than five decades; in 2013, this gap was US$680. Another unit for measuring the average income level is a constant-dollar unit, expressing the per capita mean (average) income as purchasing power parity (PPP) in 2012 US$. Mean income levels measured in this way also dipped after the Genocide and increased since then. The highest peak last measured was in 2013: PPP US$1380.

The mean (average) number of years of schooling for adults has also increased substantially over the past 30 years: from 1.1 years in 1980 to 3.3 years in 2013 (see Table 2). For youngsters aged four, the expected years that each of them, on average, will enrolled in formal schooling increased from 4.9 years in 1980, to 13.2 years in 2013.

2 Based on the latest HDI methodology (UNDP, 2014), the values were calculated on consistent indicators, methodology and time-series data. Figure 3 shows changes in values over time, reflecting the actual progress of the country. Small changes in values should be interpreted with caution, as they may not be statistically significant due to sampling variation. Changes at the level if the third decimal place in any composite indices are considered insignificant.

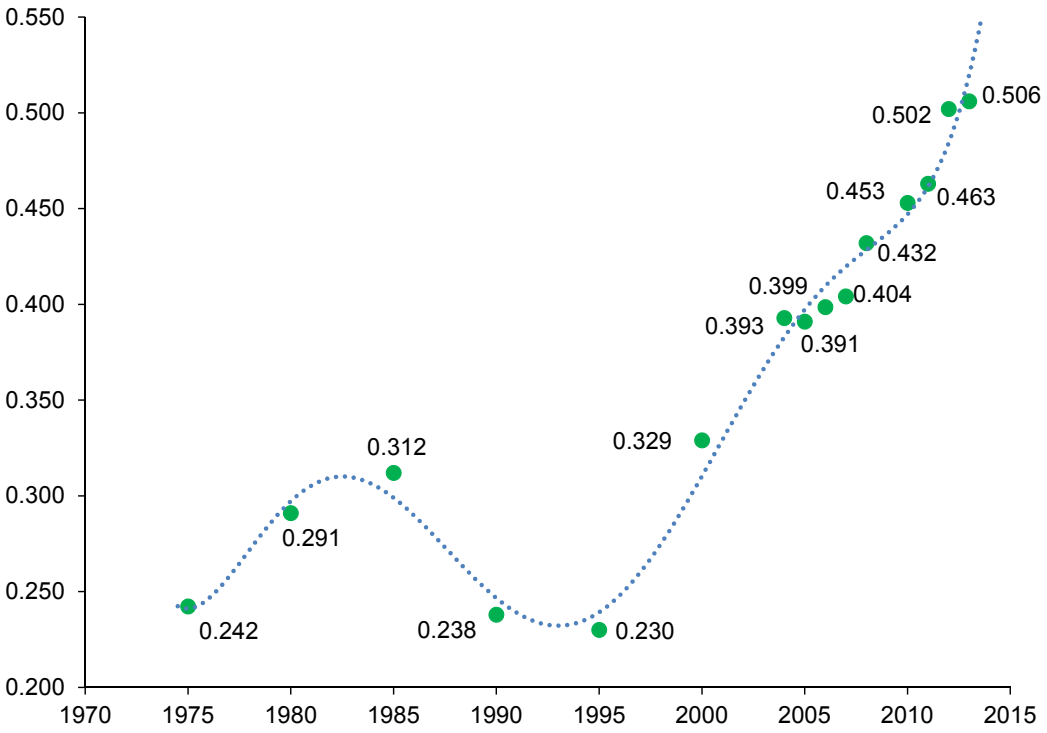


Figure 3: Evolution in Rwanda's Human Development Index, 1970–2013. Source: UNESCO estimation, adjusted according to the latest HDI methodological approach and data provided by UNDP (2014)

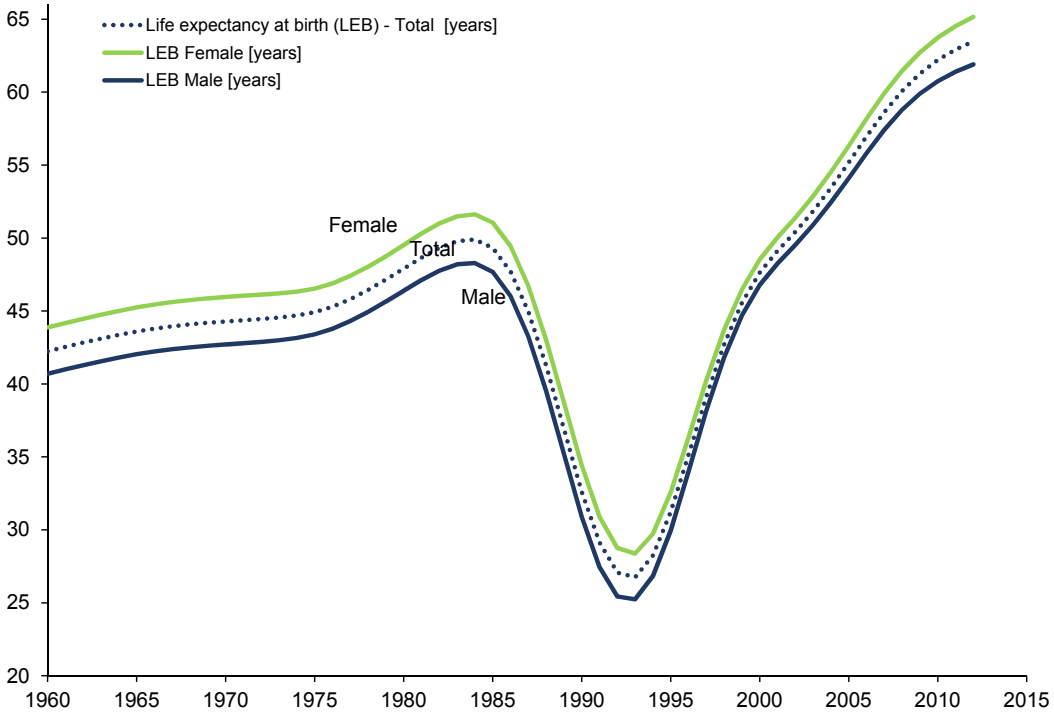


Figure 4: Evolution in life expectancy at birth in Rwanda, 1960–2013. Source: UNESCO, based on raw data provided by UN Statistics Division

Recent *Human Development Reports* have launched an Inequality Adjusted Human Development Index (IHDI) and Gender Inequality Index (GII) alongside the HDI. When Rwanda's HDI value is discounted for inequality, the HDI falls to 0.338, a loss of 33.2%. The average loss due to inequality for sub-Saharan Africa is 33.6%. The human inequality coefficient for Rwanda is equal to 33.1%.

The GII reflects gender-based disadvantages in reproductive health, empowerment and the labour market. Countries with better gender equality tend to have low maternal mortality, low adolescent fertility and a high proportion of males and females with at least secondary education. The HDI for Africa as a whole drops to 0.284 when gender inequality is taken into account, a loss of 28.5%. High inequality is undermining the positive impact of Africa's economic growth. Gender inequality on the continent is linked to the persistence of discriminatory laws, norms and practices, which restrict the access of women and girls to opportunities, resources and power.

Rwanda has a GII value of 0.573, ranking it 79th out of 149 countries in the 2013 index. n Rwanda, 51.9% of parliamentary seats are held by women[3] and 7.9% of adult women have reached at least the secondary level of education, compared to 8% of their male counterparts. For every 100 000 live births, 340 women die from pregnancy-related causes; the adolescent fertility rate is 33.6 births per 1000 live births. Some 86.5% of women participate in the labour market, compared to 85.5% of men.

In 2011, just over a billion people remained in extreme poverty, around 14.5% of the world's population (World Bank, 2014). Extreme poverty in Sub-Saharan Africa represented 47% of the Sub-Saharan African population. The 2010 Human Development Report (UNDP, 2010) introduced a new index, which identifies multiple deprivations in the same households in education, health and living standards, known as the Multidimensional Poverty Index (MPI). The education and health dimensions are each based on two indicators, while the standard of living dimension is based on six indicators. These indicators are weighted to create a deprivation score, and the deprivation scores are computed for each household in the survey. A deprivation of 33.3% is used to distinguish between the poor and non-poor.

In Rwanda, the MPI value is 0.352. 70.8% of the population are multi-dimensionally poor while an additional 17.9% are near to being multi-dimensionally poor. The intensity of deprivation in Rwanda, which is the average of deprivation scores experienced by people in multidimensional poverty, is 49.7%.

However, Rwanda made notable gains in reducing poverty and income inequality during the first *Economic Development and Poverty Reduction Strategy* (EDPRS I, 2008–2013). Since the year 2000, the National Institute of Statistics of Rwanda (Republic of Rwanda, 2012b) conducted three comparable household surveys (EICV: *Enquête Intégrale sur les Conditions de Vie des ménages*). They focused on poverty measured in terms of household consumption. Household consumption was measured in comparable terms in each survey, then adjusted later for differences between households in the prices they faced and in their size and composition. A household's standard of living was then defined by real consumption per adult-equivalent, including imputations for consumption in kind, all expressed in January 2001 prices. This number was compared against poverty lines first set for the EICV1 poverty analysis in 2001, in order to assess poverty: if RWF 64 000 (in January 2001 prices) was consumed per adult – equivalent per year , a household was considered poor; and within that group, if only RWF 45 000 was consumed, a household was extremely poor.

3 More recent data compiled by the Inter-Parliamentary Union, on the basis of information provided by National Parliaments by 1st February 2015, shows that in Rwanda 63.8% of the parliamentarian seats in the Lower House and 38.5% in the Upper House are occupied by women. In this way, Rwanda has a higher women parliamentarian representation than over 190 countries.

Table 2: Quality of life in Rwanda

Indicator	Value (2014)
Human Development Index (HDI)	
HDI [value]	0.506
HDI [world ranking out of 187 countries]	151
Health	
Public expenditure on health [percent of GDP]	10.8
Under-five mortality [per 1 000 live births]	55
Life expectancy at birth [years]	64.7
HIV prevalence [percent ages 15–49 both sexes]	2.9
Education	
Public expenditure on education [percent of GDP]	4.8
Pupil teacher ratio	59
Primary school dropout rates [percent of primary school cohort]	64.4
Expected years of schooling [of children] [years]	13.2
Adult literacy rate, both sexes [percent aged 15 and above]	65.9
Mean years of schooling [of adults] [years]	3.3
Population with at least some secondary education [percent aged 25 and above]	7.7
Inequality	
Coefficient of human inequality	33.1
Gini coefficient	50.8
Loss due to inequality in education [percent]	29.4
Loss due to inequality in life expectancy [percent]	30.2
Loss due to inequality in income [percent]	39.6
Gender	
Population with at least secondary education [ratio of females to males]	n/a
Adolescent fertility rate [births per 1000 women aged 15–19]	33.6
Labour force participation rate [ratio of females to males of ages 15 and older]	1.02
Gender-related development Index [female to male ratio of HDI]	0.95
Women in parliament [percent held by women]	51.9
Maternal mortality ratio [deaths of women per 100 000 live births]	340
Sustainability	
Carbon dioxide emissions per capita [tonnes]	0.5
Natural resource depletion [percent of GNI]	2.9
Population living on degraded land [percent]	10.1
Impact of natural disasters [deaths per year per million people]	1.6
Fresh water withdrawals [percent of total renewable water resources]	1.6
Forest area [percent of total land area]	18.0
Demography	
Urban population [percent of total]	19.7
Median age [years]	18.4
Dependency ratio of young age [ages 0–14]	74.2
Dependency ratio of old age [65 and older]	4.5

Source: UNDP (2014) *Human Development Report*

The results show an increase in this average consumption per adult-equivalent over the whole period since 2000; consumption grew at an annualised rate of 1.9% between the first two surveys but at 4.4% between the second and third surveys (Republic of Rwanda, 2012b). In other words, poverty fell from 58.9%

in 2000/01 to 56.7% in 2005/06, and fell again to 44.9% in 2010/11. One million people graduated from poverty. For the whole period, it also appears that inequality in terms of this unit of consumption fell very slightly. Income inequality among the households surveyed, as measured by the Gini coefficient, moved from 0.53 to 0.50 between the second and third surveys, signalling that inequality decreased in the second five-year period after it had increased (by a smaller magnitude) in the first.

Table 3 presents the most relevant results of the three surveys (2000/01; 2005/06 and 2010/11) and an earlier survey performed in 1985. The data presented in Table 3 was normalized to international standards (World Bank, 2014).

Table 3: Poverty indicators, 1985–2011

Indicator	1985	2000	2006	2011
Gini coefficient	0.29	0.51	0.53	0.50
Income share held by highest 10%	24.6	43.4	45.2	43.2
Income share held by highest 20%	38.9	57.2	58.6	56.8
Income share held by fourth 20%	21.6	17.9	17.4	17.8
Income share held by third 20%	16.7	11.9	11.5	11.9
Income share held by second 20%	13.1	8.2	7.9	8.3
Income share held by lowest 20%	9.7	4.8	4.6	5.2
Income share held by lowest 10%	4.4	1.9	1.8	2.1
Number of poor [millions] at $1.25 [PPP] a day	3.9	6.7	7.0	7.0
Number of poor [millions] at $2 [PPP] a day	5.4	7.7	8.4	9.2
Number of poor [millions] at $2.5 [PPP] a day	5.7	8.0	8.9	9.8
Number of poor [millions] at $4 [PPP] a day	6.0	8.3	9.4	10.6
Number of poor [millions] at $5 [PPP] a day	6.1	8.3	9.5	10.8
Poverty gap [percent of population] at $1.25 [PPP] a day	19.7	41.8	34.7	26.5
Poverty gap [percent of population] at $2 [PPP] a day	41.8	58.6	52.1	44.5
Poverty gap [percent of population] at $2.5 [PPP] a day	51.7	65.6	59.6	52.7
Poverty gap [percent of population] at $4 [PPP] a day	68.5	77.4	72.9	67.7
Poverty gap [percent of population] at $5 [PPP] a day	74.6	81.7	77.9	73.4
Poverty headcount ratio [percent of population] at $1.25 [PPP] a day	63.3	79.4	72.0	63.0
Poverty headcount ratio [percent of population] at $2 [PPP] a day	88.3	91.6	87.4	82.3
Poverty headcount ratio [percent of population] at $2.5 [PPP] a day	93.6	94.8	91.9	88.2
Poverty headcount ratio [percent of population] at $4 [PPP] a day	98.3	98.4	97.2	95.5
Poverty headcount ratio [percent of population] at $5 [PPP] a day	99.2	99.2	98.5	97.3
Poverty headcount ratio at national poverty lines [percent of population]	–	58.9	56.7	44.9
Rural poverty headcount ratio at national poverty lines [percent of rural population]	–	–	61.9	48.7
Survey mean consumption or income per capita, bottom 40% [2005 PPP $ per day]	–	–	0.5	0.6
Survey mean consumption or income per capita, total population [2005 PPP $ per day]	–	–	1.5	1.7
Urban poverty headcount ratio at national poverty lines [percent of urban population]	–	–	28.5	22.1

Source: World Bank

LONG-TERM VISION AND DEVELOPMENT PLANS FOR RWANDA

In order to transform the country into a middle income economy by 2020, Rwanda prepared a long-term strategy, known as *Vision 2020* (Rep. of Rwanda, 2000). The document was a result of a national consultative process that took place in Village Urugwiro in 1998–99. Within this process, there was broad consensus on the necessity for Rwandans to clearly define the future of the country.

The aspirations of *Vision 2020* have been organized around six pillars, which have been interwoven with three cross-cutting areas. The pillars are: (1) good governance and capable state, (2) human resource development and a knowledge based economy, (3) a private sector-led economy, (4) infrastructure development, (5) productive and market-oriented agriculture and (6) regional and international economic integration. The cross-cutting areas of *Vision 2020* are: (a) gender equality, (b) protection of environment and sustainable natural resource management, and (c) science and technology including ICT. Figure 5 shows a conceptual scheme of the role of science, technology and innovation within *Vision 2020*.

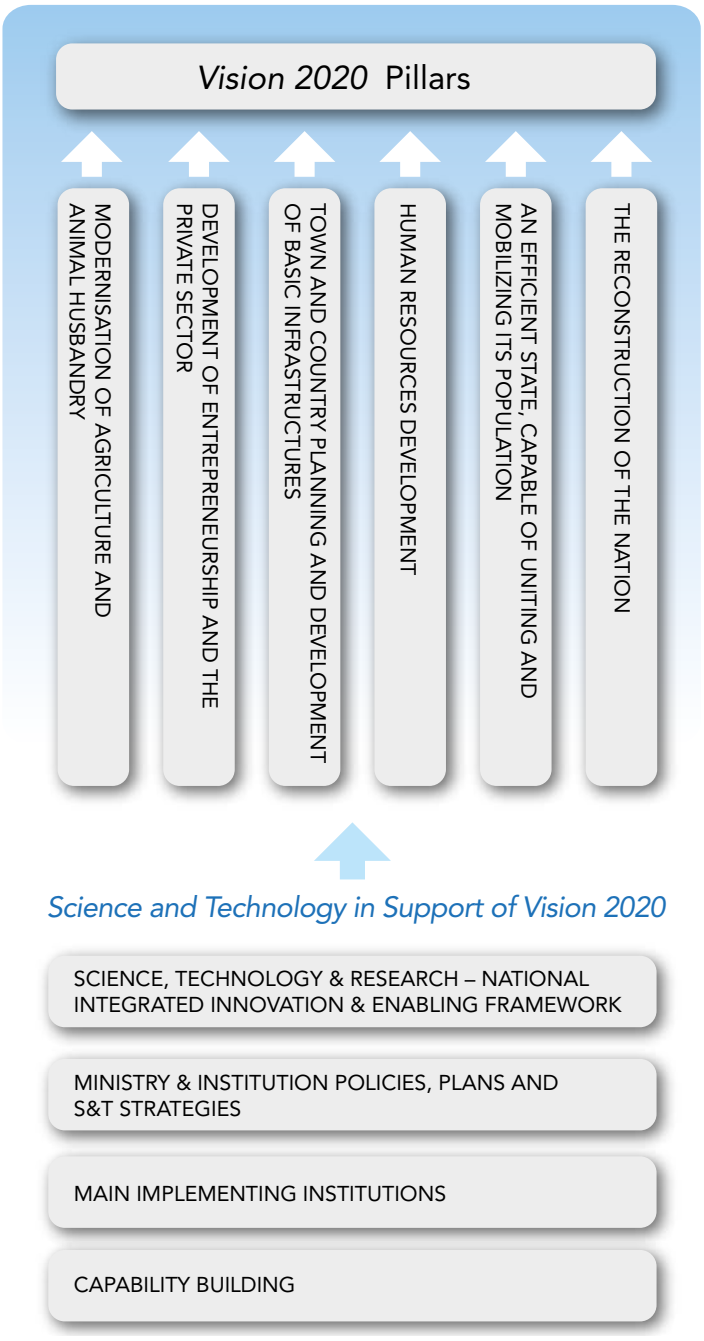


Figure 5: The role of science, technology and innovation within *Vision 2020*. Source: Rep. of Rwanda (2000, 2014d)

BOX 1– CROSS-CUTTING ISSUES OF VISION 2020

Gender Equality

Women make up 53% of the population and participate in subsistence agriculture more than men participate. They usually feed and provide care for the children and ensure their fundamental education. However, until recently, girls were the minority in secondary schools, women had little access to the opportunities available to men and they were poorly represented in decision-making positions.

In order to achieve gender equality and equity, Rwanda will continuously update and adapt its laws on gender. It will support education for all, eradicate all forms of discrimination, fight against poverty and practice a positive discrimination policy in favour of women. Gender will be integrated as a crosscutting issue in all development policies and strategies.

Natural Resources and the environment

The major problem in the field of environmental protection in Rwanda is the imbalance between the population and the natural resources (land, water, flora and fauna and non-renewable resources, which have been degrading for decades). This degradation is observed through massive deforestation, the depletion of bio-diversity, erosion and landslides, pollution of waterways and the degradation of fragile ecosystems, such as swamps and wetlands.

The average population growth of 3% per annum during the 1980's to 1990's period was faster than that of agricultural production, estimated at 2.2%. This has led to the occupation of more and more marginal areas and to the rapid and continuous soil degradation of the fragile ecosystems of the country. These environmental problems are exacerbated by the poor location of industries and the direct evacuation of their waste, without any treatment, into waterways and lakes. In order to ensure sustainable development, Rwanda will implement adequate land and water management techniques, coupled with a sound biodiversity policy.

Science, Technology and ICT

Rwandans are rightly proud of their cultural roots and the government will ensure that it takes advantage of this heritage in all facets of the development process. However, for this development process to be a success, Rwanda must embrace the future and exploit innovations in science and technology to complement its cultural strengths.

In Rwanda, the rate of adoption and integration of science and technology in socio-economic life is very low and the shortage of technically qualified professionals is visible at all levels. From now until 2020, Rwanda projects to have adequate, highly skilled scientists and technicians to satisfy the needs of the national economy. There is a need to generate, disseminate and acquire scientific skills as well as technological innovations, in addition to integrating them into the social and economic development drive, detailed above.

In order for Rwanda to achieve this objective, it will have to develop the teaching of science and technology at secondary and university levels. It will facilitate the creation of high and intermediate technology enterprises and develop access to ICT down to the administrative sector level, in accordance with the national ICT plan.

Source: Republic of Rwanda (2000)

Following the *Vision 2020* report, the government introduced the *Poverty Reduction Strategy Plan* (PRSP 1) which was implemented from 2002 to 2005 and its objective was to manage the transitional period of rehabilitation and reconstruction. It was proposed at a critical time since the country was still struggling with the aftermath of the war and Genocide.

At the end of the PRSP 1, it was evident that overall, progress was made. However, the charity sector performed better in comparison to productive sectors, including agriculture, infrastructure construction, and business and industry. The progress made did not result in significant poverty reduction due to demographic growth combined with limited availability of land. The charity sector also failed to address the poor adequately (Rep. of Rwanda, 2012c).

In 2008, Rwanda embarked on the implementation of a second-generation poverty reduction strategy termed the *Economic Development and Poverty Reduction Strategy* (EDPRS). The EDPRS I covered the period 2008–2012 and set the country's development objectives for combatting poverty (Rep. of Rwanda, 2007). The EDPRS I was fully supported by country-level stakeholders, as well as development partners, and it assigned high priority to accelerating private sector-led growth.

In order to respond to the constraints identified at the end of PRSP 1, the newly-developed EDPRS I included three flagship programmes. The first flagship, Sustainable Growth for Jobs and Exports, aimed at boosting growth by enhancing competitiveness, private sector investment and innovation, agricultural productivity, exports, and ICT competencies.

The second flagship, Vision 2020 Umurenge Programme (VUP), addressed extreme poverty and vulnerability, particularly in rural areas.

The third flagship, Governance, addressed five areas: maintaining peace and security; improving relations with all countries; promoting national unity and reconciliation; promoting justice, human rights and the rule of law; and ensuring decentralization of power, public financial management, service delivery, and the reduction of corruption.

The EDPRS I recognized that Rwanda would have difficulty achieving objectives for poverty reduction and wealth creation unless it could mobilize and coordinate efforts – to build science, technology and innovation capacity. The EDPRS I included specific SETI goals and objectives to be achieved by Rwanda in the period 2008–2013 (see items 2.57, 3.18, 3.19, 4.15, 4.19, 4.25, 4.33, 4.34, 4.40, 4.41, 4.43, 4.53, 4.54, 4.55, 4.56, 4.57, 4.58, 4.59, 4.60, 4.78 and 6.3). Within the document, science, technology and innovation played a fundamental role for the development strategy.

Under the EDPRS I, public expenditure was organised to maintain the momentum in the social sectors while targeting productive sectors to achieve the MDGs and *Rwanda Vision 2020*. In particular, expenditure was targeted to (i) address skills shortages; (ii) eliminate the infrastructure backlog (including energy, water, transport, and ICT) so as to reduce the operational costs of doing business in Rwanda; (iii) create the conditions under which science and technology pave the way towards knowledge-based services becoming a source of economic growth, employment and poverty reduction (Rep. of Rwanda, 2007).

No mention of science, technology or innovation was made in the official evaluation report of EDPRS I (see Rep. of Rwanda, 2012c). By May 2012, the Government of Rwanda revised the *Vision 2020* goals and developed a second Economic Development and Poverty Reduction Strategy (EDPRS II), to cover the period 2013–2017.

EDPRS II has four thematic areas built upon five principles, all derived from the lessons and experience of the first EDPRS I and the overarching objectives set for EDPRS II. The five principles are:

- *Innovation*: emphasising new ways of thinking, working and delivering because the status quo will not be adequate to achieve Rwanda's ambitious targets.
- *Emerging priorities:* identifying thematic strategies, which encompass new priorities, including new ways of doing business, to drive the achievement of Vision 2020 targets.
- *Inclusiveness and engagement:* creating ownership of development at all levels and providing learning and feedback mechanisms to improve solutions.
- *District-led development:* creating strong, mutually supporting linkages between district and sectoral strategies, and supporting administrative standardisation and efficiency.
- *Sustainability:* ensuring that programmes and targets achieved from EDPRS II are sustained over the long term in their economic, social and environmental dimensions.

Unfortunately, the EDPRS II does not consider that scientific research and technological development should play a role to stimulate economic growth and improvement of the quality of life. Neither EDPRS II, nor the *United Nations Development Assistance Plan (UNDAP) 2013–2018* (United Nations, 2013), proposes a strategy/activity to promote R&D. The EDPRS II does consider that innovation may be important for developing green technologies, ICTs and the private sector, and recognizes that education, skills and technology are key drivers of productivity (Rep. of Rwanda, 2013: p. 45 and p.57). Table 4 shows the EDPRS II targets in relation to those of the revised *Vision 2020*.

Table 4: EDPRS II targets linked to *Vision 2020*

Objectives	Current status	EDPRS II targets by 2017	Vision 2020 targets
Rapid economic growth to middle income status	• GDP per capita of US$644 in 2012 • Average GDP growth of 8.2% over 2008–2012	• GDP per capita of US$1000 • Average GDP growth of 10.2%	• GDP per capita of US$1240 • Average GDP growth of 11.5%
Increased poverty reduction	• Poverty reduced from 57% to 44.9% over 2006–2011 • Extreme poverty reduced from 36% to 24% over 2006–2011	• Poverty reduced under 30% • Extreme poverty under 10%	• Poverty reduced under 20% • Extreme poverty moving towards eradication
More off-farm jobs	• 1.4 million off-farm jobs in 2011	• 200 000 new off-farm jobs per year	• 200 000 new off-farm jobs per year
Reduced external dependency	• Exports growth of 22.8% over 2008–2012 • Export coverage of imports 42.3% in 2012	• Exports growth of 28% per year • Exports coverage of 75% of imports in 2017	• Exports growth of 28% per year • Exports coverage of 80% of imports in 2020
Private sector as engine of growth	• Private investment at 10% of GDP	• Private sector investment to reach 15.4% of GDP	• Private sector investment to reach 20% of GDP

Source: Republic of Rwanda (2013a)

Rwanda is one of three countries in Africa that are making especially impressive progress for several MDGs, along with The Gambia and Malawi (UNESCO, 2014b). The UNDAP (United Nations, 2013) had identified that the most important development challenges include the following: (a) reinforcing inclusive participation and strengthening the political processes through addressing the issue of political space, (b) strengthening the capacities of civil society, (c) accelerating media sector and judicial reforms that will strengthen access to quality justice, (d) ensuring reduction in backlog cases, and improving the quality of prosecution, (e) reducing constraints associated with a high population density, land degradation and scarcity; (f) reducing high youth unemployment; (g) mitigating high reliance on rain-fed and low input agriculture; (h) addressing reliance on biomass energy and reducing the high cost of electricity; (i) strengthening the private sector; and (j) mitigating high dependence on foreign aid and vulnerability to external shocks, including changes in donor policies.

In a recent opinion survey, the World Bank (2014b) was able to determine the development priorities of various stakeholders[4] (Figure 6). The top three are health (40%), education (37%) and poverty reduction (28%). These results show an interesting shift when compared to results of the previous survey, performed in 2006. In that earlier survey, respondents indicated that economic growth (53%) was the most important development priority for Rwanda, followed by poverty reduction (25%) and government effectiveness/ governance (19%).

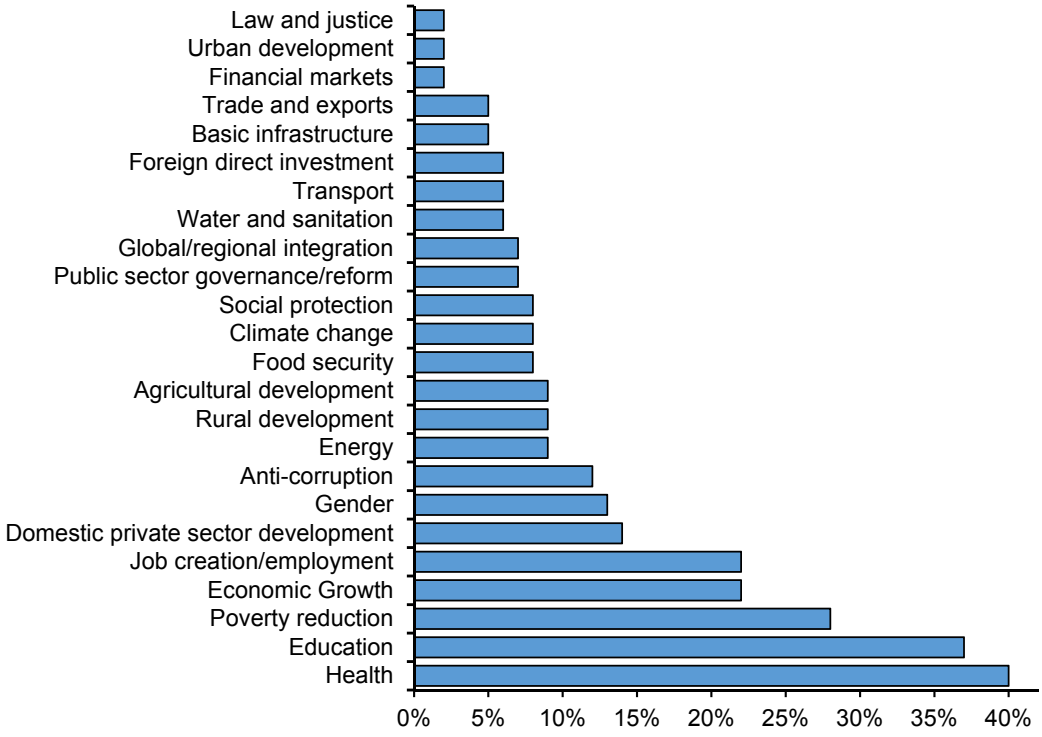


Figure 6: Development priorities according to a recent opinion survey. Source: World Bank (2014b)

The more recent survey also showed that many respondents – when asked to consider what was important to reduce poverty – view education (37%), rural development (26%) and economic growth (24%) as keys to reducing poverty.

4 In February-March 2013, 826 stakeholders identified by the World Bank in Rwanda were invited to provide their opinions on the Bank's assistance to the country by participating in a country survey. Participants in the survey were drawn from among the office of the President; the office of the Prime Minister; the office of a Minister; the office of a Parliamentarian; employees of a ministry, ministerial department, or implementation agency; consultants/ contractors working on World Bank-supported projects/programs; project management units (PMUs) overseeing implementation of a project; local government officials or staff; bilateral and multilateral agencies; private sector organizations; private foundations; the financial sector/private banks; NGOs working in the areas of advocacy and implementation; community-based organizations; the media; independent government institutions; trade unions; faith-based groups; academia/research institutes/think tanks; and the judiciary branch. 714 stakeholders participated (a 86% response rate). Source: World Bank (2014b).

LONG TERM ECONOMIC GROWTH

Sustainable economic growth is considered, for purposes of this report, a key to reducing poverty and improving the living standards of Rwandans especially given present conditions of rapid population growth. Figure 7 shows that GDP per capita remained practically constant in Rwanda for more than five decades (1960–2013). The gap with the average for sub-Saharan Africa has also remained relatively constant during the last five decades. However, since 1995, GDP per capita has been increasing at constant rate. In the same period (1995–2013), the GDP per capita expressed in constant PPP increased 260%.

Table 5 shows the annual percentage change in real GDP for a selection of countries from East Africa and the weighted average for sub-Saharan Africa, as well as projections for 2014, 2015 and 2019. In the past decade, Rwanda's economy has grown by 7.5% each year on average. This performance is surpassed only by Ethiopia (10.4%), and Zambia (7.8%). Economic growth for the EDPRS I period 2008–2012 exceeded ambitious expectations. Real GDP growth averaged 8.2% annually, which translated into GDP per capita growth of 5.1% per year. Projections made by the International Monetary Fund show a GDP growth-rate of 6.7% for 2015 and 7.5% for 2019. These growth rates are smaller than the EDPRS II goal to increase the GDP at 10.2% per year (see Table 4) for the period 2013–2017.

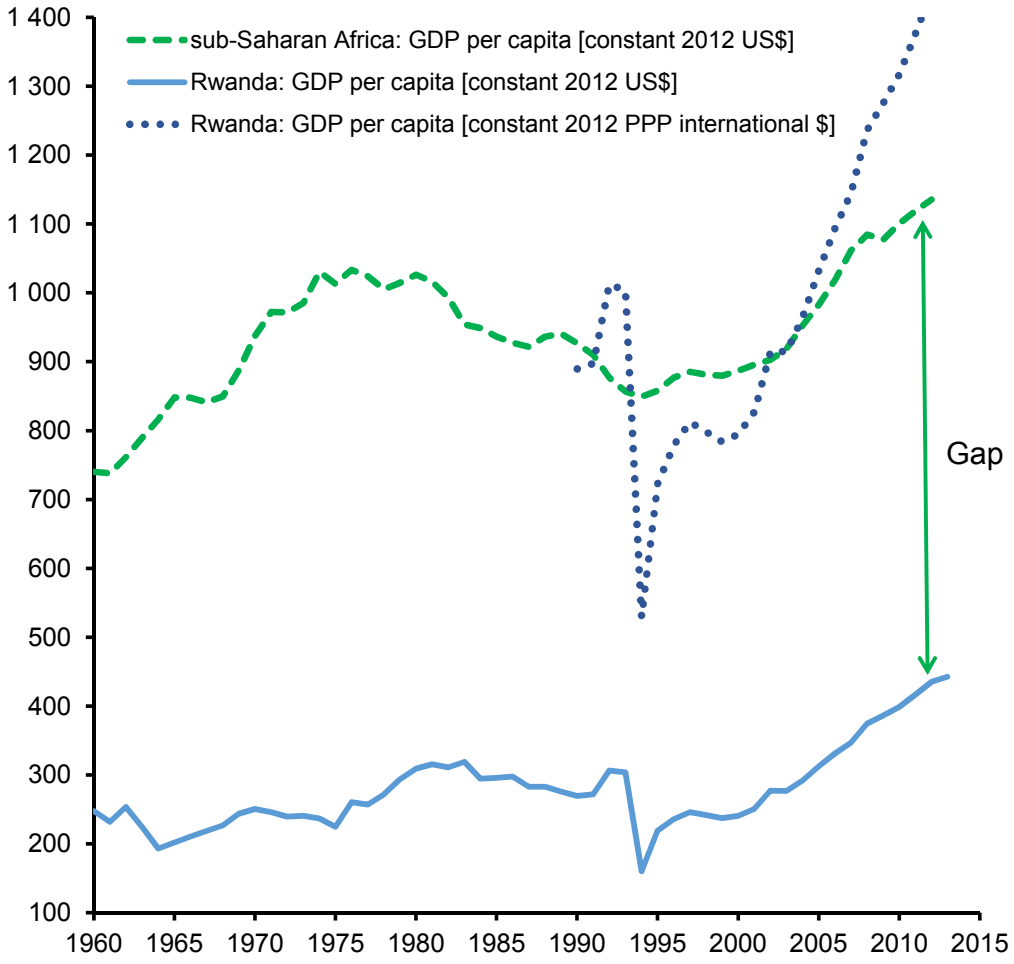


Figure 7: Evolution of GDP per capita, expressed in constant 2012 US$, in Rwanda and sub-Saharan Africa, 1960–2013. The dotted line shows the GDP per capita in constant international PPP. Source: UNESCO, based on data provided by the UN Statistics Division (Population), World Bank (GDP in US$) and US Census Office (GDP deflator)

Table 5: Annual percentage change in real GDP for a selection of East Africa countries and projections, 1996–2019

Selection of countries from East Africa	Average 1996 –2005	2006	2007	2008	2009	2010	2011	2012	2013	Projections		
										2014	2015	2019
Burundi	0.9	5.4	3.4	4.9	3.8	5.1	4.2	4.0	4.5	4.7	4.8	5.4
Comoros	2.1	1.2	0.8	0.4	1.8	2.2	2.5	3.0	3.5	3.9	3.9	5.4
Djibouti	1.2	4.8	5.1	5.8	5.0	3.5	4.5	4.8	5.0	5.5	5.5	6.5
Ethiopia	5.4	11.5	11.8	11.2	10.0	10.6	11.4	8.8	9.7	8.2	8.5	7.5
Kenya	2.8	5.6	8.0	–0.4	2.6	8.6	7.6	4.6	4.6	5.3	6.2	6.6
Madagascar	3.1	5.4	6.5	7.2	–3.5	0.1	1.5	2.5	2.4	3.0	4.0	4.5
Malawi	3.2	2.1	9.5	8.3	9.0	6.5	4.3	1.9	5.2	5.7	6.0	5.0
Mauritius	4.1	4.5	5.9	5.5	3.0	4.1	3.9	3.2	3.2	3.3	3.9	4.0
Mozambique	9.1	8.7	7.3	6.8	6.3	7.1	7.3	7.2	7.1	8.3	8.2	7.7
Rwanda	8.7	9.2	7.6	11.2	6.2	6.3	7.5	8.8	4.7	6.0	6.7	7.5
Seychelles	2.8	9.4	10.4	–2.1	–1.1	5.9	7.9	2.8	3.5	3.7	3.8	3.4
Tanzania	5.5	6.7	7.1	7.4	6.0	7.0	6.4	6.9	7.0	7.2	7.0	6.9
Uganda	7.0	7.0	8.1	10.4	4.1	6.2	6.2	2.8	5.8	5.9	6.3	7.0
Zambia	4.5	7.9	8.4	7.8	9.2	10.3	6.4	6.8	6.7	6.5	7.2	6.5
Zimbabwe	--	-3.6	-3.3	-16.4	8.2	11.4	11.9	10.6	3.3	3.1	3.2	4.4
Sub-Saharan Africa	5.4	7.0	7.9	6.3	4.1	6.9	5.1	4.4	5.1	5.1	5.8	5.5

Source: IMF (2014)

Strong and balanced economic performance has derived from sustained growth across all sectors of the economy. Services have been the main driver of growth. The sector grew at an average of 10% per year and produced around 52% of national output during the EDPRS I period 2008–2012. The main expansion areas were telecommunications with increased mobile phone and internet use, wholesale and retail trade and transport. Expansion of services accounted for just over half of total GDP growth (53%) during the EDPRS I period (Rep. of Rwanda, 2013a).

Extreme poverty, though significantly reduced during the EDPRS I period, remained high and persistent, particularly in rural areas. Though poverty fell more in rural areas than urban areas it still stood at 48.7%, compared to 22.1% in urban areas (Rep of Rwanda, 2013a). Although all provinces experienced reductions in poverty during EDPRS I, there was significant variation in the level of poverty reduction between different districts and provinces. In Rwanda's poorest district, Nyamagabe, 73% of people still live below the poverty line.

Rwanda's poverty profile indicates that women are more affected by poverty than their male counterparts are, with 47% of female-headed households being poor compared to 44.9% of all households. A key challenge for EDPRS II is, therefore, to ensure sustained growth and poverty reduction nationwide and among all groups. Focus is also required on the persistence of poverty, which remains high throughout rural areas. The depth of poverty indicators, i.e. the proportion by which poor households fall below the poverty line, show that despite improvements, many households in rural areas are far below the poverty line while others continue to be vulnerable to shocks particularly in the agriculture sector (Rep. of Rwanda, 2013a).

According to the Global Hunger Index[5] (GHI), Africa has long been a 'hungry continent', based on the countries' scoring of moderate to extremely alarming hunger since 1990. Table 6 presents the GHI values for a group of countries from East Africa. Most have improved their scores between 1990 and 2014. The exception is Swaziland, where vulnerability increased. Africa's overall hunger in 2013 was lower than in 1990. Over 1990–2014, Africa had the lowest average value for food production. Consequently, the continent has remained a net food importer and countries depending on imports of major food staples have been vulnerable to global food price volatility. Price volatility, especially for staple foods, has resulted in serious food insecurity for African farmers and consumers alike because such foods are the most widely planted by smallholder farmers and account for a large share of spending among poor consumers.

Table 6: Global Hunger Index for a selection of countries from East Africa, 1990–2013

East Africa Country	1990	Hunger level 1990	1995	2000	2005	2014	Hunger level 2014
Burundi	32.0	Extremely alarming	36.1	38.7	39.0	35.6	Extremely alarming
Ethiopia	n/a	n/a	42.6	37.4	30.8	24.4	Alarming
Kenya	21.5	Alarming	21.0	20.2	19.5	16.5	Serious
Madagascar	25.5	Alarming	24.6	25.9	24.4	21.9	Alarming
Malawi	30.6	Extremely alarming	27.6	21.6	18.7	13.6	Serious
Mauritius	8.5	Moderate	7.6	6.5	5.9	5.0	Moderate
Mozambique	36.0	Extremely alarming	32.0	28.5	25.1	20.5	Alarming
Rwanda	30.6	Extremely alarming	35.1	30.6	24.1	15.6	Serious
Tanzania	23.4	Alarming	26.9	26.1	20.5	17.3	Serious
Uganda	21.5	Alarming	22.7	20.2	18.4	17.0	Serious
Zambia	24.9	Alarming	24.5	26.3	25.3	23.2	Alarming
Zimbabwe	20.0	Alarming	22.0	21.7	20.5	16.5	Serious

Source: Global Hunger Index (several years)

Rwanda constantly improved its score over the period 1990–2014, from 30.6 (extremely alarming) in 1990 to 15.6 (serious) in 2014. This was a consequence of the technical support provided by the UN and its specialized agencies, along with the other key development partners, which enabled Rwanda to become the first country to formulate and adopt the Comprehensive African Agriculture Development Plan (CAADP). Rwanda also developed an Agricultural Sector Investment Plan (ASIP), which resulted in Rwanda being awarded aGlobal Agricultural and Food Security Program (GAFSP) grant of US$ 50 million. The dramatic increase of production levels over recent years is the result of the coherent plan embedded in the ASIP and the sustained investment made by the Government in the Agricultural sector.

5 A country's GHI is calculated by averaging the percentage of the population that is undernourished, the percentage of children younger than five years old who are underweight and the percentage of children dying before the age of five. This calculation results in a 100-point scale on which zero is the best score (no hunger) and 100 the worst. The scores are considered low if *0>GHI>4.9*, moderate if *5>GHI>9.9*, serious if *10>GHI>19.9*, alarming if *20>GHI>29.9* and extremely alarming if *GHI>30* (Grebmer *et al.*, 2013). See: www.ifpri.org/book-8018/ourwork/researcharea/global-hunger-index

ATTRACTING FOREIGN DIRECT INVESTMENT

Foreign direct investment[6] (FDI) is also usually considered a major source of growth. FDI is an important source of finance for transition economies, as it helps to cover the current account deficit and fiscal deficit (in case of privatization-related FDI) and supplements inadequate domestic resources to finance both ownership change and capital formation.

Secondly, compared with other financing options, FDI may facilitate international transfer of technology, know-how and skills, including more advanced technologies and managerial skills, and may help local enterprises expand into foreign markets. It may not only increase the activity of FDI-beneficiary firms but also have a knock-on effect on other firms and sectors through technological spillover and through increased competition, thus raising productivity for the whole industry.

Although FDI is commonly considered an important vehicle of international knowledge transfer, the effectiveness of this process depends crucially on the absorption capacity of the host economy, which is determined by a complex set of political, structural and institutional variables (competition policies, IPR, quality of education, availability of scientists and engineers, R&D infrastructure, etc.).

Countries can increase the inflow of FDI by creating a business climate that makes foreign investors feel that their capital is safe, for example by improving rule of law, stabilizing the regulatory framework, establishing and protecting private property rights, and reducing corruption. Among the incentives that governments can offer, one could cite low tax rates or other tax incentives, access to loans and co-funding, zoning in proximity to where workers live, and improved infrastructure that allows products and services to reach markets.

According to the latest *World Investment Report* (UNCTAD, 2015), developing countries accounted for a record 55% of global FDI inflows in 2014, exceeding flows to developed economies by US$182 billion. Inflows to Africa remained stable at US$ 54 billion. Central Africa and East Africa saw their FDI flows increase by 33% and 11%, to US$ 12 billion and US$ 7 billion, respectively.

Foreign economies obtain useful new technologies through various channels, such as FDI, international trade and the international diffusion of knowledge and innovation. Technology transfer may be a major reason for the growth in total factor productivity (TFP) in many economies. Wang and Wong (2012) demonstrated that, over the period 1986–2007, foreign R&D, the products of which were transferred through inward FDI and imports, improved the technical efficiency of countries by an estimated 9.97% on average. In other words, a country with an average technical efficiency score of 0.85would have dropped to about 0.72 had it not benefited from foreign R&D through FDI and imports.

This research indicates that FDI is an effective conduit for technology transfer through technology spillovers to domestically – owned firms in the host country. Managia and Bwalya (2010) analysed the significance of productivity externalities of FDI to local firms, in terms of both intra-industry and inter-industry spillovers, using firm-level data from Kenya, Tanzania and Zimbabwe. The results show evidence of intra- and inter-industry productivity spillovers from FDI for Kenya and Zimbabwe. This shows that significant knowledge spillovers occur through backward linkages from foreign firms in upstream sectors to local firms in downstream sectors. This is consistent with a vertical technology spillover hypothesis: foreign firms have an incentive to facilitate knowledge transfer to local firms to enable them to produce intermediate inputs more efficiently, thereby making them available to foreign firms upstream at a lower cost.

6 The International Monetary Fund defines (foreign) direct investment in its *Balance of Payments Manual* as the category of international investment that reflects the objective of obtaining a lasting interest by a resident entity in one economy (direct investor) in an enterprise resident in another economy (direct investment enterprise). A direct investor is defined by its ownership of 10% or more of the ordinary shares or voting power in a direct investment enterprise.

Many African governments have implemented investment-friendly policy frameworks to attract more FDI. Nonetheless, most FDI in Africa goes to extractive industries in a relatively limited group of countries. Thus, the broader development impact of FDI-backed projects is often limited. Attracting investment to diversified, high value-added sectors remains a challenge for Africa. Constraints on all investment such as weak infrastructure and fragmented markets also adversely affect FDI. FDI levels vary widely by region, sector and country.

The potential of FDI for improving technical efficiency

In their study, Wang and Wong (2012) define technical efficiency as a country's ability to obtain maximum output from a given vector of inputs, so technical efficiency improvement refers to the movements toward greater productivity. Based on showing that inflow of foreign R&D via FDI improves technical efficiency in a regular manner across countries, they were able to estimate technical efficiency scores for individual countries (as a multiple of inflow of foreign R&D transferred via FDI).

Whereas least developed countries typically do not have adequate domestic resources to promote the accumulation of R&D stock, this work points to the conclusion that adopting preferential policies to promote trade and capital inflows, so as to access results of foreign R&D, can be extremely important to improve technical efficiency and, consequently, industrial competitiveness.

However, technical efficiency, innovation and competitiveness also depend on other variables, such as infrastructure and political stability. Arnold (2004) identified still other factors, such as: managerial deficits; a lack of technological understanding, learning ability or absorptive capacity to make use of externally generated technology; failure to (re)configure public institutions, such as universities or research institutes, to work effectively within an innovation system; deficiencies in regulatory frameworks (e.g. health and safety rules); as well as other indirect factors, related to the sophistication of demand or cultural and social values, which can have a negative effect on innovation and economic performance. Improvements in infrastructure and political stability, combined with adequate human capital policies, can help to improve a country's technical efficiency and its attractiveness for FDI.

FDI trends in Rwanda since 1990

Market failures imply a potential for policies to increase welfare by encouraging technology transfer (Sagasti and Aráoz, 1976; Berg and Fuchs, 2013). To be effective, policy must alter the incentives of agents that possess innovative technologies in order to ensure that they transfer these technologies. In practice, this means encouraging the means for technology transfer: for example, licensing and inflows of FDI.

In Rwanda, laws and regulations do not place restrictions on FDI entry and establishment, and do not impose on foreign direct investors any discrimination with regard to incentives and infrastructure enjoyed by local investors. All foreign direct investments are allowed without screening or restriction of their amount or sector, and the government intends that foreign investors are be granted National Treatment (Rep. of Rwanda, 2009a).

Table 7 shows the long-term evolution of Rwanda's FDI inflow and outflow, as well as the ratio of its net FDI inflow to gross fixed capital formation[7] (GFCF) between 1990 and 2013. Figure 8 presents the long-term evolution of FDI flows as a percentage of the GDP. Table 7 and Figure 8, show a contraction of net FDI inflow between 1980 and 1994 (Genocide) followed by an expansion from 1995 to the present time. The maximum value of net FDI inflow as a percentage of the GDP was obtained in 2009 (2.3% GDP or 119 million US$). In 2012 the country received 160 million US$ which represented 2.2% GDP. This indicates that the FDI volume is small relative to GDP; consequently, FDI's impact on economic growth and technical efficiency has been very limited. Since 1999, GFCF has shown sustained growth; reaching 24.4% of the GDP in 2013 (see Figure 9).

Table 7: FDI inflow and outflow for Rwanda, 1990–2014

Year	FDI inflow [million current US$]	FDI outflow [million current US$]	FDI inflow/ GFCF*
1990	8	n/a	2.0
1991	5	n/a	1.7
1992	2	n/a	0.7
1993	6	n/a	1.8
1994	0	n/a	0
1995	2	n/a	1.3
1996	2	n/a	1.1
1997	3	1	1.0
1998	7	6	2.4
1999	2	3	0.5
2000	8	3	2.5
2001	4	1	1.2
2002	3	1	0.8
2003	5	0	1.5
2004	11	0	2.4
2005	14	3	3.2
2006	16	14	3.3
2007	82	13	10.8
2008	103	0	12.7
2009	119	0	10.5
2010	251	0	12.2
2011	119	0	9.7
2012	255	0	10.5
2013	258	14	6.1
2014	268	n/a	n/a

* Gross fixed capital formation
Source: UNCTAD World Investment Report (s) [several years]

7 GFCF consists of investment in land improvements (fences, ditches, drains and so on); plant, machinery and equipment purchases; and the construction of roads, railways and the like, including commercial and industrial buildings, offices, schools, hospitals and private residences.

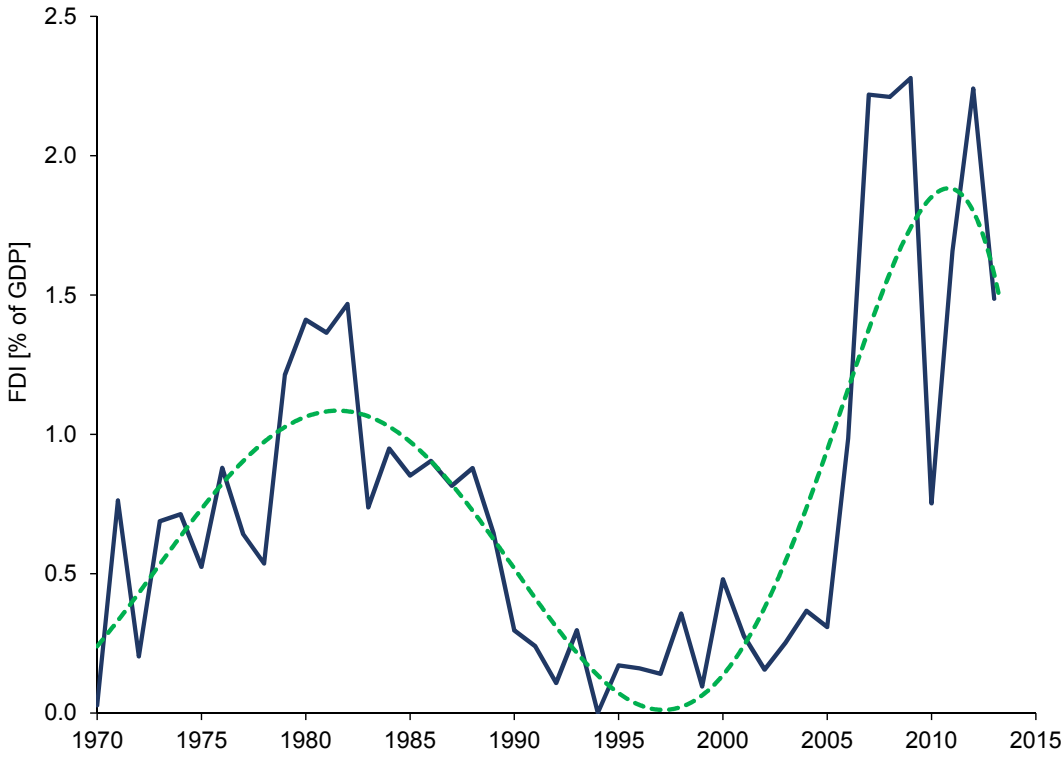


Figure 8: Evolution of net inflow of Foreign Direct Investment in Rwanda, expressed as a percentage of GDP, 1970–2013. The dotted line indicates the best-fitting curve. Source: UNESCO, based on raw data provided by the World Bank

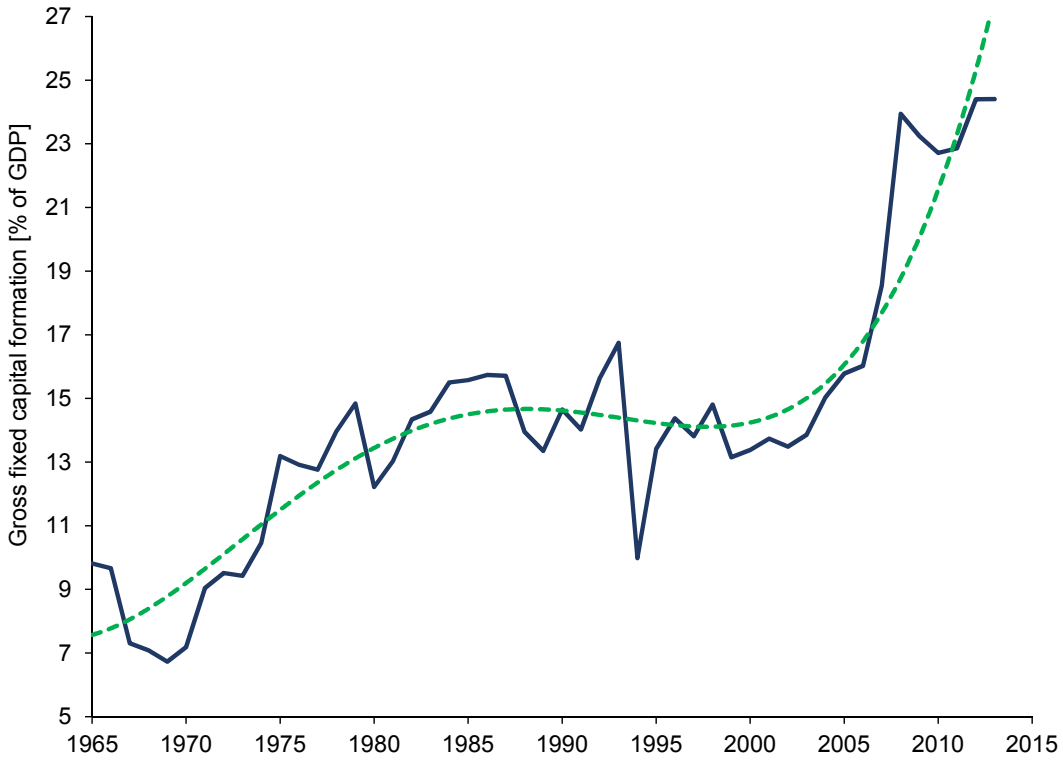


Figure 9: Evolution of gross fixed capital formation in Rwanda, expressed as a percentage of GDP, 1965–2013. The dotted line indicates the best-fitting curve. Source: UNESCO, based on raw data provided by the World Bank

PROSPECTS FOR FDI IN THE MEDIUM TERM

Rwanda, a country facing a range of other development challenges, has shown that improvements in the regulatory environment—including the adoption of global good practices—are well within the reach of low-income economies (IBRD and World Bank, 2014). Different stakeholders also corroborated these facts. The subjective perception of the international community concerning Rwanda's ability to attract FDI still ranks the country 25th out of 144 countries, according to a series of opinion polls by the World Economic Forum (2014). See also page 36. Table 8 presents the list of the major foreign direct registered investors during the period 2006–2011.

Table 8: Top-10 foreign direct registered investors in Rwanda, 2006–2011

Company	Country	Sector	Investment [US$ million]
Kivu Watt Ltd	USA & Netherlands	Energy	285.6
Kenya Commercial Bank	Kenya	Finance	214.4
Dubai World	UAE	Hotel and Real State	211.3
Convention Centre	Libya	Hotel and Tourism	137.8
Tigo	Luxembourg	Telecommunications	113.6
Airtel	India	Telecommunications	102.2
DSI Energy Ltd	Denmark	Electricity and Gas	73.0
New Century/Marriott Hotel	China (75%) Rwanda (25%)	Hotel	65.6
New Forrest Rwanda Ltd	United Kingdom	Forestry	51.2
Opulent Ltd	Tanzania	Hotel	29.4

Source: Adapted from Abbott, Malunda and Festo (2013: 36)

The new *Economic Development and Poverty Reduction Strategy* (EDPRS II) proposes to radically increase FDI in priority sectors of the economy, especially by large firms. This strategy identifies key interventions that will transform Rwanda's investment process, by: (i) strengthening the institutional set-up to lead the investment process; (ii) transforming and funding investment promotion with a revamped strategic focus; and (iii) finalising and implementing the New Investment Code (Rep. of Rwanda, 2013a).

EDPRS II considers that the small size of Rwanda's formal private sector is a major limiting factor to future prospects for economic growth. According to the new strategy, the private sector needs to undergo significant structural transformation to be able to become the main driver of economic growth and create the large number of jobs the Rwandan economy requires. The three proposed interventions to transform the private sector will be (i) strengthening the investment process, by pro-actively targeting large foreign investors in priority sectors of the economy; (ii) accelerating structural changes in the financial sector, aiming to increase long-term savings and thus credit available to the private sector; and, (iii) significantly strengthening the business environment through tax and regulatory reform to spur medium and large enterprise growth, and attract large investors (Rep. of Rwanda, 2013a).

EDPRS II is also prioritising the finalisation and implementation of the Rwanda's new Mining Law currently under development. This new law should overhaul the concessions strategy in the mining sector and merge prospecting and exploration licenses. This new legal framework will be strengthened by better information and transparency about the sector and its potential. The government of Rwanda commits to increasing investments in exploration, including petroleum exploration, based on a clear exploration strategy. This improvement in the business environment will be accompanied by measures to comply with international best standards (including environmental standards).

THE CORRELATION BETWEEN GOOD GOVERNANCE AND SCIENTIFIC PRODUCTIVITY

In an increasingly complex innovation landscape, developing effective governance requires better co-ordination at, and among, the local, regional, national and international levels. With the broadening of innovative processes, players and locations, the systems of governance that provide for their proper functioning become even more important. As no single actor has the knowledge and resources to tackle the innovation challenge unilaterally, all countries – in one way or another – face the task of better co-ordinating the various actors involved in formulating and implementing policy.

The post-conflict reconstruction of Rwanda and its social capital, anchored on good governance and an effective and capable state, is considered a minimal condition to stimulate harmonious development. It is understood that institutions, politics and economics are central to any system of governance. Where controversy has sometimes arisen, it has concerned what constitutes good and bad governance and linking governance to democracy. Rwanda's *Vision 2020* identifies democratic governance characterized by transparency and accountability as a core challenge for Rwanda. *Vision 2020* considered that the State will ensure democratic structures and processes respectful of and committed to the rule of law and the protection of human rights. The document promotes people's participation at the grassroots level through the decentralisation process, whereby local communities will be empowered in the decision making process, enabling them to address the issues which most affect them.

Since 1996, the World Bank has published a set of standardized governance indicators each year for every country in the world. The World Bank's team defines governance as the traditions and institutions by which authority in a country is exercised. This includes the process by which governments are selected, monitored and replaced; the government's capacity to formulate and implement sound policies and; the level of respect on the part of both citizens and the state for the institutions that govern economic and social interactions (Kaufman *et al.*, 1999).

Within UNESCO's GO→SPIN programme, some correlation among these governance indicators and SETI productivity was found (Lemarchand, 2013). For example, in Figure 10, countries are represented in a Cartesian graph (four quadrants), according to their positive or negative values for government effectiveness and political stability/absence of violence. The size of the bubble reflects the number of scientific publications – listed by the Web of Science – per million population. Few nations fall in the first quadrant. Those countries with the largest GDP per capita and number of scientific publications per million population are located in this first quadrant[8] (Lemarchand, 2013). The only African countries included in the first quadrant are Botswana, Cape Verde, Ghana, Mauritius, Namibia, Seychelles and South Africa (at the limit for positive values for political stability/absence of violence).

No African country features in the second quadrant (negative values for political stability/absence of violence but positive values for government effectiveness). The third quadrant (negative values for both indicators) concentrates the great majority of African countries. Lastly, 10 African countries fall in the fourth quadrant (positive values for political stability/absence of violence but negative values for government effectiveness). Figure 10 also informs about differences of scientific productivity using as its measure: the number of scientific publications resident scientists annually published in journals recognized by international indexes, per million inhabitants of the country's population. The smallest bubble size represents the least productive countries, larger bubbles represent more productive countries. The first quadrant features very high productivity.

8 The exception to the rule is Israel, which falls in the second quadrant.

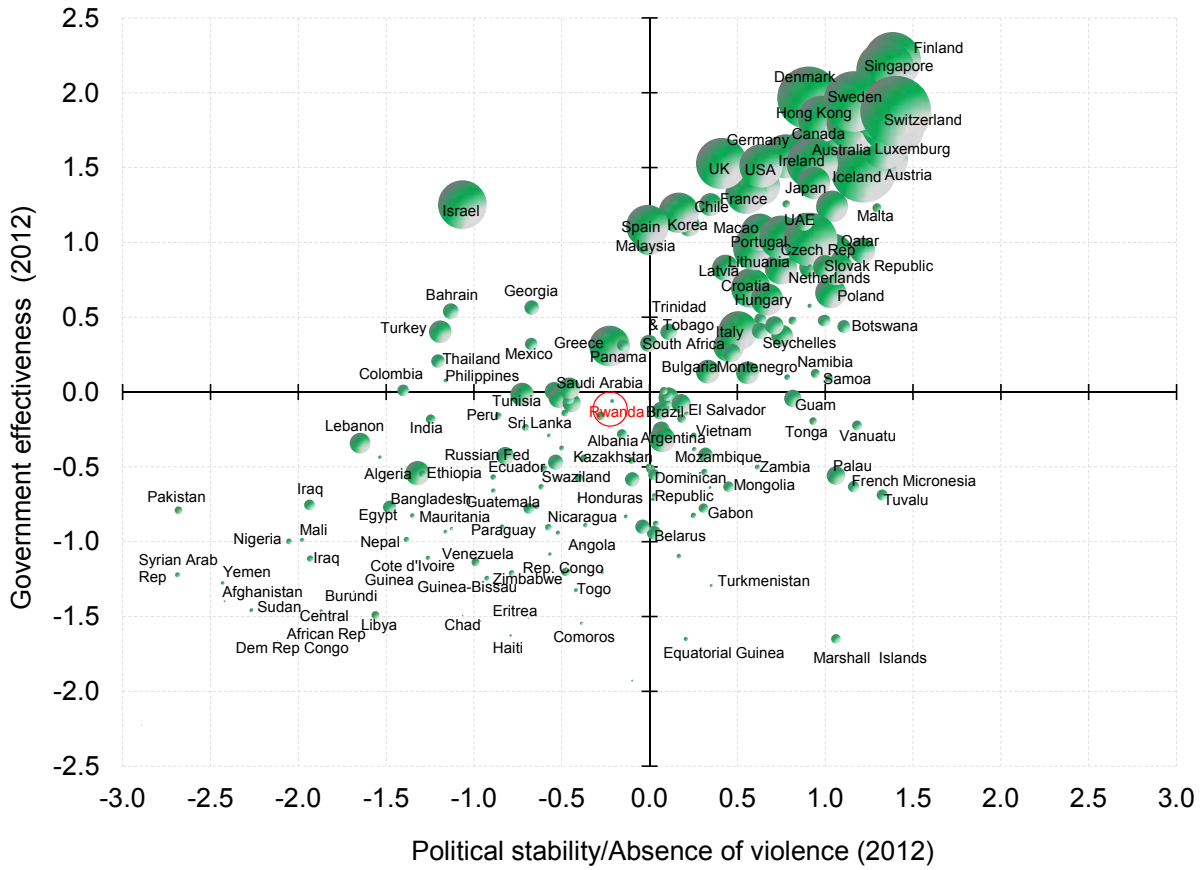


Figure 10: Evolution in government effectiveness worldwide, as measured against political stability/absence of violence, 2012. The size of the bubbles reflects the number of scientific publications per million population in 2012. Rwanda appears in the third quadrant (in red). The majority of countries with high scientific productivity appear in the first quadrant (positive values for political stability/absence of violence and government effectiveness). Source: UNESCO, based on raw data provided by World Bank, UN Statistics Division and Web of Science

Figure 11 shows on a magnified scale the evolution in the same two governance indicators (and scientific productivity) for Rwanda, over time, for the period between 1996 and 2012. Both political stability/absence of violence and government effectiveness had negative values for the entire period. Together these indicators may be said to describe governance.

During this period, governance evolved across the third quadrant; the shorter distance of the later bubbles to the origin (crossing point) of the graph's central co-ordinates indicating that governance have been improving with time. Since 1996, the governance indicators have begun improving, in spite of the fact that the country still has negative values for these two indicators. Figure 11 shows the evolution of these two combined governance indicators over time.

The first pillar of *Vision 2020* is good governance and a capable state. Social and economic transformation relies equally on state and market transformation. The state, its quality of governance and its accountability, are indispensable to creating the culture and values of service needed for wealth-creation and improved quality of living. The main objective of the EDPRS II Accountable Governance thematic area is to advance and prioritise promoting and strengthening accountable governance in Rwanda.

The Government of Rwanda (2012) has recognized that good governance minimizes distortionary incentives and ensures equitable allocation and distribution of public resources. It enhances public security and safety, and guarantees property and personal rights, which in turn creates an environment conducive to private sector investment. In the case of Rwanda, the police, the national office for legal proceedings, ombudsman, office for tender markets, and auditor general's office were designed as key government institutions with high enforcement/sanctions capacity involved in enforcing accountability and transparency mechanisms at all levels of Rwanda's administrative structure (Mudacumura, 2014).

The Rwanda Governance Board (RGB) was created as a public agency with legal personality, administrative and financial autonomy, established by law No 41/2011 of 30/09/2011. This institution promotes the principles of good governance and decentralization; monitors the practices of good governance in political, public and private institutions; coordinates and supports media sector development; registers, empowers and monitors civil society organizations; enhances civic participation; conducts research and studies related to governance; documents home grown solutions and provides policy advocacy to Government for achieving good service delivery, sustainable development and prosperity.

In order to make progress and bring closure, the government of Rwanda granted official recognition to the traditional judicial systems of *Gacaca* and *Abunzi* and used both to successfully try thousands of genocide suspects in a manner adjudged to be fair by international standards. The success of the resuscitated judicial system led the government to restore and grant official recognition to other indigenous systems of governance and public administration, such as *Abunzi, Imihigo, Ubudehe* and *Umuganda* (see Box 2).

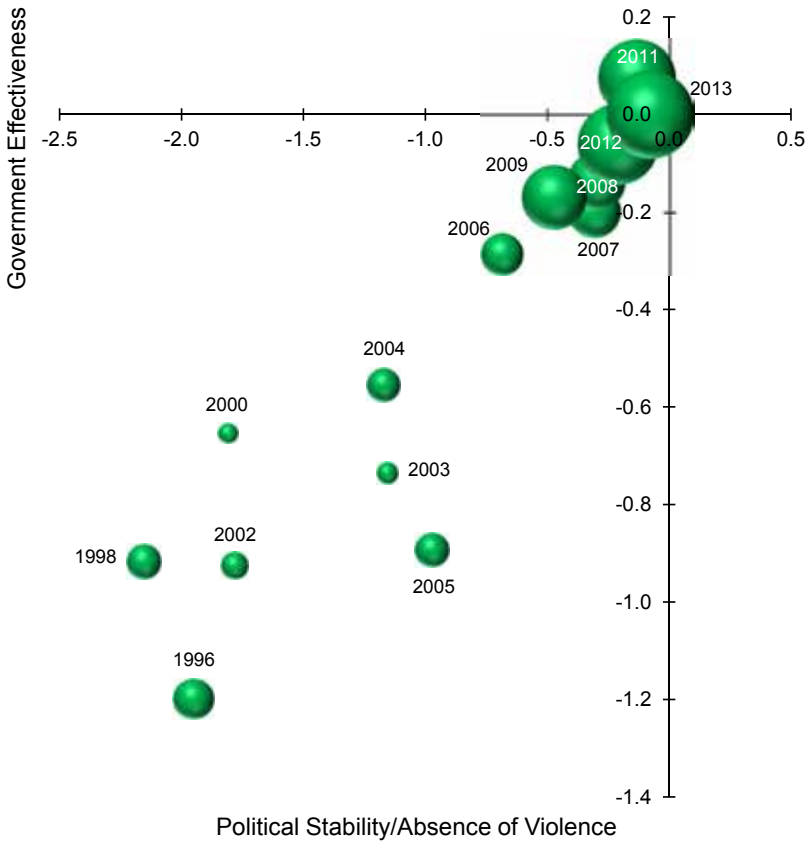


Figure 11: Evolution in government effectiveness in Rwanda, as measured against political stability/absence of violence, 1996–2013. The size of the bubbles reflects the number of scientific publications per million of population for the same years. Source: UNESCO, based on raw data provided by the World Bank, UN Statistics Division and Web of Science

BOX 2 – INDIGENOUS VALUES AND SYSTEMS

As part of efforts to reconstruct Rwanda and nurture a shared national identity, the Government of Rwanda drew on aspects of Rwandan culture and traditional practices to enrich and adapt its development programs to the country's needs and context. The result is a set of Home Grown Solutions – culturally owned practices translated into sustainable development programs, such as *Abunzi, Imihigo, Ubudehe and Umuganda*.

Abunzi

The word *Abunzi* can be translated as 'those who reconcile' or 'those who bring together' (from verb kunga). In the traditional Rwanda, *Abunzi* were men known within their communities for personal integrity and were asked to intervene in the event of conflict. Each conflicting party would choose a person considered trustworthy, known as a problem-solver, and who was unlikely to alienate either party. The purpose of this system was to settle disputes and also to reconcile the conflicting parties and restore harmony within the affected community.

Abunzi can be seen as a hybrid form of justice combining traditional with modern methods of conflict resolution. The reintroduction of the *Abunzi* system in 2004 was motivated in part by the desire to reduce the backlog of court cases, as well as to decentralize justice and make it more affordable and accessible for citizens seeking to resolve conflict without the cost of going to court. Today *Abunzi* is fully integrated into Rwanda's justice system.

This conflict resolution mechanism rooted in Rwandan culture was perceived as more accessible, less threatening and therefore more intimate and human. Those who referred their cases to *Abunzi* were more comfortable seeking mediation from within their community, which afforded them a better understanding of the issues and process at hand. As the *Abunzi* system gained more recognition as a successful method to resolve conflict and deliver justice, the importance of providing more structure and formality to their work increased. Consequently, the *Abunzi* started receiving training for mediating domestic conflicts, as well as logistical support from both governmental and non-governmental organisations, to improve the quality of their mediation services. In 2012, 30 768 *Abunzi* were operating across Rwanda.

Imihigo

Imihigo is the plural Kinyarwanda word of *Umuhigo*, which means to vow to deliver. *Imihigo* also includes the concept of *Guhiganwa*, which means to compete among one another. *Imihigo* describes the pre-colonial cultural practice in Rwanda where an individual sets targets or goals to be achieved within a specific period. The person must complete these objectives by following guiding principles and be determined to overcome any possible challenges that arise. In 2006, *Imihigo* (known also as performance contracts) were introduced to address this need.

Since its introduction, *Imihigo* have been credited with improving accountability and quickening the pace of citizen-centred development activities and programs. The practice of *Imihigo* has now been extended to ministries, embassies and public service staff. Over the years, the practice has evolved into a tool for effective planning, implementation, performance evaluation and accountability for all public institutions and staff.

Imihigo were prepared according to the government priorities as stated in EDPRS II, *Vision 2020* and other international agenda, like MDGs. However, the exact extent of the impacts of the *Imihigo* policy and the overall dynamic of the process remains to be further researched and discussed on in order to assess the responsiveness and effectiveness of this tool.

Ubudehe

Ubudehe refers to the long-standing Rwandan practice and culture of collective action and mutual support to solve problems within a community, according to a recent academic research paper. It is not known exactly when *Ubudehe* was first practiced, but it is thought to date back more than a century. The focus of traditional *Ubudehe* was mostly on cultivation.

Colonisation and the introduction of a cash-based economy weakened the practice of *Ubudehe* as some members of the community were able to pay others to do work. While this trend occurred across the country, in some places *Ubudehe* was still practiced up until the 1980s.

The *Ubudehe* Program was launched in 2001 as part of partnership between the Ministry of Finance and Economic Planning and the Ministry of Local Government. During field visits of *Ubudehe* facilitators to people, they are empowered to discuss the characteristics of poverty and their role in poverty reduction.

When *Ubudehe* was launched into Rwandan life, it was as way to better involve communities in their development by setting up participatory problem solving mechanisms. The program was seen as a way to strengthen democratic processes and good governance through greater community involvement in decision-making. *Ubudehe* creates opportunities for people at all levels of society, especially the village level, to interact with one another, share ideas, create institutions and make decisions for their collective development.

Ubudehe is one of Rwanda's best-known Home Grown Solution because of its participatory development approach to poverty reduction. In 2008, the program won the United Nations Public Service Award for excellence in service delivery. Today *Ubudehe* is one of the country's core development programs.

Ubudehe Process serves as a pro poor credit channel based on the prior successes of *Ubudehe* approach in participatory planning and management, as well as on success stories at individual and community levels in the area of poverty reduction and community ownership. Since Financial Institutions find it risky and costly to transact with the poor, *Ubudehe* Process offers an opportunity to mitigate the risk and lower costs by involving the communities. Through community collective action, the risks and costs are minimized by people owning their local problem, and more people share the benefits.

Umuganda

The word *Umuganda* can be translated as 'coming together in common purpose to achieve an outcome'. In traditional Rwandan culture, members of the community would call upon their family, friends and neighbours to help them complete a difficult task.

In Rwanda, there is a mandatory community service day from 8:00am to 11:00am, on the last Saturday of each month called *Umuganda* meaning community service. The day is called *umunsi w'umuganda*, meaning "contribution made by the community" which is designed to be a day of contribution and building the country by citizens themselves. By law all able bodied persons above the age of 18 and below 65 are expected to participate in volunteer community work. The start of this practice goes back to colonial times and is still practiced today.

Participation in *Umuganda* is usually supervised by a manager, or *Umudugudu,* a chairperson who oversees the effectiveness and efficiency of community participation. On this day, business activity halts, public transportation is limited, and people are seen everywhere working. People participate in cleaning streets, cutting grass and trimming bushes along roads, or repairing public facilities or building houses for vulnerable persons. People with particular skills offer their services for free on this day. For example, doctors may offer free medical examinations.

The benefits of *Umuganda* are not merely economic. The day is intended to build community involvement and strengthen cohesion between persons of different background and levels. One such a benefit is that people can access authorities to articulate their needs and voice opinions on various issues.

The labour cost from *Umuganda* contributes to national development programs. By reaping the rewards of the volunteer labour and by having more capital to invest in the country, *Umuganda* has contributed to the growth and development of the Rwanda.

Close to 80% of Rwandans take part in monthly community work. Successful projects include the building of schools, medical centres and hydroelectric plants as well as rehabilitating wetlands and creating highly productive agricultural plots. The value of *Umuganda* to the country's development since 2007 has been estimated at more than US$60 million.

Source: Rwanda Governance Board

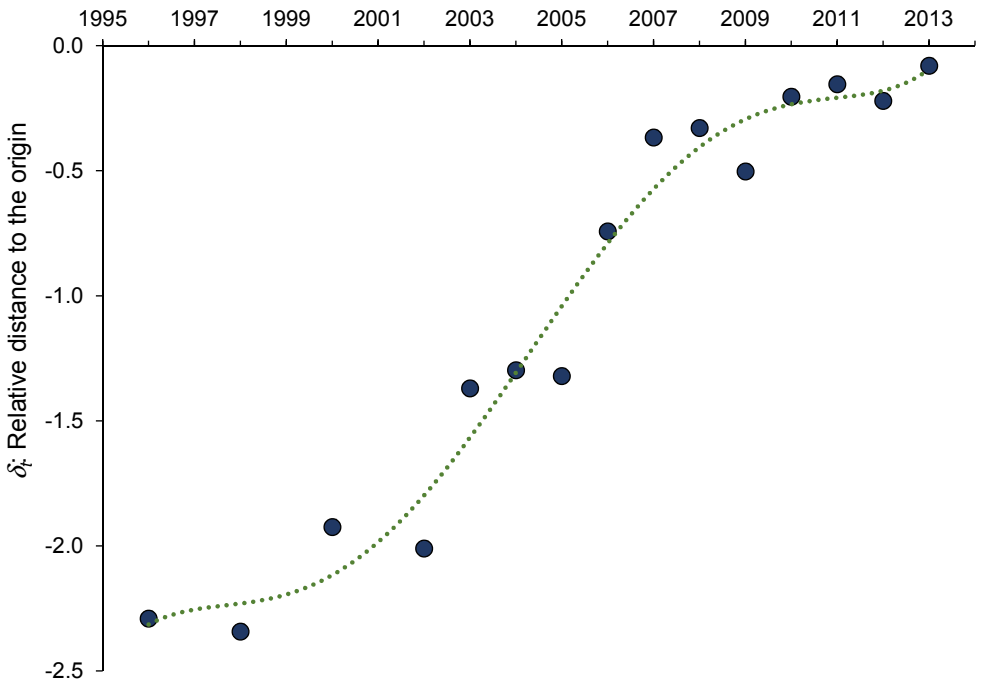


Figure 12: Evolution of the two combined governance indicators (1996–2013) represented in Figure 11. Here, the relative distance to the centre of the origin of co-ordinates is plotted over time. Since all the circles in Figure 11 fall in the third quadrant, these shorter distances mean a better level of governance. The dotted line is the best-fitting curve. It shows that Rwanda's combined governance indicators have been improving since the Genocide. The relative distance δ_t at time *t* (year or measurement) is estimated as $\delta_t = \sqrt{G_t^2 + P_t^2}$ where G_t is the value for *government effectiveness* at year *t* and P_t is the value of p*olitical stability/absence of violence* at year *t*. Source: UNESCO

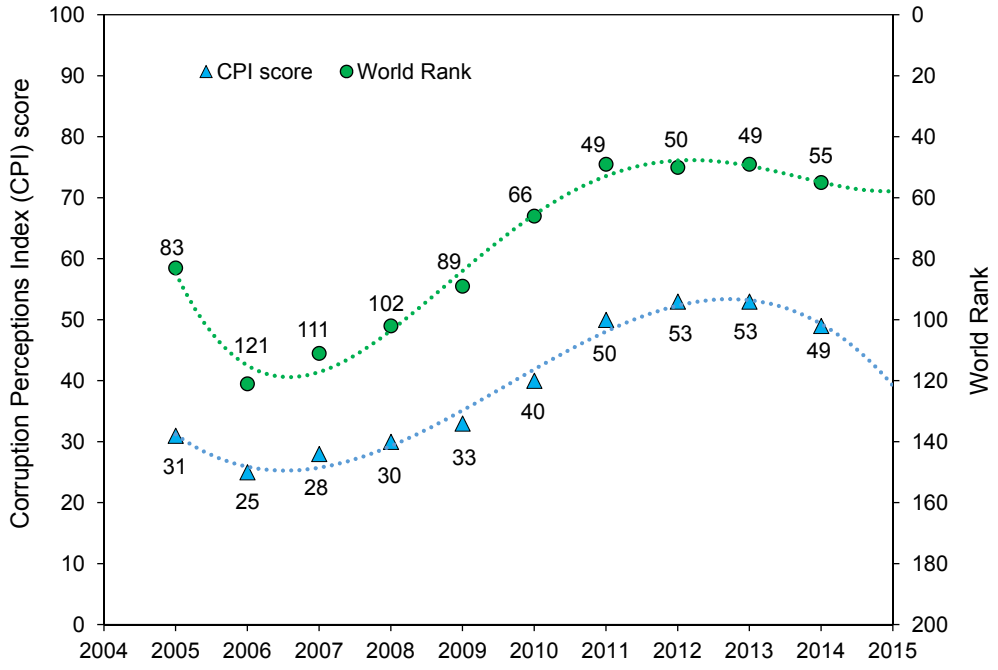


Figure 13: Evolution of the Corruption Perceptions Index (CPI) in Rwanda (triangles associated with the left-axis) and world rank (circles associated with the right-axis), 2005–2014. The dotted lines represent the best-fitting curves. Source: UNESCO, based on raw data generated by Transparency International

Corruption is another important variable – associated with the quality of governance – which has increasingly been incorporated in most of the regional and international reports published by international organizations, including the *African Economic Outlook* (ADB *et al.,* 2014). Since 1998, Transparency International has published the *Corruption Perceptions Index* (CPI). The CPI ranks countries and territories on the basis of how corrupt their public sector is perceived to be, on a scale from 0 (highly corrupt) to 100 (very clean). A country's rank indicates its position relative to the other countries and territories listed in the index. The total number of countries included in the survey varies each year, ranging from 85 (1998) to 183 (2011). The CPI is calculated using data from 10 independent institutions. All 13 sources measure the overall extent of corruption (frequency and/or size of bribes) in the public and political spheres and all sources provide a ranking of countries.[9]

Figure 13 shows the CPI scores of Rwanda and its corresponding world ranking between 2005 and 2013. The shape of these curves follows a similar pattern to that for the governance indicators (Figure 12). In 2005, Rwanda ranked 83th (out of 159 countries), in 2011, it ranked 49th (out of 183 countries) and in 2014 55th (out of 175 countries). Mudacumura (2014) argues that the tremendous pace in eliminating corruption in Rwanda has paved way for championing good governance, and helped set up a trend of formulating policies that reach the final implementation stages with success.

Political stability and good governance sustained over decades are prerequisites for developing sound public policies. Stability and predictability are particularly important for research and innovation, since both endeavours involve risk-taking with long time horizons. They thus require a stable framework, institutions and policies. Political instability may inhibit innovation by increasing uncertainty for innovators and venture capitalists; it may lessen the effectiveness of SETI policy instruments by weakening the incentives they provide.

Moreover, research and innovation are cross-cutting activities that involve the ministries of science and technology, higher education, health, agriculture, energy, mining, environment, water and planning, etc. To be effective, research and innovation measures require co-ordination and coherence among government departments, programmes and policies; empirical studies over the past two decades show that governments find this difficult, since their traditionally departmentalised structures are generally ill suited to deal with cross-cutting policy issues such as research and innovation. The way in which SETI policies are managed in Rwanda by different ministries, universities and research centres, which interact little is an example of this. Adopting a coherent approach entails not only co-ordinating a multitude of policy moves dictated by the core set of research and innovation policies, such as those for higher education and entrepreneurship, but also evaluating their possible interaction with policies pursuing other primary objectives, such as the fiscal policy, competition laws and regulations which provide the framework for innovation (OECD, 2010).

9 To determine the mean value for a country, the data are standardized using the technique of matching percentiles. This method uses the country ranking reported by each individual source. It is useful for combining sources that have a different distribution. Whereas there is some information loss with this technique, it allows all reported scores to remain within the bounds of the CPI, i.e. between 0 and 100. A beta-transformation is then performed on scores. This increases the standard deviation among all countries included in the CPI and avoids a smaller standard deviation from year to year, one of the drawbacks of the matching percentiles technique. All of the standardized values for a country are then averaged, to determine a country's score. The CPI score and the ranking position are accompanied by the number of sources, high-low range, standard deviation and confidence range for each country. The confidence range is determined by a bootstrap (non-parametric) methodology, which allows inferences to be drawn from the underlying precision of the results. A 90 percent confidence range is then established, whereby there is a 5 percent probability that the value is either below or above this confidence range. Source: Transparency International (2013)

BOX 3 – POLICY DIALOGUES AND INTERUNIVERSITY DEBATES

Debate competitions in institutions of higher learning were organized as part of the celebration of 2013 governance month event organized in Rwanda. There were 22 universities and 8 secondary schools involved in these competitions across the country.

Policy debate was chosen to be used in all institutions of learning, as the topics used were essentially policy related. Some examples of the motions used in debates were: "Rwanda should adopt agriculture rather than industry for economic development"; and "Foreign aid has done more harm than good to developing countries."

The assessment by adjudication was based on criteria agreed upon by all involved, both the adjudicators as well as the debating teams. These criteria were: command of language, answering questions, audience interaction, and time consciousness. Each one was scored from one to ten (10) on a score sheet. At the end of the debate, every speaker was assessed as an individual and then the scores for all debaters would be added up to determine a score for the whole team.

Judges were selected from among institutions such as Rwanda Tourism University College, Institute of Agriculture and Animal Husbandry, Kigali Independent University, and one was from Transparency International. Debaters were chosen based on their experience in debates and their social standing as respected lecturers from recognized establishments. All the provinces were represented during the debate competitions. Institutions were selected from each province and the *modus operandi* was to come up with the best team in the province, which would proceed to the next level of quarter finals. In the semi-final debate competitions, the institutions represented were Kigali Institute of Science and Technology, Umutara Polytechnic, National University of Rwanda and College of Education (KIE).

Source: Rwanda Governance Board (2013)

CONSTRUCTING AN INNOVATION PROFILE: INDUSTRIAL POLICIES AND DEMAND FOR SETI

The national innovation systems paradigm usually characterizes the relationship among institutions that support and foster knowledge creation, and firms that exploit this knowledge. This stream of work suggests that to maximize innovation, institutions within a country need to complement each other and work in tandem. Also, it suggests that technology policy, aiming to create efficient institutional mechanisms for integrating the functions of knowledge production and knowledge commercialization, is likely to enhance a country's ability to sustain an innovative technology system over time (Stern *et al*., 2002).

Innovation policy is usually defined as a set of policy instruments and appropriate institutions that assist in the local adoption of technology, and the introduction of new products and services to the market. This may include adapting imported technologies to local conditions. Appropriate technology and innovation policies can be derived only from an understanding of how technical change takes place in local enterprises. Whereas companies everywhere have to make an effort to master or adapt existing technologies, a high level of basic knowledge and capabilities exists in most firms in mature industrial countries, or can be easily acquired from other firms, labour markets, support institutions or consultants. This makes it relatively easy and routine to master existing technologies. In developing countries, by contrast, not only is the internal knowledge base for mastering technologies relatively weak; the support network provided by other enterprises, institutions and human capital also tends to be underdeveloped (Lall and Teubal, 1998).

Promoting innovation at firm level involves both public and private sectors (e.g. entrepreneurs, researchers, public servants, financiers, etc.) and may include civil society organizations. Successfully launching and running initiatives involving innovation requires aligning interests of numerous stakeholders. This implies a difficult co-ordination process. The state is often best placed for the role of initiating, guiding or facilitating co-ordination, owing to its stronger convening and co-ordinating power, and it has an important tool available only to it. Incentives can be designed in public policies so as to influence behaviours and relations of actors involved in the innovation process. By, for example, aligning incentives with stakeholders, establishing risk-sharing mechanisms for multi-stakeholder ventures, and promoting knowledge sharing and dissemination, the state significantly promotes the co-ordination process. In developing countries, inadequate public sector involvement to co-ordinate stakeholders may stymy innovation.

The productive sector and its markets represent demand for SETI. The characteristics and behaviour of this SETI demand over time determine whether or not it is possible, in the economy of a country, to absorb the results of research obtained by universities and research centres (SETI supply), so as to generate new goods and services. To handle new knowledge and incorporate it in production, a firm has to make a number of technological decisions. Some are clearly concerned with the choice of alternatives regarding the source of new knowledge, the source of equipment and the use of such inputs. Others have to do with the building-up of the firm's capacity (technical and design groups, administrative organisation, information) to make such choices, to adapt foreign technology and to incorporate new knowledge effectively into production. The adaptation of foreign technology is particularly important, since it contributes to the optimal use of foreign technology and can link foreign technology to domestic S&T.

Supply and demand analysis should guide the public sector's involvement. A lack of adequate understanding of the characteristics and potentialities of the SETI supply and demand in a given country will trigger failure for any research and innovation policies, policy instruments and incentives put in place.

In recent years, a growing number of surveys have studied the behaviour of entrepreneurship and innovation in different countries. Some of these provide valuable information on Rwanda (World Economic Forum, 2014; INSEAD *et al*., 2013). See Table 9 for a series of subjective and objective indicators showing the perception of research and innovation in Rwanda.

Table 9: Selected subjective and objective measurements for Rwanda

Subjective index: World Economic Forum Executive Opinion Survey 2014 (Max. value = 7)			Objective Measurements		
Indicator	Value 1–7	Rank out of 148	Indicator	Value	Rank out of 148
Quality of the education system	4.0	50	Secondary enrolment, gross percentage (2012)	31.8	134
Quality of Math and Science Education	4.1	70	Tertiary education enrolment, gross percentage (2012)	7.2	124
Quality of management schools	3.8	99	School life expectancy, in years (2012)	10.2	113
Internet access in schools	4.3	70	Individuals using internet, percent (2013)	8.7	125
Availability of research and training services	3.7	96	Broadband internet subscriptions per 100 population (2013)	0.0	137
Extent of staff training	4.0	66	Int'l internet bandwidth, kb/s per user (2013)	9.8	103
Availability of latest technology	5.3	43	Mobile broadband subscriptions/100 population (2013)	5.8	106
Firm level technology absorption	5.0	49	Mobile telephone subscriptions/100 population (2013)	56.8	134
FDI and technology transfer	5.1	25	Fixed telephone lines/100 pop (2012)	0.4	135
Capacity for innovation	3.5	86	Number of applications filed under the Patent Co-operation Treaty per million population (2011)	0.0	124
Quality of scientific research institutions	3.7	72	Scientific articles listed at SCOPUS (2013)	210	125
Company spending on R&D	2.9	94	Citable scientific articles-H index (2013)	43	145
University-industry collaboration in R&D	3.7	64	Life expectancy at birth, in years (2013)	65.5	115
Government procurement of advanced tech products	4.8	5	Women in labour force, ratio to men (2010)	1.02	3
Availability of scientists and engineers	4.0	74	Imports as a percentage of GDP (2013)	39.9	88

Note: The subjective indicators (from a low of 1 to a high of 7) are based on a series of executive opinion surveys prepared by the World Economic Forum, whereas the objective indicators (related to research and innovation) were originally produced by other agencies and have been compiled by the World Economic Forum. Both columns show Rwanda's ranking out of 148 nations for each individual indicator. INSEAD *et al.* (2014) have also produced similar surveys and data.

Source: World Economic Forum (2013) *Global Competitiveness Report* (2013–2014)

Characteristics of the manufacturing sector

The emergence of viable industry that can act as the principal growth engine of the economy is a priority for Rwanda's development. The manufacturing sector has been one of the key drivers of GDP growth in Rwanda, leading to an impressive set of figures – representing around 14% of the GDP over the past decade. Real industrial output grew 19% in 2011, 6% in 2012 and 11% in 2013. With increases in output, there has been a steady rise in capacity utilisation.

Industrial sector growth over the period of the EDPRS I was 9.8% annually. Construction has been a powerful growth-driver, at 15.0% annually, driven by remittances from the diaspora.

In recent years, several executive polls have been conducted by different international organizations to measure the dynamism of innovation and the competitiveness of different countries (i.e. World Economic Forum, 2014; INSEAD *et al.*, 2014).

Figure 14 shows the results of an executive poll designed to determine the major difficulties faced by the productive sector in promoting innovation and improving competitiveness. The poll reveals that foreign currency regulations, lack of access to financing, an inadequately educated workforce, insufficient capacity to innovate, and inadequate supply of infrastructure are deemed to be the major hurdles.

INSEAD *et al.* (2014) made a systematic analysis of the major components of innovation in 143 countries. Their study analyses seven pillars: business sophistication; creative output; human capital and research; infrastructure; institutions; knowledge and technology output and; market sophistication. Figure 15 shows the cartographic results obtained by Rwanda for each individual pillar. In 2013, Rwanda came 102nd out of 143 countries, with an integrated value of 29.3 out of 100 maximum points. Institutions and market sophistication are the pillars which have the highest scores.

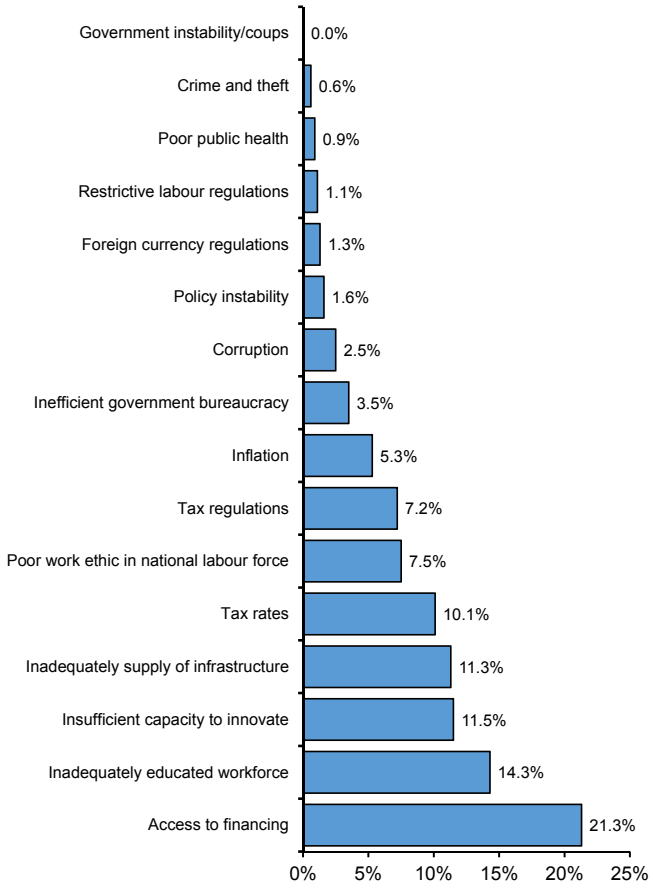


Figure 14: Major difficulties in promoting innovation and competitiveness in Rwanda, 2013. Source: World Economic Forum (2014)

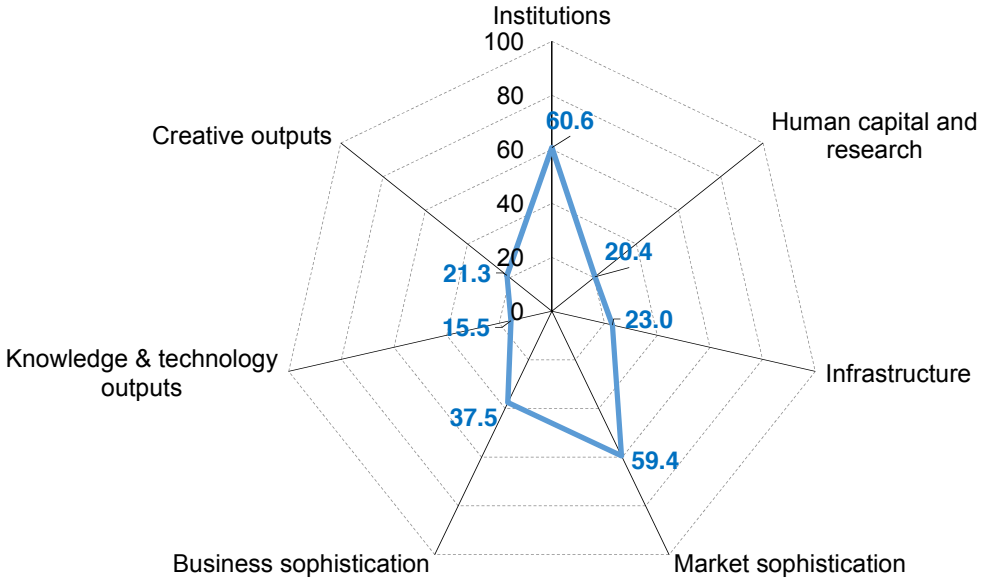


Figure 15: Rwanda's scores (0–100) for each individual pillar of innovation, taking into account the estimation of the Global Innovation Index. Source: INSEAD *et al.* (2014)

Over 90% of Rwanda's workforce is employed in the private sector. Small and medium enterprises (SME) account for 98% of the estimated 123 000 businesses operating in the country and provide 84% of private sector employment. However, only 14 000 firms are registered with the Rwanda Revenue Authority, 40% of which are registered for value-added taxes and merely 11% for income taxes. Key impediments to private sector development include the high cost of energy and transport, as well as poor business planning and management skills, particularly in SMEs. A private sector development strategy was adopted in 2013 to facilitate investment, job creation and growth in the private sector (ADB *et al.*, 2014).

One of the priorities of EDPRS II is to stimulate entrepreneurship, access to finance and business development by increasing off-farm employment, productivity and job creation driven by the private sector. The government proposes the consolidation, rationalisation, and expansion of different business support programmes into an Integrated National Employment Programme to boost entrepreneurship and job creation. The coupling between public policy and entrepreneurship is tight in developed countries and loose in developing countries according to Schott and Jensen (2008). It should be cautioned that most of the conditions that allow the coupling to be tight in developed countries are not present in the developing countries. Entrepreneurship policy also differs from industrial policy because its effectiveness depends, to some extent, on the introduction of a trade-off between market concentration and productivity performance (Audretsch, 2004).

Recently, Sheriff and Muffatto (2014) published a detailed study about the entrepreneurship policies, which have been applied in Kenya, Rwanda and Tanzania during the past decade. The following Table 10 provides the main characteristics of these policies in each different country. At present, most of the policies and programs for the promotion of entrepreneurship are short term. Therefore, Sheriff and Muffatto (2014) concluded that it is difficult to measure their real effectiveness.

Table 10: Main characteristics of entrepreneurship policies in Kenya, Rwanda and Tanzania

Policy	Kenya	Rwanda	Tanzania
Access to finance	Focused on the banking sector to overcome the difficulties in obtaining capital	Consolidate all existing funds available to SME under a chosen body to facilitate SME access to finance	Financial reforms aimed at further liberalization of the financial sector and the creation of financial intermediaries to cater for SME
Legal and regulatory framework	Reduce corruption and its disruptive effects and improve the judicial system	Simplify the fiscal and regulatory framework for SME growth	Simplification and rationalization of procedures and regulations to minimize transaction cost
Infrastructure framework	Focus on improving the quality and efficiency of operation of existing infrastructure facilities	The rehabilitation and development of infrastructure is a crucial aspect in lowering the costs of doing business in Rwanda	The Government will continue to improve the physical infrastructures and provision of utilities
Institutional framework	The Government will continue to improve the physical infrastructures and provision of utilities	Develop an appropriate institutional framework for SME development	The Government will facilitate strengthening of institutions and associations supporting the SME sector
Marketing		Access to local, regional and international markets and market information	The Government is committed to facilitating support programs aimed at improving SME' access to market
Trade	To subsidize exporting activity and improve import substitution		The government will enhance the capacity of institutions providing business training to SME
Entrepreneurship education and training	To facilitate nationwide entrepreneurship education and training		
Technology and innovation	To overcome the problems that hamper local research and development	Promote innovation and technical capacity of SME for competitiveness	Facilitate acquisition and adaptation of technologies as well as enhance networking between R&D institutions and SME
Entrepreneurship development	To develop the capacity of trainers to work with the MSE sector to enhance the transition of micro and small scale enterprises into medium-sized enterprises	Promote a culture of entrepreneurship among Rwandans	The government will promote entrepreneurship development through facilitating improved access of SME to financial and non-financial services
Socio-political environment for investments	To enhance good governance, law and order and security		
Business training			The government will enhance the capacity of institutions providing business training to SME

Policy	Kenya	Rwanda	Tanzania
Information			The government will facilitate and support programs aimed at increased access of information pertinent to the development of SME
Enterprise transition	To develop the capacity of trainers to work with the MSE sector to enhance the transition of micro and small scale enterprises into medium size enterprises		
Facilitate SME access to business development services		Lack of management and technical skills, lack of access to market information and markets, high cost of doing business, limited business development services	
Macroeconomic	A successful industrialization strategy driven by the private sector will require a stable macroeconomic environment		

Source: Sheriff and Muffatto (2014)

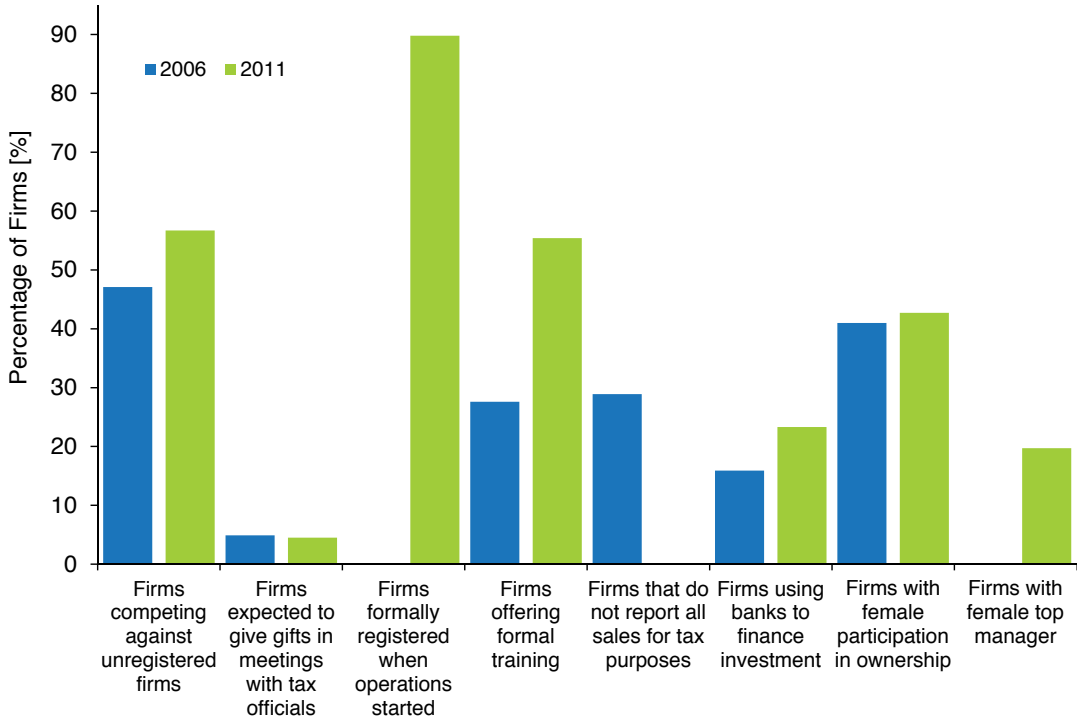


Figure 16: Main characteristics of Rwandan firms. Source: World Bank database (January, 2015)

Figure 16 shows characteristics of Rwandan firms in two periods (2006 and 2011), according to two surveys of a sampling of registered firms. Increases in capital investment in recent years are due to rapid increases in public construction expenditure, and private sector capital investment suffers low growth. Empowering and investing in youth and women is an integral part of EDPRS I priorities. Steps have been taken to promote savings and credit facilities among the youth and women through cooperatives and other initiatives, and the Government places a heavy emphasis on entrepreneurship training with several initiatives targeting women and youth. In addition, hundreds of entrenched civil servants have received entrepreneurship training or have been given access to education finance facilities for training.

Industry in Rwanda faces considerable challenges, including: (a) high transport costs (cost of transporting a container from Mombasa to Kigali amounts to 53% of its value); (b) high cost of financing; (c) high energy costs highest electricity (costs in the region at 24US cents/KWh, compared to 11US cents/KWh in Kenya); (d) low levels of technology transfer; (e) limited endogenous R&D capacity; and (f) low purchasing power (United Nations, 2013).

Against such challenges, the country has made the big strides in becoming very business-friendly by introducing reforms in seven out of the 10 categories. For example, as part of a series of reforms of the start-up process, in 2008 the government established the Office of the Registrar General to maintain an efficient business register and promote a competitive business environment. The office has the responsibility for the implementation of applicable commercial laws, such as the Companies Act, and the registration and deregistration of businesses. In 2009, it had set up a one-stop shop, streamlining company name checking, payment of incorporation fees, and tax and company registration procedures. During that year alone, 3 028 new limited liability companies were formed —almost equivalent to the total for the previous five years, when 3 374 new limited liability companies had been registered. By year 2012 the number reached 6 655 new companies.

BOX 4 – THE KNOWLEDGE TRANSFER PARTNERSHIP PROGRAMME IMPLEMENTATION

The implementation of the Ministry of Education's Knowledge Transfer Partnership (KTP) programme was officially launched in 2013. The intention was to follow-up on the July 2009 study entitled "Mapping Science and Technology for Industrial Development in Rwanda: Linking Research and Development between Industries and Higher Learning Institutions", which was sponsored by the African Development Bank and led by the former Ministry in the Office of the President in charge of science and technology. The study identified several potential partnerships between higher education institutions, research and development centres, and leading companies from key sectors of the economy (agro-processing, manufacturing, construction, textiles, cosmetics, ICT and energy). Each partnership involves a business seeking to implement a strategic project, an academic or research partner providing essential knowledge, and a highly skilled recent graduate who will manage the project. Four partnerships have already been established and are now running.

Source: Republic of Rwanda (2014c)

Table 11 shows the top ranking of countries in Africa where the national policies facilitate doing business. In recent years, Rwanda has been leading this list. The data is consistent with the opinion polls done by different organizations (INSEAD *et al.*, 2014; World Economic Forum, 2014; World Bank, 2014b).

Table 11: Ease of doing business top-ranking in Africa 2015

Country	Ease of doing business world rank 2015	Ease of doing business	Starting a business	Dealing with construction permits	Getting electronically	Registering property	Getting credit	Protecting investors	paying taxes	Trading across borders	Enforcing contracts	Resolving insolvency
Mauritius	28	74.81	92.47	67.17	83.74	66.00	65.00	65.00	91.92	87.74	66.22	62.81
South Africa	43	71.08	89.43	81.65	55.74	66.02	60.00	67.50	88.73	71.05	66.14	64.51
Rwanda	46	70.47	81.66	81.55	79.48	89.20	90.00	46.67	85.79	44.67	63.94	41.77
Tunisia	60	67.35	83.60	73.19	84.59	72.03	35.00	55.00	74.11	80.36	60.96	54.71
Ghana	70	65.24	83.63	69.14	78.29	79.23	65.00	58.33	71.53	67.10	57.59	22.45
Morocco	71	65.06	90.33	77.89	74.39	61.26	40.00	45.83	77.69	84.64	60.14	38.47
Botswana	74	64.87	71.68	71.43	75.56	78.13	55.00	49.17	77.47	52.02	64.02	57.17
Seychelles	85	63.16	77.48	78.37	64.22	71.00	10.00	58.33	81.50	81.65	56.92	52.17
Namibia	88	62.81	68.67	83.22	78.97	41.85	55.00	53.33	73.57	63.17	64.82	45.53
Swaziland	110	59.77	73.47	77.78	61.81	58.78	55.00	47.50	75.76	65.43	36.37	45.80

Source: Doing Business 2015: Going Beyond Efficiency, International Bank for Reconstruction and Development and World Bank (2014)

Today Rwanda's Office of the Registrar General, in the Rwanda Development Board, is focused on making its registration system completely paperless by promoting electronic registration services. Other priorities include ensuring accurate and timely delivery of information on its services, and raising awareness of the importance of formalizing businesses. Consistent with good practices in ensuring transparency, the Office of the Registrar General makes official fee schedules for business services easily available to the general-public at its premises as well as on its website.

Rwanda has made important strides in improving its business environment over the past decade. Its business regulation reforms have resulted in cost savings for the private sector estimated at US$5 million, investments totalizing US$45 million, and creation of about 15 000 jobs. In 2006, before these reforms, starting a limited liability company in Rwanda took nine procedures, 18 days and 235.5% of (annual) per capita income in fees. Today it takes eight procedures, 6.5 days and 52.3% of annual income.

Given weaknesses in the enabling environment and the risk-aversion of banks with regard to SME lending, most Governments – often supported by donors – continue to intervene directly in the market to increase the volume of credit flowing to SMEs, either through credit lines or partial credit guarantees (Berg and Fuchs, 2013). Several operational SETI policy instruments have been designed and applied successfully, around the world, to promote innovation within SMEs. Several empirical studies show that credit guarantees can increase firms' use of external finance and can also help these firms to grow.

Rwanda has been designing and implementing a series of policy instruments to promote partial credit guarantees for SMEs from the banking system. The processing of claims was improved (by 50%) through the introduction of a partial payment of claims before legal procedures were exhausted. According to Berg and Fuchs (2013), this new rule increased the attractiveness of the partial credit guarantees scheme while maintaining incentives for loan recovery. This policy instrument was also improved through the introduction of a new guarantee product for working capital loans, which addresses a key financing constraint of many SMEs, particularly start-ups. The entire scheme was developed and refined in close interaction with the private sector. The following Table 12 shows the main characteristics of the partial credit guarantees scheme.

Table 12: Policy instruments for partial credit guarantees

Scheme	Purpose(s)	Launch date	Maximum loan	Lending interest rate	Maximum loan term [years]	Amount financed	Number of loans financed
SME guarantee fund	50% loan guarantee scheme for SME lending by banks	2010	RWF 500 million	Not prescribed, 1% guarantee commission	10	RWF 3 000 million in June 2012	14
Agriculture Guarantee Fund	50% guarantee for agricultural loans	2011	RWF 500 million	Not prescribed, 1% fee	10	More than RWF 8 000 million	169

Source: Berg and Fuchs (2013)

In order to promote business starts-ups, Rwanda created the *Entrepreneurship Development Programme*. Through training and awareness creation, it aims to empower youth and women, and provide them with entrepreneurial skills to achieve their dreams. The Rwanda Development Board administers this programme across the country. The programme assumes that building a young generation of Rwandan entrepreneurs will ultimately lead to vibrant SMEs contributing to creating decent jobs and reducing poverty.

The overall goal of the *Entrepreneurship Development Programme* is building a critical mass of young Rwandan entrepreneurs in the next in the five years. It seeks to provide existing and potential entrepreneurs with the right skills and knowledge to become competitive players in the local or global market. The specific objectives are: (a) creating awareness among students of enterprise and self-employment as a career option, (b) developing positive attitudes towards innovation, enterprise and self-employment, (c) instilling an entrepreneurial mind-set among all Rwandans (young and old, male and female), (e) providing Rwandans with entrepreneurial skills to help run and manage income-generating and job-creating activities, (f) encouraging start-ups and supporting particularly difficult aspects of entrepreneurship, (g) developing competencies necessary to a dynamic entrepreneur, such as critical thinking, decision-making and accountability.

BOX 5 – TECHNOLOGY, RESEARCH AND INNOVATION WITHIN THE NATIONAL INDUSTRIAL POLICY

In order for Rwanda to compete in an increasingly competitive global economy and open trading system, it must build and acquire appropriate science-, technology-, and innovation-related entrepreneurial, engineering, and technical/vocational capacity to produce more value added goods and services.

The Government of Rwanda with the support of key donors embarked on a two-stage SETI capacity-building program. The first stage involved assembling teams of Rwandan and international experts to prepare a series of SETI capacity-building needs assessments and action plans. This stage is expected to be followed by a second stage, in which the Bank and donors finance the implementation of the recommendations in the needs assessments and action plans. Several broad principles for building SETI capacity emerged from these studies and related work; some of these principles are directly relevant for the development of a successful Industrial Policy, including:

1. SETI capacity building should focus on finding practical solutions to practical problems. Especially for small countries like Rwanda that are at an early stage of the development process, broad, unfocused efforts to build science in general are unlikely to have the desired developmental impact.
2. SETI capacity building is a cross-cutting issue with a direct impact on such diverse programs as private sector development, rural and agricultural development, e-Rwanda, infrastructure and sustainable energy development, and education, among others.
3. SETI capacity building is not only about scientists working in research laboratories. All levels of technology and skills—ranging from sophisticated scientists to engineers to technical and vocational workers—have to be developed, in the appropriate proportions and sequence.
4. SETI capacity building extends beyond research and development. It is about getting knowledge out of the laboratory and into the market. Therefore knowledge diffusion is a critical component of the capacity building process. Rwanda‘s private sector must have the marketing, management, and entrepreneurship capacity to utilize new and existing knowledge to produce higher-value-added, more knowledge-intensive goods and services.
5. Public–private partnerships are an essential aspect of SETI capacity building. The government of Rwanda has an indispensable role to play in supporting essential research, providing basic education, and creating an environment that will enable the private sector to create the jobs that will diversify the economy and generate wealth. However, government investments in science and education will not bear fruit unless government capacity-building programs are consistent with the needs and requirements of the private sector. Developing these programs in partnership with the private sector is the best way to ensure the required consistency.
6. There are potential advantages to being a latecomer. A latecomer such as Rwanda does not have to invent everything it needs. It can achieve significant results and solve many problems by adapting and using off-the-shelf technology. However, even this seemingly simple task will require significant investments in capacity building.
7. SETI capacity building extends beyond high tech. Producing high quality coffee, silk, and roses —as Rwanda expects to do— requires significant scientific, engineering, and technical capacity.

Source: Republic of Rwanda (2011)

Characteristics of merchandise exports

Governments are interested in setting up support programmes to enable firms to increase their export sales, given the positive impact that a surge in exports has on the economic growth and competitiveness of a country. Despite the recognized importance of micro-enterprises and SMEs, these still face major challenges today associated with business creation, survival and growth.

To visualize research and innovation as components of merchandise exports over time, Figure 17 shows the evolution between 1996 and 2012, percentage of manufactured exports as a percent merchandise exports against high-tech exports expressed as a percentage of all manufactured exports. Over the past two decades, the share of manufactured exports remained stable at between 2% and 24% of all merchandise exports. Likewise, the high-tech component of manufactured exports remained steady at between 0.6% and 27% of the total.

In 2013, the value of merchandise exports of Rwanda increased substantially by 22.7% to reach 620.5 million US$, while its merchandise imports increased slightly by 4.8% to reach 1 700 million US$. In 2013, 48.7% of Rwanda's merchandise exports went to developing countries outside the region, whereas 32.4% to other economies in sub-Saharan Africa and 17.8% to high-income economies[10].

Embedding domestic firms into global value chains has been identified as a key government priority to support export growth and diversification, bolster private sector development and leap-frog the various impediments that continue to hinder the contribution of the country's private sector. (Rep. of Rwanda, 2013a).

Rwanda has selected a set of strategic exports that include agricultural products such as tea, coffee, horticulture, hides and skins, and minerals in addition to tourism. Furthermore, success in export growth hinges on greater value addition and product diversification. Food exports, in particular, are contingent upon meeting required standards in quality control of processed food products and packaging.

The competitiveness of the country's industrial exports is however particularly challenged by its narrow domestic market and landlocked position, which renders transportation costs high. The Government of Rwanda is committed to a comprehensive privatisation policy to help reduce costs and prices and widen consumer choice, and for the state to play a strategic and catalyst role, ensuring that infrastructure, human resources and legal frameworks are geared towards stimulating economic activity and private sector investment.

Not only is such a development believed to be as conducive for sustainable economic growth, but it is also seen as important to the emergence of a vibrant middle class of entrepreneurs and to sustaining a climate of good governance. Although foreign direct investment is encouraged, a local-based business class is viewed as a crucial component of development. The non-monetized and informal share of the economy – where the majority of people work – constitutes almost 66% of the total economy; this indicates the scale of the challenge, which lies ahead, of formalising the economy.

10 Merchandise exports to high-income economies are the sum of merchandise exports from the reporting economy (in this case, Rwanda) to high-income economies, according to the World Bank classification of economies; these data are computed only if at least half of the economies in the partner country group had data.

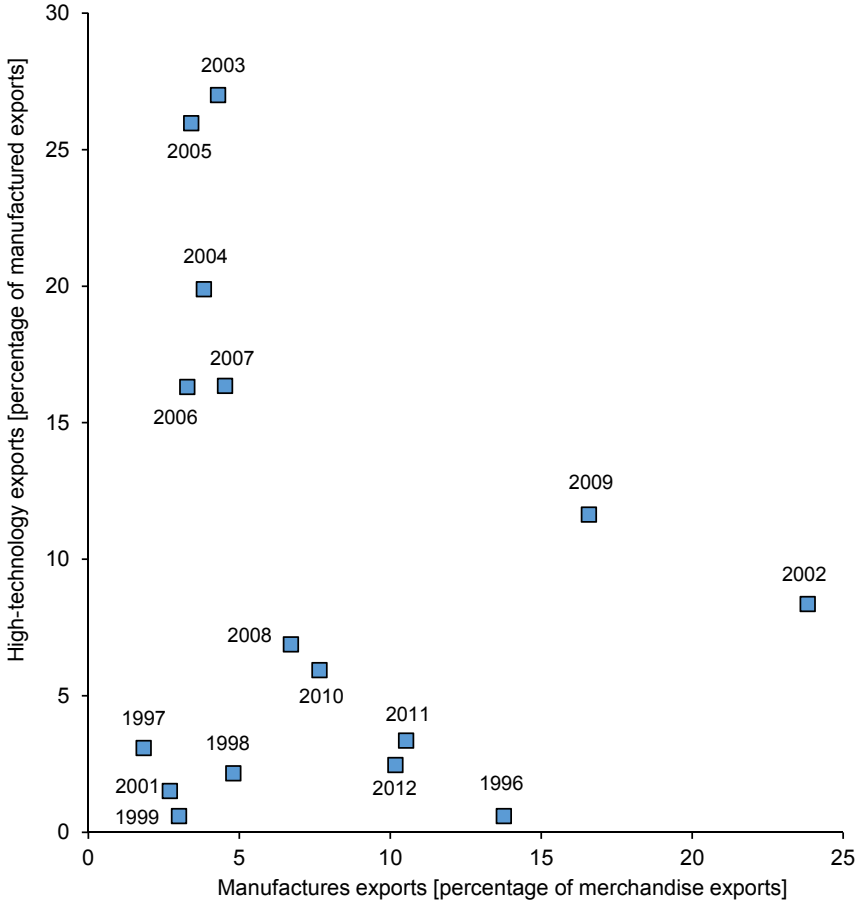


Figure 17: High-tech exports as a percentage of manufactured exports versus manufactured exports as a percentage of merchandise exports in Rwanda, 1998–2012. Source: UNESCO, based on raw data provided by World Bank

National integrated innovation framework

The Revised 2014 National Science, Technology and Innovation Policy of Rwanda proposed a *National Integrated Innovation Framework* with the purpose of creating linkages between policy, capacity and major issues, by using a cluster approach (Rep. of Rwanda, 2014d). The proposed approach will link not only the national policies to SETI projects, but also to external relationships with donor and international communities. The Government foresees that 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. For the Government, this dynamic creates a need for cluster approach to donors, and for strategic development of international partnerships to address the issues (Rep. of Rwanda, 2014d). The following Figure 18 shows the main nodes and connecting links of the proposed *National Integrated Innovation Framework*.

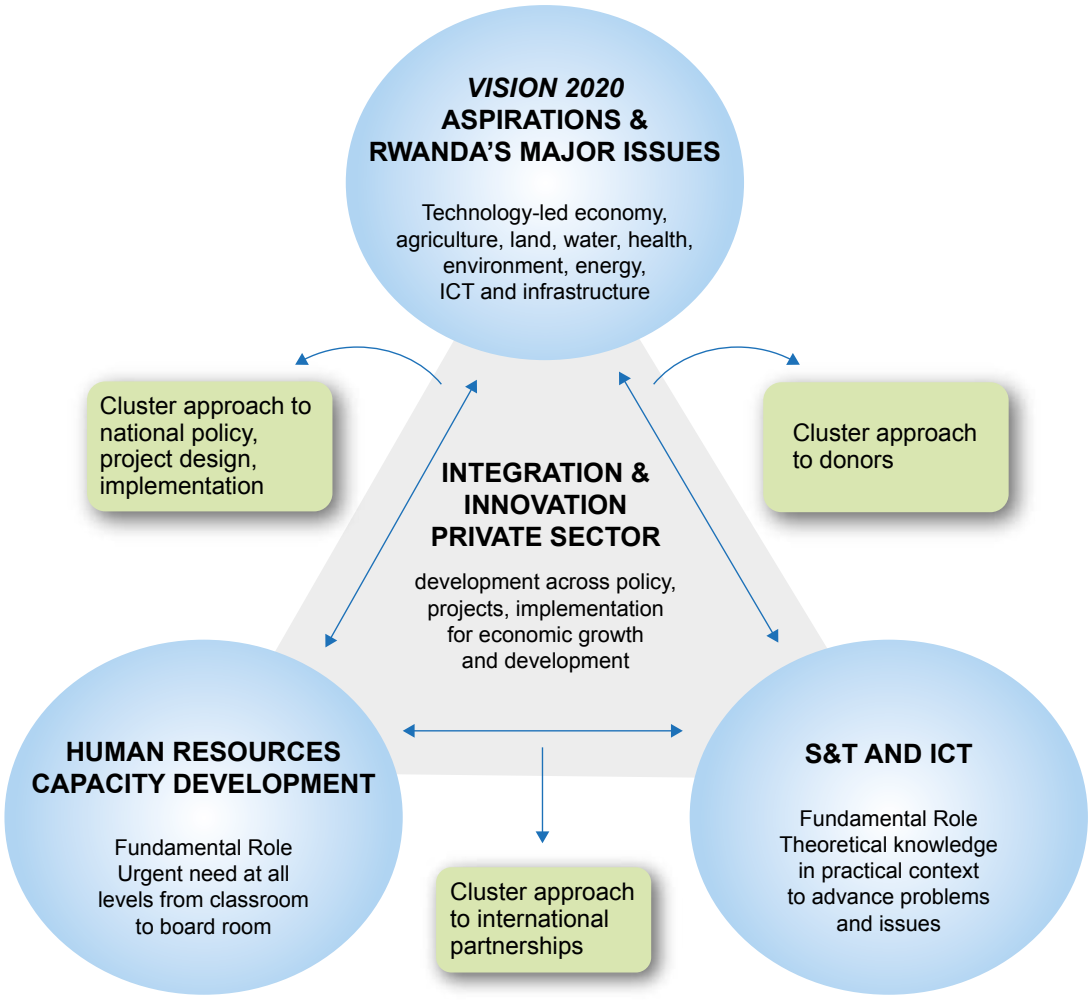


Figure 18: Overview of the National Integrated Innovation Framework. Source: Republic of Rwanda (2014e)

The framework incorporates three of the six pillars of *Vision 2020*, such as (see page 14): human resource development, development of entrepreneurship and private sector, and modernization of agriculture and animal husbandry. The Revised 2014 national Science, Technology and Innovation Policy recognized that the country still needs a suitable infrastructure and a comprehensive development in order to provide an appropriate knowledge and technology base for the different sectors of the country.

BOX 6 – THE RWANDA INNOVATION ENDOWMENT FUND (RIEF)

In 2010, the Government of Rwanda, through the Ministry of Education, in partnership with the UN in Rwanda, organized a meeting entitled: "Unlocking the Potential of Science, Technology and Innovation to achieve the Millennium Development Goals in Rwanda." The premise was that development policies that recognize and incorporate to the fullest extent possible science, technology and innovation will most profoundly impact the Millennium Development Goals (MDGs) and support the a subset of the priorities set out in the *Rwanda Vision 2020*. The meeting focused on a comprehensive review of what has been achieved, the challenges faced, and way forward in the application of STI in the sectors of Agriculture, Health, Environment, Energy, water and sanitation, ICT and Education. One specific outcome of the conference was a resolution to establish a Rwanda Innovation Endowment Fund (RIEF), similar to that being set up by the Economic Commission for Africa for the continent.

Two years after the above mentioned meeting, the RIEF was established by the Government of Rwanda, through the Ministry of Education in partnership with UNECA (SRO-EA & ISTD), and the official launch took place on 5th April 2012. RIEF is managed by the Ministry of Education through the Directorate of Science, Technology and Research (DSTR). The objective of this Fund is to stimulate economic transformation through R&D in innovative market-oriented products and processes in priority areas of the economy, thereby increasing prosperity and the competitiveness of the Rwandan economy. The orientation can be either for economic growth, social development or a combination of the two.

Following the official launch of the RIEF, a Management Team of the RIEF was established within the Ministry of Education chaired by the Director General for the Directorate of Science, Technology and Research (DSTR). The team includes DSTR staff from the R&D Unit supported by a 14 member Technical Advisory Committee, which was officially appointed by the Hon. Minster of Education. Ten members of this committee were drawn from within Rwanda and cover a wide spectrum of skills and expertise. These are backed by four members from outside Africa comprising members with extensive and proven experience in entrepreneurship, funding of innovative start-up projects as well as the link between R&D and innovation for development.

Building on the belief of the Government of Rwanda for economic development, as embodied in two documents namely, the *Vision 2020* and the National Science, Technology and Innovation Policy, RIEF focuses on the 13 priority areas as stated in the National STI Policy. For the initial phase called "proof of concept, (RIEF I)", the fund focused on three priority areas namely: Agriculture, Manufacturing and ICT. Following the success of RIEF I, it was decided to include Energy as the 4th priority area for the second round (RIEF II). The RIEF I was supported by seed funding from the Government of Rwanda and counterpart funding from UNECA. Further to this, National Awareness and Sensitization campaigns were held from September to October 2012 after which 370 applications were received from 29 districts. An assessment of concepts and full projects followed with the RIEF Management Team selecting only 8 innovations projects. The RIEF I Grant award ceremony took place on 2nd May 2013 and each successful project was awarded up to US$50 000 for a period of up to three years.

Judging from the success of RIEF I, the Government of Rwanda, through the Ministry of Education, decided to support the fund on full scale, thus calling for the second phase (RIEF II) which started in October 2013. Through RIEF II, 299 applications were received from 29 districts and the evaluation process has been conducted. It is expected that 6 successful projects will be awarded up to US$ 50 000 each, in February 2015.

Although the fund is open to applications from all Rwandans, preference is made to the following categories of people:

- Young graduates: Application led by a young graduate (as a guide, someone who graduated in the past five years) possibly leading a team whose member skills will include entrepreneurship / innovation, R&D, and business / marketing.
- The application can be made by an academic researcher possibly from a Higher Learning Institution (HLI) or a Research and Development Institution (R&DI) possibly leading a team whose member skills include entrepreneurship / innovation, R&D, and business / marketing.
- Regardless of the specific background of the applicant he/she/they must demonstrate the entrepreneurial inspiration to start the innovative business.

More details about RIEF can be found at: www.mineduc.gov.rw/rief

Marie Christine Gasingirwa
Director–General of Science, Technology and Research
Ministry of Education, Rwanda

AGRICULTURE SECTOR, SCIENCE AND TECHNOLOGY

Agriculture is the backbone of the Rwandan economy. In 2013, agriculture generated 35.8% of the GDP and employed over 80% of the population. While promotion of improved seeds and inorganic/organic fertiliser under EDPRS I increased the use of these inputs from a very low base, many farmers still do not use fertiliser and the application practices are not optimally carried out. (Rep. of Rwanda, 2013a). Agricultural research has been recognized as an engine for driving growth in the agricultural sector in Rwanda, and thus a critical tool in the fight against hunger and poverty.

Al-Ali (2014) considered that private sector should be encouraged to become deeply involved in the diffusion of these technologies; this can be done by the state applying incentives and specific policy instruments, including subsidies.

The Rwanda Agriculture Board's Research Directorate is responsible for overall coordination of countrywide agricultural research activities, and thus for influencing the adoption of technology to achieve sustainable agriculture development.

Prior to July 2011, the Rwanda Agricultural Research Institute (ISAR) was mandated to conduct scientific and technical R&D for agricultural and animal resources in Rwanda, aiming to improve the livelihoods of low-income farmers. The institute carried out research and promoted technologies in crop production, livestock, forestry, agroforestry, post-harvest management, land conservation and water management.

Now, in the Rwanda Agriculture Board, research continues to be implemented in these areas, with stronger links between research and extension services to ensure that developed technologies are disseminated to the end users. The Rwanda Agriculture Board is also specifically committed to intensify research to achieve efficient, effective and sustainable agriculture production systems in crop cultivation and animal husbandry.

Research activities have consistently aimed to contribute towards the improvement of food security. Gahakwa *et al*. (2014) showed that during the last decade, agricultural research in Rwanda played a key role in raising the nutritional levels of the Rwandan population and guaranteeing food security to the nation. In particular, the development and release of new, improved high yielding varieties in priority crops have helped to support the Crop Intensification Programme.

Agriculture research, technology, knowledge and skills are keys to improving productivity. Currently, the outreach of advisory services is not effective in Rwanda. It is estimated that only 32% of households receive information through this channel. Poor quality of delivery and/or information is a further constraint.

The capacity of the Animal Production Program to support the *Girinka* policy (one cow per poor family) through improved breeds, nutrition and health has been established. However, several challenges still need to be overcome, particularly the effective and timely transfer of technologies to end users. It is envisioned that ensuring that research is linked to extension services and dissemination of knowhow will accelerate technology transfer and uptake (Gahakwa *et al.*, 2014).

Some of the major research areas that received support in recent years were: (1) development and dissemination of improved crop varieties, (2) crop protection; (3) genetic resource conservation, (4) animal genetic improvement, (5) animal nutrition, (6) animal health, (7) soil and water management, (8) integrated soil fertility management, (9) improved agricultural productivity through fertilizer use and biological nitrogen fixation, (10) forestry and agro-forestry research, and (11) biotechnology (Gahakwa *et al.*, 2014).

The lack of local postgraduate programmes in agriculture sciences was strong barrier for the creation and expansion of agriculture researchers. To address this issue, all Rwanda's public universities were merged into the newly established University of Rwanda in September 2013, and PhD programmes in the areas of soil management and agroforestry have been established (Rahija and Gatete, 2014). At the higher education level, agriculture R&D activities are now conducted under the College of Agriculture, Animal Sciences and Veterinary Medicine.

Agricultural research has undergone a radical paradigm shift over the years, moving away from traditional research that extended processes linearly, and moving toward an Integrated Agricultural Research for Development (IAR4D) approach, based on innovation platforms. In IAR4D, stakeholders (farmers, scientists, traders, local authorities, NGOs and the private sector) are increasingly involved in research, from priority setting to technology development and technology transfer. IAR4D involves demand-driven research, and uses the organizational capacities of multiple stakeholders. The innovation platform is a key element, to select and test agricultural innovations.

Ngaboyisonga *et al.*, (2014) conducted a study in which stakeholders first identified and ranked constraints on agricultural production along the value chain, in their respective sites and contexts. Two or three main constraints were then translated into research questions. The aim became to generate practical solutions for productivity and marketing, while conserving natural resources. The researcher proposed a package of innovations; each stakeholder was assigned a role in testing, disseminating, and adopting each of them. A research agenda based on beneficiaries' demand, targeting value addition and income generation, was thus elaborated and implemented.

Because such an innovation platform proposed balancing profits and contributions, it was considered more attractive and sustainable than a traditional field research approach. Furthermore working together towards a common interest enhanced national policies and built new and strong relationships among stakeholders. The study showed that small-scale farmers increased their income and were able to improve their livelihoods (building new houses, paying school fees for their children), while collaborating with research institutions, so as to address agricultural R&D demand.

Table 13: Major constraints, enterprise focus, and quick win–win options in Rwandan agricultural Innovation Platforms

Characteristics	Mudende	Rwerere	Gataraga	Remera
Constraints	Lack of markets for farm produce especially for milk and potato Insufficient improved varieties of crops and fodder species	Insufficient options of sources of income Poor market access, lack of markets	Limited markets for farm produces Especially for potato and maize Low quality of marketable farm produce Insufficient of improved and marketable varieties	Lack and inaccessibility to markets Low quality value of marketable produce Insufficient improved and marketable varieties
Vision	Food security, increased productivity And profits	Food security and enough money to acquire all basic needs	Increased productivity leading to increased incomes and food security	Food security and income to satisfy basic needs
Enterprise focus	Milk/Irish potato	Chili pepper, passion fruit, milk	Irish potato/maize	Bean, maize
Quick-win options	Organize milk market to target Inyange dairy	Introduction of chili and passion fruit cropping to target Urwibutso	Establishing market outlets for potato production, adding value to potato produce	Organize bean and maize markets
Implementing partners*	ISAR (presently RAB), CIAT, Imbaraga, NUR, ISAE, MAK, SAC-R	Urwibutso, ISAR (presently RAB), CIAT, Imbaraga, NUR, ISAE, MAK, ANS-R, SAC-R	ISAR (presently RAB), CIAT Urugaga Imbaraga NUR, ISAE, MAK	Urwibutso, ISAR (presently RAB), CIAT, Urugaga Imbaraga, NUR, ISAE, ANS-R, SAC-R
Other partners Core	Innovation Platform members, BRD, Sector Executive Secretary, Milk collectors	Core Innovation Platform members, Banque Populaire, Sector Executive Secretary	Core Innovation Platform members, Input traders, Supermarkets and restaurants, Sector Executive Secretary	Core Innovation Platform members, Sector Executive Secretary

* Note: ANS-R Action Nord Sud-Rwanda, BRD Banque Rwandaise de Développement, CIAT International Center for Tropical Agriculture, ISAE Institut Supérieur de l'Agriculture et de l'Elevage, ISAR Institut des Sciences Agronomiques du Rwanda, MAK Makerere University, NUR National University of Rwanda, RAB Rwanda Agriculture Board, SAC-R Send-a-Cow-Rwanda

Source: Ngaboyisonga *et al.* (2014)

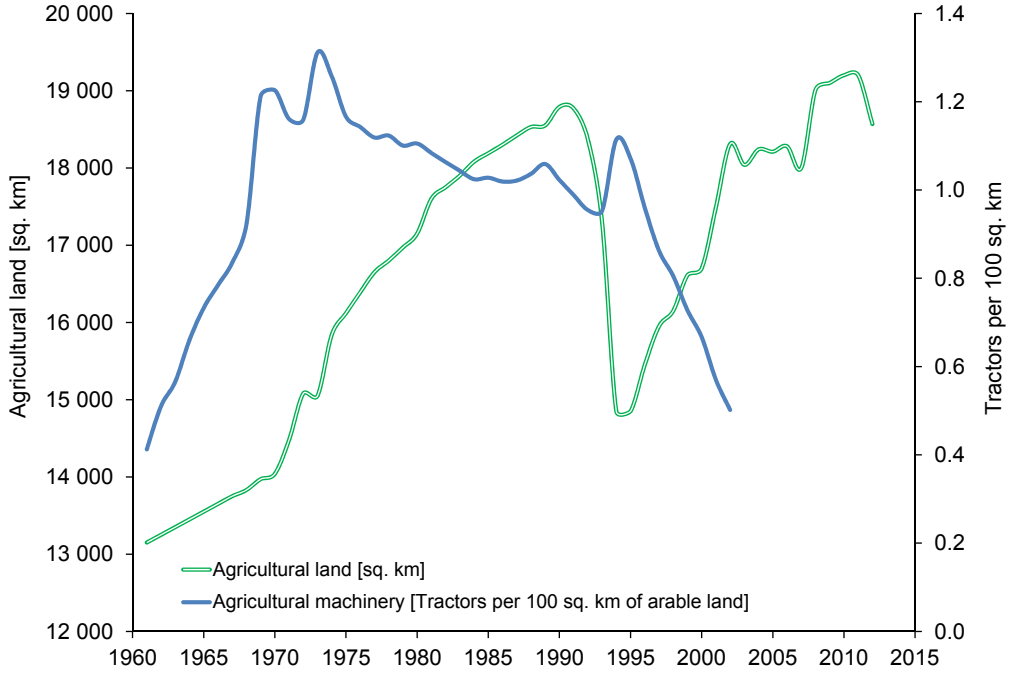


Figure 19: Evolution of the agriculture land and number of tractors per 100 sq. km, 1960–2013. Source: UNESCO based on raw data provided by World Bank

Ngaboyisonga *et al.*, (2014) concluded that following the IAF4D principles resulted in agricultural options that were quickly adopted, applied in a very short period, and profitable to all stakeholders along the value chain. The study also identified constraints to agricultural innovation platforms (see Table 13).

After the Genocide, for over a decade, agricultural productivity declined, 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 underuse of modern inputs, and weak research and extension services. Most of the agricultural sector was composed of fairly unproductive subsistence farming carried out on small plots located on steep slopes, with no protection against erosion, with rudimentary cropping practices and with insufficient inputs of fertilizing elements to compensate for those removed by crops.

The EDPRS II considered that Rwandan agriculture should move from a largely subsistence base, to a commercialised base, which can build on comparative advantages. The document established the requirement of technical and value chain expertise, which can generate high levels of income per hectare. The level of technology used in the agriculture system is still low compared with international standards. For example Figure 19, shows the increase in arable land over time (1960–2013) as well as the number of tractors per 100 km2 of arable land. Since 1973, the number of tractors per area of arable land decreased. Within EDPRS II there is no explicit strategy to improve productivity through developing special policy instruments to increase the mechanization of the agriculture system.

The Ministry of Agriculture and Animal Resources has developed an Agriculture Gender Strategy (Rep. of Rwanda, 2010b) because they detected limited availability of research on gender-sensitive technologies. Research institutions in Rwanda rarely focus on developing gender sensitive technologies. Women in agriculture often find themselves with technologies that are not adapted to their needs; for example, sizes of some agricultural machines are too big for women. Their practical needs are also not given research priority; for example, women and girls may most benefit from innovations that improve energy efficiency, access to clean water, proximity of water sources, nutrition, food processing and storage. Since 2010, the Government of Rwanda has been promoting R&D activities to fulfil these requirements, with greater sensitivity to how gender can impact the research agenda.

BOX 7 – HIGH SOCIO-ECONOMIC IMPACTS FROM INNOVATIONS AND TECHNOLOGY TRANSFERS PROMOTED BY THE UNIVERSITY OF RWANDA

Universities contributed to significant socio-economic impacts through R&D. Three examples are:

Quality coffee

Before the Rwandan civil war of the early 1990s, coffee was the biggest foreign currency earner for Rwanda accounting for 70% of all exports; it was produced by nearly half a million small landholders, on approximately 37 000 hectares of land. Coffee production was affected by the war; it dropped from 35 000 tonnes in 1992 to 15 000 tonnes in 1999 because farmers abandoned their coffee plantations. To make matters worse, in 1999, world market coffee prices dropped to below those of 1990. As a result, Rwandan farmers lacked incentives to maintain coffee production. Post-war and post-Genocide, the nation frantically sought rapid economic growth. In particular, the government of Rwanda sought to (i) increase government revenue from foreign earnings and (ii) increase income for its citizens, the majority of whom are still small-holder farmers. It was understood that Rwanda will not achieve mass production, meaning that coffee or any other export crop will continue to be grown on small plantations. The US government provided financial and technical assistance to support the transition.

In this endeavour, the Government of Rwanda approached the Faculty of Agriculture of the National University of Rwanda to assist in looking for solutions. In 1999, they started a project to build capacity in the university to foster Rwanda's potential agricultural exports, and to look for options to drastically improve incomes of rural villagers. The project, supported by the United States Agency for International Development (USAID), conducted a study, which revealed that coffee could provide some solutions. It was established that there was a growing market in the US, Europe and Japan for high quality coffees. Such coffees are grown in high altitude areas and on small plantations. Also the project established that Rwanda's Bourbon Arabica coffee is suitable for high quality coffee production and the country altitude was suitable. A study followed to improve the quality of coffees was introduced in 2000. Rwanda has since become a producer of high quality specialty coffee, and its coffee is marketed by prominent coffee roasters and importers in the United States, Europe, and Japan. Rwandan farmers have significantly increased their earnings (more than four fold), and more than 5 000 jobs have been created. The Cup of Excellence was held in Rwanda in 2009, to recognize quality coffees. More innovations have resulted in improvements to the taste and quality of coffees across the country. At the level of the University, more than 10 theses have been presented.

Biogas programme

In order to fulfil one of its core mandates, the Kigali Institute of Science and Technology (KIST) sought solutions to some issues the government had identified. After the Genocide, Rwanda prisons were filled with more than 10 000 people who had committed genocide crimes. Forests were disappearing because trees were harvested to provide fuel to the prisons. A study conducted by KIST Centre for Innovation and Technology Transfer (CITT) established that toilet waste from the huge number of prisoners could be a used to produce biogas for cooking and electricity generation. KIST-CITT introduced a Biogas project to alleviate the deforestation problem. It installed large-scale biogas plants in prisons. The plants are used to treat toilet wastes and generate biogas for cooking. The bio-effluent is used as fertiliser for production of crops and trees. Starting with one biogas plant in 2001, now they are in all 14 prisons. Annual expenditure on firewood has dropped from US$1.7 Million to US$255 000. In addition, the government has introduced a National Domestic Biogas Programme for cooking and lighting at household level, and invested in vocational skills development. These activities also created new jobs. The programme is linked to the National Program of One Cow per Poor Household.

Ban on plastic bags

An academic staff of the National University of Rwanda undertook a study on the negative impact of plastic bags. This was a study conducted in completion of a PhD thesis in Environmental Economics. The study established that plastic bags have an overwhelmingly negative impact on the Rwandan economy, environment and on public health. The scattering of plastic bags prevents water penetration into the soil thereby leads to lower agricultural productivity. The bags clog drainage systems and lead to floods during the rainy season. They are frequently burned, releasing toxic fumes in the air, thus causing increase in respiratory and other related diseases. The researchers (as part of dissemination plan of his research findings) organized stakeholders' dissemination meetings. The Rwanda Environment Management Agency picked it up. This resulted in the Government of Rwanda banning plastic bags. Since the ban, Rwanda has implemented many innovations including the local manufacture of reusable bags, and positive impacts are being recorded. Numerous studies, theses and journal/ conference articles have since been prepared.

Inadequate intellectual property rights mechanisms prevent universities and researchers from collecting fees related to their inventions, which unfortunately limits the injection of new funding for further R&D and innovation.

Verdiana Grace Masanja
University Level Research and Postgraduate Studies Unit, University of Rwanda

INFORMATION AND COMMUNICATION TECHNOLOGIES: A NEW DRIVER FOR RWANDA'S ECONOMY

Rwanda's National Information and Communications Infrastructure (NICI) Plan commenced in 1998 with the first phase concentrated on a comprehensive ICT-led Integrated Socio-Economic Development Framework. This was followed by the development of an Integrated ICT-led Integrated Socio-economic Policy for Rwanda in 2000, aimed at facilitating the country's transformation into an information-rich, knowledge-based society and economy within twenty years (Rep. of Rwanda, 2000).

The third phase of the NICI plan, which covers the period 2011–2015, builds on the two previous phases to accelerate Rwanda to the final phase of the NICI process. In this phase, emphasis has been placed on service development across five focus areas: (1) e-Government, (2) community development, (3) private sector development, (4) cyber security, and (5) skills development.

Rwanda's Policy of Science, Technology and Innovation[11] (Rep. of Rwanda, 2006) considered that the focus the STI policy on ICT should be applied to information technology, especially in the fields of intelligence systems and decision-making. According to the 2005 STI policy, the use and integration of science and computer literacy should be promoted and popularised in schools and in workplaces. Training efforts should be intensified especially in technical and scientific fields in order to advance absorption and understanding of the technologies. These initiatives influence Rwanda's local capacity to use, adapt, apply and introduce new programmes, products and services.

Recently, the EDPRS II proposed improving private sector efficiency through accelerated technological innovation. This strategy proposed that deployment for last-mile connectivity (to access the internet) be accomplished through a public-private partnership framework, to ensure that businesses can get access to high-speed internet at low cost. The proposed scheme fosters and creates some business opportunities by outsourcing of government ICT-related support work, by building new infrastructure, and by promoting and facilitating services developed by the ICT private sector (Rep. of Rwanda, 2013a).

The EDPRS II added a complementary area of focus: improving ICT Skills. This will build ICT professional skills and leverage ICTs in education in order to accelerate skills development. The scope of the skills development is twofold: first, build ICT professional skills that will increase innovation in the ICT industry and enable all sectors of the economy; and second, to leverage ICTs in education. For schools, the Ministry of Youth and ICT will ensure that all schools are connected to ICT infrastructure, that technical support is available, and that teachers are trained in basic ICT skills.

Currently, strategic national ICT projects are implemented and managed by the ICT Department in the Rwanda Development Board. However, the Rwanda Information Society Agency (RISA) is the proposed new structure for the governance, management and delivery of the goals and objectives of the new national ICT strategy, the SMART[12] Rwanda Master Plan 2015–2020 (Rep. of Rwanda, 2014b). The objectives are to bring about increased accountability and transparency; to reduce duplication, and to place greater emphasis on performance in order to bring about the desired efficiencies, improve effectiveness, and increase return on investment. The key deliverables of the new SMART Rwanda Master Plan are:

1. *24-hour self-service government:* all government services will be online by 2018.
2. *Cashless and paperless government:* all government financial transactions will be made electronically and via mobile devices by 2018.
3. *Over US$50 million saved through efficiency gains:* savings through outsourcing and reduction of future wage bill by foregoing recruitment of additional Government of Rwanda ICT staff.

11 The 2014 revised version of the Policy Science, Technology and Innovation includes ICT as one of the sector priorities.
12 SMART: **S**ervice-oriented, **M**odern, **A**ccountable and **R**eal-**T**ime.

4. *Almost US$1 billion value of opportunities for the private sector:* this is the approximate value of projects to be implemented by SMART Rwanda Master Plan, mostly through the public-private partnership model.

5. *SMART Rwanda contributes 10% to GDP:* broadband access and other ICT infrastructure projects offer a platform for economic growth.

6. *Close to 100 000 jobs are created by investment due to the SMART Rwanda Master Plan:* foster an enabling environment for private investments to drive job creation, productivity and competitiveness supported by technology and innovation.

The successful policies implemented in Rwanda have enabled the number of telecom network operators to increase from 1 in 2005 to 3 in 2013. ICT composite network coverage increased from 75% to 90% during the same period.

Rwanda is currently collaborating with institutions such as the Massachusetts Institute of Technology and Carnegie Melon University to upgrade the capacity of ICT instruction and develop critical ICT skills to support the country's contribution to ICT global value chains. In 2013, the government of Rwanda and Korea Telecom agreed on a joint venture to, among other things, deploy and operate a high-speed 4G broadband network, which will cover 95% of the population and expand the country's online services capability. A subsequent joint venture was agreed between government of Rwanda and Korea Telecom in 2014 to expand the nation's capabilities to undertake an unlimited range of online economic and social activities. These partnerships will allow Rwanda to explore niches in ICT-enabled high-value shared services, in the financial sector and in business process outsourcing, for examples. Rwanda announced the completion of the nationwide 2 300 kilometre fiber-optic cable in early 2011. The cable, which covers the entire country, connects with the Seacom undersea cable along the east coast of Africa and has seven regional links to neighbouring countries.

Figure 20 presents the evolution of internet users per 100 inhabitants between 1995 and 2013 and Figure 21 shows the trend of mobile cellular subscriptions per 100 inhabitants, between 1998 and 2013. In both cases, the curves lift off after 2005.

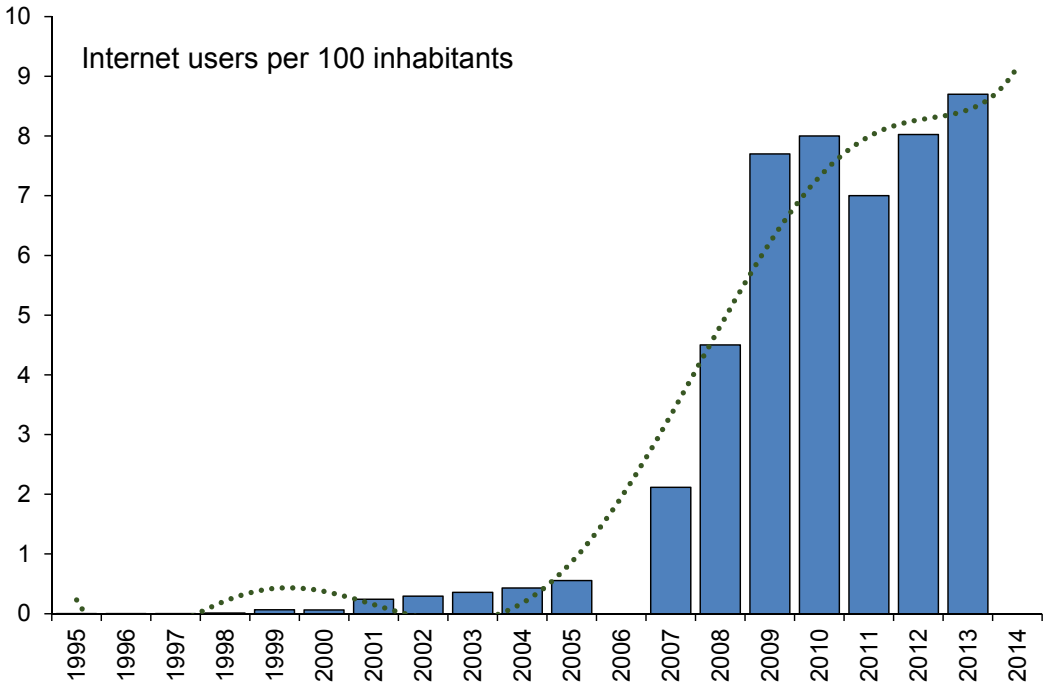


Figure 20: Evolution of internet users per 100 inhabitants, 1995–2013. Source: UNESCO, based on raw data provided by the International Telecommunications Union

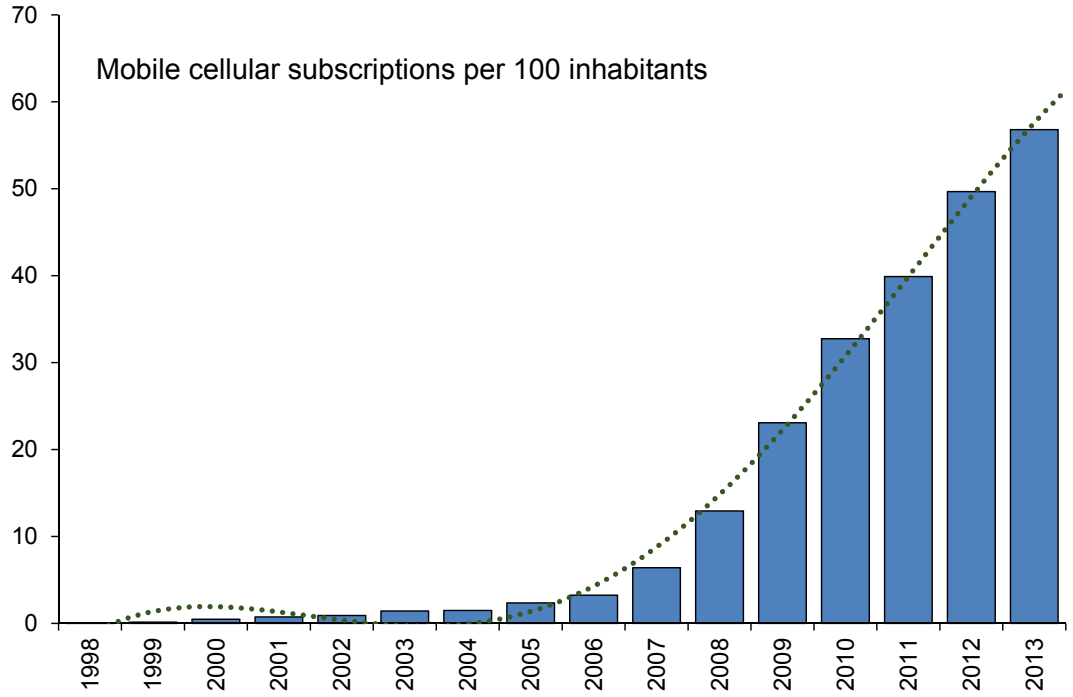


Figure 21: Evolution of mobile cellular subscriptions per 100 inhabitants, 1998–2013. Source: UNESCO, based on raw data provided by the International Telecommunications Union

The *SMART Rwanda Master Plan 2015–2020* (Rep. of Rwanda, 2014b) identified a series of very ambitious goals to promote innovation in the private sector. In each case, at least one project was proposed, such as:

To cultivate new local ICT enterprises: in order to cultivate new local ICT enterprises in the future, the proposed project will seek to identify technically innovative and entrepreneurial talent from the earliest education level, primary school and then to track that through high school to college, university and beyond. The goals will be: to establish 100 innovation studios in primary and high schools; have 200 supported new projects in universities, colleges; 1000 students placed in world class technology universities; and US$ 100 million invested by new venture funds to support the tech entrepreneurs .

To grow existing endogenous ICT companies: in order to facilitate existing endogenous companies in their competitiveness and help them growth to become global players, a competitiveness index project is proposed. It will look at the investment readiness of indigenous companies, under a flagship project Rwanda ICT Business Investment Readiness Index. Goals will be: 50 stock market list-able companies; 100 indigenous companies with market capitalization of US$ 100 million; US$ 10 million in new annual local investments, and 10 000 advanced technology-jobs created.

To Improve business and industry productivity and efficiency: ICT's contribution to economic development can come in three broad categories both to private and public organizations: (i) reducing costs, (ii) Improving service delivery and (iii) creating new revenue streams. A project will aim to assess ICT's added value to business and industry, and to track it, in order to maximize it. Goals will be: 500 000 farmers trained and tracked to assess ICT-impact on their business; 500 000 businesses using ICT in their business; and 1 000 000 new ICT jobs.

To expand exports and foreign direct investment: in order to expand private sector ICT exports and foreign direct investments in relation to local ICT businesses, a project will seek to expand ICT export potential and attractiveness for foreign direct investment. Goals will be: US$ 100 million in new export revenue; 50 exporting companies; US$ 1 billion in operational foreign direct investments; and 100 000 export-related jobs created.

SUPPLY AND DEMAND OF SKILLED LABOUR IN RWANDA

Over the past two decades in Rwanda, some progress in the areas of education and skills development has been made. However, significant barriers still remain, and it is challenging to match skills with opportunities in the labour market (Rep. of Rwanda, 2013c).

In order to address the critical skills scarcity, the government designed a five-year program for skills development to deliver EDPRS II (2013–2018) in the following high priority sectors: (i) infrastructure; (ii) agriculture; (iii) natural resources; (iv) investment, trade and industry; (v) ICT; (vi) health and (vii) education.

In spite of the crosscutting nature of SETI activities, within this selection process, science and engineering were not identified as a priority. *Rwanda Vision 2020* foresees a knowledge economy in the country by year 2020. The emerging knowledge societies (i.e. Brazil, China, Malaysia, etc.) usually need a threshold of 1 000 or 1 200 full time equivalent (FTE) scientific researchers per million inhabitants, to trigger the transformation of the country into a knowledge economy. Developed countries have more than 5 000/6 000 FTE researchers per million inhabitants.

Recent estimations show that Rwanda has less than 40 FTE researchers per million inhabitants (see pages 86–89), an amount 30 times smaller than the critical mass needed to trigger a knowledge economy, which is also equivalent to 125/150 times smaller than the number of FTE researchers per million inhabitants that a developed country has.

Developing quality, adequately skilled human resources is—for EDPRS II—the key towards achieving desired levels of economic growth; reducing the rate of poverty; achieving economic transformation and rural development; improving productivity, youth employment, and accountable governance.

In order to implement the five-year program for skills development, the following policy actions have been taken (Rep. of Rwanda, 2013c):

- put in place a National Capacity Building Secretariat (NCBS) to coordinate implementation of Capacity Building activities in the public, private sectors and civil society to mitigate overlaps and duplication of effort;
- establish a high level National Steering Committee to oversee the implementation of the five year program for skills development in priority sectors;
- put in place a mechanism for private sector investment in priority skills development;
- prioritize scholarships for high flyers in priority sectors;
- securing fees waivers from reputable training providers in priority areas;
- initiate twinning arrangements and partnerships between local institutions and international /regional institutions with priority for acquiring skills, best practices and knowledge management;
- put in place a National Commission for Science and Technology (see pages 150–151) in collaboration with relevant institutions, to monitor the progress and performance of Rwandans undergoing training in areas of science and technology; and advise the government on strategic and relevant placement of trainees in areas of science and technology;
- strengthen the operations of the labour market, specifically by improving information systems to ensure an overarching and long-term perspective;
- put in place a national qualification and competency framework;

- prepare an annual sector capacity-building plan that is based on needs assessment conducted every five years;
- establish technology and business incubation facilities in the SETI oriented institutions of higher education in Rwanda;
- empower national training institutions to effectively offer courses in both priority skills and specialised skills;
- create national centres of excellence, and decentralize academic faculties in priority skills.

Figure 22 shows the required skills by graduation level (i.e. ISCED level 6, 7 and 8; see Glossary, pages 252–253) and the number of technicians, artisans and international certification[13]. The Ministry of Public Service and Labour estimated that the education sector requires 96% of the projected number of new PhDs (2013–2018). The requirement of new masters has the following distribution: investment, trade and industry (36%); education (25%); natural resources (18%) and health (21%). The ICT sector requires 92% of the graduates with professional and international certification, the infrastructure sector 65% of the TVET technicians and the agriculture sector 65% of the artisans.

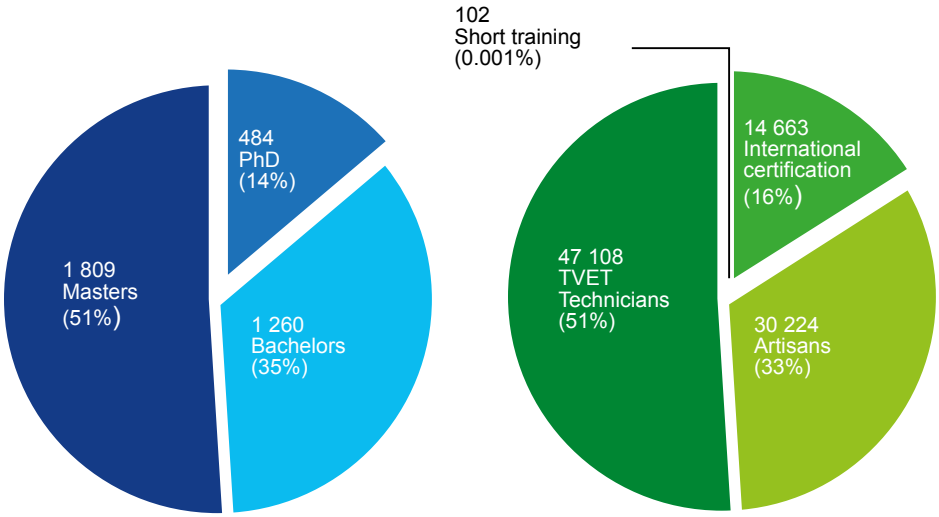


Figure 22: Required number of skills in Rwanda, 2013–2018. Source: Rep. of Rwanda (2013c)

The Government of Rwanda envisages big projects to be undertaken within the next five years including: construction of a railway line, energy generation and gas methane projects, booming industry and private investments; construction of new roads; irrigation infrastructures and new mines; and expanded ICT exploitation.

The government recognizes the need of engineers and technicians to facilitate the projected operations. This is the reason why the capacity building for these sectors will foresees a set of strategies, such as: (a) coordinate with the University of Rwanda to provide programmes related to the critical and scarce skills in priority sectors; (b) expand the capacities of TVET institutions with the support of private investors; (c) put in place an Aviation Training Centre to enhance air traffic service and airport operations; (d) identify top innovative and hardworking graduates and take them abroad for graduate programmes and industrial detachments in specialized careers; among others.

13 According to the Rwanda Qualification Framework for Higher Education, in Rwanda there are only seven education levels instead of the eight levels proposed by ISCED's new classification. See http://www.hec.gov.rw/IMG/pdf/Rwanda_National_Qualifications_Framework_for_Higher_Education_Institutions-2.pdf

The government is exploring the possibility of piloting a Regional Centre of Excellence for training in one region's university, or a collaborative programme by several universities from the region. This approach shall tap into capabilities of universities that already have some of the core department related to Country priority sectors. Some plan have been developed in this direction with the support of the World Bank (see pages 82–83).

There are also plans for setting standards and guidelines for researchers, engineers and technicians career path progression. These proposals originally started in the late seventies when some regulations were introduced to complete the harmonization of the status of all researchers in Rwanda with those of scientists-teachers of the University (Morand, 1981, 1984). These discussions took into consideration the *Recommendation on the Status of Scientific Researchers* adopted by UNESCO Member States during the General Conference held in 1974 (UNESCO, 1974b).

EDUCATION PROFILE AND HUMAN CAPITAL FOR SCIENCE AND ENGINEERING

Investment in human capital via education is a major tool for sustainable development. Education is recognized the world over as a fundamental and universal human right and a prerequisite for economic growth, human development and poverty reduction. It enables the population to make informed decisions about its economic, social and political well-being. Education is important for protecting children from exploitative labour practices and is the most empowering tool for gender equality and equity.

The education sector is uniquely responsible for promoting and raising high-qualify human resources for critical areas such as SETI, which are commonly seen as dominant factors behind rapid economic and industrial growth and for improving quality of life. *Rwanda Vision 2020*, its National Policy on Science, Technology and Innovation, and the EDPRS II are all based on the premise that, through embarking on a concerted effort to build SETI capacity, Rwanda will greatly enhance its prospects of achieving the growth, poverty reduction, wealth creation and export diversification objectives.

The education strategies in Rwanda are shaped by a number of national aspirations and international goals embodied in policy declarations and plans. These include *Rwanda Vision 2020* and Seven-Year Government Programme, the priorities of the EDPRS II, the Millennium Development Goals and Education for All Goals. There are also regional commitments made as part of Rwanda's membership of the East African Community (Rep. of Rwanda, 2013b).

During the past decade, the Government of Rwanda have been releasing a number of sub-sector policies in education. These policies include: (1) 2008 Girls Education Policy, (2) 2008 Higher Education Policy, (3) 2008 Quality Standards in Education, (4) 2008 Special Needs Education Policy, (5) 2008 and 2014 ICT in Education Policy, (6) 2008 Technical and Vocational Education and Training (TVET) Policy, (7) 2011 Teacher Development and Management Policy, (8) 2011 Early Childhood Development Policy and Strategic Plan, (9) Youth and Adult Literacy Strategic Plan (awaiting approval), (10) School Health Policy (in development), (11) Draft Policy on Teacher Incentives (in development), (12) 2005 and 2014 National Science, Technology and Innovation Policy.

In addition to these policies, the following strategic plans were also developed: (a) 2008 Nine-Year Basic Education Strategy, 2008–2012 Draft Strategic Plan for Technical Education and 2009 Draft Higher Education Strategic Plan.

The structure of Rwandan education system

In Rwanda, the education system is composed of four main levels: (i) pre-primary, (ii) primary, (iii) secondary, and (iv) higher education, with a significant technical vocational education and training (TVET) stream at both secondary and higher education levels. In addition, there is non-formal education, or Adult Basic Education (ABE) as it is now more commonly referred to. Compulsory education spans the nine years from age 7 to age 15, covering primary and lower secondary education, and is commonly known as Nine Years Basic Education (9YBE).

Pre-primary education is organised in nursery schools and for a period of three years for children between the age of 4 and 6. Primary education lasts six years with the official school age at this level being from 7 years to 12 years. This stage focuses on core literacy and numeracy skills, as well as preparation for secondary studies. Primary education ends with national examinations, which determine eligibility for proceeding to Lower Secondary school.

Secondary education also lasts for 6 years with the official age for this level being from 13 years to 18 years of age. It is subdivided into lower secondary (the first three years) and upper secondary (the last three years), both culminating in national examinations which respectively determine eligibility for upper secondary, and secondary graduation or entry to higher education. At upper secondary level students choose between continuing in general secondary schools, or enrolling in a Technical Secondary School or a Teacher Training Colleges to train as a primary teacher.

Technical and Vocational Education and Training (TVET) provides young people and the unemployed with the skills to gain productive employment and also provides those already in employment with an opportunity to upgrade their skills, including entrepreneurs and those wishing to work for themselves. TVET is delivered through the Technical Secondary Schools, Vocational Training Centres and Integrated Polytechnic Regional Centres.

Higher education students can pursue their studies in a range of academic directions or opt to enter an array of technical or vocational fields. Undergraduate degrees currently require four years to complete, though the option of reducing this to three years in order to harmonise with the rest of the region is being explored.

One of the most important objectives of the National Science, Technology and Innovation Policy (Rep. of Rwanda, 2006, 2014d) is the promotion of knowledge acquisition. The policy proposes different types of interventions according to the different education levels, from primary schools to higher education. The following Figure 23 shows a brief description of different objectives and proposed policy interventions.

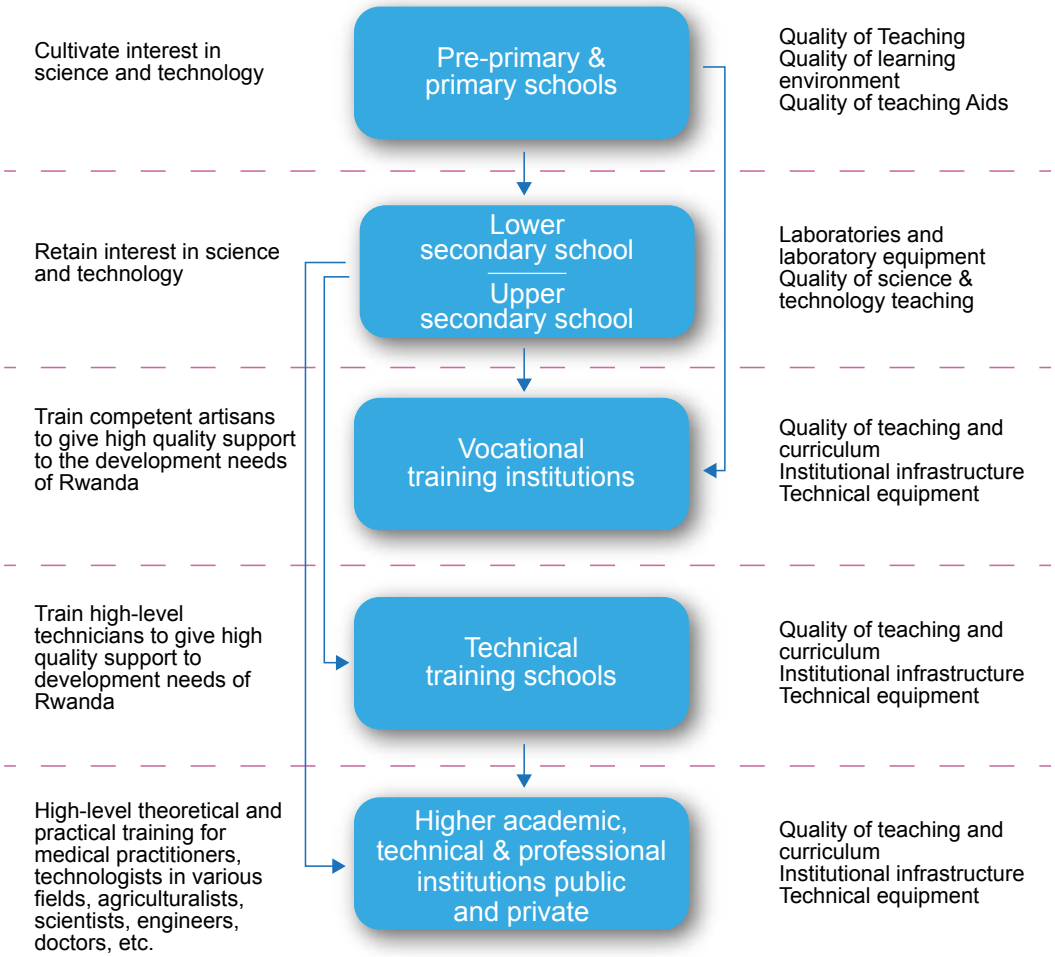


Figure 23: Objectives and interventions at all levels of science and technology education and training. Source: Republic of Rwanda (2014d)

Primary education

Rwanda has made impressive strides since 2000 in extending access to basic education to as many of its children as possible. The challenge going forward is to target the hardest-to-reach to ensure that all children of the official primary age group are accessing schooling (Rep. of Rwanda, 2013b).

Since the introduction of 9 years basic education in 2009, primary education in Rwanda is fee-free. Since 2011, there has been an expansion to 12 years basic education. This has positively impacted on increasing the number of enrolled pupils in this part of the education system (Rep. of Rwanda, 2014c).

Table 14 shows a list with the most relevant indicators on primary education in Rwanda (2008–2013). The number of pupils, teachers and schools increased over the considered period. However, the number of classrooms decreased, which implies that the number of pupils per classroom increased. The number of students per teacher is still very high.

The achievements in the area of strengthened performance in SETI in primary education include (Rep. of Rwanda, 2014c):

- the total number of laptops in primary schools increased from 226 500 in 2012/13 to 269 478 in 2013/14. As the original target was 245 756 laptops, the Ministry of Education has surpassed not only that target, but has also gone beyond the 2014/15 target of 259,252 laptops; an increase of 19% was achieved in only one year, as compared to the targeted 8.50% increase planned for two years.
- the share of primary schools with internet connectivity was 4% in the fiscal year 2013/14. This value is lower than the projected target (6.9%). This implies that more effort needs to extend internet connectivity, especially in view of the 2014/15 target of 7.7%.
- the percentage of primary schools with required science facilities (science kits) was 39% in the FY 2013/14. The predicted target for that year was 33%, and that for 2014/15 was 37%.
- in terms of other science equipment, the percentage of primary schools with required science corners was 3% in the FY 2013/14. The predicted target for 2013/14 was 5.6%. Since the target was not met, more needs to be done with regard to science corners provision in order to meet the target of 8.2% for the FY 2014/15.

Table 14: Indicators of primary education in Rwanda, 2008–2013

Indicator	2008	2009	2010	2011	2012	2013
Total number of students	2 190 270	2 264 672	2 299 326	2 341 146	2 394 674	2 402 164
Females [%]	50.9	50.8	50.7	50.9	50.7	50.7
Males [%]	49.1	49.2	49.3	49.1	49.3	49.3
Total number of qualified teachers	35 672	35 664	36 352	40 299	40 397	40 159
Females [%]	53.2	53.0	53.7	51.6	52.6	53.1
Males [%]	46.8	47.0	46.3	48.4	47.2	46.9
Qualify teachers [%]	91.0	96.0	98.5	98.6	95.6	95.2
Total number of schools	2 432	2 469	2 510	2 543	2 594	2 650
Classrooms	30 989	31 453	27 184	28 817	28 914	29 367
Students per classroom	71	72	85	81	83	82
Gross enrolment rate [%]	127.9	128.5	126.5	127.3	123.2	138.5
Gross enrolment rate females [%]	128.5	129.5	127.6	128.9	124.8	139.4
Gross enrolment rate males [%]	127.3	127.4	125.2	125.7	121.7	137.5
Net enrolment rate [%]	94.2	92.9	95.4	95.9	96.5	96.6
Net enrolment rate females [%]	95.1	94.1	96.5	97.5	98.0	97.5
Net enrolment rate males [%]	93.3	91.6	94.2	94.3	95.0	95.7
Students/Teachers ratio	61:1	64:1	63:1	58:1	59:1	60:1
Students/Qualified teachers ratio	67:1	66:1	64:1	59:1	62:1	63:1

Source: Rwanda Statistical Yearbook 2014

Secondary education

Table 15 shows the most relevant indicators on secondary education in Rwanda (2008–2013). The number of students, teachers, schools, classrooms increased. The number of students per classroom and students per teacher decreased.

In terms of basic infrastructure, the Ministry of Education (Rep. of Rwanda, 2014c) has recorded a significant increase in the percentage of secondary schools with access to electricity (54%) and with access to clean water (51%) in 2013/14.

On the one hand, the percentage of secondary schools with internet connectivity was only 14% in 2013/14, imposing severe restrictions to achieve the projected target for 2014/15, which is 45%. On the other hand, the percentage of secondary schools with access to computers was 76% in 2013/14.

Moving on to the discussion of science facilities in secondary schools, it should be noted that the percentage of secondary schools with required science kits was 71% in 2013/14. The growth in the percentage of secondary schools with required science corners was less successful than in the case of science kits. This value stood at 7% in 2013/14, while only 17% of the schools had science laboratories.

The proportion of students enroled in science and technology fields at upper secodary level increased from 41% in 2012/13 to 59% in 2013/14.

Table 15: Indicators of secondary education in Rwanda, 2008–2013

Indicator	2008	2009	2010	2011	2012	2013
Total number of students	288 036	346 518	425 587	486 437	534 712	566 370
Females [%]	47.2	49.0	50.7	51.5	52.2	52.6
Males [%]	52.2	51.0	49.3	48.5	47.8	47.4
Total number of teachers	5 849	8 710	8 681	13 206	15 748	17 698
Females [%]	24.5	28.4	26.8	27.8	27.4	28.5
Males [%]	75.5	71.6	73.2	72.2	72.6	71.5
Qualify teachers [%]	57.4	60.4	60.0	64.4	67.5	69.3
Total number of schools	689	686	1 399	1 362	1 466	1 502
Classrooms	6 420	7 695	9 477	11 487	13 490	15 087
Pupils per classroom	45	45	45	42	40	38
Gross enrolment rate [%]	20.7	25.9	31.5	35.5	38.0	41.5
Gross enrolment rate females [%]	23.4	25.0	31.5	36.2	40.0	42.5
Gross enrolment rate males [%]	22.0	26.8	31.5	34.9	37.0	40.3
Net enrolment rate [%]	13.9	13.2	22.6	25.7	28.0	36.4
Net enrolment rate females [%]	13.9	13.7	23.7	27.2	30.0	38.5
Net enrolment rate males [%]	13.8	12.8	21.6	24.2	26.0	34.1
Students/Teachers ratio	28:1	24:1	29:1	24:1	23:1	22:1
Students/Qualified teachers ratio	49:1	40:1	49:1	37:1	34:1	32:1

Source: Rwanda Statistical Yearbook 2014

Technical vocational education and training (TVET)

As identified in the country's *Vision 2020*, one of the pillars of continued growth is human resource development. In order to provide a strategic response to the challenges to skills development across all sectors of the economy, the Government of Rwanda has created the Workforce Development Authority (WDA), an institutional framework working under the Ministry of Education (Rep. of Rwanda, 2014c). The main mission of WDA is to promote and guide the development and upgrading of skills and competencies of the Rwandan workforce, in order to enhance its competitiveness and the employability of its participants through Technical and Vocational Education and Training (TVET).

TVET institutions will be required to be models of entrepreneurship for students, including incorporating business practices in financial management. Institutions will be expected to develop strategic plans, which will include targets for income generation.

Because providing TVET is substantially more expensive than the provision of general education, the Government of Rwanda considers especially important that TVET graduates acquire skills that ensure their employability (Rep. of Rwanda, 2010a). As the economy becomes more sophisticated and dynamic, TVET graduates will increasingly need to have general business or 'catalytic' skills, for example ICT, communication (language, business, interpersonal), problem solving and critical thinking. Consequently, TVET institutions in Rwanda will need to ensure adequate coverage in their programmes of these skills.

EDPRS II proposed the establishment of Sector Skills Councils to provide a forum for feedback and discussion to ensure that employers' voices are heard throughout the policy-making process for skills and TVET policy. The first such Council was established in the mining sector, after which councils are being established for the other seven priority Rwanda Development Board sectors (construction, agriculture, energy, trade & manufacturing, financial services, ICT, and tourism). The Rwanda Development Board identified 4 key objectives for each Sector Skills Council. These are: reducing skills gaps and shortages; improving productivity and business performance; increasing opportunities to boost the skills and productivity of everyone in the sector's workforce, including action on equal opportunities; and improving quality and relevance of training for employment.

According to EDPRS II, the TVET courses design must be demand-driven, and the education and private sector must coordinate to ensure this is fulfilled. In this way, the Sector Skills Councils will give private sector employers a voice in the entire policy process of design, provision, and evaluation of employment-focused education. Focus will be on training for priority sectors with high potential for job growth including priority export sectors in areas such as construction, tourism, and food processing.

The production of training modules and curricula development has been centred on a Competence-Based Training approach. The recruitment of trainers and upgrading of their skills constitute a core responsibility of the WDA. So far, there are 2 909 trainers in TVET system and about 358 of these were trained in 2013/14.

Competency-Based Training was also introduced with the hospitality sector. Currently, there are 416 trainees and four hotel training sites under this skills development project.

Under a Skills Development Fund initiative aiming at quick skills delivery (conducted in partnership with World Bank), over 37 TVET training providers and companies have been funded to take part in skills development in different training fields. So far, over 1 200 youth beneficiaries have been empowered and certified.

In the process of ensuring and improving the quality of TVET delivery, the WDA has put in place training standards and specific requirements for training facilities. Furthermore, at least 200 TVET schools have been inspected for quality assurance. In terms of strengthening the relevance of education and training to meet labour market demands, private sector/industry involvement in curricula development and TVET skills delivery have been crucial. The ongoing up-scaling of Industrial Attachment Practice to all 340 TVET schools is helping TVET graduates to make their skills more relevant to the labour market.

Since the Sector Skills Council initiative started in 2013, seven councils are in place thus far, bringing private sector on board for the task of making TVET more demand-driven. Table 16 provides an overview of the main achievements of TVET programmes.

Table 16: Main achievements of TVET programmes 2013/14

TVET Sub-programs	Baseline 2012/13	Progress 2013/14	Observation
Competence Based Curriculum	25	40	More 15 Competence Based Curriculum have been developed
Training of Trainers on Competence Based Training	20	296	More trainings planned for 2014/15
Examination and certification	17 223	21 600	About 99% of students are expected to sit for exam
TVET Schools Development	16	21	About 21 schools have been rehabilitated or renovated
Supply of equipment to TVET schools	35	69	The number of schools supplied with equipment increased by 34
TVET Awareness Campaign	4 216	5 321	The TVET Expo attracts more people annually
Industrial Based Training	n/a	416	The Industrial Based Training started in 2013/14 in hospitality sector
Industrial Attachment Programme	9 123	12 231	The number of internees increased by 7%
Accreditation and Quality Assurance	220	123	More than 100 TVET schools are inspected every year.
TVET Enrolment	73 681	83 893	The number of trainees increased by 12%

Source: Republic of Rwanda (2014c)

Higher education

The overarching mission of the higher education sub-sector is "to provide quality higher education programmes that match the labour market and development needs of Rwanda for graduates who are capable of contributing to national economic and social needs and who can compete on the international labour market". Around half of all university graduates in the workforce are employed by the public sector, which might be an indication that the skills currently acquired though higher education are more relevant for public sector than for private sector employment. The links between universities and employers have been inadequate and this will need to be addressed more directly (Rep. of Rwanda, 2010a). In order to remain demand-driven and allow university graduates to drive innovation in the private sector, higher education institutions need to respond to changes in technology and innovations in the productive sector. This in turn requires universities to absorb up-to-date knowledge and adapt it to-date equipment and teaching materials, and provide adequate practical experience and assessment.

Figure 24 presents the evolution of the higher education enrolment (total, female and male) represented as a percentage of the gross, between 1970 and 2013. Figure 25 shows the total enrolment in tertiary education per 100 000 inhabitants, between 1967 and 2013. Both figures represent the long-term evolution of the population's access to higher education. It is possible to distinguish two different periods: from Independence (c. 1962) to Genocide (c. 1994), with a very restricted access to higher education (less than 60 students per 100 000 inhabitants) and a quasi-exponential explosion after the Genocide (reaching around 750 students per 100 000 inhabitants in 2013). The curves are in agreement with the policies expressed within *Rwanda Vision 2020* and EDPRS I & II documents. Figure 25, shows more clearly the change of slope after that occurs after year 2000, when *Rwanda Vision 2020* was released.

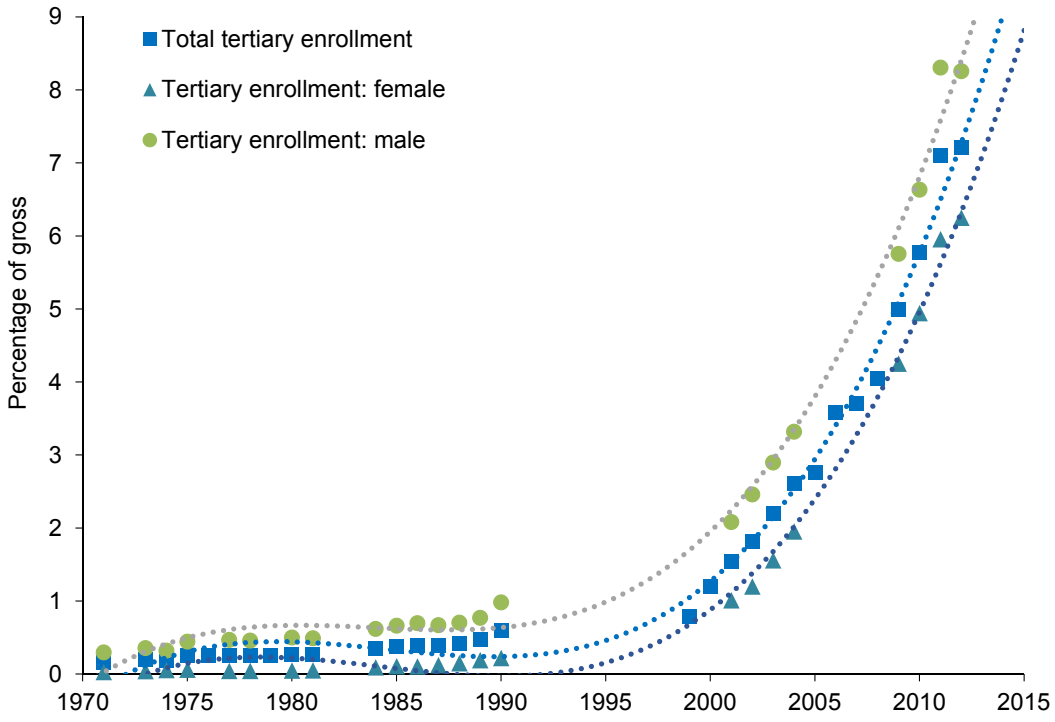


Figure 24: Total, female and male tertiary enrolment in Rwanda as a percentage of gross, 1970–2012. The dotted lines are the best-fitting curves. Source: UNESCO, based on raw data provided by the UNESCO Institute for Statistics

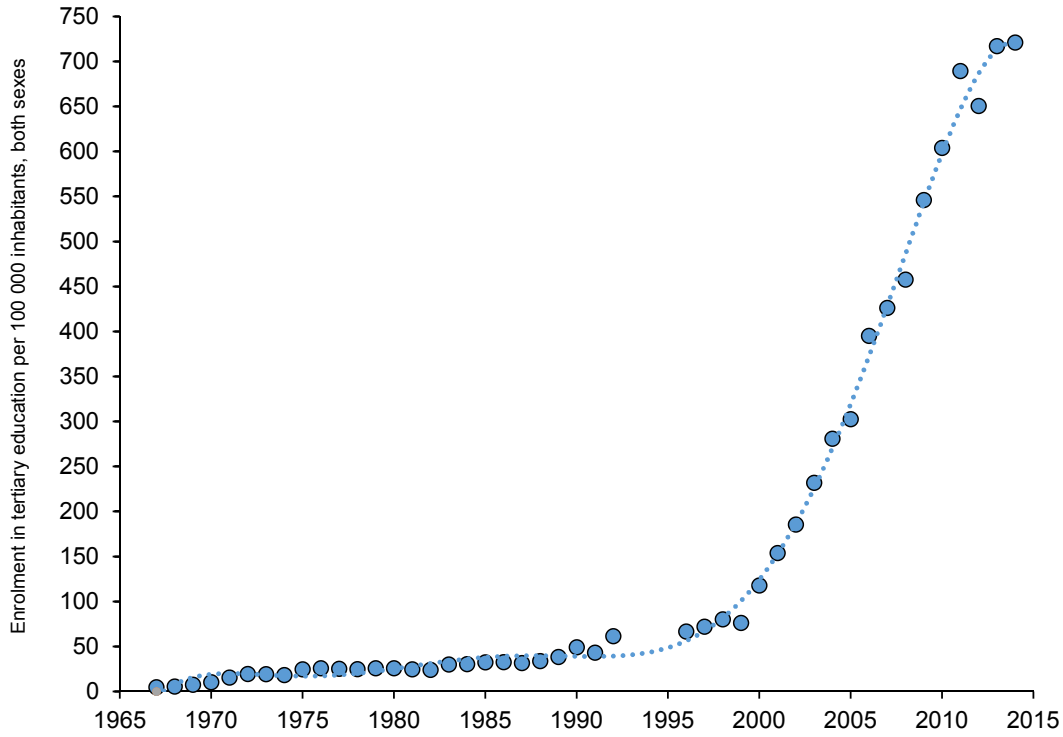


Figure 25: Total tertiary education enrolment (both sexes) per 100 000 inhabitants in Rwanda, 1967–2013. The dotted lines is the best-fitting curve. Source: UNESCO, based on raw data provided by the Ministry of Education of Rwanda and UNESCO Statistical Yearbooks (1972–1999)

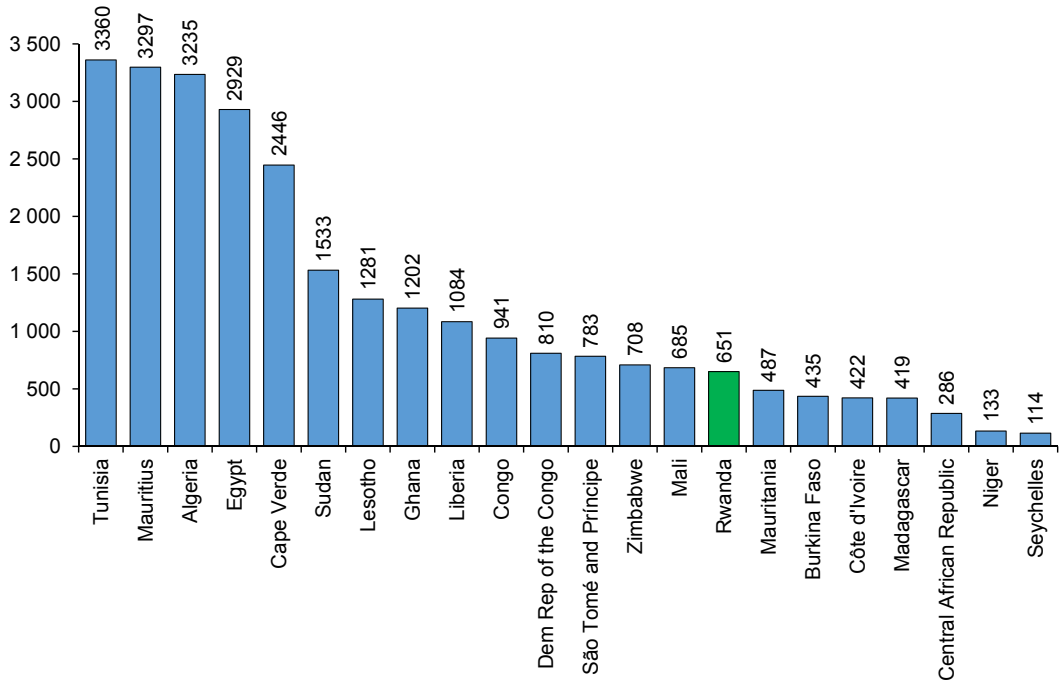


Figure 26: Total tertiary education enrolment (both sexes) per 100 000 inhabitants in several African countries (c. 2012). Source: UNESCO, based on raw data provided by the UNESCO Institute for Statistics

In spite of the exponential growth shown in the tertiary enrolment per 100 000 inhabitants, the present value is still low compared with other developing regions or with countries of the African continent. The critical mass needed to trigger a knowledge economy is probably ten times the present value. Rwanda still has eleven times less students per capita than Japan, South Korea or USA; ten times less than Argentina, Chile, Cuba or Mongolia; five times less than Tunisia, Mauritius or Algeria, four times less than Cape Verde, Egypt or India, etc. Figure 26 shows the higher education enrolment per 100 000 inhabitants in several African nations for the year 2012[14].

Table 17 presents the 2012–2013 sex-disaggregated enrolment at different public higher education institutions in Rwanda, while Table 18 shows the same information for the private institutions. In both cases, the total enrolment increased in the past years.

It is very important to emphasize that on September of 2013 a major reform of the higher education system took place in Rwanda. The Government of Rwanda established the University of Rwanda (UR) through the Law no 71/2013 (*Official Gazette* N° 38 of 23/09/2013). This was done through the merger of seven public higher education institutions: the National University of Rwanda, Kigali Institute of Science and Technology, School of Finance and Banking, Kigali Institute of Education, Kigali Health Institute, Institute of Agriculture and Animal Husbandry and Umutara Polytechnic (see pages 162–171).

The University of Rwanda seeks to support the development of Rwanda by research and the advancement of existing knowledge, while being committed to the highest standards of academic excellence and creating a place where students are being prepared for lives of service and leadership. The University of Rwanda is now structured on disciplinary colleges. All similar disciplines from former Institutions were pooled together to form a given College as explained below:

- *College of Science and Technology:* Kigali Institute of Science and Technology[15] (KIST) contributed with 43% of the infrastructure; the Faculties of Science and Engineering and the Centre for Geographic Information Systems and Remote Sensing of former National University of Rwanda contributed with 51%; finally the Departments of Science and Technology of Umutara Polytechnic and the Institute of Agriculture and Animal Husbandry together contributed with the remaining 6%.
- *College of Business and Economics*: the National University of Rwanda contributed with 73% of the new college, Umutara Polytechnic with 19% and the School of Finance and Banking with 8%.
- *College of Agriculture, Animal Sciences and Veterinary Medicine:* the National University of Rwanda contributed with 39% of the infrastructure (and 92% of staff); the Institute of Agriculture and Animal Husbandry contributed with 35%; Umutara Polytechnic with 21%; and the Kigali Institute of Science and Technology contributed with 5%.
- *College of Education:* the Kigali Institute of Education contributed with 98% of the infrastructure and the National University of Rwanda contributed with the remaining 2%.
- *College of Medicine and Health Sciences:* the National University of Rwanda provided all the medicine and public health disciplines infrastructures (93% of the total for the College) including three teaching hospitals and state of the art national laboratory (ISO certified), Kigali Health Institute contributed 6.5% (nursing, dentistry and paramedical); and the Umutara Polytechnic with 0.5% (environmental health).
- *College of Arts and Social Sciences:* 99% of the infrastructure was provided by the National University of Rwanda (Law, Arts and Humanities, Social Sciences) and the remaining 1% comes from the former Kigali Institute of Education (gender studies).

14 To avoid any methodological bias, and use comparable data among different countries, Figure 22 was prepared based on the standard practice followed by UNESCO Institute for Statistics (UIS). The *2014 Rwanda Statistical Yearbook* (Rep. of Rwanda, 2014a) shows that the tertiary education enrolment (both sexes) per 100 000 inhabitants in past years have higher values than the ones published by UIS. For example, 701 for 2010; 808 for 2011; 800 for 2012 and 913 for 2013.

15 With the exception of the Food Science and Technology Department which transferred to the new College of Agriculture, Animal Sciences and Veterinary Medicine.

With this reform, the National University of Rwanda made contributions to each College, also 39% of the students, 34% of academic staff and 87% PhD holders, 96% Masters programmes, 98% of major funding for research and infrastructure (ICT band width, library resources, etc.) were inherited from the former university.

Table 17: Enrolment in higher education institutions (public) in Rwanda, 2012–2013

Higher-Education Institution (public)	2012			2013		
	Males	Females	Total	Males	Females	Total
School of Finance and Banking	1 631	1 090	2 721	1 626	1 110	2 736
Umutara Polytechnic	2 072	1 374	3 446	2 072	1 374	3 446
Higher Institute of Agriculture and Animal Husbandry	1 686	681	2 367	1 750	722	2 472
Institute of Legal Practice and Development	25	13	38	134	72	206
Kigali Health Institute	794	523	1 317	845	530	1 375
Kigali Institute of Education	5 850	3 004	8 854	5 906	3 423	9 329
Kigali Institute of Science and Technology	1 968	737	2 705	2 142	781	2 923
National University of Rwanda	7 798	3 401	11 199	7 227	3 529	11 256
Kavumu College of Education	331	185	516	454	341	795
Rukara College of Education	751	338	1 089	1 125	545	1 670
Kicukiro College of Technology	1 423	275	1 698	1 809	331	2 140
Tumba College of Technology	446	188	634	421	126	547
Kabgayi School of Nursing and Midwifery	31	182	213	41	244	285
Rwamagana School of Nursing and Midwifery	16	203	219	30	246	276
Byumba School of Nursing and Midwifery	75	116	191	114	166	280
Kibungo School of Nursing and Midwifery	80	105	185	131	130	261
Nyagatare School of Nursing and Midwifery	104	136	240	146	180	326
Integrated Polytechnic Regional Centre South	–	–	–	164	19	183
Gishari Integrated Polytechnic	–	–	–	184	21	205
Kitabi College of Conservation and Environmental Management	–	–	–	18	2	20
Total Enrolment in Public Institutions	25 081	12 551	37 632	26 839	13 892	40 731

Source: Rwanda Statistical Yearbook 2014

Table 18: Enrolment in higher education institutions (private) in Rwanda, 2012–2013

Higher -Education Institution (private)	2012			2013		
	Males	Females	Total	Males	Females	Total
Catholic University of Rwanda	736	1 175	1 911	791	1 442	2 233
Protestant Institute of Arts and Social Sciences	367	298	665	577	425	1 002
Institut Supérieur Pédagogique de Gitwe	394	727	1 121	355	698	1 053
Institut Polytechnique de Byumba	892	980	1 872	1 117	1 090	2 207
Kigali Independent University	4 851	6 969	11 820	5 702	6 579	12 281
Catholic Institute of Kabgayi	454	919	1 373	443	869	1 312
Institute of Agriculture Technology and Education of Kibungo	1 916	1 863	3 779	2 173	2 842	4 415
Independent Institute of Lay Adventist of Kigali	2 446	3331	5 777	2 790	3 685	6 475
Kigali Institute of Management	336	512	848	542	945	1 487
Rwanda Tourism University College	889	998	1 887	1 044	1 260	2 304
Institut d'Enseignement Supérieur De Ruhengeri	1 698	1 541	3 239	1 661	1 738	3 399
Adventist University of Central Africa	1 502	1 302	2 804	1 268	1 095	2 363
Grand Séminaire de Nyakibanda	219	0	219	215	0	215
Mount Kenya University	919	713	1 682	1 332	959	2 291
Kibogora Poltechnic	–	–	–	161	155	316
Carnegy Mellon University	–	–	–	18	6	24
St Joseph Integrated Technical College	–	–	–	192	20	212
Akhilan Institute of Women	–	–	–	0	128	128
Total Enrolment in Private Institutions	17 669	21 328	38 997	20 381	23 336	43 717

Source: Rwanda Statistical Yearbook 2014

Table 19 shows the distribution of graduates (bachelors and advanced diplomas) classified by major field of knowledge (UNESCO, 1978, 1988; OECD, 2002) between 1996 and 2013. During the whole 18-year period, the average distribution of graduates per major field of knowledge was the following: natural sciences 10%, engineering and technology 10%, medical and health sciences 16%, agricultural sciences 10%, social sciences 48% and humanities 7%. Considering, the distribution only over the last year (2013) the shares changed a little bit: natural sciences 14%, engineering and technology 18%, medical and health sciences 18%, agricultural sciences 2%, social sciences 45% and humanities 3%.

Table 20 shows the distribution of Master degrees classified by major field of knowledge between 2005 and 2013. It clearly shows the low number of Master degrees produced. Within this period, there were no Masters at all over several years. This low number of Masters does not allow the presentation of any aggregated statistical distribution. Social sciences had the major proportion of Masters in the whole period.

In July 2014, the University of Rwanda Academic Workload Framework was approved. For research activities performed by the academic staff, the framework establishes that: (1) Associate professors and full professors will spend 50% of their time on research; (2) lecturers, senior lecturers, and module leaders will spend 40% on research; (3) assistant lecturers and programme leaders will spend 35% on research; (4) heads of departments, deputy deans of schools and college directors of centres will spend 30% on research; and (5) deans of schools will spend 25% on research.

Table 19: Graduates (bachelors and advance diplomas) in higher education in Rwanda, 1996–2013

Year	Natural sciences		Engineering and Technology		Medical and Health sciences		Agricultural sciences		Social sciences		Humanities	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1996	25	8	13	0	50	35	22	7	78	30	43	14
1997	49	13	22	1	179	64	38	16	296	112	77	31
1998	90	35	90	5	106	45	32	5	372	141	15	7
1999	26	7	57	5	6	6	24	7	258	126	33	9
2000	64	18	0	0	70	41	78	5	123	70	75	29
2001	33	12	0	0	59	23	28	11	188	84	36	23
2002	35	9	220	58	109	33	27	11	247	129	47	14
2003	20	7	0	0	137	128	90	11	107	134	0	0
2004	67	27	226	54	170	141	289	73	460	336	50	2
2005	123	37	531	120	31	28	112	69	412	404	33	20
2006	361	73	100	12	465	443	275	71	1 279	1 014	132	28
2007	145	67	235	66	41	24	188	63	538	619	0	0
2008	1 054	241	499	85	756	594	349	100	1 450	1 410	895	306
2009	386	126	168	38	277	318	498	176	978	1 439	172	113
2010	619	173	438	101	431	387	536	299	2 239	1 808	75	6
2011	360	124	612	176	188	297	624	216	2 052	1 757	145	184
2012	1 099	445	1124	282	894	871	1130	486	3 186	2 237	98	75
2013	900	326	1284	343	655	899	149	63	2 514	1 426	148	105

Source: Ministry of Education of Rwanda

Table 20: Postgraduates and Master's degrees in Rwanda, 2005–2013

Year	Natural sciences		Engineering and Technology		Medical and Health sciences		Agricultural sciences		Social sciences		Humanities	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
2005	0	0	0	0	0	0	0	0	0	0	0	0
2006	0	0	0	0	0	0	0	0	0	0	0	0
2007	0	0	0	0	0	0	0	0	0	0	0	0
2008	0	0	36	6	0	0	0	0	0	0	0	0
2009	0	0	0	0	6	2	0	0	0	0	0	0
2010	0	0	18	4	0	0	0	0	0	0	0	0
2011	0	0	0	0	0	0	0	0	0	0	0	0
2012	59	13	5	1	0	0	0	0	86	33	61	0
2013	0	0	0	0	0	0	0	0	3	7	0	0

Source: Ministry of Education of Rwanda

During the academic year 2013/2014, the proportion of students enrolled in science and technology fields at tertiary level was 30% of the total enrolment. However, higher education institutions in Rwanda recorded a number of challenges: (i) not enough laboratory technicians to operate the laboratories in the University of Rwanda; (ii) low numbers of academics and researchers applying for a research grant; (iii) high staff turnover; and (iv) high reliance on expatriate staff in certain areas (Rep. of Rwanda, 2014c). Based on the previous challenges, the Ministry of Education suggested the following actions: (a) training and other incentives for laboratory technicians to ensure their availability and retention; (b) elaboration and implementation of an aggressive staff development policy; (c) elaboration and implementation of staff retention strategies; (d) tackling the financial and material issues which hinder the Early Childhood Development and catch-up programme; and (e) increasing the financial and material support for the adult literacy programme.

Higher education and gender

Education statistics in sub-Saharan African countries show that women continue to lag behind men in education in general and specifically in science, technology, engineering, and mathematics (Masanja, 2010).

Rwanda is signatory to various international conventions, including, the Convention for the Elimination of all Forms of Discrimination Against Women (CEDAW), the Beijing Declaration and Platform for Action and other instruments for promoting gender equality. The commitment was also translated into action by integrating gender dimensions into the *Rwanda Vision 2020* and by establishing institutional structures to address challenges of achieving gender equality, including placing responsibility for it and women's empowerment at a central level within government.

Rwanda's constitution mandates a minimum female representation in politics and public sector management. The constitutional provision and the government's commitment to gender equality have resulted in an increase in the number of parliamentary seats held by women from 17% in 1994 to 56% in 2008 and 64% in 2013. The UN Millennium Development Goal target on parity between boys and girls in primary and secondary education enrolment has been achieved. However, as it was shown on Figure 24 (see page 67) and on Table 17 and 18 (see pages 70–71), female students account for only for 44% of the total enrolment in 2013.

The sex distribution of graduates (bachelors and advanced diplomas), classified by major field of knowledge (see Tables 19 and 20) between 1996 and 2013, shows that during the 18-year period the average percentage of female graduates in various fields of knowledge were as follows: natural sciences 24%; engineering and technology 19%; medical and health sciences 49%; agriculture sciences 27%; in social sciences 44% and in humanities 32%.

Narrowing this to results during the last year (2013) only, the sex distribution of graduates shows that the percentage of female graduates is: natural sciences 27%; engineering and technology 21%; medical and health sciences 58%; agriculture sciences 30%; in social sciences 36% and in humanities 42%.

Figure 27 shows the participation of female teachers within tertiary education between 1970 and 2010. The highest participation was obtained in 1974 with women making up 19.2% of all teachers. Since then, this participation decreased to its lowest value in 1990: 5%. After the Genocide, the females teaching within the higher education system increased again to 16.2% in 2010. These values are still far from reaching gender parity. The 2014 revised Science, Technology and Innovation Policy (Rep. of Rwanda, 2014d) does not include any specific strategy to promote gender equality for the research and innovation system in the country.

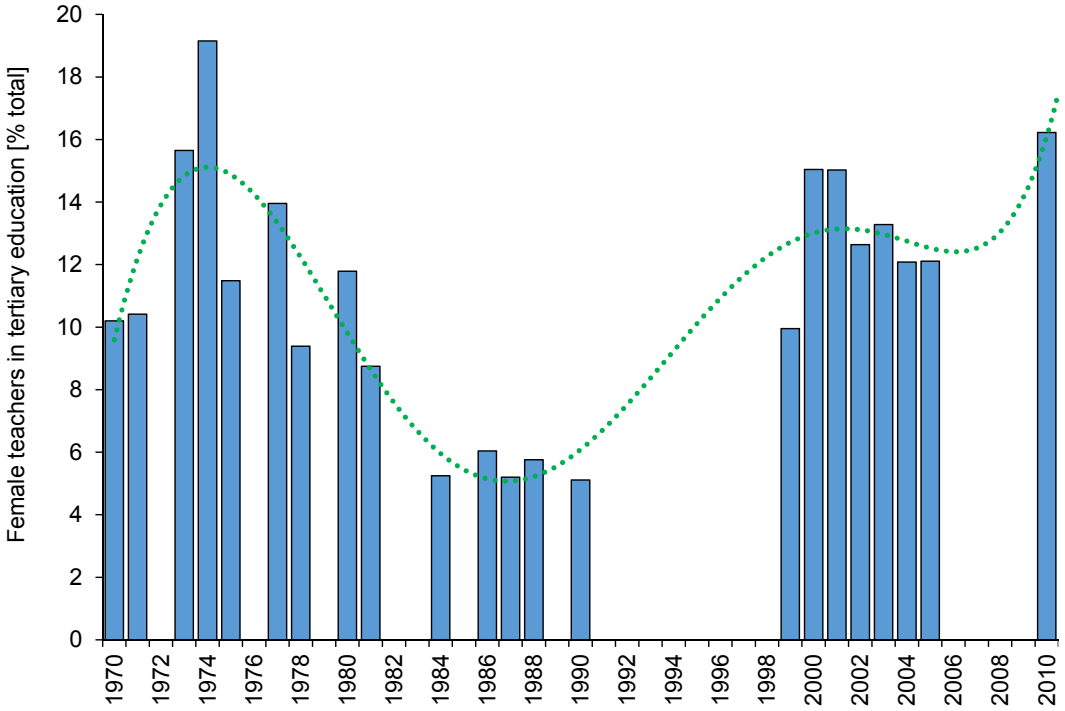


Figure 27: Distribution of female teachers within the higher education system in Rwanda, 1970–2010. The dotted line is the best-fitted curve. Source UNESCO, Source: based on raw data provided the UNESCO Institute for Statistics

BOX 8 – REDUCING THE GENDER GAP IN RESEARCH AND POSTGRADUATE STUDIES

Although the negative consequences of not having enough female students, teachers, researchers and professors in higher education institutions is well known, the status quo prevails. The former National University of Rwanda undertook a holistic approach to promote gender equality in all its spheres. In 2011, the National University of Rwanda carried out a study aimed first, to comment on how the National University of Rwanda, at the institutional level, deals with gender issues in general, and among the academic staff in particular; and second, to illuminate factors that have obstructed female academic staff members' career aspirations, research and publishing. It was established that existing gender discrepancies arise largely from barriers at the institutional level. Based on the study findings, it was proposed that the National University of Rwanda should address the following:

- women´s perspectives in decision making,
- gender analysis in research,
- gendered knowledge,
- gender-sensitive pedagogical environment, and
- gender-responsive organisational cognitive system and work culture.

The National University of Rwanda started the process of integrating gender into its policy framework. A gender baseline study and a gender audit were carried out in 2011/ 2012. A five-year gender strategic plan was developed, and a process to streamline gender in the organs and committees was initiated. The Gender Strategic Plan includes gender capacity building, gender training, evaluation of gender aspects in research proposals, in recruitment, in staff promotion,

in career development, and in PhD and Masters Scholarships. A Gender Committee would be formed in each Faculty. They would be tasked to analyse all activities from a perspective of gender equality and follow up on the extent to which targets have been achieved. Now the National University of Rwanda does not exist anymore, the newly-created University of Rwanda will take over and it has committed to contextualise and continue the gender policy and processes initiated by the National University of Rwanda.

The National University of Rwanda also started initiatives for gender analysis to be integrated in curricula and research. Two projects, one funded by the Dutch Government another by the United States Agency for International Development (USAID), both introducing Masters programmes and small scale research projects were piloting gender as a theme integrated into curricula and research. Both projects have been inherited by the University of Rwanda and continue. The USAID project deals with the *Master of Science in Agribusiness* and the Dutch-funded projects deals with the *Master of Science in Geo-Information Science for Environment and Sustainable Development*.

In both projects, integrating gender in curricula emphasises three things: (i) equal treatment, which focuses on non-discriminatory practices; (ii) affirmative action, which involves addressing disadvantages experienced by women as compared to men; and gender mainstreaming, which refers to making a conscious and systematic effort to promote gender equality.

Gender integration in curricula

The representation of men and women in education and related employment in the disciplines shows that women are very much underrepresented. Through the Masters programmes, gender gaps will be addressed and gender knowledge and skills are instilled in students aiming for them to be transformative agents in their work-life experience. The programmes aim to attract and retain qualified women by taking the following actions:

- *Recruitment:* Extra efforts are made to ensure qualified women are aware of the programme and are convinced to apply for admission.
- *Admissions:* Some affirmative action to attain gender balance in admission have been introduced.
- *Financial Support:* Because many qualified women might fail to join the programme due to financial reasons, financial support for women has been introduced.
- *Mentoring:* additional support is offered to ensure women receive the kind of assistance they need in order to be successful in the program; e.g. child care facilities, etc.
- *Alternative Delivery Systems:* In order to accommodate the schedules of working-women who also might have responsibilities in the home and in their local communities, the programme offers flexible alternative delivery systems. Nights and weekends for example might not be accessible by married women and young mothers.
- *Women in Leadership Training:* The USAID-supported Programme offers Seminars, Workshops, and Training for both female and male students on "Women in Leadership" with the aim to develop professional and leadership skills of women in the workforce and sensitizing all students to gender dynamics in professional contexts.

Each programme has a specific module on Gender, which contains gender theories and gender dimension of the subject matters. Also, gender is integrated in all other modules where the theories are applied to the specific gender dynamics in the science and society interplay. Gender integration in curricula considers gender sensitivity and gender inclusiveness in the content and in delivery. In addition, the USAID-supported programme includes an internship scheme, which has a gender component as an opportunity for students to gain understanding of gender dynamics in the workplace. Gender analysis is expected of students in the assessment of their participation in these internships. The internships' aim is to offer workforce experience and help students, both men and women, to gain the knowledge, skills, and confidence they need in order to enter the workforce upon graduation.

Gender integration in research

In both projects, frameworks have been developed and training of researchers are undertaken to ensure the gender dimension in research content is taken into consideration, and researchers do analysis of the relevance of gender for and within the subject matter. Researchers conduct an assessment to ensure the following: (i) the scientific methodology differentiates between the sexes/genders and takes into account men's and women's situations equally. (ii) that data collection tools are gender-sensitive to avoid gender bias; (iii) research reports, oral presentations and publications use gender-inclusive language and enable readership to detect the different realities of men and women; (iv.) Research involves gender-balanced end-user groups to guarantee the highest impact; (v) researchers considers specific dissemination actions – e.g. publications focusing on gender and Institutions that focus on gender so as to include women and girls in the target groups for dissemination.

Verdiana Grace Masanja
University Level Research and Postgraduate Studies Unit
University of Rwanda

Student mobility

Since the seventies, there has been a great expansion in higher education enrolment across the world. Governments are currently going through a period of policy transition, with policy makers seeking to reorient the objectives and instruments of policy to reflect the increasingly sharp awareness of knowledge creation and learning as drivers of innovation, growth, employment and wealth.

Human resources are recognised as being key for conducting scientific research, developing new technologies, commercialising and diffusing innovation. Among them, doctorate holders are not only the most qualified in terms of educational attainment, but also those who are specifically trained to conduct research. Governments and institutions increasingly build internet-based social networks that are expressly designed to allow post-graduate students, doctorates and researchers abroad to keep in contact with institutions in the home country, e.g., diaspora networks.

The international mobility of tertiary students has been a phenomenon of growing interest for scholars and policy makers since the sixties and can have a significant impact on shaping the structure of national innovation systems. The mobility of students worldwide is perhaps the most visible form of cross-border higher education, and one that has been monitored over years.

According to UNESCO Institute for Statistics (2012), in 1980 the population of internationally mobile students was about 1.1 million. The number increased slightly to 1.3 million in 1990 but by 2009 had tripled to 3.4 million. The number of mobile students has been expected to grow to 8 million by 2020 (Altbach, 2006).

Students from Rwanda are dispersed across a wide range of host countries. A wider dispersion may imply that students are returning to their home country with a richer mix of new ideas. Table 21 shows the number of Rwandan tertiary students studying abroad within the top-40 countries over the past 15 years. In order of importance, France, USA, Belgium, India, Canada, Germany, United Kingdom and South Africa were the preferred destinations. South Africa is not only the leading host country in Africa but also ranks 11th among host countries worldwide. Its higher education sector is well developed with strong infrastructure and several respected research institutions that appeal to international students.

Table 21: Number of Rwandan tertiary students studying abroad, 1998–2012

Country	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Australia			2		7	8	10	13	10	7	8	8	15	22	29
Austria		50	38	42	28	19	19		15	13	11	15	12	10	9
Belgium		275	478	440	622	217	1	9	11	8	50	76	89	98	72
Burundi		36			217								697		
Cameroon							25			15			25		
Canada	39	51	42	48	63	60	66	93	210	132	90	93	111	126	
Central African Republic									11						
Congo						20								3	
Cuba		1			6	1	1	1	1	1	1				
Czech Republic											2	2	2	2	2
Denmark		1	1	2	10	16	2	2	5	3	2	1	5	3	1
Finland	3	4	5	6	9	10	11	8		9	12	19	21	20	24
France		170	225	247	309	418	482	504	588	599	561	556	599	692	716
Germany		109	107	100	89	84	77	59	34	47	66	69	61	85	75
Greece						6	4	4	6	4			2	3	
India			191	145	128	45	2	35	30					409	719
Ireland	1		4	3	5	4	3	4	2	4	4	2	3	3	4
Italy		25	18	22	28	35	29	27	27	26	34	42	28	50	62
Japan			1	1	1	1	1	1		2	6	6	7	6	9
Malaysia	1	1	1		3	2	3		2	2	1	23	18	24	
Mauritius													2	6	9
Morocco						3	2	11	12	32	41	50	47		
Mozambique														20	
Namibia					8	8		7	3		7				
Netherlands		8	7	15	24	18	9	17	13	9	6	5	9	13	35
Norway	4	1	4	11	21	39	68	85	80	80	76	60	64	57	41
Philippines		10		6	1	4	6	2	3		5				
Poland	8	4	4	2	2	2	1	5	6	7	6	5	4	6	6
Portugal					1	1	1	2	2	1	1	6	6		3
Republic of Korea						2	1	3	3	2	9	12	19	45	54
Russian Federation											14	9		12	
Saudi Arabia		3				13	12	13	16	17	18	19	26		
Serbia											3	3	10	6	25
South Africa											133	193	219	472	
Spain		6	7	2	3	6	1				3	4	7	7	4
Sweden		1	8	6	6	10	5				12	25	27	32	40
Switzerland		63	7	57	55	48	44	48	31	31	31	36	29	30	25
United Kingdom	17	18	48	47	45	48	82	75	82	88	91	112	90	99	84
USA		74	121	226	263	149	275	199	223	215	270	360	447	448	450
Zimbabwe												12	12	3	1

Note: empty cells indicate that no information on the number of Rwandan tertiary students was submitted to the UNESCO Institute for Statistics by the host country. Source: UNESCO Institute for Statistics

A fraction of the Rwandan tertiary performing postgraduate studies abroad are Government- sponsored by scholarships and other policy instruments. The following Tables 22–24 show the information that the Ministry of Education have been collecting on the number of Rwandan graduate and postgraduate students studying abroad. These numbers are smaller than the total numbers of Rwandan tertiary students shown in Table 21. This is so because the information collected by UNESCO Institute for Statistics is based on a different source: surveys conducted by each UNESCO Member State on the number of foreign tertiary students in their homeland, classified by nationality and year (these surveys suggests numbers of Rwandans studying abroad may be slightly higher than known to the Ministry of Education).

Table 22 shows the estimation made by Rwanda's Ministry of Education about the sex-disaggregated distribution of Rwandan students studying abroad to obtain a Bachelor degree, according to the major field of knowledge (2001–2020). It has to be noted that in some foreign countries (i.e. China, Germany, Norway or the Russian Federation) the Rwandan students need to start learning the local language. In this case, the time required to obtain a degree is extended.

Table 23 shows the estimation made by Rwanda's Ministry of Education about the sex-disaggregated distribution of Rwandan students studying abroad to obtain a Master's degree, according to the major field of knowledge (2004–2014).

Finally, Table 24 shows the estimation made by Rwanda's Ministry of Education about the sex-disaggregated distribution of Rwandan students studying abroad to obtain a PhD, according to the major field of knowledge (2001–2014).

Table 22: Number of Bachelor's degrees by major field of knowledge obtained by Rwandans abroad, 2001–2014

Year	Natural sciences		Engineering and Technology		Medical and Health sciences		Agricultural sciences		Social sciences		Humanities	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
2001	0	0	0	0	0	0	0	0	1	0	0	0
2002	0	0	0	0	0	0	0	0	0	0	0	1
2003	0	0	0	0	0	0	0	0	1	0	0	0
2004	3	1	10	3	2	0	2	2	8	5	1	0
2005	4	1	3	0	4	3	4	1	24	14	2	5
2006	10	3	24	5	3	0	13	4	7	8	6	1
2007	3	0	5	1	2	0	10	4	5	5	1	2
2008	14	5	8	1	9	4	12	3	6	4	1	0
2009	7	2	9	3	2	0	14	0	5	9	0	0
2010	8	6	38	3	14	1	1	0	7	4	0	0
2011	22	13	41	6	18	11	8	0	13	5	0	0
2012	34	7	60	6	13	4	7	5	31	18	0	1
2013	40	11	104	16	6	4	12	2	15	2	0	0
2014	17	8	138	2	4	4	5	0	6	6	0	0

Source: Ministry of Education of Rwanda

Table 23: Number of Master's degrees by major field of knowledge obtained by Rwandans abroad, 2004–2014

Year	Natural sciences		Engineering and Technology		Medical and Health sciences		Agricultural sciences		Social sciences		Humanities	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
2004	4	1	0	1	4	1	0	1	5	10	1	1
2005	3	0	7	1	3	0	4	0	10	10	8	3
2006	3	4	13	6	3	4	1	0	14	12	1	1
2007	6	1	9	1	6	1	1	0	14	8	1	0
2008	7	6	8	1	7	6	1	2	18	7	1	0
2009	15	2	21	4	15	2	1	5	39	15	0	0
2010	22	4	30	7	22	4	9	3	60	28	1	0
2011	18	2	15	1	18	2	11	6	14	12	0	0
2012	10	6	23	1	10	6	0	1	16	7	0	0
2013	29	6	41	5	29	6	5	0	31	14	1	1
2014	44	9	90	12	44	9	14	6	60	15	2	1

Source: Ministry of Education of Rwanda

Table 24: Number of PhDs by major field of knowledge obtained by Rwandans abroad, 2003–2014

Year	Natural sciences		Engineering and Technology		Medical and Health sciences		Agricultural sciences		Social sciences		Humanities	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
2003	0	0	0	0	0	0	0	0	1	0	0	1
2004	2	0	2	0	2	0	0	0	4	0	3	1
2005	1	0	0	0	2	1	1	0	5	0	1	0
2006	7	0	0	0	4	0	0	0	4	0	0	0
2007	2	1	1	0	3	0	1	0	5	0	5	1
2008	1	0	0	0	0	0	2	0	5	0	3	1
2009	3	1	1	0	1	0	1	0	1	3	3	3
2010	3	1	1	0	1	1	0	0	9	0	4	0
2011	2	0	1	0	3	0	1	0	1	1	0	0
2012	6	1	0	0	3	0	1	0	15	2	2	0
2013	4	1	7	1	2	1	0	0	7	1	3	0
2014	3	0	4	1	4	0	3	0	12	1	3	1

Source: Ministry of Education of Rwanda

INTERNATIONAL PROJECTS ON EDUCATION, SCIENCE, ENGINEERING AND TECHNOLOGY

The Government of Rwanda has been working with international partners to foster co-operation agreements around high-impact SETI projects, such as:

Establishment of the International Centre for Theoretical Physics branch in Rwanda *(in progress)*

The establishment of the International Centre for Theoretical Physics (ICTP) branch in Rwanda was approved by the Cabinet of the Government of Rwanda in October 2013. The main activities of the ICTP Branch in Rwanda will be: (a) promotion of capacity building in basic science, and many other areas of science such as climate change, telecommunication, high performance computing, etc.; (b) a focus on experimental science through partnership with numerous laboratories in Italy; (c) PhD training (full-time and sandwich), Masters and fellowship programmes; (d) various high level research programmes, partnerships and networks and (e) visiting scientist programmes, whereby global experts will be supported to teach as visiting professors. Preparatory works toward starting the ICTP branch are on-going. The centre will be hosted by the University of Rwanda College of Science and Technology.

Establishment of the Rwanda Academy of Science *(in progress)*

Since its establishment, the Rwanda Academy of Science (RAS) taskforce accomplished the following tasks: (i) developing the RAS concept paper as a guiding document; (ii) organizing and conducting the RAS awareness-raising general meeting which took place on December 2013, involving over 60 distinguished academics; (iii) with support from the Ministry of Education, the RAS taskforce employed a legal consultant to construct the institution's legal framework. The RAS taskforce developed and approved the following documents: RAS Framework Report; RAS Draft Law; RAS Governance Structure; and RAS Administrative Procedures Manual. It is expected that following the Cabinet approval of RAS, a permanent secretariat will be appointed.

Partnership in Applied Sciences Engineering and Technology *(in progress)*

The Ministry of Education of Rwanda is working with the World Bank in a Partnership in Applied Science Engineering and Technology (PASET), aiming to promote S&T skills at all levels of education. PASET meetings was held in Senegal in June 2014 in which 12 African countries participated, and in Ethiopia in July 2015 in which 8 participated. The participating state include Angola, Burkina Faso, Cameroon, Cote d'Ivoire, Democratic Republic of the Congo, Ethiopia, Kenya, Malawi, Rwanda, Senegal, Tanzania, Uganda and Zambia.

BOX 9 – THE IMPORTANCE OF ACADEMIES OF SCIENCE

Academies of science, medicine and engineering can be found in most of the world's countries. With their members selected from among the leading scientific, medical and engineering minds within a country, academies are merit-based. Typically, although they are supported by government funds, they are also independent institutions designed to recognize excellence and achievement.

However, the strength of academies is not what they can do for the scientific community, but that they are able to mobilize scientists to play a leading role in society and development. This is especially true when it comes to providing up-to-the-minute syntheses of complex issues on areas of science that touch on policy. By mobilizing national science leaders, as well as international experts, academies are able to produce unbiased reports, recommendations and advice for policy-makers.

In Africa, some 20 countries have established national science academies – many of them in the past few years following the capacity building efforts of IAP – the global network of science academies (hosted by The World Academy of Sciences in Trieste, Italy) and its regional network for Africa, NASAC – the Network of African Science Academies, based in Nairobi, Kenya. These academies should be seen as a resource to be used by their national governments when seeking advice on scientific issues – whether the issue is developing a nation's renewable energy policy for the next 20 years, or plans to manage water resources more sustainably, or to improve agricultural production or urban health.

It is also through IAP and NASAC that Africa's weak and new academies can synergise their strengths and work together for greater impact. One such example is IAP's Science Education/ Science Literacy Programme, which is promoting Inquiry-based Science Education (IBSE) in several African countries via academy-led initiatives. The programme promotes science, technology, engineering and mathematics (STEM) education that will develop necessary critical thinking skills in children, as well as promoting outreach activities to the general public that will improve their understanding of science and technology issues.

To date, despite its focus on the use of science and technology for development, Rwanda does not have a national science academy. This is changing, however, with plans to establish a Rwanda Academy of Sciences during 2015 already at an advanced stage.

In 2013, the Rwandan Ministry of Education appointed a taskforce to carry out all necessary consultations for the establishment of the academy. The taskforce held a first consultation meeting in July 2013 to explain the key roles and functions of an academy to national stakeholders and discuss the concept note for the academy. A revised concept for the proposed Rwanda Academy of Sciences was presented at a second consultative meeting in December 2013. The final document has since been submitted to the Rwanda Law Reform Commission and the Rwanda Cabinet to request formal approval for establishing the academy.

Such a move will bring Rwanda in line with other African countries with active science academies, such as Kenya, Nigeria, Senegal, South Africa and Uganda. The new Rwandan academy will also be able to tap into lessons learned by the suite of newly-established academies on the continent, including Mozambique, Sudan and Tanzania.

As the input of science and technology is increasingly being recognized by decision-makers when designing effective policies, the role of academies in providing timely and unbiased advice is being recognized more and more around the world. The establishment of the Rwandan academy will thus complement the governmental science institutions and will contribute in a fair and informed way to Rwandan national development.

Peter McGrath
IAP/IAMP Coordinator
The Global Network of Science Academies, Trieste, Italy

BOX 10 – HIGHER EDUCATION CENTRES OF EXCELLENCE IN AFRICA

From 12th to 13th of March 2014, the *Forum on Higher Education for Science, Technology and Innovation: Accelerating Africa's Aspirations*, took place in Kigali, Rwanda. It was jointly organized by the Government of Rwanda and the World Bank and brought together senior government representatives from Ethiopia, Mozambique, Rwanda, Senegal and Uganda[16]. The purpose of the meeting was strengthening science, technology and innovation capabilities for economic transformation and development in Africa.

Representatives of international and regional research organizations, educational institutions, eminent scientists and technologists, the private sector, as well as technical and financial partners, participated in the Forum. The President of the Republic of Rwanda, His Excellence Paul Kagame, spoke at the Forum.

Participating African governments resolved to adopt a strategy that uses strategic investments in science and technology to accelerate Africa's development, aiming to create developed knowledge-based societies within one generation. Within the final declaration, the participating governments declared their commitment to the following fourteen actions:

1. to collaborate with business people, development partners and other stakeholders so as to develop and implement an action plan that will accelerate the supply of qualified human resources in critical areas of science, engineering and technology that will address Africa's development challenges;
2. to promote adoptive research for technology transfer, giving it more weight to create competitive value chains;
3. to use FDI as a platform to technology capability accumulation by higher education and research institutions;
4. to increase the share of students in sciences, engineering and technology to serve strategic areas of Africa's development, such as agriculture, extractive industries, energy, ICT, health and environment and set national, sub-regional and regional target as well as setting up mechanism to monitor these targets;
5. to promote and encourage regional solutions including creation of regional partnerships and initiatives as well as the establishment of regional institutions and centres of excellence with the scale and finances to provide high quality specialized training and conduct strategic research linked to development needs;
6. to work together to support STI initiatives for Africa's development that aim at strengthening higher education and other knowledge institutions and mechanisms;
7. to undertake reforms of the tertiary education systems to build science and technology capacity including rebalancing the system towards increasing the number and quality of graduates with science and technology competences, strengthening governance, and improving quality assurance and accountability for results;
8. to strengthen science and mathematics education at all levels including a focus on science and mathematics at the primary and secondary levels with an emphasis on girls 'science and mathematics learning to ensure a supply of students interested in the field at post-secondary levels;
9. to increase female participation in science, engineering and technology in order to achieve gender parity in STI system, including decision-making, education and employment;
10. to enable Research and Development to drive technological adaptation and innovation by business. These include creating an enabling environment as well as explicit policies to encourage private-sector demand for science and ethnology;

16 http://www.mineduc.gov.rw/innovation/IMG/pdf/HEST_AGENDA_FINAL.pdf

11. to build public support for science, engineering and technology by having inclusive and participatory process of formulating and implementing STI policies and programs;
12. to harness the African Diaspora in order to tap into preexisting international networks and capitalize on the potential reservoir of talent and entrepreneurship in support of building science and technology capacity;
13. to strengthen existing data sources and develop new sources of information and knowledge-sharing, including an up-to-date solid statistics, and indicators of inputs, policies and outcomes of the STI system; and
14. to establish a mechanism/ identify institutions for monitoring progress towards these commitments, including reaching out to AMCOST and other regional bodies.

In order to implement the forum recommendations, the World Bank approved a US$ 290.8 million-project to establish and fund a series of Higher Education Centers of Excellence in Africa. The project will involve selecting a group of higher education institutions operating in Africa, and strengthening their capacity to deliver quality education and applied research in relevant areas to address regional challenges.

Remy Twiringiyimana
Director of Research and Development
Rwanda Ministry of Education

R&D indicators for Rwanda

UNESCO has been conducting global surveys on R&D indicators since the early 1960s (UNESCO, 1960). For decades, this work was performed by the organization's former divisions of Science Policy and of Statistics on Science and Technology. Between 1970 and 1999, information from UNESCO's global R&D surveys was published in the *UNESCO Statistical Yearbooks* and in special reports prepared by the aforementioned divisions. Between 1960 and 1990, several R&D surveys were conducted in Africa. In Rwanda, UNESCO conducted R&D surveys in 1965, 1967, 1980–1985, 1990 and 1995 (UNESCO, 1972, 1982a, 1998).

In the late 1990s, the Division of Statistics left UNESCO headquarters in Paris to become the UNESCO Institute for Statistics (UIS) in Montreal. Since then, the UIS has become the international repository of statistics on R&D input for the United Nations system. In 2014, it published the findings of its first global innovation survey (although Rwanda was not yet among the countries participating).

In 2003, African countries endorsed the compilation of indicators for scientific research, technological development and innovation. To make this possible, the African Science, Technology and Innovation Indicators (ASTII) initiative was launched on 17 September 2007 in Mozambique as a flagship programme of *Africa's Science and Technology Consolidated Plan of Action.* The overall goal of ASTII is to help improve the quality of STI policies at national, regional and continental levels by strengthening Africa's capacity to develop and use STI indicators. ASTII sets out to support evidence-based policy addressing Africa's development challenges in the context of STI. So far, ASTII has brought together 28 African Union member states and published two *African Innovation Outlooks* (AU–NEPAD, 2011; NPCA, 2014).

In 2015, the Government of Rwanda will start conducting R&D surveys through the Directorate of Science, Technology and Research under the Ministry of Education and the National Statistical Office.

R&D PERSONNEL

Policymakers and researchers have increasingly emphasized the importance of skilled people—what social scientists refer to as human capital—to both knowledge creation and productive innovation. As technical content spreads throughout a knowledge-based economy, the knowledge and skills associated with science and engineering are increasingly necessary for workers with formal training in science and engineering skills who work in non-research and innovation jobs as well as for those in occupations traditionally classified as part of the R&D labour force. The planning and formulation of SETI policies requires the knowledge, especially in developing countries, of the total numerical strength of the most qualified human resources, namely the total stock and the number of economically active persons who possess the necessary qualifications to be scientists, engineers and technicians.

In this section, the assumed definitions on the different categories of R&D personnel follow the ones presented in the Glossary (see pages 252–254). Certain categories of measures are better adapted for addressing some questions than others, and not all general population and workforce surveys include questions in each category. Fortunately, the available data on Rwanda, presented in this study, has not only the historical value, but also affords the possibility to find some long-term trends, and thus to consider if policy change causes impacts.

Table 25 shows the distribution across fields of scientists and engineers engaged in R&D by their field of study, 1967 and 1981 corresponding to the data generated by two UNESCO R&D surveys.

Table 26 shows the number of full-time equivalent (FTE) researchers and technicians engaged in R&D activities in Rwanda for several years between 1965 and 2009. Data corresponding to the years between 1965 and 1995 were published at the *UNESCO Statistical Yearbook* (UNESCO, 1972, 1982, 1998). Data corresponding to years 2008 and 2009 were estimated for this study based on: data about researchers within the higher education sector, published by UIS, and data on the public sector provided by the Agricultural Science and Technology Indicators (ASTI) initiative (see Table 27). These values have an uncertainty of +/- 15%.

Table 25: Historical data on head counts number of scientists and engineers engaged in R&D by their field of study, 1967 and 1981

R&D personnel by their field of study [Head counts]	1967						1981					
	Total	Natural sciences	Engineering and technology	Medical sciences	Agricultural sciences	Social sciences	Total	Natural sciences	Engineering and technology	Medical sciences	Agricultural sciences	Social sciences
Researchers	207	25	13	75	24	70	245	37	40	14	64	90
Technicians	454	13	59	198	88	96	n/a	n/a	n/a	n/a	n/a	n/a
Researchers [F]	17	1	0	8	0	8	n/a	n/a	n/a	n/a	n/a	n/a
Technicians [F]	85	7	6	50	0	22	n/a	n/a	n/a	n/a	n/a	n/a

Source: UNESCO Statistical Yearbook (1972, 1982)

Figure 28 presents the evolution of the number of FTE researchers and FTE researchers per million inhabitants between 1965 and 2009 using the same data. The dotted lines are the best fitting curves and their shape show a total correspondence with the evolution of other related indicators within the same period (i.e. Fig. 3, Fig. 7 particularly the curve of GDP per capita in PPP, Fig. 9, Fig. 24 and Fig. 25). In all the cases, their trends shows an abrupt slope-change between 2000 and 2005. This is interpreted as a consequence of important improvements in the country governance.

In general, the number of scientific articles published in mainstream journals corresponds well to the number of scientists working (Lemarchand, 2015). A correspondence is found between the evolution of the number of FTE researchers and the evolution of the number of scientific articles published in main- stream journals, when Figure 28 and Figure 30 (see page 101) are compared.

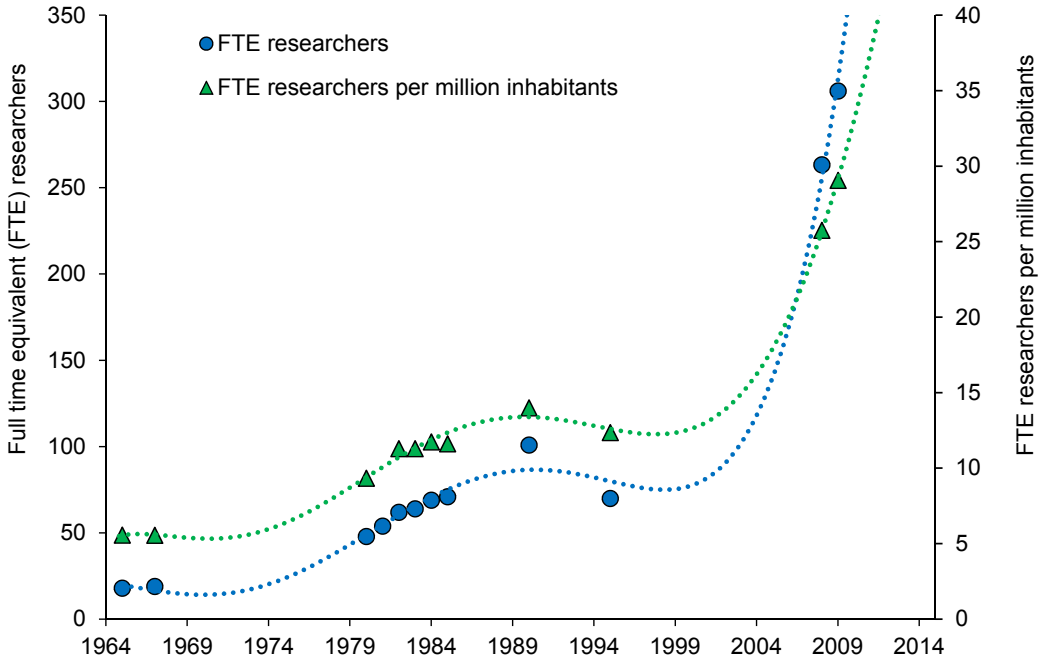


Figure 28: Long-term evolution of FTE researchers and FTE researchers per million inhabitants. The dotted lines are the best fitting curves, 1965 – 2009

Table 26: Historical data on FTE R&D personnel, several years between 1965 and 2009

Full time equivalent R&D personnel				
Year	Total Personnel	Researchers	Technicians	Administrative
1965	n/a	18	n/a	n/a
1967	n/a	19	n/a	n/a
1980	n/a	48	n/a	n/a
1981	117	54	36	27
1982	130	62	41	27
1983	149	64	55	30
1984	164	69	60	35
1985	n/a	71	n/a	n/a
1990	n/a	101	n/a	n/a
1995	122	70	16	36
2008*	n/a	263	n/a	n/a
2009*	n/ a	306	n/a	n/a

Source: UNESCO Statistical Yearbook (1972, 1982, 1998)

* Note: estimation by UNESCO based on surveys of FTE researchers the higher education sector, and at the government sector within agriculture sciences

Since 2001, there has been a deliberate effort to build the capacity of agricultural researchers in Rwanda. The Agriculture Science and Technology Indicators (ASTI) initiative, which is led by the International Food Policy Research Institute (IFPRI), has the most complete internationally comparable database on agricultural R&D investments and capacity for developing countries. Table 27 shows the data collected by ASTI on Rwanda.

The number of public agricultural researchers in Rwanda grew significantly during 2008–2011. Moreover, the number of FTE researchers qualified to the PhD level increased from 13 to 22, while the number qualified to the MSc level more than doubled (Rahija and Gatete, 2014).

The researcher/technician ratio is still below the required target of 1:2. Furthermore, a staff competence indicator is the number of PhDs that are actively engaged in research; it is low, hence, there is a critical need to further build the capacity and numbers of scientists (Gahakwa *et al*., 2014).

Table 27: Characteristics of FTE researchers in Agriculture sciences, 2005–2011

FTE researchers in agriculture sciences	2005	2006	2007	2008	2009	2010	2011
Total [Government sector]	119	120	125	125	143	163	180
Number per 100 000 farmers	3	3	3	3	3	4	4
Number of PhDs	12	12	13	13	20	22	22
Number of MSc	28	31	34	40	59	76	94
Number of BSc	78	77	78	71	64	64	65
Male [% of total]	–	–	–	84	–	–	76
Female [% of total]	–	–	–	16	–	–	24
< 31 years [% of total]	–	–	–	–	–	–	17
31–40 years [% of total]	–	–	–	–	–	–	50
41–50 years [% of total]	–	–	–	–	–	–	26
51–60 years [% of total]	–	–	–	–	–	–	6
> 60 years [% of total]	–	–	–	–	–	–	1
BSc [% of total]	66	64	62	57	45	40	36
MSc [% of total]	24	26	27	32	41	47	52
PhD [% of total]	10	10	11	11	14	14	12
Speciality crops [% of total]	–	–	–	59	–	–	65
Speciality livestock [% of total]	–	–	–	25	–	–	16
Speciality fisheries [% of total]	–	–	–	1	–	–	1
Speciality forestry [% of total]	–	–	–	3	–	–	2
Speciality natural resources [% of total]	–	–	–	4	–	–	3
Other commodity focus [% of total]	–	–	–	8	–	–	12

Source: Agricultural Science and Technology Indicators (ASTI) database

R&D expenditure in Rwanda

In developed countries, R&D activities are an important input to commercial innovation and the objectives of government agencies. R&D is part of a class of intangible inputs that also include software, higher education, and worker training. Intangibles are at least as important sources of long-term economic growth as are physical investments in machinery. In developing countries, without an industrialized economy and without a minimum threshold of R&D personnel (i.e. 1 000/ 1 200 FTE researchers per million inhabitants), it is virtually impossible to determine any high correlation between investment in R&D and its impact on economic growth.

It happens frequently that the expenditure for a given year does not correspond exactly to what was foreseen, because of changes in sources of funds (e.g. new contracts) and of the gradual spending of sums allotted to SETI activities (e.g. the acquisition of scientific equipment may entail, from the decision to purchase to the payment of the invoice, a procedure which exceeds one year). It goes without saying that financial appropriations and actual expenditure are two complementary indicators, each stressing some aspects, and requiring different treatment and sources of data. It may be recalled that SETI policy-makers attach great importance to financial appropriations especially for the public sector. However, highest priority is attributed herein to the real financial effort made by SETI organizations, as shown by actual expenditure.

Funds that support the conduct of R&D usually come from a variety of sources, including businesses, national and other governments, academic institutions, foreign donors and other non-profit organizations. The mix of funding sources varies in relation to the characteristics of individual countries. There is no recent data about the profile of R&D expenditures in Rwanda. In 2013, the authorities of the Directorate of Science, Technology and Research at the Rwanda Ministry of Education estimated that R&D expenditure was approximately 0.4% of the GDP[17].

Figure 29 shows a compilation of the data registered over the years by different UNESCO Statistical Yearbooks (UNESCO, 1972, 1982a, 1998) on the R&D expenditures as a percentage of GDP between 1963 and 1995. This historical data also show that 80% the expenditures were provided by the government and the remaining 20% by foreign donors. The data from Figure 29 clearly reflects a drastic halt in spending caused by the Genocide. This data is also consistent with the evolution of the number of FTE researchers (see Figure 28) and the evolution of scientific publications over time (see Figure 30, page 101).

Thanks to surveys made my ASTI, the agriculture research sector is the only one with recent data on R&D expenditures. Rahija and Gatete (2014) show that agricultural R&D spending in Rwanda grew by about 50% during 2005–2011. The government contributes the largest share of the Rwanda Agricultural Board's funding (55% 2011). Some is generated internally through the sale of good and services (5% in 2011).

The Rwanda Agriculture Board also relies on foreign financial sources to fund research activities. Several regional and international organizations contribute to fund agricultural R&D activities in Rwanda, such as Association for strengthening Agricultural Research in Eastern and Central Africa (ASARECA), A Green Revolution in Africa (AGRA), Consultative Group on International Agricultural Research (CGIAR), Food and Agriculture Organization (FAO), among others.

Table 28 presents the main financial figures on agriculture research in Rwanda, which were collected by the ASTI database.

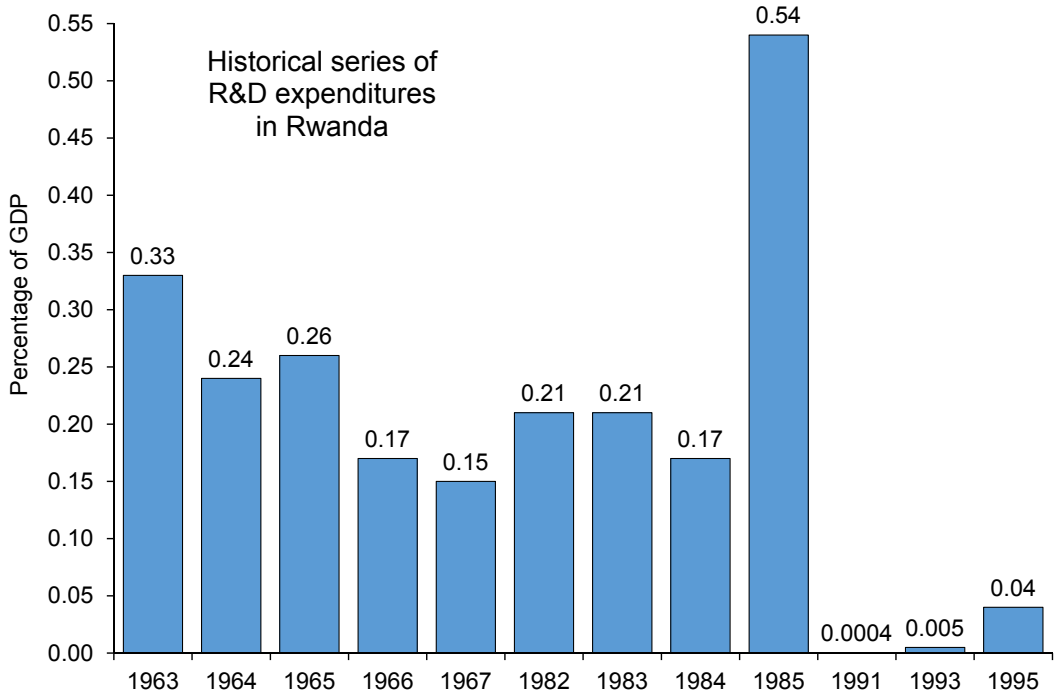


Figure 29: Historical series of R&D expenditures in Rwanda, several years between 1963 and 1995. Source: UNESCO Statistical Yearbook (1972, 1982a, 1998)

17 Presentation of Dr Marie Christine Gasingirwa, Director General for Science, Technology and Research, Rwanda Ministry of Education, First Regional Conference on Bio-Innovate, See: http://bioinnovate-africa.org/component/joomarticle/item/142-rwanda-seek-science-technology-and-innovation-policies-to-sustain-growth

Table 28: Characteristics of R&D expenditures in agriculture sciences, 2005–2011

FTE researchers' spending	2005	2006	2007	2008	2009	2010	2011
Total, public [million constant 2005 PPP$]	18.6	18.8	18.9	20.2	21.8	23.4	27.2
Total, public [million constant 2005 US$]	6.2	6.3	6.3	6.8	7.3	7.8	9.1
Total, public [million constant 2005 LCU]	3 472.1	3 501.9	3 515.9	3 768.0	4 057.9	4 358.5	5 071.5
As a share of Agriculture GDP [%]	0.6	0.6	0.6	0.6	0.6	0.6	0.7
Salaries [% of total spending]	...	...	...	...	...	44.2	40.2
Operating and program costs [% of total spending]	...	...	...	...	...	51.1	54.2
Capital investments [% of total spending]	...	...	...	...	...	4.7	5.6
FTE researchers' funding							
Government [% of total funding]	...	...	...	...	...	52.5	55.4
Donors and development banks [% of total funding]	...	...	...	...	...	38.8	39.2
Sales of goods/services [% of total funding]	...	...	...	...	...	8.7	5.4

Note: financial data exclude the higher education sector.

Source: Agricultural Science and Technology Indicators (ASTI) database

R&D ACTIVITIES, SCIENTIFIC AND TECHNOLOGICAL SERVICES (STS) AT THE UNIVERSITY OF RWANDA THROUGH INTERNATIONAL CO-OPERATION

Unlike department-based research institutes or public research institutes, the primary function of higher education Institutions is teaching, not research, which is the secondary function of most universities. In many developing countries, the higher education Institutions are the main seat of R&D activity. After the 2013 after the reorganization of the public higher education system in Rwanda, the University of Rwanda became the most important research university in the country. Box 11 presents a set of widely-accepted definitions to estimate the R&D expenditures within a higher education institution (UNESCO Institute for Statistics, 2014).

As it was mentioned before, the Government of Rwanda is planning to implement in 2015 a new R&D survey. As a result, accurate data on R&D expenditures by sector (public, business, higher education and private non-profit) is expected.

In general, the sources of funding for R&D activities in a higher education institution are composed income from endowments, shareholdings, property, student fees and subscriptions to own journals, direct grants from national, federal state, provincial and local government, funds from government research institutes, national agencies funding (i.e. research and innovation funds), domestic business including industry funds, other national sources, such as other higher education institutions, not-for-profit organizations and donations and bequests from individuals (see Box 11). In Africa, foreign R&D investment usually contributes an extensive part of the total.

Table 29 presents an inventory of the Memoranda of Understanding of the University of Rwanda, recently signed to support R&D activities, as well as scientific and technological services. The table also provides information on international participating organizations, brief descriptions of each individual project, and fund amount.

BOX 11 – DEFINITION AND CALCULATION OF IN-HOUSE R&D EXPENDITURE AT HIGHER EDUCATION INSTITUTIONS

A higher education institution is –for the purposes of a survey— considered a 'unit'. It may have expenditures on R&D either within the unit (intramural) or outside it (extramural).

Intramural expenditures are all expenditures for R&D performed within a statistical unit or sector of the economy during a specific period – whatever the source of funds. Expenditures made outside the higher education institution but in support of intramural R&D (e.g. purchase of supplies for R&D) are included.

Extramural expenditures are the sums the unit has paid or committed itself to pay to another unit (or organization or sector) for the performance of R&D during a specific period. This includes acquisition of R&D performed by other units, and grants given to others for performing R&D.

Annual R&D expenditure data should be compiled based on performers' reports. As supplementary information, the review of trace records of extramural expenditures is desirable.

R&D expenditure is broken down into two major accounting categories – namely, current expenditure and capital expenditure.

Current expenditures

Current expenditures are principally composed of:

Labour costs of R&D personnel: annual wages and salaries and all associated costs or fringe benefits. If R&D is not the primary function of certain persons, the R&D coefficients derived from time-use studies or other methods could be used directly at an appropriate level (i.e. individual, institute, department, university, etc.) to estimate the share of R&D in total labour costs.

Other current costs: encompass non-capital purchases of materials, supplies and equipment to support R&D, including water, gas and electricity; books, journals, reference materials, subscriptions to libraries, scientific societies, etc.; materials for laboratories such as chemicals or animals; costs for on-site consultants; administrative and other overhead costs (e.g. office, insurance, post and telecommunications); costs for indirect services (e.g. security, storage, computer services, printing of R&D reports and the use, repair and maintenance of buildings and equipment); and labour costs of non-R&D personnel.

Current expenditures include (but not limited to):

- Direct project costs, project consumables and running costs linked to research, such as materials, fuels and other inputs, including telephone and printing.
- Subsistence and travel expenses.
- Repair and maintenance expenses.
- Payments to outside organizations for use of specialised testing facilities, analytical work, engineering or other specialised services in support of R&D projects carried out by this reporting unit.
- Commission/consultant expenses for research projects carried out by this reporting unit.
- The relevant percentage of indirect and institutional costs and utility costs, such as rent, space charge, leasing and hiring expenses, furniture, water, electricity and any other overhead costs.
- The relevant percentage of labour costs of persons providing indirect services such as the head office, human resources, finances, security and maintenance personnel as well as staff of central libraries and IT departments.

Where current expenses such as direct project costs and consumables are used solely for R&D, allocate the full cost of the items. If these current expenses are used for more than one activity, include only an estimate of the portion used for R&D. Only where such an estimate of the portion used for R&D is not available, such as indirect and utility costs and labour costs of staff providing indirect services, it is advised that respondents apply the percentage time that researchers in the reporting unit spent on R&D to the total of these current expenditures. For example, if a faculty's income and expenditure statement shows that the current expenditure for indirect and utility costs and labour costs of staff providing indirect services for the year was US$ 1 250 000 and that researchers on average spent 22% of their time to R&D, then this component of R&D current expenditure may be estimated as 0.22 x US$ 1 250 000 = US$ 275 000.

Exclude from current expenditures:

- Contract R&D expenses where the research project is carried out elsewhere by others on behalf of this reporting unit.
- Payments for purchases of technical expertise (goodwill).
- Licence fees.
- Depreciation provisions.

Capital expenditures

Capital expenditures are the annual gross expenditures on fixed assets used in the R&D programmes of the unit. They include:

- land and buildings;
- instruments and equipment; and
- computer software.

The full cost of capital expenditures must be reported in the year of purchase (do not depreciate).

Capital expenditures include – but are not limited to:

- Expenditure on fixed assets used in the R&D programmes of the unit.
- Acquisition of software, including license fees, expected to be used for more than one year.
- Purchase of databases expected to be used for more than one year.
- Major repairs, improvements and modifications to land and buildings.

Where a capital expenditure is used solely for R&D, allocate the full cost of the item. If the capital expenditure is used for more than one activity, include only an estimate of the portion used for R&D. For example, a new piece of equipment will be used for R&D (included), testing (excluded) and quality control (excluded). If the intended use of this new equipment for R&D purposes is 40% of the total usage (i.e. the other 60% for other activities), only 40% of the total equipment cost should be considered as relevant R&D expenditure. Only where such an estimate of the portion used for R&D is not available, apply the percentage time that the unit's researchers spent on R&D to the cost of the item.

Exclude from capital expenditures:

a) Other repairs and maintenance expenses.
b) Depreciation provisions.
c) Proceeds from the sale of R&D assets

Source: UNESCO Institute for Statistics (2014)

Table 29: Memoranda of Understanding of the University of Rwanda to support R&D and STS activities

Project name	Area of support by each cooperation	Agreement date	Funder	Agreed contract amount	Fund Currency	College where each project belongs
SPH Training Health Researchers into Vocational Excellence Project	Training Health Researchers into Vocational Excellence	2009–2014	Training Health Researchers into Vocational Excellence	244 469	Pound	CMHS*
SPH BTC–CTB	Scientific support	2011–2012	Belgian Development Agency (BTC)	62 460	Euro	CMHS*
APPEAR	To promote professional social work education and practice to more effectively contribute towards social development and poverty reduction in achieving the Millennium Development Goals in East Africa	March, 2011–Feb, 2014	Austrian Development cooperation	19 075	Euro	CASS*
European Union through EU FP7 – Healthy futures	Healthy, environmental change and adaptive capacity: mapping, examining and anticipating future risks of water-related vector-borne diseases in eastern Africa	2011–2014	European Union	330 440	Euro	CST*
CGIS ESRI Germany	GIS Software site license and management support	2009 – 2013	ESRI (private company)	209 880	Euro	CST*
NICHE/RWA/071	Strengthen the capacity of the University of Rwanda to provide quality education, research and consultancy	1st April 2011 – 31st March 2015	Netherlands Organisation for International Cooperation in Higher Education	1 800 000	Euro	CST*
Liege University under sponsor of European Union, EDULINK PROJECT	Financing Postgraduate Studies in Pharmaceutical Sciences	2010–2013	EDULINK	122 886	Euro	CMHS*
Conseil Inter Universitaire Francophone / Belgium	Supports capacity building of the Faculties of Applied Science. It also support the UR ICT and Research and Postgraduate Studies Unit for post–doctoral scholarships	2010–2014	Conseil Interuniversi-taire de la Communauté Française (CIUF)	1 320 000	Euro	All Colleges
GLMC-European Union.	To Support Great Lakes Media Council in Rwanda	2011–2014	European Union	500 000	Euro	CASS*
Ulg-UCL/CUD-CIUF	(a) Establishment of a unit of analysis ensuring the quality control and the development of drugs or not and the toxicant research (b) to reinforce the capacity of research and formation of the department of Pharmacy	2007–2014	Conseil Interuniversi-taire de la Communauté Française (CIUF)	370 000	Euro	CMHS*
SPARK	Entrepreneurship education and development.	2011-2014	USAID	50 000	Euro	CBE*
PIC project	To Support Research training	2010-2015	Belgium	19 000	Euro	CMHS*

Project name	Area of support by each cooperation	Agreement date	Funder	Agreed contract amount	Fund Currency	College where each project belongs
BTC-CTB	Etude de guidance scientifique pour le passage à un programme integré de la coopération Belgo-rwandaise dans le secteur de santé	2008-2014	Belgian Development Agency (BTC)	2 111 111	Euro	CMHS*
Rubarn Africa project	Research on exploring connections between rural transformation , mobility , and urbanization process	2012-2016	European Union	162 960	Euro	CST*
ARISE-Network Project	Research and Training Centre	2012–2016	Netherlands Organisation for Scientific research	242 913	Euro	CMHS*
Social Sciences and Humanities Research Council	Research in areas of Social worker	2013–2015	Social Sciences and Humanities Research Council	102 711	Euro	CASS*
SIDA Research Collaboration	Research Cooperation	2007–2014	Swedish International Development Cooperation Agency (SIDA)	249 000 000	SEK	All Colleges
SPH Rockefeller Project	Establishing a Centres of Excellence for Strengthen Health Care	2011 – 2014	Rockfeller Foundation	964 340	US$	CMHS*
SPH CDC Project	Supporting the UR/SPH to improve Quality of HIV/AIDS and Health Service Delivery to the population of Rwanda	2010-2015	Centres for Diseases Control and Prevention (CDC)	3 232 000	US$	CMHS*
SPH Global Fund Project	Single stream of Funding SSF/HIV/AIDS 2010–2013	2010–2013	Global Fund	846 000	US$	CMHS*
SPH PHIT Project	MPhil/PhD Program Coordination (Capacity Building Project.)	2010–2015	Rwanda Population Health Implementation and Training (PHIT)	559 316	US$	CMHS*
UNICEF and RBC	Impact Assessment of the PMTCT program at six weeks in Rwanda	2010 – 2012	UNICEF	619 386	US$	CST*
Association of Africa Universities	To raise HIV awareness in higher learning Institutions of CASRN	2011–2014	Association of African Universities	55 000	US$	CASS*
MacArthur Foundation	Enhancing capacity building for conservation and climate change adaptation in Albertine Rift Region	2012–2014	MacArthur Foundation	250 000	US$	CBE*
MIS Rockefeller Foundation	To support development of MIS	2007–2014	Rockefeller Foundation	304 000	US$	CASS*
Sharing growth through informal employment in East and Southern Africa project	Research Inform employment	2012–2014	International Development Research Centre (IDRC)	167 000	US$	CASS*

Project name	Area of support by each cooperation	Agreement date	Funder	Agreed contract amount	Fund Currency	College where each project belongs
Trust Africa IDRC	Study on SMEs In Rwanda	2012–2013	International Development Research Centre (IDRC)	44 525	US$	CASS*
USAID	To asses and document social economic and environment effects of land used consolidation in Rwanda	2013–2014	USAID	109 658	US$	CASS*
Simulation Centre Project	Dalhousie University	2012–2014	Dalhousie University	45 850	US$	CMHS*
Rwanda women leadership program in agriculture	To strengthen women research in Agriculture	2013–2015	USAID	631 180	US$	CAVM*
Engaging graduate students in achieving health infant growth	Western Ontario	2012-2014	Research Project	7 530	US$	CMHS*
HRH Project	Contribution to residency stipend	2013–2014	Centres for Diseases Control and Prevention (CDC) and Committee on Agriculture (COAG)	371 071	US$	CMHS*
Centre for Global Health at Aarhus University	Mutual educational and scholarly interest	2012–2016	Denmark – The Centre for Global Health at Aarhus University	23 353	US$	CMHS*
MHA	Master of Hospital Administration (MHA) Program	2012–2019	Ministry of Health–Single project implementation unit	471 383	US$	CMHS*
GCC Project	Implementing Research on Hypertension in Low and Middle Income Countries	2013–2018	Grand Challenge Canada (GCC)	552 396	US$	CMHS*

Note: CST: College of Science and Technology; CBE: College of Business and Economics CAVM: College of Agriculture, Animal Sciences and Veterinary Medicine; CE: College of Education; CMHS: College of Medicine and Health Sciences, and CASS: College of Arts and Social Sciences

Source: University of Rwanda

A scientometric analysis of Rwanda

Basic research is usually carried out in universities or other academic institutions. The traditional method used to measure or assess the results of academic research uses bibliometric indicators. Bibliometrics is a general term for the inventory and statistical analysis of articles, publications and citations and other more complex indicators of scientific production derived from such statistics. Bibliometric indicators are important tools for assessing R&D, performance and the specialization of countries, institutions, laboratories, universities, thematic areas and individual scientists. As with any indicator, they are not faultless and should, therefore, be interpreted with caution.

The procedure for assessing the impact of industrial R&D is essentially based on an analysis of patent statistics and, when it comes to the impact of industrial R&D on trade, based on an analysis of high-tech products, as well as through studies of the trade balance of high-tech items for each country.

Both bibliometric analyses and patent statistics are included in a discipline known as scientometrics. At present, thanks to exponential growth in our data-processing capacity, it is possible to prepare sophisticated multidimensional indicators on the production of scientific articles in all disciplines, from exact sciences to humanities. Moreover, very precise analyses can be made of the impact of publications, the state-of-the-art of knowledge in various subject areas in each country, the level of co-operation in terms of co-authorship of publications, co-citations, the creation and evolution of scientist networks ('invisible colleges'), etc. By analysing cross-references used in patent applications or by cross-referencing information published in scientific literature, we can use bibliometrics to examine the links between STI and patents (Lemarchand, 2010).

One of the most relevant sources of information about the productivity of scientific knowledge is accessible through international databases (Lemarchand, 2013). This type of information is not usually open access. In particular, a very well established class of indicators about scientific production can be estimated by counting the number of articles and citations published in mainstream journals. One of the most complete databases is the Web of Science, which includes the Science Citation Index (SCI), Social Science Citation Index (SSCI) and Arts and Humanities Citation Index (A&HCI). The latter is now maintained by Thomson-Reuters, a private company, and covers 12 000 peer-reviewed journals. The other major database is SCOPUS, which is maintained by Elsevier Science and covers 18 000 peer-reviewed journals.

An analysis of the aggregated temporal evolution in the data available at the Web of Science shows a homogeneous trend that is independent of any academic discipline and avoids any substantial change in national trends, owing to the continual incorporation of new journals in the databases. In this way, it is also possible to study the evolution in cooperation patterns among countries and institutions, search for the most developed disciplines and analyse the impact of scientific research based on how other scientists have made use of this material.

Not all Rwandan scientists submit their research results to mainstream journals listed by the Web of Science. Therefore, the existence of local and regional journals in several countries may reflect some peculiar domestic circumstances or a specific national scientific agenda that are not considered by the mainstream journals. For this reason, publication in mainstream journals represents only a fraction of the total scientific production of any particular country. The main advantage of using these databases is that they have been systematically collected and organized over several decades using similar methodologies, allowing us to perform a long-term analysis with a relatively high level of confidence (Lemarchand, 2012).

In spite of the drawback of underrepresented local and regional journals, it can be argued that there is a good correspondence among Web of Science database (SCI Extended, SSCI, A&HCI) and other international databases on scientific knowledge production. De Moya-Anegón and Herrero-Solana (1999) and Lemarchand (2012) have shown a strong correlation in the distribution of citable articles between the Science Citation Index Extended and other databases like PASCAL, INSPEC, COMPENDEX, CHEMICAL ABSTRACTS, BIOSIS, MEDLINE and CAB. They have obtained the following values for the correlation coefficient (R) among the different databases: $0.957 \leq R \leq 0.997$. This finding supports the hypothesis that the combination of SCI Extended, SSCI and A&HCI, listed by the Web of Science database, is a good indicator for any study of mainstream scientific knowledge production and trends in co-authorship networks among different countries.

At this point, it is important to take into account that, during the period analysed here (1966–2013), the number of journals has expanded substantially and, consequently, so has the total number of published articles included in the Web of Science database. Mabe (2003) showed that journal growth rates have been remarkably consistent over time, with average rates of 0.034 since 1800 to the present day. This study presents evidence that, during the entire 20th century, these growth phenomena appear to show a system that is self-organizing and in equilibrium, with a 0.032 growth constant. Considering that the Web of Science database includes only a fraction of all the new journals that are published, the growth rate for databases should be even smaller than that estimated by Mabe (2003).

Lemarchand (2012, 2015) has developed a mathematical model showing the proportionality between the size of the national scientific network (e.g. number of FTE researchers in a country) and the corresponding scientific productivity (in terms of the aggregate number of publications per year and the number of co-authored scientific articles between pairs of countries). In this way, the productivity of scientific articles over time is a good proxy for estimating the extent of growth in the number of full-time-equivalent researchers.

In recent years, several studies on scientometric productivity among African countries were performed by several research groups and international organisations (Adams *et al.*, 2010; Pouris, 2010; AU-NEPAD, 2011; Onyancha and Maluleka, 2011; Toivanen and Ponomariov, 2011; AOSTI, 2013; UNESCO, 2013, 2014a, 2014b; Nature Index Africa, 2014; NPCA, 2014; World Bank and Elsevier, 2014).

The number of Rwanda's scientific publications listed by international databases (i.e. Web of Science, SCOPUS, etc.) has evolved in recent decades. In 2013, Rwanda occupies the 125th rank in the world and the 25th rank in Africa. Table 30 shows the distribution of mainstream scientific publications, number of citations, citations per article, H index[18], world ranking and African ranking for 53 African countries.

Between 1996 and 2013, Rwanda produced 1 061 scientific publications listed by SCOPUS which received 8 700 citations, where 767 were self-citations. The average number of citations per article was 14.08. Rwanda's H index for this period was 43, placing it 145nd in the world.

Table 30: Distribution of mainstream scientific publications, citations, H index and regional and global ranks for all African countries, 2013

Country	Articles	Citable articles	Citations	Self-Citations	Citations per article	H* index	African rank	World rank
South Africa	15 181	14 180	8 224	2642	0.54	260	1	34
Egypt	13 554	12 908	4 339	1407	0.32	148	2	38
Tunisia	5 672	5 242	1 175	358	0.21	97	3	51
Nigeria	4 926	4 628	834	217	0.17	103	4	53
Algeria	4 561	4 400	798	271	0.17	89	5	54
Morocco	3 577	3 240	1 202	349	0.34	109	6	57
Kenya	1 955	1 858	1 153	274	0.59	149	7	65
Ethiopia	1 365	1 310	461	134	0.34	82	8	77
Ghana	1 133	1 048	508	92	0.45	82	9	81
Uganda	1 076	1 012	706	152	0.66	111	10	83
Tanzania	993	933	657	134	0.66	102	11	85
Cameroon	975	936	444	96	0.46	78	12	87
Sudan	657	634	156	27	0.24	58	13	96
Senegal	576	535	213	54	0.37	83	14	98
Zimbabwe	430	411	245	35	0.57	81	15	105

18 The H index is an indicator of the impact of an individual's scientific output and also, in an aggregate manner, that of institutions and countries (Hirsch, 2005).

Malawi	423	393	408	54	0.96	89	16	106
Libyan Arab Jamahiriya	411	397	112	22	0.27	41	17	108
Benin	386	371	137	53	0.35	55	18	109
Burkina Faso	377	368	171	30	0.45	71	19	112
Botswana	354	331	100	10	0.28	63	20	113
Zambia	344	319	289	62	0.84	75	21	115
Congo	331	311	221	25	0.67	56	22	116
Côte d'Ivoire	306	295	122	29	0.40	76	23	118
Madagascar	256	244	128	39	0.50	62	24	122
Rwanda	232	210	143	34	0.62	43	25	125
Mozambique	218	203	179	22	0.82	60	26	126
Namibia	211	199	135	28	0.64	62	27	127
Mauritius	207	193	64	18	0.31	45	28	128
Mali	196	187	196	18	1.00	59	29	131
Gabon	156	147	91	15	0.58	67	30	133
The Gambia	149	134	239	10	1.60	85	31	134
Togo	126	117	32	5	0.25	33	32	139
Niger	104	100	74	8	0.71	51	33	147
Swaziland	90	86	40	4	0.44	35	34	150
Angola	62	61	24	3	0.39	28	35	161
Seychelles	46	44	23	3	0.50	38	36	165
Democratic Republic Congo	45	41	22	2	0.49	33	37	166
Sierra Leone	45	41	27	1	0.60	23	38	167
Mauritania	41	39	9	2	0.22	28	39	168
Guinea	39	37	10	1	0.26	37	40	169
Burundi	38	37	5	1	0.13	26	41	170
Central African Republic	37	31	16	0	0.43	36	42	172
Lesotho	37	36	48	10	1.30	23	43	174
Guinea-Bissau	35	34	12	3	0.34	44	44	176
Cape Verde	33	28	18	3	0.55	13	45	178
Liberia	29	27	10	2	0.34	16	46	179
Eritrea	26	24	11	2	0.42	28	47	184
Chad	25	24	8	1	0.32	29	48	187
Comoros	20	18	2	0	0.10	11	49	189
Djibouti	17	17	5	1	0.29	15	50	192
Somalia	14	12	4	0	0.29	13	51	198
Equatorial Guinea	9	9	4	0	0.44	17	52	205
São Tomé and Príncipe	4	3	4	0	1.00	15	53	215

Source: SCOPUS database (December 2014)

Figure 30 presents the long-term evolution in the number of scientific articles listed in the SCI Extended, SSCI and A&HCI between 1973 and 2013. After reaching a peak of 38 publications in 1992, the number of published articles in mainstream journals decreased linearly to a lowpoint of 6 papers in 2000. Since then the number of scientific publications listed in the WoS shows exponential growth.

Figure 31 shows the evolution in scientific articles listed at the SCI Extended, SSCI and A&HCI between 1970 and 2013 per million-inhabitants. This indicator is a proxy for measuring the level of societal interest in promoting the creation of knowledge. The shape of this curve follows the same mathematical function shown in the previous figure. Until today, the highest peak was reached in 2013 with 15.7 publications per million population.

The last survey of R&D indicators in Rwanda was done in 2009, listing 306 FTE researchers[19] or 29 FTE researchers per million inhabitants. Each FTE researcher published an estimated 0.29 scientific articles in mainstream journals in 2009. This is equivalent to each FTE researcher publishing just one article every 3.4 years. This is a relatively low individual productivity compared with other countries of the region (UNESCO, 2013, 2014a, 2014b).

Over the years, the specialized literature has tended to assume that there is a high correlation between the number of publications per million population and GDP per capita in different countries (Konrad and Wahl, 1990; Ye, 2007). This correlation has been tested in several empirical studies by applying different mathematical models (Lemarchand, 2012), including for African countries (UNESCO, 2013, 2014a, 2014b). Figure 32 shows that, in the case of Rwanda, this correlation is relatively good (R2=0.86), following a parabolic mathematical relation. This means that any increment (or other type of variation) in one unit of GDP per capita would generate a change in the number of scientific publications per million inhabitants (λ) approximately equal to $\lambda = [0.00039\ \alpha^2 - 0.201\ \alpha + 27.792]$, where α is GDP per capita. Slowness of improvement relative to that of GDP can be explained by the absence of financial incentives and adequate policy instruments to promote research and innovation in Rwanda. In this context, the evolution in the number of scientific publications over time will be more strongly related to other incentives affecting an individual scientist, who may, for example, need to publish in order to advance in in a career. The observed growth in the number of publications since year 2000 relates to the fact that an increasing majority of these articles (around 85%) have been co-published with other countries (see Figure 33 and Table 31).

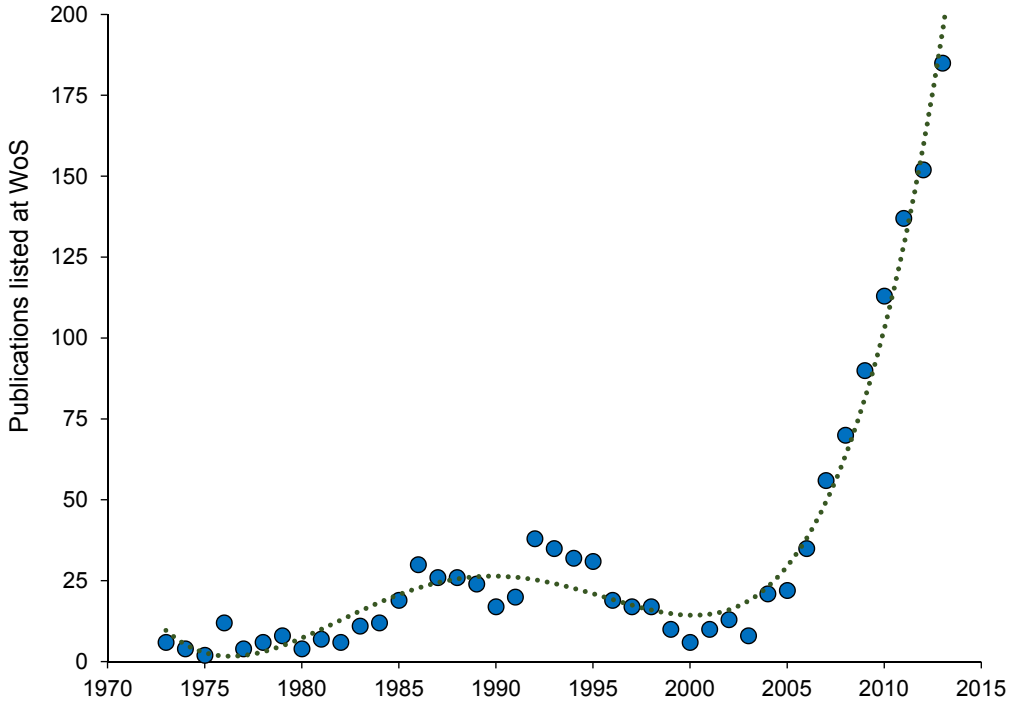


Figure 30: Evolution in number of scientific publications listed by the Web of Science for Rwanda, 1973–2013. The dotted line indicates the best-fitting curve. Source: UNESCO, based on data provided by Web of Science

19 As it was explained in previous section (see page 87) this value is an estimation based on the combination of FTE researchers within the higher education sector and the government sector (agriculture research).

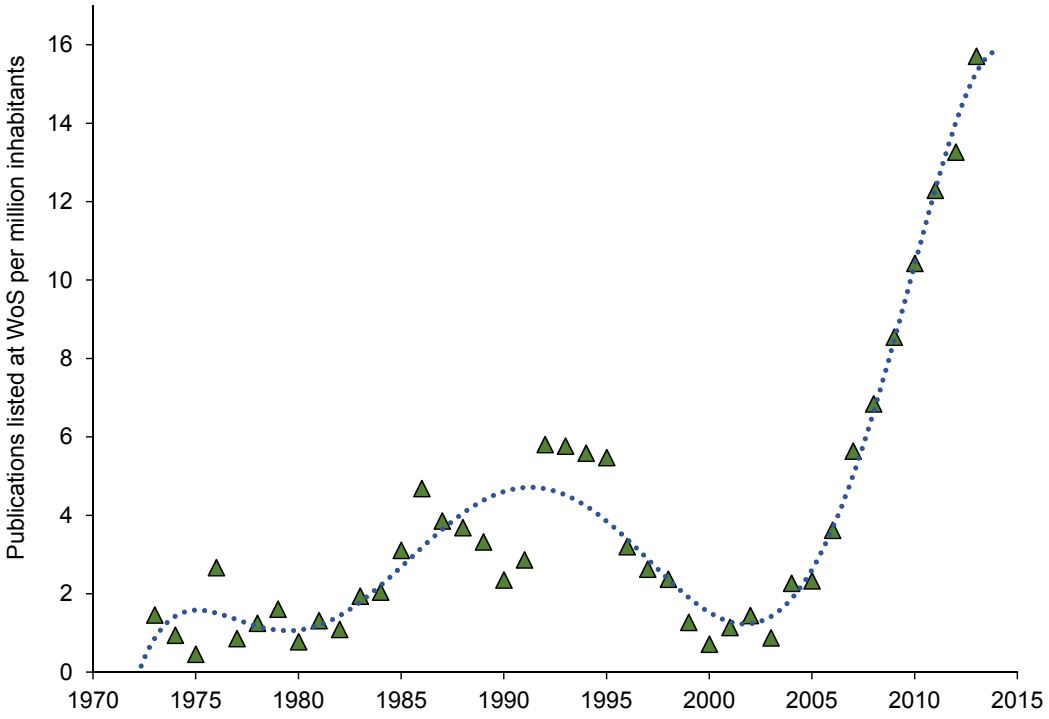


Figure 31: Evolution in the number of scientific publications per million inhabitants in Rwanda, 1973–2013. The dotted line indicates the best-fitting curve. Source: UNESCO, based on data provided by Web of Science and UN Statistics Division

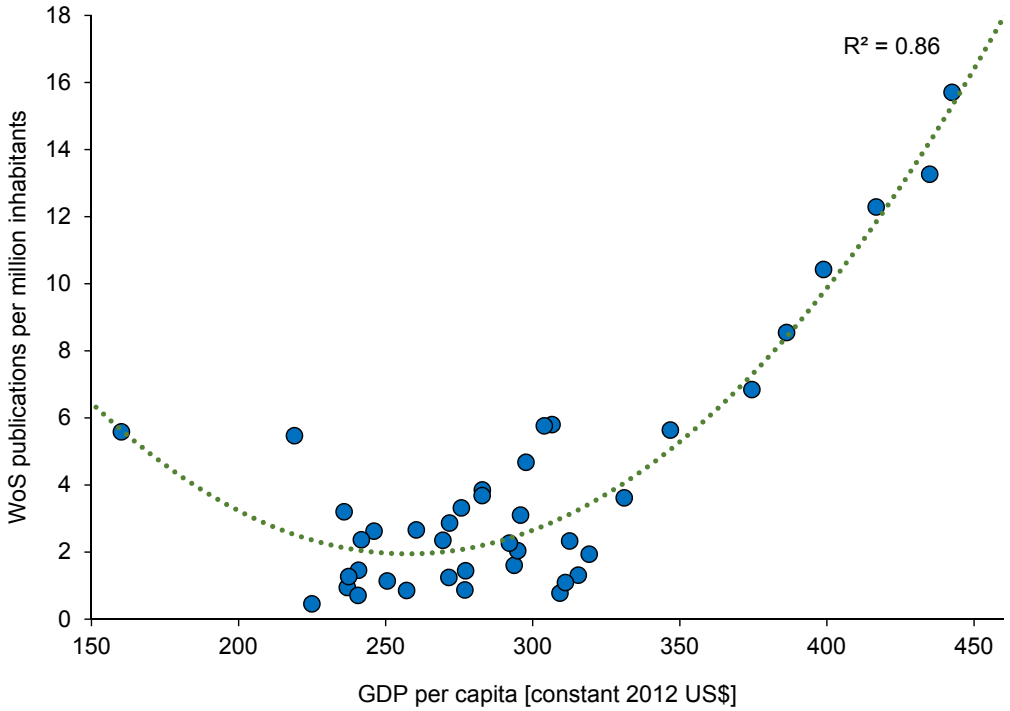


Figure 32: Quadratic correlation between GDP per capita in constant US$2012 and the number of scientific publications listed by Web of Science per million population, 1973–2013. Source: UNESCO

Figure 33 shows the internationalization of Rwanda's publications. In the past decade, between 71.4% and 99% of all scientific articles have been co-published with authors from abroad.

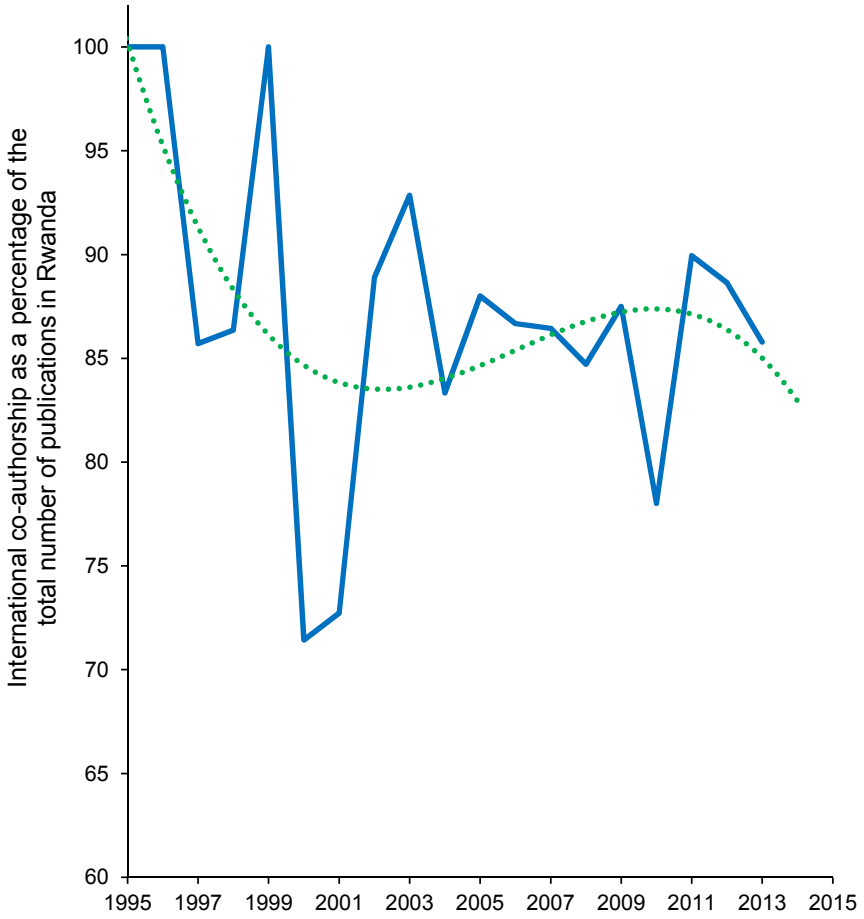


Figure 33: Evolution in international collaboration in scientific publications as a share of total annual publications in Rwanda. The dotted line is the best-fitting curve. Source: UNESCO, based on data provided by Web of Science

Table 31 shows the distribution of co-authored articles with Rwanda for the 30 most important partners over four different periods. A quick analysis shows how rapidly co-authorship has increased. In the first 11-year period between 1973 and 1983, the total amount of articles was very small (70) and Belgium was the top partner, sharing 32.9% of publications, followed by the United Kingdom (11.4%), the Netherlands and Canada (2.9%)). In the period 1984–1993, with a total production of 247 articles, again Belgium had become the top partner (35.2%), followed by the USA (16.6%), France (12.1%), Switzerland (4.9%) and Spain (3.2%). Over the third decade period (1994–2003), the top partner was the USA (37.4%), followed by Belgium (23.3%), France (20.2%), the United Kingdom (14.1%) and Switzerland (7.4%). During the most recent decade (2004–2013), the USA attained the top position (40.3%), followed by Belgium (19%), the United Kingdom (14.6%), Uganda (10.6%) and the Netherlands (10%).

Table 31: Countries with which Rwandan scientists co-authored mainstream scientific publications, 1973–2013

Rank	1973–1983			1984–1993			1994–2003			2004–2013		
	Country	Pub	Share of total [%]	Country	Pub	Share of total [%]	Country	Pub	Share of total [%]	Country	Pub	Share of total [%]
	Rwanda	70	100.0%	Rwanda	247	100.0%	Rwanda	163	100.0%	Rwanda	881	100.0%
1	Belgium	23	32.9%	Belgium	87	35.2%	USA	61	37.4%	USA	355	40.3%
2	UK	8	11.4%	USA	41	16.6%	Belgium	38	23.3%	Belgium	167	19.0%
3	Netherlands	2	2.9%	France	30	12.1%	France	33	20.2%	UK	129	14.6%
4	Canada	2	2.9%	Switzerland	12	4.9%	UK	23	14.1%	Uganda	93	10.6%
5	Zimbabwe	1	1.4%	Spain	8	3.2%	Switzerland	12	7.4%	Netherlands	88	10.0%
6	USA	1	1.4%	Germany	7	2.8%	Cote d'Ivoire	12	7.4%	Kenya	86	9.8%
7	Spain	1	1.4%	Peru	5	2.0%	Netherlands	11	6.7%	South Africa	79	9.0%
8	South Africa	1	1.4%	Japan	4	1.6%	Germany	11	6.7%	Zambia	64	7.3%
9				Rep. Dem. Congo	3	1.2%	Uganda	8	4.9%	Germany	56	6.4%
10				UK	3	1.2%	Zambia	6	3.7%	France	47	5.3%
11				Zimbabwe	2	0.8%	Kenya	5	3.1%	Tanzania	42	4.8%
12				Philippines	2	0.8%	Brazil	5	3.1%	Switzerland	34	3.9%
13				Netherlands	2	0.8%	Spain	4	2.5%	Canada	26	3.0%
14				Italy	2	0.8%	Rep. Dem. Congo	3	1.8%	Italy	22	2.5%
15				Colombia	2	0.8%	Thailand	3	1.8%	Luxembourg	21	2.4%
16				Canada	2	0.8%	South Africa	3	1.8%	Sweden	20	2.3%
17				Sweden	1	0.4%	Canada	3	1.8%	Cameroon	19	2.2%
18				Saudi Arabia	1	0.4%	Bangladesh	3	1.8%	Rep. Dem. Congo	18	2.0%
19				Mali	1	0.4%	Australia	3	1.8%	Burkina Faso	18	2.0%
20				Kenya	1	0.4%	Tunisia	2	1.2%	India	17	1.9%
21				Ethiopia	1	0.4%	Sweden	2	1.2%	Zimbabwe	15	1.7%
22				Cote d'Ivoire	1	0.4%	Italy	2	1.2%	Nigeria	14	1.6%
23				Congo People Rep	1	0.4%	Burundi	2	1.2%	Ghana	14	1.6%
24				Cameroon	1	0.4%	Zimbabwe	1	0.6%	Australia	13	1.5%
25							Ukraine	1	0.6%	Mozambique	12	1.4%
26							Tanzania	1	0.6%	Mali	12	1.4%
27							Senegal	1	0.6%	Congo	12	1.4%
28							Russia	1	0.6%	China	11	1.2%
29							Papua New Guinea	1	0.6%	Gabon	11	1.2%
30							Norway	1	0.6%	Burundi	11	1.2%

Source: UNESCO, based on articles listed at the Science Citation Index Extended, Social Science Citation Index and Arts & Humanities Citation Index

Table 32 shows the 25 most productive institutions in Rwanda in terms of scientific articles included in the SCI Extended, SSCI and A&CI from 1973 to 2013. The National University of Rwanda[20] has been the country's leading institution for the production of scientific articles only in two periods 1973–1983 (54.3% of the publications) and 2004–2013 (26.1% of the publications). This is a very different than the performance shown by other countries of the region like Botswana, Malawi and Zimbabwe (UNESCO, 2013, 2014a, 2014b). In these countries, the national universities dominated the production of scientific articles over all periods, with shares above 50% of national publications.

The other relevant institutions with shares over 10% of the total national scientific publications were: the Central Hospital of Kigali, Karisoke Research Centre, the National AIDS Control Programme and more recently the Ministry of Health. This is consistent with the fact that the most important research topics are related to medical and health sciences (see Table 34 and Figure 34).

Table 32: Distribution of mainstream scientific publications in Rwanda, by national institution and laboratory, 1973–2013

Rank	1973–1983			1984–1993			1994–2003			2004–2013		
	Institution	Pub	Share of total [%]	Institution	Pub	Share of total [%]	Institution	Pub	Share of total [%]	Institution	Pub	Share of total [%]
	Rwanda	70	100.0%	Rwanda	247	100.0%	Rwanda	163	100.0%	Rwanda	881	100.0%
1	National University of Rwanda	38	54.3%	Central Hospital Kigali	103	41.7%	National AIDS Control programme	43	26.4%	National University of Rwanda	230	26.1%
2	Central Hospital Kigali	12	17.1%	National University of Rwanda	66	26.7%	Central Hospital Kigali	40	24.5%	Rwanda Ministry of Health	105	11.9%
3	Karisoke Research Centre	8	11.4%	National AIDS Control programme	41	16.6%	National University of Rwanda	36	22.1%	Project San Francisco	52	5.9%
4	Ruhengeri Hospital	3	4.3%	Rwanda Ministry of Health	16	6.5%	Ministry of Health	14	8.6%	Rwanda Biomed Centre	29	3.3%
5	Rwanda Tourisme & Parcs Nationaux	3	4.3%	Hospital Nemba	9	3.6%	Institute Sci. Agron. Rwanda	9	5.5%	Kigali Institute of Science and Technology	29	3.3%
6	Institute Sci. Agron. Rwanda	2	2.9%	Project San Francisco	8	3.2%	Institute for Research, Science and Technology	7	4.3%	Project Mu Buzima	25	2.8%
7	Institute Trop. Med.	2	2.9%	Institute Sci. Agron. Rwanda	6	2.4%	Project San Francisco	6	3.7%	Partners Health Rwanda	24	2.7%
8	Vet. Res. Lab.	2	2.9%	Ministry of Agriculture	4	1.6%	Mt Gorilla Vet Centre	4	2.5%	Kigali Institute of Education	23	2.6%
9	Hop. Kigeme	1	1.4%	Reg. Sanit. Gisenyi	3	1.2%	Centre Med. Soc. Bilyogo	3	1.8%	Kigali Health Institute	22	2.5%

20 On September 2013, a reform of the public higher education system took place (see pages 162–171). Several higher education institutions were merged and consolidated with the creation of the University of Rwanda. Table 32 represents the institutional productivity before the new affiliations appear in the scientific articles in 2014.

Rank	1973–1983			1984–1993			1994–2003			2004–2013		
	Institution	Pub	Share of total [%]	Institution	Pub	Share of total [%]	Institution	Pub	Share of total [%]	Institution	Pub	Share of total [%]
	Rwanda	70	100.0%	Rwanda	247	100.0%	Rwanda	163	100.0%	Rwanda	881	100.0%
10	Mt. Gorilla Vet. Centre	1	1.4%	Centre Int. Agr. Trop.	2	0.8%	Curphametra	2	1.2%	Rwanda Zambia HIV Research Group	22	2.5%
11	Pecherie Ihema	1	1.4%	Centre Med Soc. Nyamirambo	2	0.8%	Karisoke Research Centre	2	1.2%	Central Hospital of Kigali	18	2.0%
12				Centre Med. Soc. Bilyogo	2	0.8%	Wildlife Conservation Society Rwanda	2	1.2%	Kigali University	18	2.0%
13				Hospital Ruhengeri	2	0.8%	CRP Sante	2	1.2%	University Teaching Hospital Kigali	13	1.5%
14				Adventist University Central Africa	1	0.4%	Centre Vet Volcans	2	1.2%	Partners Health Inshuti Mu Buzima	12	1.4%
15				CIAT Rwanda	1	0.4%	Afrena Rwanda Project	1	0.6%	Int. Gorilla Conservation Program	9	1.0%
16				Centre Med Social Kanombe	1	0.4%	Byumba Hospital	1	0.6%	Rwanda Dev. Board	9	1.0%
17				Curphametra	1	0.4%	Centre Med Social Bilyago	1	0.6%	Institute Sci. Agron. Rwanda	8	0.9%
18				Damien Fund Rwanda	1	0.4%	Int. Gorilla Conservation Program	1	0.6%	Mt Gorilla veterinary Centre	8	0.9%
19				Murunda Health Centre	1	0.4%	Ministry of Education, Science, Technology and Research	1	0.6%	Rwanda Agriculture Research Institute	8	0.9%
20				Projet Carte Pedol Rwanda	1	0.4%	Nyungwe Forest Conservation Project	1	0.6%	Kanombe Mil Hospital	7	0.8%
21				Rwandese Red Cross	1	0.4%				Ruhengeri Hospital	7	0.8%
22				Sci. Agr. Inst. Rwanda	1	0.4%				Rwanda Agriculture Board	7	0.8%
23				Volcano Vet Centre	1	0.4%				Government of Rwanda	6	0.7%
24										Umutara Polytech	5	0.6%
25										Interact Rwanda	4	0.5%

Source: UNESCO, based on Web of Science articles

Figure 34 shows the distribution of publications (1996–2013) for six main research fields[21] (UNESCO, 1978; OECD, 2002): agricultural sciences; arts and humanities; engineering and technology; exact and natural sciences; medicine and health sciences and social sciences. This figure was organized in this way in order to allow comparisons with R&D input indicators for the number of graduates, number of researchers by field of science (i.e. Tables 19 and 20, page 72) and R&D expenditure, all of which were disaggregated by field of science.

Figure 34 shows that, over the past two decades, most research articles have related to medicine and health sciences (between 35% and 65%), followed by agricultural sciences (between 6% and 35%), exact and natural sciences (between 6% and 30%), social and human sciences (between 4% and 25%). The share of publications in engineering and technology has oscillated between nothing (1996–2004) and 15% (2007).

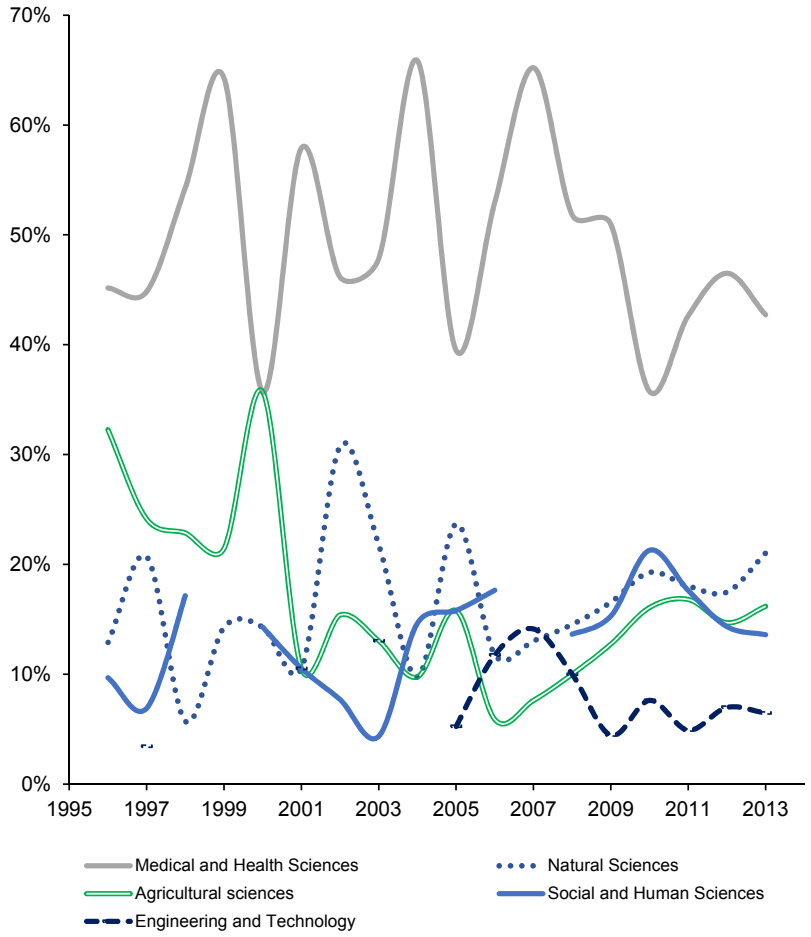


Figure 34: Distribution of publications by field of science, 1996–2013. Source: UNESCO estimation based on SCOPUS data

21 Due to the small number of published articles, in Figure 34, "arts and humanities" and "social sciences" were merged into "social and human sciences"

Figure 35 shows the distribution of graduates in Rwanda between 1996 and 2013 by main field of science. Clearly, there is no correlation between the shares of scientific publications and graduates by field of science. Taking into account the goal to transform Rwanda in a knowledge economy by 2020, these graphs show the need to increase the numberof engineers and research in engineering in order to transform the present profile of the country.

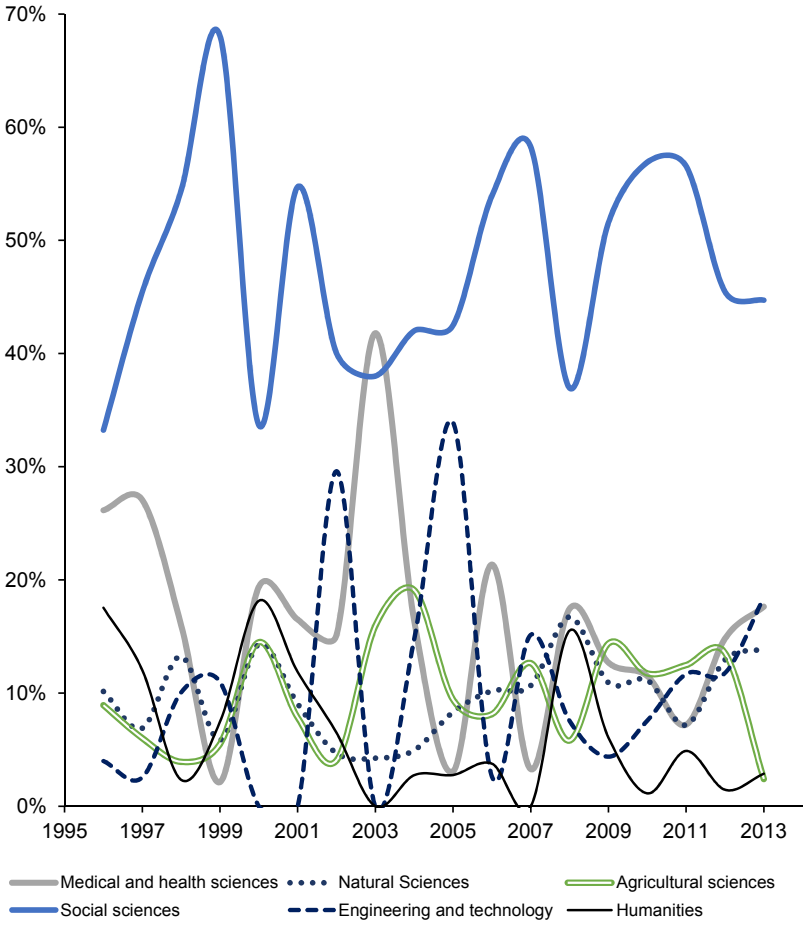


Figure 35: Distribution of Rwandan graduates by field of science, 1996–2013. Source: UNESCO based on raw data provided by the Ministry of Education of Rwanda

Table 33 presents the ten most important foreign and international research organizations responsible for co-authoring scientific articles listed in the SCI Extended, SSCI, and A&HCI. As observed in the previous tables, the diversity of institutions and the number of co-publications have increased over time. The most important collaborative ties established over a period of decades were with the Free University of Brussels, Ghent University, the University of Cambridge, the University of California, the University of Bordeaux, the *Institut national de la santé et de la recherche médicale* (INSERM), John Hopkins University and the Institute of Tropical Medicine Antwerp.

Table 33: Top ten foreign research institutions and centres co-authoring articles with Rwandan scientists, 1973–2013

Rank	1973–1983			1984–1993			1994–2003			2004–2013		
	Institution	Pub	Share of total [%]	Institution	Pub	Share of total [%]	Institution	Pub	Share of total [%]	Institution	Pub	Share of total [%]
	Rwanda	70	100.0%	Rwanda	247	100.0%	Rwanda	163	100.0%	Rwanda	881	100.0%
1	Free University of Brussels	11	15.7%	Free University of Brussels	65	26.3%	Institut national de la santé et de la recherche médicale.	23	14.1%	University of California	73	8.3%
2	Ghent University	7	10.0%	University of California	34	13.8%	University of Bordeaux	23	14.1%	Harvard University	70	7.9%
3	University of Cambridge	7	10.0%	Belgian Rwandese Med Coop	18	7.3%	Institute of Tropical Medicine	21	12.9%	Emory University	68	7.7%
4	University St Raphael	4	5.7%	Institute Trop. Med,	18	7.3%	University of California	21	12.9%	Institute Trop. Med,	51	5.8%
5	University of London	3	4.3%	Institut national de la santé et de la recherche médicale	16	6.5%	Johns Hopkins University	17	10.4%	Columbia University	49	5.6%
6	Inst Hyg Epidemiol	2	2.9%	Universite Bordeaux	16	6.5%	University of Alabama	17	10.4%	University of Amsterdam	47	5.3%
7	University of Antwerp	2	2.9%	Ghent University	13	5.3%	Belgian Rwandese Med Coop	14	8.6%	Ghent University	45	5.1%
8	Assistance Techn. Belge	1	1.4%	KU Leuven	13	5.3%	World Health Organization	12	7.4%	Free University of Brussels	42	4.8%
9	Centre University Recherche Pharmac. Med. Tradit.	1	1.4%	World Health Organization	13	5.3%	Centre Orstom Petit Bassam	10	6.1%	University of London	38	4.3%
10	Dartmouth College	1	1.4%	Johns Hopkins University	9	3.6%	State University of New York	9	5.5%	International AIDS Vaccine Initiative	33	3.7%

Source: UNESCO based on articles listed at the Science Citation Index Extended, Social Science Citation Index and Arts & Humanities Citation Index

Table 34 analyses in detail the distribution of articles by 30 sub-fields of science over four different periods between 1973 and 2013. The data show clearly that medicine and agriculture are the most important research fields in Rwanda over this 41-year period.

Table 34: Distribution of mainstream scientific articles by sub-field, 1973–2013

Rank	1973–1983			1984–1993			1994–2003			2004–2013		
	Sub-fields	Pub	Share of total	Sub-fields	Pub	Share of total	Sub-fields	Pub	Share of total	Sub-fields	Pub	Share of total
	Rwanda	70	100.0%	Rwanda	247	100.0%	Rwanda	163	100.0%	Rwanda	881	100.0%
1	General internal medicine	15	21.4%	Infectious diseases	46	18.6%	Infectious diseases	48	29.4%	Infectious diseases	174	19.8%
2	Tropical medicine	11	15.7%	General internal medicine	43	17.4%	Immunology	47	28.8%	Public environmental occup. health	144	16.3%
3	Zoology	6	8.6%	Tropical medicine	30	12.1%	Virology	29	17.8%	Immunology	107	12.1%
4	Plant sciences	6	8.6%	Immunology	30	12.1%	Public environmental occup. health	17	10.4%	Tropical medicine	100	11.4%
5	Public environmental occup. health	4	5.7%	Agriculture	28	11.3%	Agriculture	13	8.0%	Virology	92	10.4%
6	Pharmacology and pharmacy	4	5.7%	Pharmacology and pharmacy	25	10.1%	Tropical medicine	10	6.1%	General internal medicine	58	6.6%
7	Environmental sciences ecology	4	5.7%	Public environmental occup. health	24	9.7%	General internal medicine	9	5.5%	Agriculture	47	5.3%
8	Dermatology	4	5.7%	Plant sciences	21	8.5%	Plant sciences	8	4.9%	Environmental sciences ecology	44	5.0%
9	Arts & humanities	4	5.7%	Virology	20	8.1%	Paediatrics	8	4.9%	Science technology other topics	43	4.9%
10	Behavioural sciences	3	4.3%	Microbiology	18	7.3%	Environmental sciences ecology	7	4.3%	Health care sciences services	42	4.8%
11	Agriculture	3	4.3%	Paediatrics	12	4.9%	Pharmacology and pharmacy	6	3.7%	Pharmacology and pharmacy	40	4.5%
12	Veterinary sciences	2	2.9%	Ophthalmology	10	4.0%	Veterinary sciences	5	3.1%	Plant sciences	32	3.6%
13	Science technology other topics	2	2.9%	Integrative complementary medicine	9	3.6%	Microbiology	5	3.1%	Parasitology	30	3.4%
14	Obstetrics & gynaecology	2	2.9%	Obstetrics & gynaecology	6	2.4%	Pathology	4	2.5%	Respiratory	26	3.0%
15	Microbiology	2	2.9%	Chemistry	6	2.4%	Cell biology	4	2.5%	Psychology	25	2.8%
16	Marine freshwater biology	2	2.9%	Forestry	5	2.0%	Rheumatology	3	1.8%	Microbiology	23	2.6%

Rank	1973–1983			1984–1993			1994–2003			2004–2013		
	Sub-fields	Pub	Share of total	Sub-fields	Pub	Share of total	Sub-fields	Pub	Share of total	Sub-fields	Pub	Share of total
	Rwanda	70	100.0%	Rwanda	247	100.0%	Rwanda	163	100.0%	Rwanda	881	100.0%
17	Infectious diseases	2	2.9%	Entomology	5	2.0%	Respiratory	3	1.8%	Biomedical social sciences	23	2.6%
18	Biochemistry and molecular biology	2	2.9%	Environmental sciences ecology	4	1.6%	Parasitology	3	1.8%	Zoology	21	2.4%
19	Area studies	2	2.9%	Biochemistry and molecular biology	4	1.6%	Obstetrics & gynaecology	3	1.8%	Obstetrics & gynaecology	20	2.3%
20	Paediatrics	1	1.4%	Zoology	3	1.2%	Genetics heredity	3	1.8%	Physics	17	1.9%
21	Pathology	1	1.4%	Veterinary sciences	3	1.2%	Evolutionary biology	3	1.8%	Water resources	16	1.8%
22	Mathematics	1	1.4%	Urology & nephrology	3	1.2%	Energy fuels	3	1.8%	Chemistry	15	1.7%
23	Literature	1	1.4%	Surgery	3	1.2%	Chemistry	3	1.8%	Cardiovascular cardiology	14	1.6%
24	Life sciences biomedicine	1	1.4%	Science technology other topics	3	1.2%	Biochemistry and molecular biology	3	1.8%	Biotechnology & applied microbiology	14	1.6%
25	Integrative complemen-tary medicine	1	1.4%	Rheumatology	3	1.2%	Anthropology	3	1.8%	Food science technology	13	1.5%
26	Genetics heredity	1	1.4%	Respiratory	3	1.2%	Zoology	2	1.2%	Biochemistry and molecular biology	13	1.5%
27	Forestry	1	1.4%	Pathology	3	1.2%	Surgery	2	1.2%	Veterinary sciences	11	1.2%
28	Demography	1	1.4%	Oncology	3	1.2%	Marine freshwater biology	2	1.2%	Surgery	11	1.2%
29	Chemistry	1	1.4%	Research experimental medicine	2	0.8%	International relations	2	1.2%	Nutrition dietetics	11	1.2%
30	Cell biology	1	1.4%	Dermatology	2	0.8%	Government law	2	1.2%	Geology	11	1.2%

Source: UNESCO, based on articles listed at the Science Citation Index Extended, Social Science Citation Index and Arts & Humanities Citation Index

WHAT PATENTS TELL US ABOUT RESEARCH AND INNOVATION

A patent is a document issued by an authorized government agency granting the right to exclude—using the legal system—anyone else from the production or use of a specific new device, apparatus, or process for a stated number of years (see Glossary, page 254–255). The grant is issued to the inventor of this device or process after an examination that focuses on both the novelty of the claimed item and its potential utility.

Measuring the link between publications and patents has been a subject of academic research in recent decades. It helps us to understand the intensity and orientation of research, as well as the relation between science and technology. A measurable relation allows us to investigate knowledge transfers and potential spillovers; to describe the knowledge base of particular technologies; to disclose the technological neighbourhood of scientific themes or research fronts; to reveal an ongoing innovation process (from research to technology then on to commercialisation).

A patent constitutes a milestone in the progress of a given technology. However, it is only one piece in a larger puzzle of technological innovation, which entails combining new knowledge with a suitable business strategy and other factors to achieve commercial success. Patent data have been widely used in many innovation studies (Griliches, 1990). Next to patent count data, it is obvious that patent documents, because of legal reporting requirements, provide the STI policy expert with a wealth of information, which can be used for various types of foresight and strategic analysis. For instance, typical patent documents contain the names and the addresses of the inventors and their applicants, as well as references to other scientific and technological documents. This information can easily be used to map progress and collaboration in technological fields, as well as to assess the vitality of various organisations (firms as well as universities) in a particular field of technological development or in a particular system of innovation.

The kind of economic studies in which patent statistics have been used include those that examine: the long-term changes in the amount and direction of inventive output in particular industries; the relationship between these changes and other long-term economic indicators; the relative efficiency of company-financed and government-financed industrial R&D; the contribution of individual firms to particular areas of innovative activity; the relative significance of foreign and home-generated technology; and individual inventive output.

Patent analysis takes many forms, with important distinctions between micro- and macro- analyses (Trippe, 2003). In the private sector, for instance, intellectual asset management groups probe deeply to understand the development of individual technologies through a systematic mapping of the content of patents. From the perspective of SETI policy studies, the methodological approach has recourse to macro-analysis. This analysis focuses on studying the patenting patterns at national level, combining this with bibliometric research.

Even though patent grants can be thought of as a moving average of past applications, statistical studies reveal that the figures for granted patents tend to fluctuate as much, or more, than the number of patent applications. It is also clear that economic conditions impinge on the rate of patent applications (Griliches, 1990). Any analysis of long-term temporal series of patents will reflect the innovation behaviour of a particular country and the stage of national development at different epochs, as well as any economic, political and societal crises along the way.

BOX 12 – INDIGENOUS KNOWLEDGE, GENETIC RESOURCES AND IPR

The *Declaration on Science and the Use of Scientific Knowledge* that came out of the World Conference on Science in June 1999, which was organized by the International Council of Science (ICSU) and UNESCO, calls for a broad collaboration between science and local cultures in meeting the challenges of the future. The declaration noted that "traditional and local knowledge systems" are "dynamic expressions of perceiving and understanding the world, [which] can make and historically have made, a valuable contribution to science and technology."

The need to develop a special legislative and institutional framework for the protection of traditional knowledge and to ensure prior-informed consent and benefit-sharing for access to genetic resources in Rwanda was emphasised as a priority need by various stakeholders in Rwanda. According to the conclusion of a national stakeholders' workshop held in Rwanda, the legal and institutional framework needs to be aimed, among others, at: recognising the value of traditional knowledge and responding to the needs of the knowledge holders; promoting respect for traditional knowledge and its conservation and preservation including repression of unfair and inequitable uses of the knowledge; promoting innovation and creativity and overall community development including facilitating legitimate trade in traditional knowledge-based goods and services; and preventing bio piracy. Other countries, like Botswana, already have legal instruments to protect indigenous knowledge and their communities (see UNESCO, 2013).

The new Rwanda Intellectual Property Law mandates the development of a special law on traditional knowledge and genetic resources. To be able to develop a comprehensive law will require a national stakeholder consultations and the development of the legislative framework all of which will require technical and financial assistance. To ensure that the resulting legislative and institutional framework is comprehensive and fit for purpose the technical assistance should be provided by an interdisciplinary team of experts (Rep. of Rwanda, 2009a).

Stakeholders also considered the need for technical and financial assistance to train the representative of the key stakeholders within government and in the private sector, research institutions and civil society in basic concepts around innovation, IP and creativity, including the use of flexibilities in international treaties was emphasised by numerous stakeholders. Equally, many stakeholders stressed the need for technical and financial assistance to support national public awareness programmes delivered through radio, television and other media.

In the medium-term, a consensus gave priority to the development of advanced tailor-made courses on development, innovation and intellectual property for: government officials in all the key ministries and agencies particularly Ministry of Trade and Industry, Ministry of Youth and ICT, Ministry of Education, and Rwanda Development Board; senior industry managers and managers of the key scientific institutions; and for IP teaching in law, economics, science and management faculties at the university.

To ensure continued education and capacity development among governmental, private sector, research and civil society stakeholders as well as to support research and policy analysis in the longer-term, the need for establishing an intellectual property resource and information centre was also identified as a priority. Technical and financial assistance will therefore be needed to establish such a resource and information centre at Ministry of Trade and Industry. Such a centre would provide services to both government officials and other stakeholders including researchers.

Source: Republic of Rwanda (2009a)

Patent offices and regional bodies

Aggregate patent statistics are usually classified in a variety of ways and have been compiled since the late 19th century[22]. Studies of patent statistics are generally based on information produced by international databases. The most relevant databases are United States Patents and Trademark Office (USPTO), Japan Patent Office (JPO) and European Patent Office (EPO). This is so because these offices are based in highly industrialized countries, which consequently have a higher likelihood of transforming the patent claims into an innovation.

In 1974, the World Intellectual Property Organisation (WIPO) became a specialized agency of the United Nations system with a mandate for administering intellectual property matters, and compiling and publishing global statistics on patents, trademarks and industrial designs.

Rwanda acceded to the Convention establishing the WIPO in 1983, as well as the Paris Convention for the Protection of Industrial Property and the Bern Convention for the Protection of Literary and Artistic Works, in the same year. These conventions were brought under the World Trade Organisation's Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) in the 1986–1994 Uruguay Round. In 1996, Rwanda acceded to the World Trade Organisation and has therefore been subject to the TRIPS Agreement ever since. In 2011, Rwanda acceded to the WIPO- administrated Hague Agreement and Patent Cooperation Treaty, and in 2013 to the Madrid Protocol.

The African Regional Intellectual Property Organization (ARIPO), formerly the African Regional Industrial Property Organization, is an intergovernmental organization-fostering co-operation among African states in patenting and other intellectual property matters. ARIPO was established by the Lusaka Agreement[23] of 1976. It has the capacity to hear applications for patents and registered trademarks in its member states which are parties to the Harare (patents) and Banjul (marks) protocols. Rwanda deposited its Instrument of Accession to ARIPO on the 24th of June 2011, and acceded to the Harare Protocol. Rwanda thus became the 17th member state, and state party to the Harare Protocol. ARIPO also features a protocol on the protection of traditional knowledge, the Swakopmund Protocol, signed in 2010 by nine of ARIPO's member states. As of December 2014, the protocol had not yet been endorsed by Rwanda.

The approach to patents under the Rwanda Intellectual Property Law follows the standard approach in line with the requirements of the WTO's TRIPS Agreement. The statute defines the criteria for patentability, the scope of patentable subject matter, the rights conferred by a patent, and use exceptions. The recent law,accession to the Harare Protocoland other international treaties on patent, industrial designs, trademarks, etc. is likely to result in the increase in the number of patent applications.

2009 Intellectual Property Policy

In 2006, within the republic of Rwanda's Policy on Science, Technology and Innovation (Rep. of Rwanda, 2006) intellectual property rights were mentioned as part of sector policy statements and strategies, but no specific action or mechanism was explicitly addressed[24].

22 The year 1883 marked the birth of the *Paris Convention for the Protection of Industrial Property*, the first major international treaty designed to help the people from one country obtain protection in other countries for their intellectual creations in the form of industrial property rights, known as: (a) inventions (patents); (b) trademarks and (c) industrial designs.

23 The members of ARIPO are those, which have ratified the Lusaka Agreement: Botswana, The Gambia, Ghana, Kenya, Lesotho, Malawi, Mozambique, Namibia, Sierra Leone, Liberia, Rwanda, Somalia, Sudan, Swaziland, Tanzania, Uganda, Zambia and Zimbabwe.

24 The 2014 *Revised National, Science, Technology and Innovation Policy*, reproduced an abridged version of the 2006 text on IPR. However, no specific policy instruments or mechanisms were proposed here to improve the intellectual property ownership in the country.

In 2009, the Government of Rwanda proposed the first explicit policy on intellectual property (Rep. of Rwanda, 2009a). This policy was designed with the objective of providing guidance and a road map to ensure that the intellectual property laws, practices and strategies in Rwanda support and facilitate the achievement of the country's high-level vision and targets. For Rwanda, the key strategy is to facilitate technological learning. The implementation of the policy will require a conducive national and international environment. Consequently, this Intellectual Property Policy is based on the following six interrelated objectives:

1. Increasing technological literacy and advanced scientific and technological skills that in turn would increase the innovation capacity.
2. Promotion of innovation and creativity including minor and incremental innovations to provide an opportunity for the largest number of individuals and firms to participate in innovation.
3. Increasing access to foreign and local technology by local firms and research institutions.
4. Improving access to IP-based essential goods and services especially health and food
5. Facilitating investments in innovative and creative activities.
6. Enhance the protection of traditional knowledge and facilitate equitable access to genetic resources and benefit-sharing.
7. The 2009 Rwanda Intellectual Property Policy proposed to enable disclosure of patent applications and information on use exceptions, so as to support the firms and research institutions accessing technologies, especially as part of individuals' accessing essential goods and services. In this regard, the 2009 Rwanda Intellectual Property Policy suggests:

   - The exclusion of pharmaceutical products from patentability in accordance with the WTO Decision providing transition period for LDCs until, at least, 2016 will be maintained.
   - Consideration should be given to retaining patent examiners to enforce the requirements of enabling disclosure under the IP law in key sectors such as agriculture even though Rwanda does not intend to have routine examination of all patent applications. This will promote technology transfer and dissemination.
   - The research and experimental use exception, including for commercial purposes and for public not-for-profit use as contemplated under the IP Law should be encouraged in both public and private sector institutions. Restricting the exception to not-for-profit entities or activities would be counter-productive. The exception should be aimed at facilitating a broader set of technological activities related to the application of knowledge to particular problems.
   - To support transfer of technology, specialists should be retained to scrupulously examine the terms and conditions of licensing agreements to ensure that such licenses do not restrict competition or negatively affect the government's effort to boost technology transfer and that there are no prohibited clauses as stipulated in IP Law. Such specialists, who should also perform surveillance functions, could be attached to the Ministry of Trade and Industry, the Rwanda Development Board or the Rwanda Science and Research Council. Continuous monitoring of the behaviour of parties is important since parties might present legally a permissible contract to the authorities but later enter into side agreements that defeat government objectives.
   - Where applicable, and in appropriate cases, compulsory licenses should also be considered in cases of dependant patents and to remedy abuse and enforce competition regulations.

BOX 13 – TRADITIONAL MEDICINE IN RWANDA: ROOM FOR INNOVATION AND PATENT PROTECTION

Plant biodiversity plays major specific roles in the cultural evolution of local human societies. Of the many diseases traditionally treated with medicinal plants, hepatitis ranks amongst one of the most severe. In contrast to many other pathologies, the symptomatology of a number of hepatic conditions is evident. Traditional healers can easily evaluate the response to treatments and thus select efficient herbal medicines. Recently, Mukazayire *et al.* (2011) presented a very well documented study exploring the extent to which plant remedies are used in the traditional treatment of hepatitis and the concepts underlying the preparation of remedies specifically used for hepatitis patients in Southern Rwanda.

Indeed, Mukazayire *et al.* (2011) published the first comprehensive inventory of the natural flora of Southern Rwanda which is applied to control hepatitis. This survey identified 86 herbs used in traditional remedies, where *Crassocephalum vitellinum, Hypoestes triflora*, and *Erythrina abyssinica* were the most widely used plants. Previous surveys made in different regions (Northern and Western Rwanda) had reported 49 of these herbs but with different association of plants and varied modes of preparation, suggesting widespread but also very local traditional knowledge. Mukazayire *et al.* (2011) identified for the first time a group of endemic plants, commonly used to treat hepatitis in Southern Rwanda. The study showed that many indigenous plants still not known are used and deserve to be studied. The study concluded that: (a) Southern Rwandese traditional health practitioners possess a vast knowledge of medicinal plants; (b) herbal remedies for hepatitis are widely used in this region; (c) Southern Rwanda shows a high diversity of herbal medicines which have a clear potential, both scientific and commercial, to be further explored from the chemical, pharmacological and toxicological points of view. The authors considered the strategic value that preservation of bio-cultural data and phytoteraphy identification might have for the quality of life of Rwandans.

Since 1996, the Government undertook a series of studies, and held numerous discussions on the pharmaceutical sector with its national and international partners and make essential drugs accessible to all the people of Rwanda as part of its health policy. Simiyu *et al.* (2010) presented detailed arguments showing that the main opportunities in science-based health innovation and biotechnology for Rwanda are in traditional plant technologies (see Table 35 for selected opportunities).

In recent years, several local companies have been developing health products. For example, a firm called Ikirezi Natural Products has been involved in extraction and export of geranium oil, which is used as an essential oil in remedies for dermatological conditions. Also interested in health technology is Rwanda's largest industrial manufacturer, Utexrwa, which specializes in textile manufacture. The company has expressed interest in manufacture of pyrethrum impregnated mosquito nets which would serve two purposes: provide a market for pyrethrum that is currently being exported unprocessed outside the country, and create savings by reducing imports of long lasting mosquito nets. There are talks between the firm and universities in Canada about developing technology that could use pyrethrum to replace synthetic pyrethroids, for long lasting Insecticide–treated mosquito nets (Simiyu *et al.*, 2010).

An adequate set of SETI policy instruments is needed to promote the identification of active substances from traditional medicines and to design appropriate legal devises for guaranteeing the protection of IPR of indigenous communities.

Source: Mukazayire *et al.* (2011) and Simiyu *et al.* (2010)

Table 35: Various products and processes being developed in Rwanda institutions

Product	General Area	Organization	Description
Traditional herbal medicines • *Gifurina-Datura stramonium* • *Bentakor-P. Lanceolata* • *Tusinkor-E. Globulus* • *Tumitusilinga-T.Vulgaris* • *Kanwalina-M.Sacchalinensis* • *Calendula-C.Officinalis* • *Tembatembe A-N.Mitis*	• Anti-spasmodic • Anti-cough • Anti-cough • Oral disinfectant • Anti-arthritic • Anti-inflammatory • Scabies	Institut de Recherche Scientifique et Technologique	Whole plant extracts. Adoption of existing practices by traditional healers and carry out safety and efficacy tests
Essential oils-Geranium	Cosmetics / Dermatology	Ikirezi Natural Products (private firm)	Extraction of essential oils from geranium plant
Intravenous fluids and water for injection		Pharmaceutical Laboratory of Rwanda (Laborphor)	For use in hospitals, since transport costs for this bulky product are high
Pyrethrum treated long lasting mosquito nets	Malaria	Utexrwa (private firm)	Concept under development with researchers from Canada
Health information technology software	Health IT	National Treatment and Research AIDS Center	Developing software for integrating health information, in partnership with Voxiva

Source: Adapted from Simiyu *et al.* (2010)

Analysing patent trends in Rwanda

Rwanda has had some form of IP framework since colonial times. The policy and legal environment has continued to evolve since then, with incremental changes being introduced over time. The lead agency for policy-making and legislative development on intellectual property in Rwanda is Ministry of Trade and Industry except with respect to copyright where the lead agency is Ministry of Sports and Culture. Until mid-2008, a few staff at Ministry of Trade and Industry were responsible for all IP policy and legislative work, as well as intellectual property administration. At Ministry of Sports and Culture, there is also limited staff time dedicated to copyright. Since the creation of the Office of the Registrar General at the Rwanda Development Board, intellectual property administration has been transferred to its responsibility, and both Ministries tasked to focus on policy-making, policy implementation and monitoring.

According to WIPO (2014), 2 567 000 patent applications were presented during 2013 at different patent offices in the world, where 66.5% corresponded to applications by residents. In the same period, Africa generated 14 900 patent applications, where only 15.4% corresponded to applications by residents. In 2013, Rwanda generated 70 patents applications, where 57% were presented by residents.

Figure 36 shows the evolution in patent applications, disaggregated by residents and non-residents of Rwanda, between 1967–2013 (see Glossary, pages 254–255). Figure 37 shows the evolution patent grants, disaggregated by residents and non-residents, between 1964–2012. Historically the number of patent applications and patent grants has been very small compared with other countries of the region (see UNESCO 2013, 2014a and 2014b). Only in recent years, these numbers have increased. Rwanda presented only two patent applications at the United States Patents and Trademark Office, between 1991 and 2010.

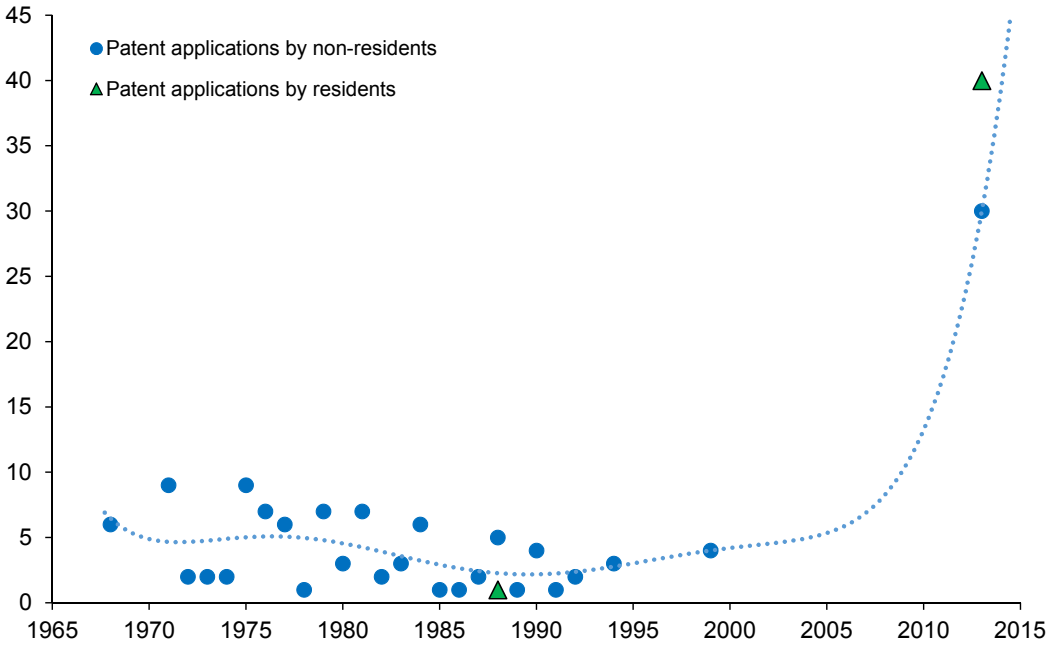


Figure 36: Evolution in patent applications in Rwanda by residents (triangles) and non-residents (circles), 1967–2012. The dotted line is the best-fitting curve. Source: UNESCO, based on data provided by WIPO.

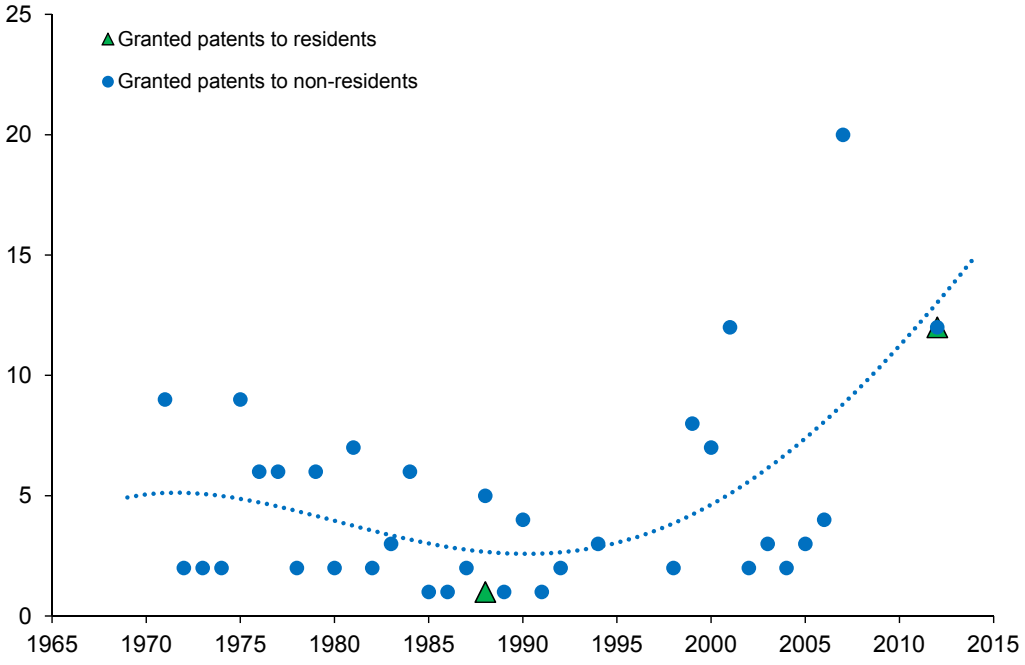


Figure 37: Evolution in patents granted in Rwanda by residents (triangles) and non-residents (circles), 1964–2012. The dotted line is the best-fitting curve. Source: UNESCO, based on data provided by WIPO.

These curves are consistent with trends in the local productive sector, the lack of endogenous industrial innovation and the absence of incentives for entrepreneurship and commercialization of research results during twentieth century. The new policy instruments that were implemented in recent years are changing this behaviour effectively. Figure 38 shows the distribution of patent application by top field of technology for recent years (1998–2012).

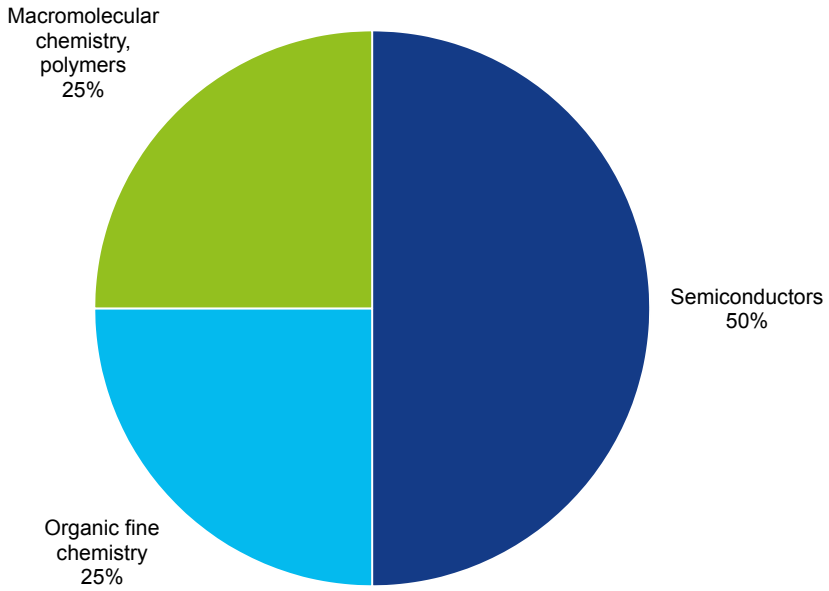


Figure 38: Patent applications in Rwanda by top field of technology, 1998–2012. Source: WIPO

What trademark and industrial design data reveal about innovation

Recently, trademark data have also been used to convey information on two key aspects of innovation, which are not usually covered by traditional indicators: marketing innovation and innovation in the services sector (Millot, 2009). Different empirical studies have shown the link between trademark counts and other indicators of innovation performance, when available. For instance, trademark numbers at the firm level have been found to correlate positively with innovation as reflected in responses to innovation surveys, with R&D (for certain industries), with patents, and with the number of new product launches. This correlation is particularly high in knowledge-intensive services and in high-tech sectors like the pharmaceutical industry. A further advantage of trademarks as a source of data is their broad availability and relatively easy accessibility.

A trademark is a sign capable of distinguishing the goods or services of one enterprise from those of other enterprises. Trademarks are protected by intellectual property rights. In principle, a trademark registration will confer an exclusive right on the use of the registered trademark. This implies that the trademark can be used exclusively by its owner, or licensed to another party for use in return for payment. Registration provides legal certainty and reinforces the position of the right holder, for example, in case of litigation. The term of registration can vary but is usually ten years. It can be renewed indefinitely on payment of additional fees. Trademark rights are private rights and protection is enforced through court orders.

The link between trademark deposits and product innovation is relatively straightforward: the commercialisation of new products is sometimes associated with the creation of a new trademark in order to communicate about the innovation and, later, possibly become the reference on the market for the product, which in turn enables firms to appropriate the benefits of their innovation. When it comes to marketing innovation, the link with trademark deposits is more complex.

Data on trademarks are available for Rwanda from 1965 onwards. Figure 39 shows the evolution in trademark applications by residents and non-residents between 1965 and 2012. The vertical axis has a logarithmic scale. The non-resident applications' trend shows three decades with a relatively constant number of applications (1965–1995) followed by an exponential growth after the Genocide (c. 1994). However, the resident applications' trend shows an oscillatory erratic behaviour with a strong drop during the Genocide.

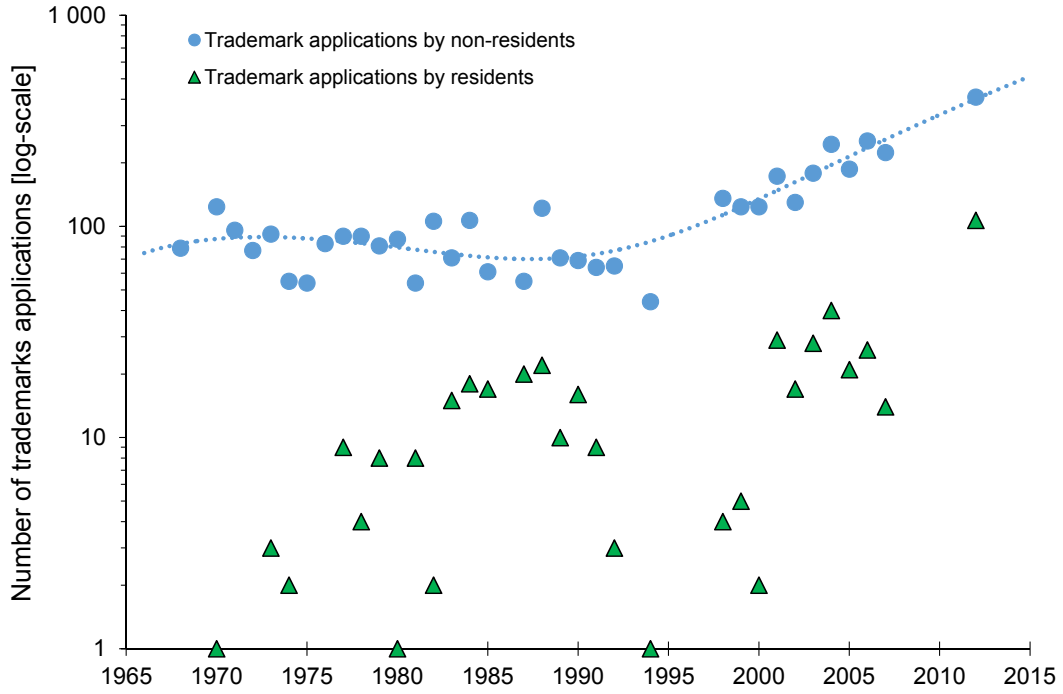


Figure 39: Evolution in the number of trademark applications in Rwanda, 1965–2012. The dotted line is the best-fitting curve. The vertical axis is expressed on a logarithmic scale. Source: UNESCO, based on data provided by WIPO

Table 36 shows the number of trademark registrations by residents and non-residents, as well as the number of trademarks registered by Rwandans abroad (1998–2012). The number of trademark registrations follows very well the behaviour of the trademark applications in the same period.

According to WIPO (2014) an estimated 956 600 industrial design applications were filed worldwide in 2013, with modest growth of 1.7% over 2012, the lowest in the past two decades after three consecutive years of double-digit growth.

Industrial designs are applied to a wide variety of industrial products and handicrafts. They refer to the ornamental or aesthetic aspects of a useful article, including compositions of lines or colours or any three-dimensional forms that give a special appearance to a product or handicraft. The holder of a registered industrial design has exclusive rights against unauthorized copying or imitation of the design by third parties. Industrial design registrations are valid for a limited period. The term of protection is usually 15 years for most jurisdictions. In an industrial design application or registration, some offices allow applications to contain more than one design for the same good or in the same class—others allow only one design per application. To capture the differences in application filing systems across offices, one needs to compare their respective application and registration design counts (WIPO, 2014). It is important to notice that ARIPO does not register industrial designs with automatic region-wide applicability. Thus, for this office, each application is counted as one application abroad if the applicant does not reside in a member state or as one resident application and one application abroad if the applicant resides in a member state.

Table 36: Trademarks registrations, 1998–2012

Year	Residents	World rank	Non–residents	World rank	Abroad	World rank
1998	4	91	136	107	–	–
1999	5	97	104	113	–	–
2000	2	93	124	110	–	–
2001	29	88	173	110	–	–
2002	17	91	130	113	–	–
2003	179	77	28	111	–	–
2004	40	87	245	105	–	–
2005	21	92	187	113	–	–
2006	26	93	254	110	–	–
2007	14	93	224	115	3	149
2008	0	–	0	–	–	–
2009	0	–	0	–	27	133
2010	0	–	0	–		–
2011	0	–	0	–	3	170
2012	109	82	408	111	0	–

Source: WIPO

Table 37 shows number of industrial designs applications and registrations by residents and non-residents in Rwanda (1998–2012).

Table 37: Industrial design applications and registrations, 1998–2012

Year	Industrial design applications				Industrial design registrations			
	Resident	World rank	Non–resident	World rank	Resident	World rank	Non–resident	World rank
1998	0	–	1	96	0	–	1	87
1999	0	–	0	–	0	–	0	–
2000	0	–	0	–	0	–	0	–
2001	0	–	0	–	0	–	0	–
2002	0	–	0	–	0	–	0	–
2003	0	–	0	–	0	–	0	–
2004	0	–	3	97	0	–	3	89
2005	0	–	0	–	0	–	0	–
2006	0	–	0	–	0	–	0	–
2007	0	–	1	107	0	–	1	101
2008	0	–	0	–	0	–	0	–
2009	0	–	0	–	0	–	0	–
2010	0	–	0	–	0	–	0	–
2011	0	–	1	108	0	–	1	106
2012	20	79	20	94	0	–	16	92

Source: WIPO

Historical background to SETI policies in Rwanda

SCIENCE IN COLONIAL TIMES

As early as 1923, the *Geological Service* was established in Rwanda and located at Ruhengeri (Birunga volcano region). A great variety of research was carried out by the official services and by private institutions and a considerable body of documentation was collected, in those days, on casseterite, gold, wolfram, beryl, and so on.

The first institution of higher education, the diploma-granting Grand Seminary de Nyakibanda, was established in 1936 by the Roman Catholic Church specifically to train men for the priesthood.

The Congolese National Institute of Agronomic Research (INEAC*) was originally created in 1934. This institute carried out research on: (a) food crops (production of the most suitable varieties, study of fallow land, rotation, irrigation, and so on); (b) cash crops (production of Arabica coffee seeds, sorting, varieties, comparative trials, studies of introduced varieties of tea); (c) animal husbandry (selection of local stock, cross-breeding with introduced species, feeding of dairy cattle, and so on); (d) agrostology (study of pasture-land associations, new pasture lands, behaviour of various types of plant, and so on); (e) forestry (management of the Butare arboretum, comparative trials); (f) soil science (soil map of Rwanda, soil chemistry laboratory, analyses); (g) entomology and phytopathology (disease control methods, cotton plants, coffee plants, banana trees, citrus trees, and so on); (h) creation of rural communities and local experiments (supervision of pilot rural communities, advice to government staff managing them).

INEAC research work was carried out in: (a) the sparsely populated and arid low-altitude zone (4 500 feet) at Karana; (b) the heavily populated medium-altitude zone (5 000 to 5 900 feet) at Rubona; (c) in the cold and heavily populated high altitude zone at Riverere.

In 1947, Prince Charles of Belgium (1903–1983) founded the Institute for Scientific Research in Central Africa (IRSAC*). This institute had its headquarters at Butare in Central Rwanda in the medium-altitude zone. It also had two research sites: in the low-altitude zone at Muriuli (Musara) and in the high-altitude zone in the forestland on the Congo-Nile ridge at Niuka. Apart from research in the human sciences (linguistics, social anthropology, history, physical anthropology) and the physical sciences (seismology), the centre was mainly concerned with botany.

IRSAC had, beginning in 1952, three labs covering the three field of solar radiation, ionospheric surveys, and solar noises, which made the unit a uniquely complete installation in the tropics for the study of the Sun and of the upper atmosphere. A terrestrial magnetism and gravimetry programme was created within the framework of the general geophysical study of the Great African Rift, at the centre of which the Lwiro facility was conveniently located. Also in geophysics, the centre had a seismology service for the study of microseisms, and for measuring volcanic-eruptions.

In 1960, with the support of UNESCO, a survey on the teaching of science in Ruanda-Urundi was conducted (Fiasse, 1960). By that time, the total number of secondary schools in both countries were only 67. The total enrolment was 5 059 pupils. The average teaching of science subjects (e.g. biology, chemistry and physics) totalled 3 hours per week, while the time spent in teaching mathematics was around 4 hours per week. Every school had a modest laboratory, but most of the science teachers were of European origin. These figures show the weaknesses of elementary science education in the country before independence.

* Corresponds to the original assigned acronyms (in French).

SCIENTIFIC RESEARCH AND SETI POLICIES FOR A NEWBORN COUNTRY

After Independence, in 1962, the main scientific activities performed in the country were conducted within INEAC and IRSAC, two research institutes started under the colonial administration.

In 1963, the National University of Rwanda was created. The headquarters were established at Butare, and the first opened Faculties were on Medicine, Science, Letters, Social Science and Secondary Education (see pages 162–171).

By a special Convention between Belgium and Rwanda, in 1964, the two research institutes were transferred to Rwandan authorities. BY 1965, IRSAC was then transformed into the National Institute for Scientific Research (INRS*) overseen by the Ministry of Education; and INEAC became the Rwanda Institute of Agricultural Sciences (ISAR*) overseen by the Ministry of Agriculture.

The Institut Pédagogique National (IPN) was established in 1966 with support from UNESCO and UNDP; its mission was to train secondary school teachers and conduct research in education.

In spite of its limited resources and competing priorities of an emerging nation, Rwanda was able to participate at the *International Conference on the Organization of Research and Training in Africa in Relation to the Study, Conservation and Utilization of Natural Resources* (Lagos, 1964), which was organized by UNESCO and UNECA. This was the first African Conference on SETI policies. A decade later Rwanda presented the first national report on SETI policies within the *First Conference of Ministers of African Member States Responsible for the Application of Science and Technology to Development* (CASTAFRICA I) held in Dakar in 1974 (UNESCO, 1974a).

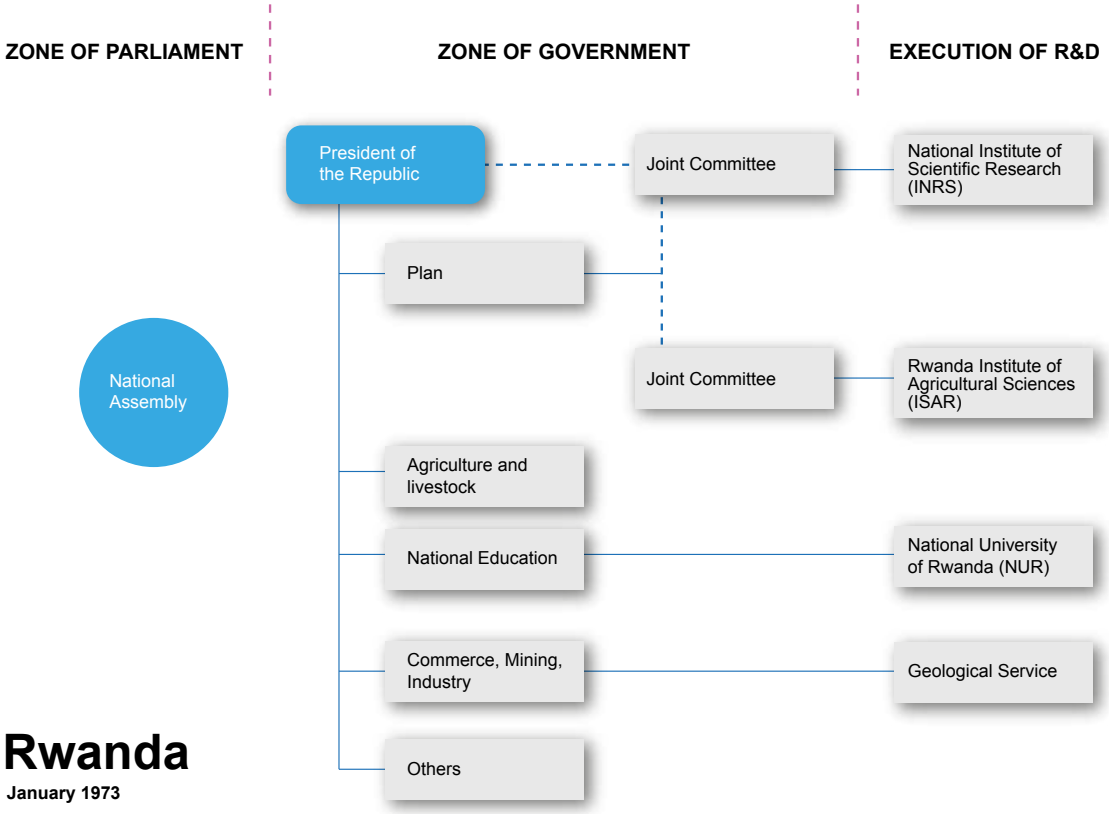


Figure 40: Organization chart showing Rwanda's research and innovation system in 1973.
Source: UNESCO (1974a)

BOX 14 – HISTORICAL REMARKS: UNESCO'S FIRST SURVEY ON SETI POLICIES IN RWANDA

On 14 November 1958, the General Assembly of the United Nations (13th session, 780th plenary meeting) adopted Resolution 1260 requesting the Secretary-General:

> *… in co-operation with the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the other Specialized Agencies concerned with the peaceful application of science, as well as the International Atomic Energy Agency, to arrange for a survey to be made on the main trends of inquiry in the field of the natural sciences and the dissemination and application for peaceful ends of such scientific knowledge, and on the steps which might be taken by the United Nations, the Specialized Agencies and the International Atomic Energy Agency towards encouraging the concentration of such efforts upon the most urgent problems, having regard to the needs of the various countries…*

In the same resolution, the General Assembly requested that the Secretary-General 'submit this survey to the Economic and Social Council at its thirtieth session' in July 1960.

Ultimately, this report was co-ordinated and edited by Pierre Auger, a prominent physicist and former Assistant Director-General for Science at UNESCO. The study included a description of the most influential trends in scientific research and a series of analyses of their potential long-term impact on humanity (Auger, 1961). The report introduced the need for states to establish national scientific and technological policies, as well as new schemes fostering international scientific co-operation, one example being UNESCO's proposal in the early 1950s for the creation of the European Centre for Nuclear Research (CERN).

Auger's report broke new ground. For the first time, the UN system proposed a standard classification for scientific research and experimental development and defined scientific researchers, technicians and engineers. This preceded the OECD's Frascati Manual (c. 1963) and even the OECD itself, founded in 1961.

Using the standard classification proposed by Auger, UNESCO conducted a regional survey in 1962 and 1963 of the scientific and technical potential of 42 African countries[25]. This survey provided numerical data, for the first time, on the scientific and technical personnel working in different scientific disciplines and special fields of scientific investigation, as well as an inventory of research institutions and the number of researchers and technicians, the size of laboratories and experimental stations, number of library volumes, etc.

Fifty years ago, these results were presented at an *International Conference on the Organization of Research and Training in Africa in Relation to the Study, Conservation and Utilization of Natural Resources,* jointly organised by UNESCO and UNECA in Lagos (Nigeria) between 28 July and 6 August 1964. Table 38 presents the main findings of UNESCO's survey on SETI policies in Rwanda in 1963.

25 UNESCO/CORPSA/4.B; Paris, 6 July 1964

Table 38: Main findings of UNESCO's survey on SETI policies in Rwanda in 1963

Institution	Characteristics	Personnel	Remarks	Research Topics	Infrastructure	Publications
Rwanda Geological Service	Public institution. Engaged in research.		Situated at Ruhengeri in the Birunga volcano region	Since 1923, research has been carried out on casseterite, gold, wolfram, beryl, and so on. Published the first 1/100 000 geological map of the country		
National Institute of Scientific Research (INRS)	Public institution. Engaged in research. Fundamental research	50 of which 4 are research workers and 1 technician	Two field stations at Minueli and Uiuka	Botany (herbarium of Rwanda and Burundi); zoology; geology; social anthropology; linguistics; history; demography; economics; seismology	Library and Anthropological Museum. Laboratories	
Rwanda Institute of Agricultural Sciences (ISAR)	Quasi-public institution. Engaged in research. Pure and applied research	450 of which 10 are research workers & 7 technicians	Includes the Pilot Station of Karama (Kigali) and the Testing Centre of Rwerere (Ruhengeri)	Animal husbandry; pasture research; agricultural chemistry; food crops; industrial plants; forests; plant pathology; peasantry and planning, entomology; climatology; crop testing	Library of 2 000 volumes. Laboratories of 6 458 square feet and experimental fields of 7 410 acres	
National University of Rwanda (NUR)	Public institution, also engaged in research. Free fundamental research, oriented fundamental research and applied research.	123 of which 48 teaching staff and research workers & 3 technicians	Faculties of Medicine, Science, Letters, Social Science and Secondary Education		Library of 8 000 volumes. Laboratories of 9 000 square feet.	Rwanda ethnography; Rwanda sociology; Rwanda linguistics; Rwanda floral; Rwanda economy

Source: UNESCO

According to the national report on SETI policies presented by Rwanda at CASTAFRICA I, by the end of 1973 the country had neither a coordinating unit on scientific and technological policies nor any SETI activities included in the national development plan. Figure 40 presents the national SETI organizational chart for Rwanda in January 1973.

In 1976, in the private sector, the *Institut Africain et Mauricien de la Statistique et de l'Économie Appliquée* (IAMSEA) was established in Kigali, and was closed in 1994 as a consequence of the Genocide.

FIRST SPECIALIZED INSTITUTIONS FOR SETI POLICIES

In 1975, a Directorate of Higher Education and Scientific Research was created within the Ministry of Education. In 1977, UNESCO sent the first mission to help the country to develop a national S&T policy (Kutchoukov, 1978). By 1981, the Ministry of Higher Education and Scientific Research (MINESUPRES*) and a scientific commission within the National Revolutionary Movement for Development (MRND*) were created. A scientific commission was then nominated to prepare the first national science and technology policy, which was submitted to the third National Congress of the MRND.

In 1981, the Government of Rwanda identified the following problems posed by the scientific and technological research in the country (Morand, 1981, 1983): (i) small opportunities to train local scientists and technicians; (ii) mismatch between the effort made by the Government to finance research and the fundamental role that itwill play in the socio-economic development of the country; (ii) insufficient number of researchers and technicians; (iv) lack of an inventory of SETI potential; (v) lack of an evaluation of the existing R&D local productivity; (vi) lack of recognition and support for community of scientists.

Thereafter, in accordance with the objectives of a new Five Year National Development Plan (1982–1986) of which the main priority was food self-sufficiency, the identified SETI priority areas were: (i) agriculture and animal husbandry, (ii) health (i.e. pharmacopoeia in research) and (iii) development of new alternative energy sources.

The Government of Rwanda, with the support of a group of UNESCO experts (Polinière, 1975; Kutchoukov, 1978; Morand, 1981, 1982, 1984; El Hares, 1992), started working in the formulation of a new institutional framework to coordinate the SETI activities and policies in the country. In those days, they proposed the creation of the following new institutions:

a) A National Council of Scientific and Technological Research for Development (CNRSTD*) with the responsibilities to coordinate SETI activities in the country and their integration into the national quinquennial development plans[26].

b) A National Centre for Documentation and Scientific Information (CNDIS*) with the purpose to improve the diffusion of endogenous scientific research and to promote the communication among researchers at national and international level.

c) A National Centre for Development and Transference of Technology (CNTDT*) with the objective to reduce the technological dependence of the country with other nations.

d) Specific guidance to secure conditions of scientific researchers based on the world standard, as set in an instrument adopted by the General Conference of UNESCO in 1974 (UNESCO, 1974b).

* Corresponds to the original assigned acronyms (in French).

26 In 1977, the Government of Rwanda prepared a draft decree (see ref. 713/2912 of 8/24/1977) to create the National Council of Scientific and Technological Research for Development (Morand, 1983; UNESCO, 1987a).

By the early eighties, the national structures for science and technology policy-making consisted of: the Central Committee of the National Revolutionary Movement for Development (MRND*), which included a scientific commission, and the Ministry of Higher Education and Scientific Research, which included an Inter-ministerial Co-ordination Committee (CIC*).

The national decrees No. 252/06 of 2 July 1981 and No.73/06 of 23 February 1984 designated the Ministry of Higher Education and Scientific Research as the governmental institution in charge of the SETI policy in the country. The attributions were following:

a) Formulate and implement the national science and technology policy;

b) Prepare a SETI implementation plan, its budget and its relation to the corresponding quinquennial National Development Plans;

c) Prepare the annual budgets for the scientific and technological research programmes and research centres;

d) Promote innovations and inventions, identify and foster scientific and technological endogenous developments;

e) Promote and sustain science education at all educational levels;

f) Create favourable conditions, at national level, to promote scientific and technological creativity and good working conditions for scientists, engineers and technicians;

g) Promote international and regional co-operation of scientific and technological research for the benefit of humankind; and

h) At that time, the research in Rwanda remained concentrated in the same two research institutes: the Rwanda Institute of Agricultural Sciences (ISAR*) and the National Institute of Scientific Research (INRS*).

The National University of Rwanda (see pages 162–171) had a University Research Centre for Pharmacopeia and Traditional Medicine (CURPHAMETRA*), a Centre for the Study of Energy in Rwanda (CEAR*), a Centre for Fundamental Research for Teacher Training and Lifelong Education (CRAFOP*) and a Study Group on Applied Linguistic Research (GERLA*).

In 1987, the Government of Rwanda sent a delegation, chaired by Charles Nyandwi, then Minister of Higher Education and Scientific Research, to the *Second Conference of Ministers Responsible for the Application of Science and Technology to Development in Africa* (CASTAFRICA II).

During CASTAFRICA II, Nyandwi made a presentation on the difficulties experienced by the States and peoples of Africa (famine, malnutrition, inadequate standards of hygiene and health, and the lowest per capita income of any region in the world). Nyandwi considered that the underlying reason for this situation was the level of scientific and technological development in the countries of the region, which was at that time unacceptably low. Consequently, the African countries were relatively unsuccessful in performing essential tasks related to the rational exploitation of natural resources and to the introduction of change and innovation into their production systems (UNESCO, 1987a).

The situation in Rwanda was described in the context of the Fourth National Development Plan (1987–1991), whose basic strategy was to achieve self-sufficiency in national food production. For the Government of Rwanda, the key elements were the tasks laid down under the plan, in particular: the development of appropriate technologies; the development of human resources and educational structures; the strengthening of international co-operation; and the promotion and exchange of scientific and technical information at the national, subregional and regional levels. Priority was accorded to agriculture and stock raising, health, energy and industry.

* Corresponds to the original assigned acronyms (in French).

With regard to the promotion of research, by then several initiatives had been set up, such as: a Fund for Developing Scientific and Technological Research and Cottage Industry, including a prize for outstanding scientific work in connection with the development of Rwanda; National Science Days; and Rwandese Association of Exact, Natural and Applied Sciences.

In the private sector, the number of higher education institutions doubled, from three to six, with the addition of the Adventist University of Central Africa (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.

Despite these efforts, the scientific and technical structures of Rwanda in the late eighties had several weaknesses, which were due mainly to the lack of top-level personnel, adequate financial resources, appropriate national infrastructure for scientific and technical information and instrumentation, and maintenance services. Another important issue was the absence of any machinery for upgrading research, and absence of a national policy regarding the importation of technology.

The SETI policy was focused on: (i) a reform of the higher education system; (ii) a re-organization of national research structures; (iii) improvement in the standard of research personnel; (iv) improvement in research programming methods; (v) development of the scientific and technological information sector; (vi) focusing research on the sectors of agriculture and fisheries, energy and medicine; and (vii) mobilizing youth to play a full part in solving national problems (UNESCO, 1987b).

These initiatives produced some visible effects, for example, the highest registered investment in R&D activities was achieved in 1985 with 0.52% of GDP (see Fig. 29, page 90). Within this quinquennial period, the R&D surveys were conducted annually (see Fig. 28 and Table 26, pages 87–88). The scientific productivity in terms of publications in mainstream journals also showed a constant growth over this period (see Fig. 30, page 101) In spite of these observations, the funds available to the scientific and technological units, and the number of researchers in some areas did not match the needs of the country. However, major efforts were made by the institutes to focus their research on the exploitation of the country's potentialities (e.g. renewable energy, pharmacopoeia, problems posed by agriculture and livestock, Rwandan culture, etc.). Nevertheless, the country was not ready to deal with all its development issues.

During the early nineties, a subsequent political instability, the increase of internal conflicts and the extreme deterioration of the economy eroded completely all SETI initiatives (see Fig. 29, page 90). Finally, the Genocide stopped all Academic and R&D activity and destroyed much of the infrastructure in the country.

SETI AS A CROSSCUTTING TOOL FOR DEVELOPMENT

The Government of Rwanda has established 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 was very low as historically the SETI development has at best been marginal (Murenzi and Hughes, 2005).

During 1997–1998 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 these discussions *Rwanda Vision 2020* (Rep. or Rwanda, 2000) was born and further developed to become a high level vision of the future of the country (see pages 14–16). *Rwanda Vision 2020* highlights the crucial role that SETI will play for future'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 SETI capacity, and to reinforce the development pillars, across all sectors of the Rwandan economy (see Fig. 5, page 14).

Vision 2020 argues that the development of SETI 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, SETI is meant to 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.

The 2005 National Science, Technology and Innovation Policy was developed with the help of considerable support from international organizations and development partners[27]. A series of events to formulate the policy took place in Rwanda, between 2004 and 2005. Briefly:

September 2004. The post of Advisor Science and Technology established and incumbent appointed, with support of the World Bank.

- *November 2004.* Presentation of a concept paper: "Preparatory National Integrated Innovation Framework for Rwanda," prepared by the Australian Commonwealth Scientific and Industrial Research Organisation (CSIRO). A workshop to consider it was organized with support of UK' Department for International Development (DFID) and UNESCO.
- *December 2004 – April 2005.* Drafting of an initial policy document with extensive consultation with key stakeholders, organized with support of UK' Department for International Development (DFID).
- *May 2005.* National Science and Technology Conference in Butare, to review draft policy document.
- *July 2005.* National Policy on Science, Technology and Innovation (National STI Policy) approved by Rwandan Cabinet.
- *August – October 2006.* The National STI Policy published, with support from UNESCO and United Nations University.
- Following extensive discussion and debate on a draft policy document, during the National Science and Technology Conference in Butare (May, 2005) a 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 (Rep. of Rwanda, 2006).

In March 2006, Prof. Romain Murenzi[28] was appointed as Minister in the President's Office in Charge of Science, Technology and Scientific Research. By July 2009, the Ministry of Science, Technology and Scientific Research was transformed into a Directorate of Science, Technology and Research within the Ministry of Education.

The Directorate of Science, Technology and Research, an agency under the Ministry of Education, oversees the National STI Policy. The Directorate aims to coordinate research, technological advancement, and innovation with Rwanda's development goals, especially through technology transfer, capacity building, and innovation promotion.

The 2005 National STI Policy outlined 13 different sectors in which research and innovation should be used to increase productivity and enhance capacity: education, energy, transport, agriculture, information and communication technologies, geo-information, water and sanitation, biotechnology, industry, private sector, tourism, environment, and health.

27 This was (is) done following the tradition established during the seventies and eighties (see previous sections), where the national SETI policies are prepared –usually– by foreign consultants. Following the formulation of the 2005 National STI Policy, DFED provided assistance to elaborate the SETI legal framework; the World Bank published a book on "Building Science, technology and Innovation Capacity in Rwanda" (Watkins and Verma, 2008), the Global Knowledge Initiative (GKI, 2012) prepared a STI policy review and help UNECA to prepared the 2014 Revised National STI Policy. UNESCO through the Nairobi and Paris offices have also been contributing through consultants to this policy design/review process.

28 Prof. Romain Murenzi is now Executive Director of TWAS, The World Academy of Sciences for the Advancement of Science in Developing Countries.

For each sector, the National STI Policy emphasized the need of endogenous R&D, suggesting the creation of national guidelines, procedures, and standards, supporting entrepreneurship, and promoting new technologies. Agriculture and ICT[29] appeared as the two highest priority sectors, as in *Rwanda Vision 2020* (Rep. of Rwanda, 2000). The 2005 National STI Policy had a strong influence on strategies proposed in the EDPRS I (see pages 16–17).

By the time when the 2005 National STI Policy was released, the agricultural R&D priorities were based on the 2004 National Agricultural Policy developed by Ministry of Agriculture and Animal Resources. The policy's objective was to convert subsistence farming to modern agriculture, while contributing to economic growth, poverty reduction, food security, and natural resource preservation.

A new Strategic Plan for the Transformation of Agriculture in Rwanda (PSTA II) was proposed in 2009. The Plan elaborates sector-wide actions necessary to achieve the agriculture-based goals of *Vision 2020* (Rep. of Rwanda, 2009b). It seeks to increase output of all types of agricultural products with emphasis on export products, which have high potential and create large amounts of rural employment; and to do so while seeking sustainability (in modes of production/crops).

Since 2006, the government has recognized the need to consolidate extension services and closely link them with agricultural R&D. Since the colonial times the Rwanda Institute of Agricultural Sciences (ISAR) was in charge of agricultural R&D activities. Over the years, ISAR lost the capacity to conduct both research and extension, so the Government created two new agencies, Rwanda Agricultural Development Authority (RADA) and Rwanda Animal Resources Development Authority (RARDA).

The 2005 National STI Policy had proposed the creation of a National Research Fund (NRF) and it was suggested that the Government should allocate 0.5% of the total national budget to it. This idea was not new, it was also originally proposed in the early eighties. The Government of Rwanda agreed to the Decision of the Assembly of the AU 8th ordinary session in 2007, which recommended allocating at least 1% of the GDP to R&D. By January 2015, the NRF is still under planning.

The new structuring helped to address some of the problems of management, fragmentation, and coordination between research agencies, as well as weak linkages with extension agencies and farmers, an assessment of agricultural research and technology transfers found (Tizikara *et al.*, 2007).

The agricultural sector in Rwanda continued to grow over time, and demands for a more efficient agricultural R&D and extension system prompted the government to instigate a different strategy. As a result, in 2011 the government merged ISAR, RADA, and RARDA, to form Rwanda Agriculture Board. In spite of the fact that the merger allowed a rational management of the resources, a set of difficulties emerged. The Rwanda Agriculture Board still needs to further integrate research and extension activities at the programme level if it is to succeed in fully taking advantage of the potential synergies and efficiencies of the new structure (Rahija and Gatete, 2014).

29 This was done before the formulation of the new ICT policy (see pages 55–57) and the creation of the Ministry of ICT and Youth, which is coordinating the ICT policies over the whole nation.

SETTING UP NEW INSTITUTIONS FOR THE NATIONAL INNOVATION FRAMEWORK

In April 2013, the Ministry of Education and its Directorate of Science, Technology, and Research initiated a review of the 2005 National Science, Technology and Innovation Policy in partnership with the United Nations Economic Commission for Africa (UNECA). Rwanda Ministry of Education, though the financial support of UNECA invited the Global Knowledge Initiative (GKI), an international non-profit organization that specializes in promoting SETI for development, with support from a local consultant, to perform the review. Specifically, the review team was asked to evaluate how the 2005 National STI Policy's objectives have been implemented on the ground in Rwanda, identify specific successes or gaps in implementation, and make recommendations for a possible update of the 2005 National STI Policy itself (Rep. of Rwanda, 2014e).

In 2013 the Government of Rwanda introduced a series of important institutional reforms regarding SETI activities, such as: (1) the creation of the University of Rwanda (see pages 162–171); (2) the creation of the National Science and Technology Commission (see pages 151–152), (3) the creation of the National Industrial Research and Development Agency (see page 152), (4) the creation of the Rwanda Standards Board and (5) the introduction of new legislation regarding higher education.

In 2013, the Government of Rwanda also introduced the second Economic Development and Poverty Reduction Strategy (EDPRS II). As it was shown in previous sections (see pages 14–17), the terms science, technology and scientific research practically disappeared form the content of this new national strategy. This represented a strong policy change relative to previous national strategies (i.e. *Vision 2020*, EDPRS I). Only within SME, ICT and agriculture, support for innovation remained explicit(as part of policies implemented by the Ministries of Trade and Industry; ICT and Youth and Agriculture and Animal Resources).

In the context of these institutional and political changes, it was appropriate to encourage a review of the 2005 National STI Policy in order to proceed toward a 2014 Revised National Science, Technology and Innovation Policy (Rep. of Rwanda, 2014e).

The text of the 2014 Revised National STI Policy will be analysed in the following sections. The GO→SPIN standardized methodological approach to study of the analytic content of SETI policies will be used (see pages 140–141).

BOX 15 REFORMS TO STRENGTHEN AGRICULTURAL R&D CAPACITY

In 2012 the Government of Rwanda established the *Strategic Capacity Building Initiative* (see pages 58–59) for the purpose of building human resource capacity across the public sector. Given Rwanda's lack of local training programs, the initiative also incorporates a strategy of hiring international experts to train and mentor younger staff. By 2014, nine senior-level researchers have been recruited through the Ministry of Agriculture and Animal Resources, predominantly from Kenya and Uganda. Various European donors and regional organizations, such as the African Green Revolution Alliance (AGRA), the Forum for Agriculture Research in Africa (FARA), and the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA), have supported some of Rwanda Agriculture Board's researchers in undertaking postgraduate training overseas, mostly in South Africa, and Eastern African and European countries. Given that these training opportunities were already in place for researchers, Phase II of the Strategic Plan for Agricultural Transformation—financed by the International Fund for Agricultural Development—focused primarily on providing MSc-level training to extension agents, 46 agents and 4 researchers took advantage of this training during 2010–2013.

The lack of local postgraduate programs in agricultural sciences makes it difficult and expensive for Rwandan researchers to build their qualifications. To address this issue, all of Rwanda's public universities were merged into the newly established University of Rwanda in September 2013 (see pages 162–171), and PhD programmes in the areas of soil management and agroforestry have been established. The government has provided substantial financial support to the University of Rwanda both for training (such as student scholarships), as well as laboratory equipment and facilities. While these efforts indicate excellent progress, further expansion of graduate programs in agricultural sciences will be necessary if Rwanda is to maintain a pool of well-trained researchers into the future.

Source: Rahija and Gatete (2014)

The SETI policy cycle of Rwanda

The term 'policy cycle' refers to the recurrent pattern of processes that lead to the creation of a public policy and its renewal. The greatest advantage of the analytical model of a SETI policy cycle is that it facilitates an understanding of public policy-making by breaking down the complexity of the process into a limited number of stages and sub-stages, each of which can be investigated alone, or in terms of its relationship to any or all of the other stages of the cycle. This also allows for an examination of the role played by all actors and institutions dealing with SETI policies, rather than solely those governmental agencies formally charged with the task.

The GO→SPIN methodological approach divides the SETI policy cycle into five stages. Here are the working definitions provided for the survey:

I. **Agenda-setting:** refers to the process by which problems involving SETI in relation to society and the economy come to the attention of the government. Agenda setting is also a socially- constructed process, in which actors and institutions, influenced by their respective ideologies, play a fundamental role in determining which problems or issues require government action (Howlett and Ramesh, 2003).

II. **Policy formulation:** refers to the process by which SETI policy options are formulated by the government. Policy formulation involves identifying and assessing possible solutions to policy problems, weighing the pros and cons, and deciding which should be accepted and which rejected. The relationship between the government and social actors thus exerts a significant influence on the formulation of public policies.

III. **Decision-making:** refers to the process by which governments adopt a particular course of action or non-action.

IV. **Policy implementation:** refers to the process by which governments put SETI policies into effect. This is when a decision is carried out through the application of government directives and is confronted with reality.

V. **Policy evaluation:** refers to the process by which the impact of SETI policies are monitored by both state and societal actors, the result of which may be a re-conceptualisation of policy problems and solutions.

SETI POLICY CYCLE IN RWANDA

The Government of Rwanda (2013d) prepared a *Cabinet Manual* to explicitly define the different decision-making mechanisms and procedures concerning the establishment of new policies.

Agenda setting: the National Development Agenda, which embraces SETI, is set by the government, usually under leadership of the Ministry of Finance and Economic Planning.

Policy formulation: in Rwanda, SETI policy formulation is usually a consultative process led by the Directorate of Science, Technology and Research within the Ministry of Education. Owing to the cross-cutting nature of research, innovation and scientific and technological services, other line ministries contribute to the formulation of the national SETI policy, such as: the Ministry of Agriculture and Animal Resources; the Ministry of Health; the Ministry of Trade and Industry; Ministry of Finance and Economic Planning; the Ministry of Natural Resources, the Ministry of Youth and ICT; and the Rwanda Development Board. The National Science and Technology Commission advise the government on policies, legislation and regulations in SETI fields.

Decision-making: it is normal practice for a policy to be reviewed at different levels before adoption. Responsibility falls to the government to ensure that a policy addresses the challenges faced by the population. The Office of the Prime Minister and Cabinet are responsible for the overall decision-making process.

Policy implementation: implementation covers research and innovation and the provision of scientific and technological services by the appropriate units. Owing to the cross-cutting nature of SETI activities, the implementation plans are the responsibility of the line ministries, such as: the Ministry of Education Ministry of Agriculture and Animal Resources; the Ministry of Health; the Ministry of Trade and Industry; the Ministry of Finance and Economic Planning; the Ministry of Natural Resources; the Ministry of Youth and ICT; and the Rwanda Development Board.

Policy evaluation: The Prime Minister's Office, under the authority of the Prime Minister, is entrusted with assisting the Prime Minister in the implementation and evaluation of national policies, leading Government activities according to the guidelines given by the President of the Republic, and ensuring law enforcement. The National Science and Technology Commission has the responsibility to monitor implementation of SETI policies, their legislation; to carry out analysis of the nature and effective use of national resources and infrastructure; and to prepare and disseminate an annual report on the state of science and technology in Rwanda.

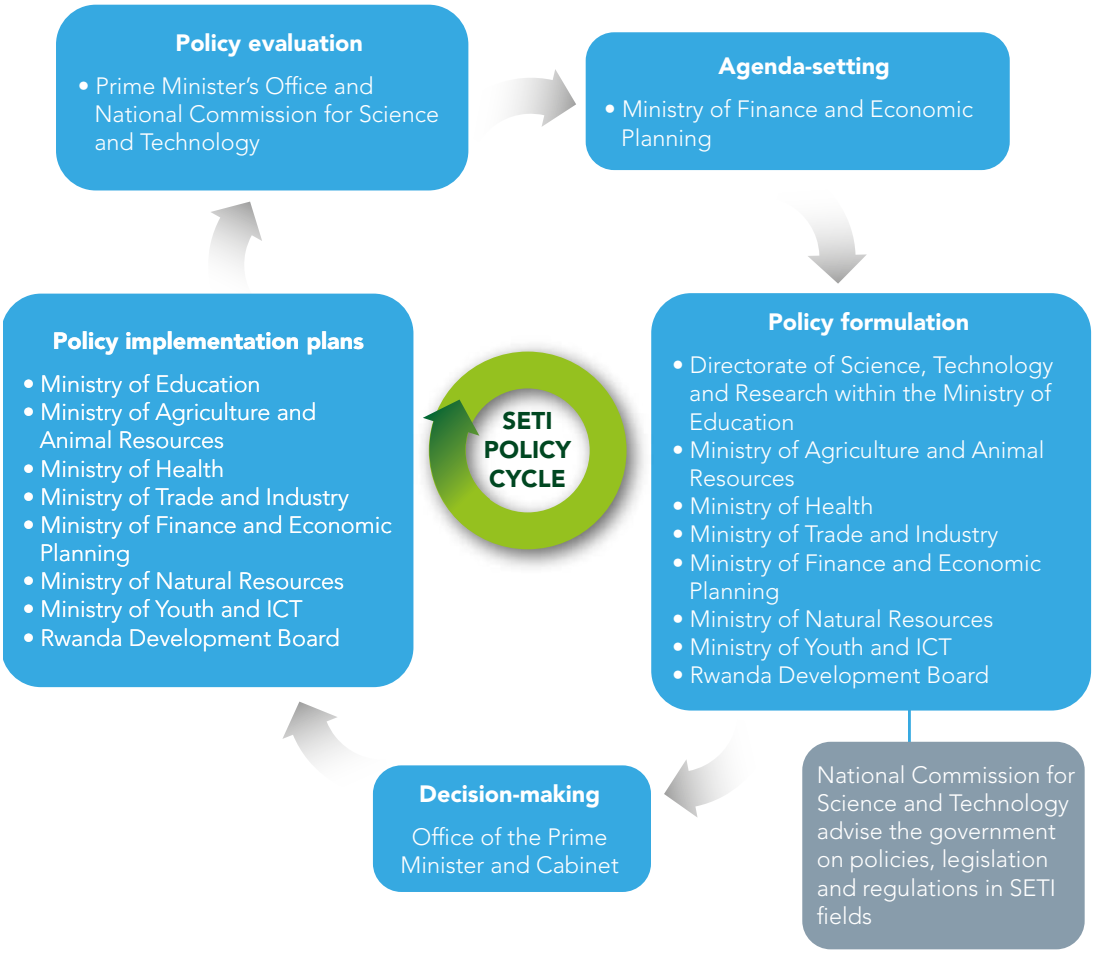
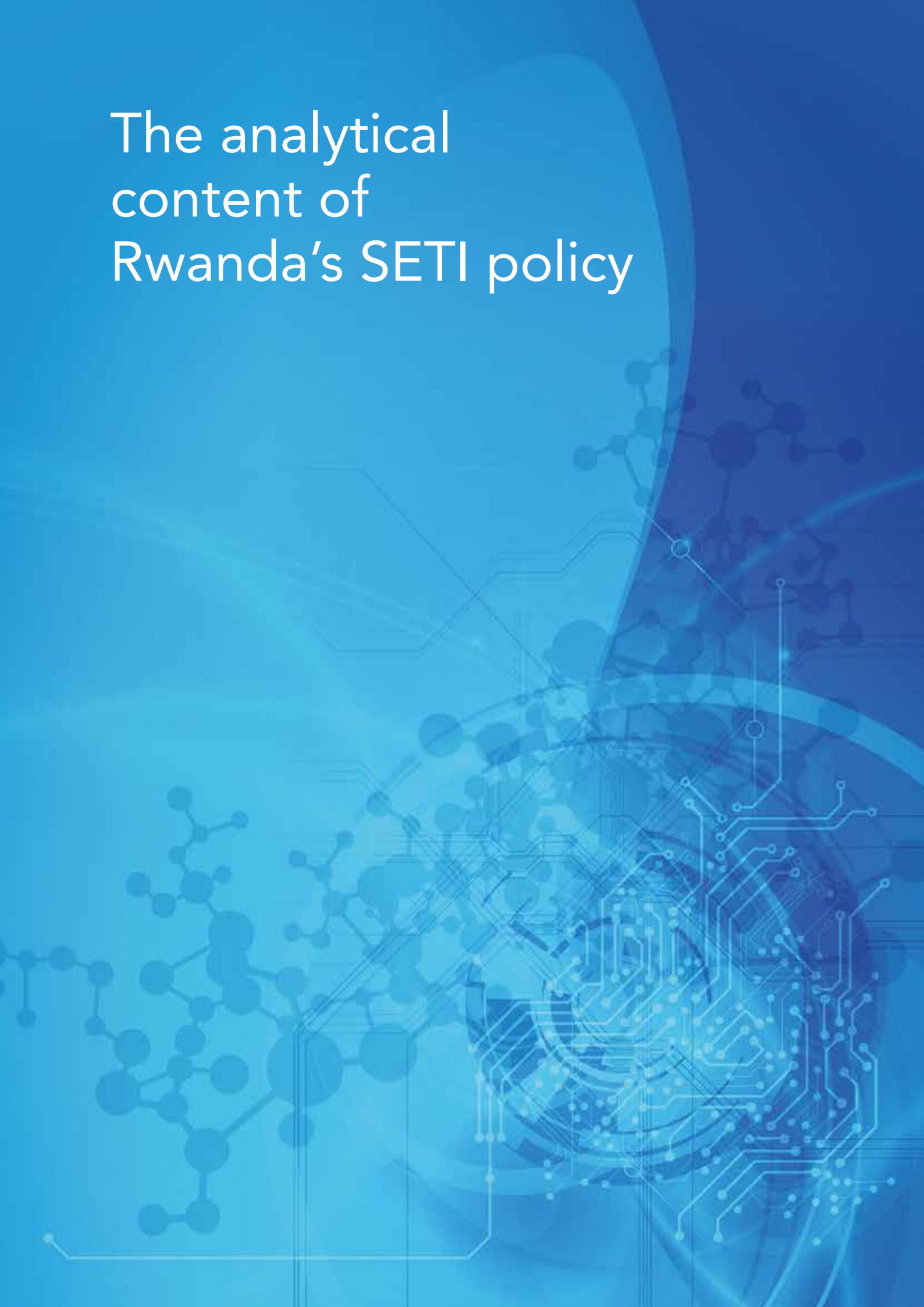


Figure 41: SETI policy cycle in Rwanda (c. 2015). Source: UNESCO

The analytical content of Rwanda's SETI policy



This section analyses the formal content of the 2014 Revised National Science, Technology and Innovation Policy of Rwanda[30], in accordance with the methodological approach of the GO→SPIN survey, which has been designed to allow for international comparisons of the SETI policies adopted by different countries.

All the statements in the pages that follow have been reproduced from the official policy document (Rep. of Rwanda, 2014d) but are organized hereafter according to the 14 standard fields proposed in the GO→SPIN survey. Some of these fields may be left vacant, owing to the fact that the explicit policy does not take these particular items into account.

ANALYTICAL CONTENT OF THE 2014 REVISED NATIONAL SCIENCE, TECHNOLOGY AND INNOVATION POLICY

I. **Policy vision:** 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

II. **Policy mission:** n/a

III. **Policy goals:** n/a

IV. **Policy objectives:** (i) improve skills and knowledge among the population, specifically to create a "knowledge-based" economy; (ii) maintain viability and strategically choose to enhance opportunities for growth in rural areas; (iii) integrate technical education with commerce, industry and the private sector in general and (iv) capacity building for: (a) knowledge acquisition, (b) knowledge creation, (c) knowledge transfer and (d) innovation culture

V. **Priorities at the strategic level of the SETI policy:** the 2014 Revised STI National Policy prioritized the following sectors: (i) education, (ii) health, (iii) agriculture and animal husbandry, (iv) environment, (v) water sanitation, (vi) energy, (vii) transport, (viii) ICT, (ix) tourism, (x) industry and (xi) private sector

VI. **Normative planning strategies of the policy:** (i) to support the growth of the economy of Rwanda, specifically to support the *Vision 2020* targets of a steady growth in GDP – 11.5% per year from 2014 to 2020; (ii) advance the quality of life for all the citizens of Rwanda, specifically to support the *Vision 2020* target of a GDP per inhabitant of US$ 1 240 by 2020

VII. **Policies related to the supply of SETI:** (i) knowledge acquisition: cultivate interest in S&T within pre-primary and primary schools, retain interest in S&T within secondary schools; train competent artisans at vocational training institutions, train high-level technicians at TVET; train medical practitioners, technologists, agriculturalists, scientists, engineers and PhD at higher education level; (ii) promote creation and transfer of knowledge and an innovation culture; (iii) the government implementation of STI reforms includes the following pillars (II) cultivate an innovation mind-set in all Rwandans, (III) increase supply of employable technical education and training graduates;

VIII. **Policies related to demand for SETI:** (i) focus on technological and innovative advancements in support of the emergence of a healthy private sector that will lead economic growth in Rwanda, (ii) develop the National integrated innovation framework; (iii) government support to science, technology and innovation through the following pillars: (I) perform scans for opportunities and SETI solutions needed for Rwanda, (II) cultivate an innovation mind-set in all Rwandans, (III) increase supply of employable technical education and training graduates, (IV) support innovation in the private sector, (V) improve transfer of research results into meaningful inputs for businesses and

30 At the time the GO→SPIN Country Profile was prepared, the *2014 Revised National Science, Technology and Innovation Policy,* was not yet approved by the Government. For practical purposes it was decided to make the study of the content analysis using the 2014 revised version text instead of the previous one (Rep. of Rwanda, 2006).

communities, (VI) address structural barriers to innovation (high energy-costs/tax-rates/teaching-loads), (VII) coordinate Rwanda's SETI efforts to advance EDPRS II achievement and (VIII) position SETI to inform decision-making; (iv) promote public-private partnerships in R&D; (v) promote intellectual property rights mechanisms

IX. **Policies to foster networking between the SETI supply and demand sides:** promotion of public-private partnerships in R&D; process scientific and/or technological innovations or inventions that can lead to acquisition of Intellectual Property Ownership (IPO)

X. **Regional and international dimensions of SETI policies:** n/a

XI. **Monitoring, assessment, technological forecasting and prospective scenarios:** According to Art 5 of Law No 80/2013 of 11 September 2013, the 2014 Revised National STI policy delegates all these functions to the National Science and Technology Commission.

XII. **SETI policy start date:** 2015

XIII. **Timespan for SETI policy planning:** 2015 onwards

XIV. **Link:** n/a

BOX 16 – FURTHER ANCHORING INDIGENOUS KNOWLEDGE SYSTEMS IN RWANDA'S RESEARCH AND INNOVATION POLICIES

The contents of Box 11 and 12 (see pages 92–93 and 113) showed that Rwanda has room for important innovations within the health sector based on traditional medicines and indigenous knowledge. However, there is no mention of these important issues in the national STI policies.

International recognition of the importance of indigenous and local knowledge was triggered by the *1992 Convention on Biological Diversity* and its well-known article 8(j): 'Each [state signatory] shall, as far as possible and as appropriate…respect, preserve and maintain knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity and promote their wider application with the approval and involvement of the holders of such knowledge, innovations and practices and encourage the equitable sharing of the benefits arising from the utilization of such knowledge innovations and practices.'

Over the past few decades, governments have addressed the issues of knowledge access and benefit sharing, including through the *Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization* (2010). Negotiations relating specifically to intellectual property continue through WIPO's Intergovernmental Committee on Intellectual Property and Genetic Resources, Traditional Knowledge and Folklore.

Growing attention is also being paid to the wider application of indigenous knowledge systems, as well as to its multiple dimensions. Beyond its contribution to identifying valuable genetic resources with applications in health, agriculture or industry, indigenous knowledge has gained growing recognition in such diverse fields as renewable resources, wildlife or fisheries management, natural disaster preparedness and response, environmental impact assessment and climate change assessment and adaptation. Recently, for example, the Intergovernmental Panel of Experts on Climate Change (IPCC) has encouraged authors of the Fifth Assessment Report, published in three volumes in 2013 and 2014, to consider indigenous knowledge alongside scientific knowledge when assessing the impact of climate change and opportunities for adaptation. Similarly, the newly established Intergovernmental Platform on Biodiversity and Ecosystems Services (IPBES), which counts Rwanda among its current 118 members, has adopted, as one of its founding principles, to 'recognize and respect the contribution of indigenous and local knowledge to the conservation and sustainable use of biodiversity and ecosystems'. These emerging fields of relevance to indigenous knowledge might also be considered through the development of an indigenous knowledge systems policy for Rwanda's sustainable development.

Such a policy might also provide Rwanda with the opportunity to consider the multiple dimensions of indigenous knowledge systems. Indigenous knowledge, for example, has gained specific recognition for its heritage values through *UNESCO's 2003 Convention for the Safeguarding of Intangible Cultural Heritage*. Recognition of the value of indigenous knowledge systems should be accompanied by a long-term vision not only of what these can contribute to Rwanda's sustainable development but also by a reflection on what measures may be required to ensure the long-term vitality of indigenous knowledge systems themselves. This also brings to the fore the issue of the continuing transmission of such knowledge and its relationship to education systems, both non-formal and formal. The United Nations Convention on the Rights of the Child underlines the importance of education that respects the language and culture of indigenous children. Ensuring the longevity and dynamism of indigenous knowledge systems, including through intercultural and mother tongue education, is also an investment in the long-term opportunities that these systems can bring Rwandan society.

The importance of traditional knowledge is recognized by the United Nations Declaration on the Rights of Indigenous Peoples (2007), adapted to the African context through the deliberations of the African Court of Human Rights, which provides a holistic framework for an enlarged and multidimensional vision of indigenous knowledge systems that can bring long-term benefits to Rwanda. It is also recognized by the *Swakopmund Protocol on the Protection of Traditional Knowledge and Expressions of Folklore*.

Source: UNESCO's Local and Indigenous Knowledge Systems (LINKS) programme

BOX 17 – UNESCO'S REVIEWS OF SETI POLICIES IN RWANDA

UNESCO has been collaborating and accompanying the Government of Rwanda in its efforts in the area of SETI policies and governance over the past decades.

From the sixties through the early nineties, within its Science and Technology Policy (STP) programme, UNESCO conducted a number of analytical studies, missions, consultations, surveys and inventories on SETI in Rwanda, accompanied with official technical reports and recommendations to the Government. These resulted in recommendations and guidance related to: the development of the Rwanda's science and technology system, including its organizational structures, governance and financial mechanisms (UNESCO, 1974, 1987a, 1987b; Kutchoukov, 1978; Morand, 1981); its priorities, programmes and potential (Morand, 1983, 1984); its development plan and implementation; as well as its R&D activities' performance and evaluation (El Hares, 1992).

UNESCO also undertook important surveys and analyses focused on: the science education system (Fiasse, 1960), possible educational options and strategies, as well as on the establishment of a national information system in S&T in Rwanda including assessment analysis (Polinière, 1975) and technical assistance for its development (Morand, 1983).

Later in 2004, among other international and development agencies, UNESCO cooperated with the Rwandan authorities on the development of its national Science, Technology and Innovation (STI) Policy document, approved by the cabinet in 2005, and later reviewed in 2014 (Republic of Rwanda, 2006, 2014e).

Over the past few years, the collaboration with Rwanda regained its momentum and has received financial support from the One UN Fund for Rwanda and the Government of Sweden. The technical assistance was coordinated by UNESCO's Division of Science Policy and Capacity-Building and its Regional Office for Eastern Africa in Nairobi, Kenya.

In 2013, at the request of the Government of Rwanda, UNESCO engaged in the formulation of the Global Observatory of STI policy Instruments (GO→SPIN) project for Rwanda, which became operational in late 2014, with a first technical mission in Kigali, in November 2014. During the mission, visits and consultations were conducted within the major STI stakeholders for the completion of the inventories needed for the development of the GO-SPIN country profile in STI policy. As one of the core objectives of the project was to strengthen capacities in data collection, assessment and evaluation of the strengths, weaknesses, opportunities and threats of the research and innovation system (SWOT analysis), a training session was designed and run by UNESCO expert Guillermo Lemarchand, to engage selected national actors, including representatives of: the Ministry of Education, science-based ministries, S&T units of major universities, research institutes and the National Commission for Science and Technology. Throughout the process, UNESCO worked hand-in-hand with the Ministry of Education, and national senior consultants; the National Commission for UNESCO served as intermediary with the Government.

In parallel to the exercise of mapping research and innovation in Rwanda, at the request of the Directorate of Science, Technology and Research in the Ministry of Education and with support from One UN, UNESCO provided technical assistance for the formulation of the Rwanda National Research Policy (RNRP), in 2013-2014. The RNRP, falling within the Rwanda STI Policy developed in 2005 and prescribed by *Rwanda Vision 2020*, was developed with the mission to 'build lasting foundations for a solid national capacity for scientific research and innovation, increase the performance, competitiveness and equity of Rwanda's economic, social and cultural development'. Moreover, the RNRP was developed with an ambition to address the three main problems that research in Rwanda experienced to date:

i. Lack of a coordinated Research Agenda.
ii. Shortage of qualified researchers in the country.
iii. Low level of funding of research activities.

In order to develop the RNRP, a series of consultations were organized in Kigali and Muzanze in May 2013 and March-April 2014, which gathered more than 80 stakeholders involved in research activities including international development partners, who contributed to the draft policy

prepared by an international expert recruited by UNESCO. The draft framework document of the RNRP was submitted for final validations by stakeholders in June 2014 and is today under consideration for adoption by the Cabinet.

The RNRP covers the following strategic areas which underpin its actions:

- Structural and Organizational Framework.
- Establishing mechanisms or instruments for financing R&D.
- Human Capital Development and training.
- Institutional Capacity-building of R&D, information, extension and technological innovation.
- Organization of the National Research and Innovation System (NRIS).
- Promotion of cooperation and partnership in science and technology.
- Promotion of a national culture of science and technology.
- Monitoring and evaluation of overall and sectoral implementation of RNRP.
- Promotion of research dissemination, utilization and maximizing the benefits of research and innovation to the 'end users'.

In January 2015, the first draft of the GO→SPIN country profile was submitted to the Rwandan authorities. In late April 2015 and upon reception of the feedback from relevant stakeholders, a second technical mission was conducted in Kigali to collect missing information notably related to operational policy instruments for the promotion of innovation and science in companies. A validation workshop was held on 29 April 2015 to discuss the country profile and to collaboratively analyze and complete the missing gaps. UNESCO wishes to thank the Government of Sweden as well as all national stakeholders that took part in the GO→SPIN exercise, for their commitment to the project.

Kornelia Tzinova
Assistant Programme Specialist
Section for Science Policy and Partnerships
Division of Science Policy and Capacity Building
Natural Sciences Sector
UNESCO

Group of participants at the GO→SPIN validation workshop, held in Kigali on April 29, 2015. Sitting in the first row, from left to right are: Marie Christine Gasingirwa (Director General for Science, Technology and Research at the Ministry of Education); Eliphaz Bahiz (General Secretary for the Commission Nationale Rwandaise de l'UNESCO); Verdiana Masanja (UNESCO Local Consultant); R.H. Prof. Silas Lwakabamba (Minister of Education of Rwanda); Charles Ndagije (UNESCO Local consultant) and Guillermo A. Lemarchand (UNESCO International Consultant).

Analysis of the SETI organizational chart and flows in Rwanda

The SETI organizational chart shows the distribution of responsibility for implementing a given policy. In the organisational chart, there are five distinct levels: (1) the policy-planning level (policy design); (2) the promotional level (funding); (3) the performance level (scientific research, technological development and productive innovation); (4) all science and technology services, and (5) the assessment/ evaluation level.

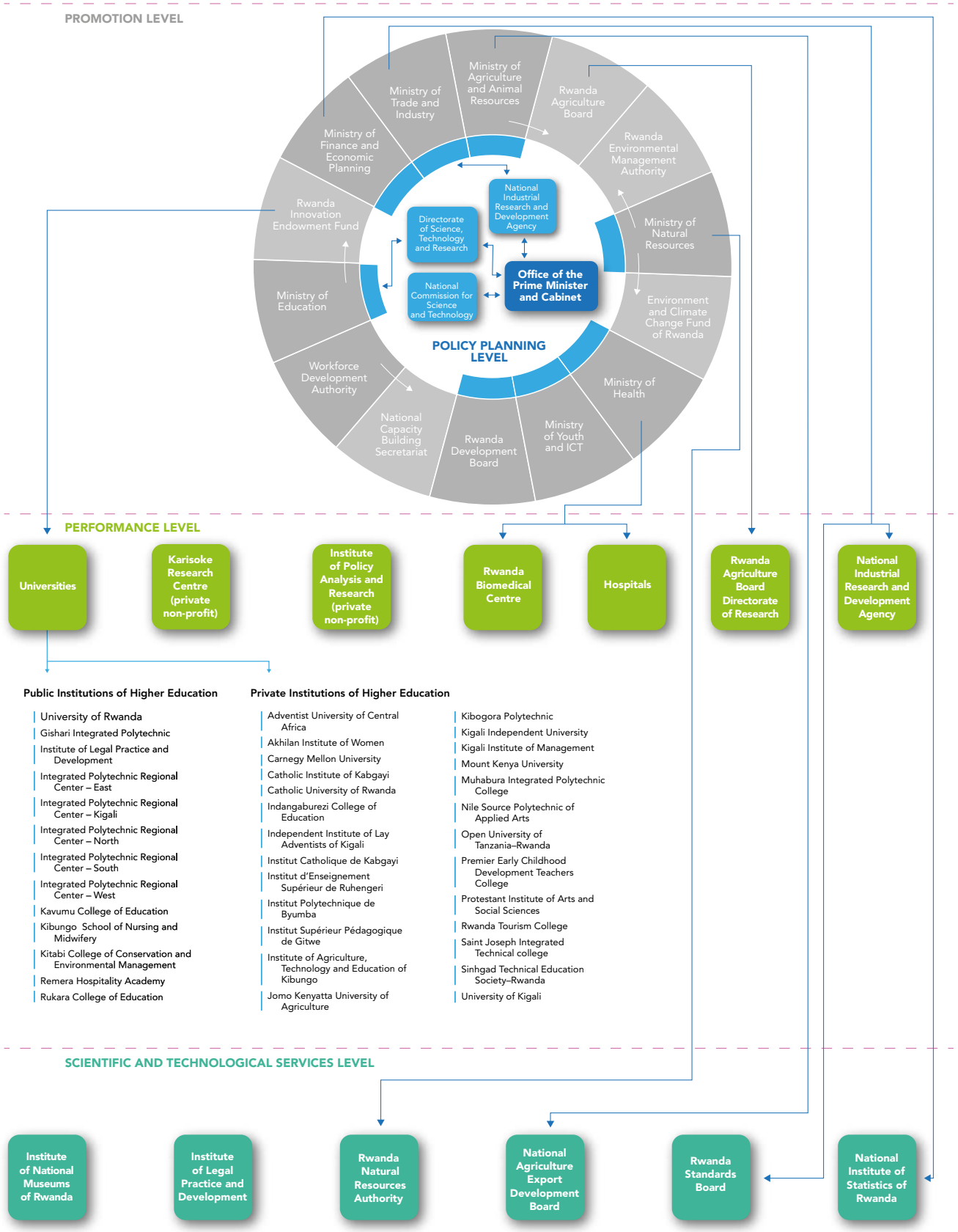


Figure 42: Organizational chart showing Rwanda's research and innovation system (c. 2015). Source: UNESCO

Inventory of the SETI institutions in Rwanda

Government Ministries and Public Agencies

Establishment and promotion of SETI activities require the commitment and cooperation of line ministries, parastatals, and public as well as non-governmental, non-profit and private sector institutions. Priority activities are undertaken by publicly funded science and technology organisations, and government provides the National Commission for Science and Technology as well as the line ministries with resources to facilitate their coordinating roles and establish appropriate links with private sector.

Three main implementing Units have been established to oversee the development of Science, Technology and Research in Rwanda namely:

1. National Commission for Science and Technology (NCST) established under Law Number 80/2013 of 11 September 2013.
2. Science, Technology, Innovation and Research (STIR) Unit of the Ministry of Education.
3. National Industrial Research and Development Agency (NIRDA) established under Law Number 51/2013 of 28th June 2013.

NATIONAL COMMISSION FOR SCIENCE AND TECHNOLOGY (NCST)

Address: P.O. Box: 1334 Kigali-Rwanda

Telephone: +250785230769

Website: www.ncst.gov.rw

Contact person: Director General, Dr Ignace Gatare

Email: igatare@ncst.gov.rw

Phone: +250788300083

Location: Nyarugenge District, Kigali City, Pension Plaza

The National Commission for Science and Technology (NCST) has aims to advise the Government of Rwanda on all matters pertaining to National Science, Technology, Innovation and Research policy, legislation and regulations, including knowledge and skills management, with a focus on capacity building and development strategies to support the achievement of a competitive and sustainable socio-economic sector.

In addition, the NCST aims to serve as a think-tank advising Government of Rwanda on crosscutting SETI strategies and programs and their relevance to national development.

The main responsibilities of the NCST are as follows (Ref. Art 5 of Law No 80/2013 of 11 September 2013):

1. To advise the Government on policies, legislation and regulation in the fields of science, technology, research and innovation and monitor the implementation of such policies and legislation;
2. To collaborate with competent organs with intention to advise the Government on educating and training people in matters relating to national needs in the fields of science and technology and to make a follow up on the organization and productivity of such training;
3. To ensure that people who are educated or trained in Rwanda or abroad in the fields of science and technology are facilitated to enter the labour market in order to work professionally and stay productive for the benefit of their country;
4. To examine, identify and support new initiatives that may be useful for the country in the fields of science and technology through investment in people's potential;

5. To carry out an analysis of the nature and effective use of national resources and infrastructure in order to support science and technology as well as their innovative use in a sustainable manner;
6. To establish, update and disseminate specific database of skills available and those needed in the country in the fields of science and technology;
7. To cooperate and collaborate with other advanced regional and international institutions of excellence with similar mission;
8. To prepare and disseminate annual report on the state of science and technology.

New funding mechanism for SETI: One of the responsibilities of the NCST is be to establish the National Research Fund (NRF). The Government of Rwanda agreed to the Decision of the Assembly of the AU 8th ordinary session in 2007 which recommended allocating at least 1% of GDP to R&D, and of this sum the Government shall allocate annually 0.5% of the total budget to the NRF to be managed by the NCST for R&D activities oriented towards the development goals of Rwanda (Rep. of Rwanda, 2014c).

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. SETI 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 research programme in the public interest.

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 other contributions to the strategic and socio-economic development of the country.

Ministry of Education

SCIENCE, TECHNOLOGY, INNOVATION AND RESEARCH UNIT (STIR)

Address: P.O. Box 622, Kigali – Rwanda

Telephone: +250 785068350

Email: cgasingirwa@mineduc.gov.rw

Website: www.mineduc.gov.rw/

Contact Person: Director General Marie Christine Gasingirwa

Location: Ministry of Education, Kigali

The Science, Technology, Innovation and Research Unit (STIR) is staffed with a science and technology analysts/specialists capable of supporting Ministry of Education to handle its science and technology in education portfolio, including strengthening research and innovation within the education system.

Particular attention is paid to complementarity with both the NCST and the National Industrial Research and Development Agency. The STIR shall focus on supporting Ministry of Education to smoothly implement its science, technology, innovation and research in the education programs.

The main responsibilities of the STIR are as follows:

1. To advise the Minister of Education on policies and strategies for science and technology as they relates to programmes in the education sector.
2. To coordinate programmes in the education sector strategy which relate to science and technology knowledge acquisition, knowledge creation, and knowledge transfer, as well as the promotion of an innovation culture within the national education system.
3. To initiate and oversee the implementation of programmes that strengthen scientific research capacity at all levels of the national education sector, including both formal and informal educations.
4. To promote the adoption of suitable and improved technologies and support the development of technological innovation and problem solving capacity within the education sector.
5. To support in coordinating and following up partnerships and collaboration between the Ministry of Education and relevant national and international organizations operating in the areas of science, technology, research and innovation.

THE NATIONAL INDUSTRIAL RESEARCH AND DEVELOPMENT AGENCY (NIRDA)

Address: P.O. Box 273 Kigali,

Email: nirda2015@gmail.com

Phone number: +250255104465

Website:

Contact person: Joseph Mungarulire

Location: 13th Floor, Kigali City Tower, Nyarugenge District

NIRDA shall be in charge of industrial research development, research product valorisation and commercialization. NIRDA shall support SMEs and entrepreneurs in areas of industrial product development, through capacity building as well as technology business incubation. Whenever necessary, NIRDA can also advise Government of Rwanda on matters pertaining to industrial R&D.

The main responsibilities of NIRDA were determined by Art 4 of Law No 51/2013 of 28 June 2013, as follows: (1) to implement the national industrial development policy, patent inventions and traditional knowledge in relation to industrial development and promote the trade of research products; (2) to carry out industrial and technology development research through the establishment of technology incubation centres and pilot plants and rural industrialisation; (3) to contribute to establishment of trade companies of research products; (4) to train business entrepreneurs who wish to invest in new or improved industrial research products; (5) to establish and develop industrial research and development partnership with international, regional and national institutions, whether private or public; (6) to facilitate the vertical growth of small and medium enterprises for them to enter new markets and increase new improved products; (7) to advise the Government on the national industrial research and development policy if necessary; (8) to build the capacity of small and medium enterprises by providing prototype development, reverse engineering, manufacturing facilities and business incubation.

The organization, functioning and responsibilities of organs of NIRDA shall be determined by a Prime Minister's Order.

Other governmental units

RWANDA GOVERNANCE BOARD (RGB)

Address: Kigali, Rwanda - KG 178 ST – P.O Box 6819, Kigali

Telephone: +250 55112023

Email: info@rgb.rw

Website: www.rgb.rw

Contact Person: Chief Executive Officer

Location: Remera, Gasabo, Kigali City

Background: Rwanda Governance Board (RGB) was formed from the merging of Rwanda Governance Advisory Council (RGAC) and the National Decentralization Implementation Secretariat (NDIS). In due course, other services have been moved to RGB from different government ministries. These include the department in charge of registration of FBOs and NGOs (transferred from the Ministry of Local Government), the department in charge of issuing of legal personality to CSOs (transferred from Ministry of Justice), and the department of Media development, Advocacy and Reforms (transferred from the former Ministry of Information). The Rwanda Governance Board (RGB) is a public agency with legal personality, administrative and financial autonomy, established by law No 41/2011 of 30/09/2011. It is managed in accordance with Organic law No 06/2009 of 21st December 2009 establishing general provisions governing public institutions functioning and administration.

Vision: The vision of RGB is "Fostering Good Governance for Sustainable Development."

Mission: The mission of RGB is to promote the principles of good governance and decentralization ; monitor the practices of good governance in political, public and private institutions ; coordinate and support media sector development ; register, empower and monitor civil society organizations ; enhance civic participation ; conduct research and studies related to governance ; document home grown solutions and provide policy advocacy to Government for achieving good service delivery, sustainable development and prosperity.

In particular, RGB has in its mission the following: (a) to promote good governance principles in political, public, corporate and nongovernmental domains; (b) to give policy related proposals and advice related to the improvement of governance with regards to domains referred to; (c) to monitor these domains in order to ensure compliance with good governance principles and activities meant for its promotion; (d) ensure coordination of activities by stakeholders of the implementation of national decentralization policy and local government's empowerment and to ensure monitoring thereof; (f) to conduct regular research and surveys on issues pertaining to good governance and disseminate findings; (g) to develop appropriate mechanisms to increase civic participation in policy formulation and to attain observance of accountability; (h) to ensure coordination of capacity building for local administrative entities; (i) to participate in initiating and implementing policies and strategies in the field of good governance and to advise the Government thereof; (j) to carry out a performance audit of boards of directors of government agencies; (k) to register local non-governmental and religious organizations grant them the legal status and monitor the conformity of their activities to the law; (l) to establish cooperation and collaboration relations with other national, regional and international institutions having missions that are similar to those of RGB; and (m) to implement the national policy on media which aims to develop the industry into a professional, vibrant and responsible sector, making full contribution to achieving high level governance and democracy ideals.

MINISTRY OF AGRICULTURE AND ANIMAL RESOURCE

Address: P.O. Box 621- Kigali

Telephone/Fax: +250 584644; +250 585008

Email:

Website: www.minagri.gov.rw

Contact Person: Permanent secretary

Location: Kacyiru (Kigali City)

In 2015, the Minister of Agriculture and Animal Resources is Mukeshimana Gerardine and the State Minister in charge of Agriculture is Mr. Tony Roberto Nsanganira.

Mission: To initiate, develop and manage suitable programs of transformation and modernization of agriculture and livestock, so to ensure food security and to contribute to the national economy.

Vision: The vision is to modernize agriculture and livestock to achieve food security. One of the key pillars of this vision is the transformation of agriculture from subsistence to a productive high-value market-oriented farming that is environmentally friendly and has an impact on other sectors of the economy.

The policy of the Ministry of Agriculture and Animal Resources is to increase animal production, modernize farming, reduce poverty, ensure food security and have surplus for the market. This will ultimately result in the increase of the standard of living of the population. The transformation of the animal resources industry can only be achieved if the constraints to animal production are reversed.

The strategic thrusts have been identified, as follows: (1) Diversification and intensification of plant, animal and fish production, (2) Diversification of income and employment sources for rural populations, (3) Linking products to markets and mainstreaming the agricultural economy into the national and regional economies, (4) Sustainable management of natural resources, particularly soil and water, (5) Organization, mobilization and capacity-building for producers and their organizations, (6) Capacity-building for service providers, privatization and private-sector development, (7) Creating an enabling institutional framework for the professionalization of producers and modernization of agriculture in Rwanda, (8) Creating an enabling environment for productive investment and the development of entrepreneurship and employment in agro-industry, (9) Redefining the role of the Ministry of Agriculture and redirecting its actions towards the sector programme approach in a context of decentralization and promoting the gender approach and reducing vulnerability among disadvantaged groups.

The plan of action focuses on four priority programmes: (a) Intensification and development of sustainable production systems; (b) support for producer professionalization, (c) promotion of product chains and agro-industry development and (d) institutional development.

This Ministry has the following strategies and policies: mechanisation strategy, rice policy report, Knowledge Management and Communication strategy and Ministerial instruction on public institution restructuration.

RWANDA AGRICULTURE BOARD (RAB)

Address: P. O Box 5016 Kigali-Rwanda

Email: infos@rab.gov.rw

Website: www.rab.gov.rw

In 2015, the Director General of RAB is Jean Jacques Mbonigaba Muhinda.

Mission: RAB has the general mission of developing agriculture and animal husbandry through their reform, and using modern methods in crop and animal production, research, agricultural extension, and in education and training of farmers in new technologies.

Responsibilities: In particular, RAB has the following responsibilities: (a) to implement the national policy of agriculture and animal husbandry; (b) to contribute in determining policy in agriculture, animal husbandry, agricultural and animal husbandry research and technology; (c) to provide farmers and consumers of agricultural products with information, techniques and services meant for improving their profession and supplying the internal market with increased and quality production thereby raising their agricultural and animal husbandry incomes; (d) to prevent and fight animal diseases and implement appropriate strategies meant for ensuring control, prevention, diagnosis and treatment of animal diseases, (e) to prevent and control plant diseases, insects and pests and implement appropriate strategies meant for ensuring control and prevention of plant diseases; (f) to conduct baseline survey and research aiming at development and solving problems identified in agriculture and animal husbandry and by products; (g) to monitor and coordinate activities of persons exercising the profession of agriculture, animal husbandry and research and stakeholders; (h) to identify and provide farmers with new technologies for proper management of land, water and use of agricultural and animal husbandry mechanization; (i) to coordinate activities aiming at promoting agricultural and animal husbandry infrastructure; (j) to examine and issue certificates of standards for agricultural and animal husbandry products meant for export; (k) to examine, verify and issue certificates authorizing imports of domestic animals, semen, fertilized eggs, seeds, plants and cuttings and other agricultural and animal husbandry products; (l) to work closely with other institutions in charge of standards and environment while importing fertilizers, crop protection products and other agricultural and animal husbandry inputs; (m) to contribute in establishing, publicizing and enforcing laws and regulations governing agriculture, animal husbandry, research as well as related products; (n) to establish relations and collaborate with other regional and international institutions having the same mission as RAB; (o) to ensure preparation, conservation, issuance and use of veterinary and crop protection products as well as their import and export; (p) to issue licenses and control the trade of veterinary products and agriculture inputs; (q) to ensure and monitor activities of production, control and trade of selected seeds; (r) to collect national and international innovations, new and appropriate technologies and refine them for use in agriculture and animal husbandry in Rwanda; (s) to provide agricultural extension services in accordance with agricultural and animal husbandry needs; (t) to coordinate activities of agricultural extension and research plans and disseminate such agricultural and animal husbandry needs as determined by zonal branches of RAB; (u) to support and coordinate agricultural extension and research activities in administrative decentralized entities; (v) to support agricultural and animal husbandry cooperatives towards a better service delivery; (w) to ensure partnership and coordinate activities of the non-governmental organizations, private operators and organs involved in implementation of agricultural and animal husbandry programs.

RWANDA AGRICULTURE BOARD DIRECTORATE OF RESEARCH

Address: P. O. Box 5016 Kigali-Rwanda

Telephone: Call toll free: 4676

Email: infos@rab.gov.rw

Website: www.rab.gov.rw

Contact Person: Deputy Director General In charge of Research in RAB

Location: Remera (Kigali City)

In 2015, the Deputy Director General In charge of Research in RAB is Dr Daphrose Gahakwa.

The RAB Directorate of Research is responsible for overall coordination of countrywide agricultural research activities and driving science-based technology generation for sustainable agriculture development. Agricultural research has been recognized as the engine driving agricultural growth in Rwanda and a critical tool in the fight against hunger and poverty.

The Research focuses mainly on the following areas: (a) forestry-based research, (b) animal-based Research, (c) crop-based Program and (d) soil-based research.

NATIONAL AGRICULTURAL EXPORT DEVELOPMENT BOARD (NAEB)

Address: P.O. Box 104 Kigali – Rwanda

Telephone: +250 0252 57 56 00

Email: info@naeb.gov.rw

Website: www.naeb.gov.rw

Contact person: Director General

Location: Gikondo Magerwa (Kigali City)

Vision: to be a world class agriculture and livestock commodity export-development promoter through innovation.

Mission: *to* facilitate the growth of business to diversify agriculture and livestock commodity export revenues.

The National Agricultural Export Development Board is registered under Ministry of Agriculture. It was created through merging Rwanda Tea Authority, Rwanda Coffee Authority and Rwanda Horticulture.

NAEB is aimed to improve the balance of payment of Rwanda Economy through increased agricultural exports. The National Agricultural Export Development Board was set up by bringing together three government agencies responsible for the entire Agriculture Export and cash crop base under one management.

Responsibilities*:* (a) to participate in elaboration of policies and strategies for developing exports of agricultural and livestock products; (b) to implement policies and strategies for promoting and developing agricultural and livestock products for export; (c) to identify and support research on agricultural extension regarding agricultural and livestock products for export; (d) to collaborate with other institutions to identify places where to install factories processing agricultural and livestock products for export and to grant them authorization; (e) to set quality standards of agriculture and livestock export commodities and make sure they are implemented; (f) to issue certificates of origin for agricultural and livestock products for export as provided for by relevant laws; (g) to supervise facilitate and train private operators and cooperatives involved in agricultural and livestock production for export to benefit them and the country; (h) to partner with and coordinate activities of non-governmental organizations, private operators and organs involved in exporting agricultural and livestock products; (i) to contribute to increase investments in industry and infrastructure meant for adding value to agricultural and livestock products for export; (j) to collect information on local, regional and international markets and disseminate them to stakeholders for use; (k) to coordinate activities of stakeholder networks as regards agricultural and livestock products for export; (l) to participate in various international negotiations and trade fairs, (m) to establish good relations with international organizations with regard to develop agricultural and livestock products export from Rwanda.

RWANDA ENVIRONMENT MANAGEMENT AUTHORITY (REMA)

Address: B.P 7436 Kigali, Rwanda

Telephone: +250252580101

Fax: +250252580017

Email: info@rema.gov.rw

Website: www.rema.gov.rw

Contact person: Director General

Location: Kacyiru (Kigali City, Gasabo District)

Under the supervision of the Ministry of Natural Resources, and based on the Law n°63/2013 of 27/08/2013 (determining its mission, organization and functioning), REMA is legally mandated for national environmental protection, conservation, promotion and overall management. It has an advisory role to the government on all matters pertinent to the environment and climate change.

Mission: To promote and ensure the protection of the environment and sustainable management of natural resources through decentralized structures of governance and to define national positions addressing emerging global issues with a view to enhancing the well-being of the Rwandan people.

Vision: All sectors of the Rwandan Society value and undertake sound environmental management and rational use of natural resources in order to contribute to the national aspirations for sustainable development.

Responsibilities: As stipulated in the Law N° 63/2013 of 27/08/2013, REMA has the following main responsibilities: (a) to implement Government environmental policy; (b) to advise the Government on policies, strategies and legislation related to the management of the environment as well as the implementation of environment related international conventions, whenever deemed necessary; (c) to conduct thorough inspection of environmental management in order to prepare a report on the status of environment in Rwanda that shall be published every two (2) years; (d) to put in place measures designed to prevent climate change and cope with its impacts; (e) to conduct studies, research, investigations and other relevant activities in the field of environment and publish the findings; (f) to closely monitor and assess development programs to ensure compliance with the laws on environment during their preparation and implementation; (g) to participate in the preparation of activities strategies designed to prevent risks and other phenomena which may cause environmental degradation and propose remedial measures; (h) to provide, where it is necessary, advice and technical support to individuals or entities engaged in natural resources management and environmental conservation; (i) to prepare, publish and disseminate education materials relating to guidelines and laws relating to environmental management and protection and reduce environmental degradation risks; (j) to monitor and supervise impact assessment, environmental audit, strategic environmental assessment and any other environmental study. REMA may authorize in writing, any other person to analyse and approve these studies.

RWANDA STANDARDS BOARD (RSB)

Address: P.O Box 7099 Kigali-Rwanda

Telephone: Tel: +250 586 1003; Fax: +250 583 305

Email: info@rbs.org.rw

Website: http://www.rsb.gov.rw/

Contact Person: Director General

Location: Kicukiro (Kigali City)

In 2015, the Director General is Dr Mark Cyubahiro Bagabe.

Vision: The vision of RSB is to be a trusted party in providing internationally recognized and customer-suited standardization services.

Mission: To provide standards-based solutions for Consumer Protection and Trade promotion for socio-economic growth in a safe and stable environment.

Responsibilities: (a) to establish and publish national standards; (b) to disseminate information on standards, technical regulations relating to standards and conformity assessment; (c) to raise awareness and promote the importance of standards and quality; (d) to offer services and tools to improve market access technology transfer and sustainable development; (e) to carry out research in the areas of standards and metrology for the setting up of measurement standards and reference materials in the field of chemical metrology; (f) to participate in monitoring standardization at national, regional and international level; (g) to participate in putting in place technical regulations relating to standards; (h) to provide products and quality service certifications and monitor conformity for issued certifications; (i) to provide legal, scientific and industrial metrology services; (j) to represent the country at the regional and international standardization organizations; (k) to establish laboratories capable of conducting tests and offering testing services; (l) to act as reference laboratory in the quality domain; (m) to carry out measurement and comparison of proficiency with same level regional and international institutions; (n) to organize training programs in the area of standardization, metrology and conformity assessment; (o) to advise the Government on defining, devising and implementing the standardization policy and (p) to establish and develop relations and collaboration with other institutions at national, regional and international levels with similar mandate, whether public or private.

NATIONAL INSTITUTE OF STATISTICS OF RWANDA (NISR)

Address: P.O. Box: 6139 Kigali, Rwanda

Telephone: +250 252 571035;

Fax: +250 252 570705

Email: info@statistics.gov.rw

Website: http://www.statistics.gov.rw/

Contact person: Director General

Location: Nyarugenge (Kigali City)

The National Institute of Statistics of Rwanda (NISR) was created in October 2005 as an independent institution out of the former Department of Statistics in the Ministry of Finance and Economic Planning (MINECOFIN) and the National Service of Census.

Law N° 53bis/2013 of 28/06/2013 is a new law that was adopted after reviewing the Organic Law N° 09/2005 of 14/07/2005 – the law establishing the National Institute of Statistics of Rwanda. (Source: Official Gazette n° 30 bis of 29/07/2013).

Organic Law N° 45/2013 of 16/06/2013 is a new law on the organisation of Statistical Activities in Rwanda. This Organic Law repealing the Organic Law N° 01/2005 of 14/02/2005 is N° 05/2013/OL of 16/06/2013. (Source: Official Gazette no Special of 16/06/2013).

As the primary data producer, NISR produces mandatory statistics such as the Gross Domestic Product (GDP), Consumer Price Index (CPI), Producers Price Index (PPI), external trade figures, population statistics and other special purpose statistics from surveys such as the Demographic and Health Survey (DHS),

Household Living Conditions Survey (Enquete Integrale sur les Condition de vie des ménages or EICV in French), Census and others. It also conducts specific studies such as the Agriculture Survey or the Service Provision Assessment Survey in partnership with other institutions.

Mission: To assume the leading role in improving capacity to use information for evidence-based decision-making by coordinating the national effort to collect and archive reliable data, to analyse, document and disseminate data within an integrated and sustainable framework.

Vision: To develop and sustain a culture of excellence in statistical production and the management of national development.

MINISTRY OF NATURAL RESOURCES

Address:

Telephone: +250 252 582628; fax: +250 252 582629

Email: info@minirena.gov.rw

Website: www.minirena.gov.rw

Contact Person: Permanent Secretary

Location: Nyarugenge – Kigali City

The Ministry of Natural Resources has the mission to ensure the protection and conservation of the environment and ensure optimal and rational utilization of natural resources for sustainable national development. Specifically, the Ministry of Natural Resources is responsible for:

1. Developing and disseminating the sector policies, strategies and programs through: a) elaboration and dissemination of national policies, strategies and programs that aim at conserving the environment and ensuring optimal and rational utilization of natural resources; b) development of strategies to promote partnership and enhance capacity of private sector and attract operators to invest in activities of environment and natural resources for sustainable economic development; c) Exhaustive assessment of Rwanda's ground and surface natural resources and establish appropriate mechanisms for their national extraction and promotion.

2. Regulating the sector and related sub-sectors through the development of development of laws and regulations to ensure rational utilization of natural resources and ensure protection of the environment and conservation of natural ecosystems.

3. Developing institutional and human resources capacities in the sector of environment and natural resources and its sub-sectors.

4. Monitoring and evaluating the implementation of sector and sub-sector policies, strategies and programs through: a) setting up and implementing appropriate mechanisms and systems for monitoring and evaluation of environment and the climate change situation in the country as well as in the region; b) Monitoring and assessing the implementation and mainstreaming of policies and laws that enhance the protection of environment and the rational utilization of natural resources in all cross-cutting sectors in the country; c) Monitoring the sector's performance indicators and consolidating the data from decentralized institutions; d) Submitting to the government periodic and annual reports on the impact of the sector policies, strategies, programs and projects on sustainable national social economic development.

5. Overseeing the institutions under its supervision through: a) guidance and orientations on the implementation of specific programs to be realized by the institutions under its supervision and by local governments; b) supervision and orientations on functioning of sector public institutions and promotion of synergies between various actors intervening in the sector.

6. Mobilizing resources for the development of the sector and related programs through: a) coordination of activities of mobilizing resources and supervision of actions to ensure their rational utilization in the sector development; b) mechanisms put in place for promoting and development in the sector.

RWANDA BIOMEDICAL CENTER (RBC)

Address: P.O. Box 83 Kigali

Telephone:

Email: info@rbc.gov.rw

Website: http://www.rbc.gov.rw/

Contact Person: Director General

Location: Nyarugenge District (Kigali City)

In 2015, the Deputy Director of the RBC is James Kamanzi. The RBC was created by the law no 54/2010 of 25th January 2011.

Vision: To become a centre of excellence for the prosperity of the country, ensuring quality health service delivery, education and research.

Mission: To promote quality, affordable and sustainable health care services to the population through innovative and evidence-based interventions and practices guided by ethics and professionalism.

The Rwanda Biomedical Center has the following divisions: (a) the Rwanda Health Communication Center; (b) the Epidemic Surveillance and Response (ESR) Division, (c) the HIV/AIDS and STIs Diseases Division; (d) the Mental Health Division; (e) the Non Communicable Diseases Division; (f) the National Center for Blood Transfusion (NCBT), and (g) the Malaria and Other Parasitic Diseases Division.

INSTITUTE OF LEGAL PRACTICE AND DEVELOPMENT (ILPD)

Address: P.O .Box: 49,Boulevard de l'Umuganda

Telephone: (+250)0252533238

Email: info@ilpd.ac.rw

Website: http://www.ilpd.ac.rw/

Contact Person: Vice-Rector

Location: Avenue des sports, Nyanza District (Southern Province)

Background: The Institute of Legal Practice and Development is a public institution established by law. The ILPD aims to serve as a national, regional and continental institute for: (a) practical legal training and (b) applied legal research in three languages (English, French and Kinyarwanda). The three legal traditions (common law, civil law & customary law) meet at the Institute. In 2012, ILPD was to become the research centre of the justice sector.

Vision: To promote legal development and practices. It will do this through the provision of information services and products that are innovative and sufficiently flexible to support the ILPD's strategic priority of being an e-research centre for Rwanda and the region.

Mission: (a) to meet the research needs of the ILPD's students by acquiring, providing and enhancing high quality information resources and collections that are appropriate. It will develop students' ability to access and utilize information in order to succeed at ILPD and beyond; (b) to satisfy the demands of the ILPD curriculum and facilitate the education of its student by providing access to comprehensive and up-to-date information resources and services, and (c) to meet the needs of the public and to serve the legal information needs of the local community, the region and the citizens of Rwanda.

INSTITUTE OF NATIONAL MUSEUMS OF RWANDA

Address: P.O. Box: 630 Butare-Rwanda

Telephone: +250730741093

Email: info@museum.gov.rw

Website: http://www.museum.gov.rw/

Contact Person: Director General

Location: Huye District (Southern Province)

The Institute of National Museums of Rwanda is a government institution, which was inaugurated on September 18th, 1989 with an ethnographic museum based in Huye (Butare) Southern Province, which is officially known as the National Museum of Rwanda.

Mission: The Institute of National Museums of Rwanda's mission is to collect, preserve, research, and present Rwandese past and present cultural and natural national heritage.

Vision: to provide museums and heritage sites around the country with a platform for educating and exposing Rwandan Cultural and Natural richness.

NEURO PSYCHIATRIC HOSPITAL OF NDERA – CARAES NDERA

Address: P.O. Box 423 Kigali

Telephone: (+250) 788827364 /788307932, +250 255113551

Email: cnkubili@yahoo.fr

Website: http://caraesnderahospital.com/

Contact person: Medecin Directeur

Location: Nder

Public Institutions of higher education

UNIVERSITY OF RWANDA

Location: Although it has its headquarters in Kigali city, Kicukiro District, Gikondo sector, the University of Rwanda has six colleges reaching all provinces of Rwanda.

Vision: By 2020 the University of Rwanda will have educated the next generation of leaders in Rwanda who are prepared and dedicated to building a more just and sustainable world.

Mission: The University of Rwanda will support the development of Rwanda by discovering and advancing knowledge; it is committed to the highest standards of academic excellence, and is a place where students are prepared for lives of service, leadership and solutions.

Objectives: The University of Rwanda will (a) develop interdisciplinary, problem-based academic programmes aligned with Rwanda's development needs, (b) integrate IT-based resources from around the world, (c) ensure students have the leadership, entrepreneurship and management skills needed to create employment, (d) prepare students for service to their communities and country through applied service learning programmes nationally and internationally, (e) create applied, evidence-driven, research centres focused on problem solving, aligned with Rwanda's development needs, and (f) develop continuous education programs for upgrading skills and knowledge.

Core Values: Its core values are (a) academic excellence; (b) honesty and integrity; (c) freedom of inquiry; (d) student-centred; (e) humanitarian perspective; (f) innovation; (g) creativity; and (h) social justice.

History of the University of Rwanda: The University of Rwanda (UR) is newly created in 2013 by Rwanda Law N° 71/2013 of 10/09/2013 as appearing in the Official Gazette N° 38 of 23/09/2013, by the merger of seven existing public higher learning institutions, including:

1. National University of Rwanda (NUR)
2. Higher Institute of Agriculture And Animal Husbandry (ISAE French acronym)
3. Kigali Health Institute (KHI)
4. Kigali Institute of Science And Technology (KIST)
5. Kigali Institute of Education (KIE)
6. School of Finance and Banking (SFB)
7. Umutara Polytechnic (UP)

History of the National University of Rwanda (NUR): The National University of Rwanda (NUR) (in French: *Université Nationale du Rwanda)* was established on 3rd November 1963 by the government of a newly independent country in cooperation with the Congregation of the Dominicans from the Province of Quebec, Canada. It was located in the city of Butare (now known as Huye) in the Southern Province. When it was established, the NUR had three divisions (the Faculty of Medicine, the Faculty of Social Sciences, and the Teacher Training College). The university suffered badly during the Genocide and had to close in 1994, reopening in April 1995. At that time, English was introduced as a medium of instruction alongside French. NUR was the most comprehensive, oldest and largest University in Rwanda. By September 2013, the university had nearly 12 000 students and 500 lecturers and taught all major disciplines in General Medicine, Public Health, Pharmacy, Clinical Psychology; Agricultural Sciences, Journalism and Communication; Arts, Languages, Law, Social Sciences, Natural Sciences, Engineering and Technology, Economics and Management; it conferred degrees ranging from Bachelor's degrees to PhD degrees. NUR was the only higher education institution offering PhD degrees by the time of merger with other public higher education institution to form the University of Rwanda.

Important dates and facts are:

- November 3, 1963: Official opening of NUR
- May 12, 1964: Law establishing the NUR
- 1965: A journal called *L'Informateur* was established.
- 1966: The National Institute of Education was created thanks to the UNDP and UNESCO. The Institute aimed at training and improving elementary secondary school teachers' skills. It also aimed at implementing multidisciplinary pedagogical research.
- 1967: Creation of the University Extension as a unit with the mission to reflect NUR by its services to the people.
- 1972: Creation of a research centre on pharmacopoeia and traditional medicine (CUPHARMETRA) in the Faculty of medicine. This became an autonomous body since 1980.
- 1973: NUR, in conjunction with the Ghent Faculty of Applied Sciences put up a progressive training program for civil engineers specialized in building and set up a four-project program in electro mechanic engineering.
- 1973: The University of Instelling Antwerpen contributed in the opening of the Faculty of Law.
- 1974: A centre for study and experimentation of energy in Rwanda was created within the Faculty of Sciences. It became autonomous since 1977.
- 1977: The journal *L'Informateur* was renamed *Etudes Rwandaises*; it focused on publishing research works conducted in or on Rwanda.
- 1979: The Faculty of Agriculture, which was a department in the Faculty of Science, was created.
- 1981: NUR and the National Institute of Education were merged. Since then, the National University of Rwanda had two campuses: one at Ruhengeri (now Muzanze) and another at Butare (now Huye). A few years later, the Faculty of Law shifted to Mburabuturo (Kigali), and this is now known as Gikondo Campus.
- 1988: Celebration of the 25th anniversary of NUR. Official opening of the Institute of Public Administration (ISAP), born of a cooperation between NUR and the Konrad Adanauer Foundation (FKA).
- 1994: The university community lost a good number of its staff and students who were killed during the war and Genocide. They were victims of their ideology or ethnic identity. The University suffered a great loss: laboratory equipment, the computer equipment and academic infrastructure were destroyed or taken away. NUR was closed because of the prevailing war in the country, those who were not killed had to hide themselves, and others fled in exile.
- 1995: The campus of Ruhengeri and the Kigali Faculty of Law became part of the campus of Butare (now Huye Campus). NUR reopened. The main change was that all the faculties and schools were regrouped in Butare Campus for security reasons first and then for administrative reasons. The beginning was not easy but the government committed to the smooth running of NUR. A campus that was built for 1 600 students now had to lodge more than 4 500. English became a new language of teaching and research in addition to French.
- 1996: Creation of the School of Information Sciences and Techniques.
- 1997: A preliminary year of language learning (French and English) is established for all NUR beginners.
- 1998: Creation of a doctorate (PhD) level degree training at the Faculty of Medicine, training jointly with Belgian Universities.
- 1998: Creation of the Research Commission, to coordinate research, publication, and funding. The Faculty of Sciences was also merged with the Faculty of Applied Sciences (Engineering) to form the Faculty of Science and Technology.

- 1999: Creation of the Centre for Conflict Management. The University League against Aids was created, an action research and dissemination centre. The University Centre for Arts was created, aiming to stimulate arts and culture, in order to bring their contribution to reconciliation, peace and national unity, and to promote Rwandan arts and culture internationally.
- 2000: The School of Public Health was created to conduct health research and Postgraduate training. The School of Information Sciences and Techniques became the School of Journalism and Communication. The programme changed to answer more efficiently the needs of the country.
- 2005: The official re-launching of post-graduate studies in the Faculty of Medicine. 'Radio Salus', a university radio station was officially launched.
- 2007: The Research Commission was transformed into a Research Directorate with a wider mandate to coordinate research, consultancy and postgraduate Studies, including PhD research degrees. Creation of Directorate of Postgraduate Studies to handle Masters-level teaching. The first PhD graduates of NUR pass oral examinations in Belgium and at NUR, then graduate at NUR. Enrolment of MPhil and PhD students started to be offered entirely by NUR. Establishment of the Committee of Senate; the Research Commission delegated to it the handling of some research, consultancy and technology transfer (RCTT-C) matters.
- 2008: establishment of standing committees of RCTT-C dealing with ethics and PhD/ MPhil matters.
- 2009: *Etudes Rwandaises* was renamed *Rwanda Journal* and will from this time publish in English, aiming to increase its readership and visibility.
- 2010, *Rwanda Journal* was indexed within Africa Journals Online, and it obtained a digital object identifier (DOI) in 2011.
- 2013: In the context of the creation of the University of Rwanda, on 19th December 2013, the Directorate of Research of the former NUR was transferred to the University of Rwanda central level to Coordinate Research and Postgraduate Studies.

History of the Institute of Agriculture and Animal Husbandry (ISAE): The Institute of Agriculture and Animal Husbandry (ISAE for its French acronym – *Institut Supérieur d'Agriculture et d'Elevage*) was established in 1989 by the Government of Rwanda to train highly qualified specialists, technicians, engineers as well as veterinary doctors, in various fields of agriculture and animal husbandry, so that they might serve the country and beyond. Until 2006, ISAE was offering Advanced Diploma programmes. Degree Programmes were introduced in 2007. The following are some major historical events at ISAE:

- 1989: ISAE was created at Busogo, Northern Province, Rwanda as an A1-awarding institution, in agriculture and animal husbandry.
- 1990: ISAE relocated to Kigali at the former Institute of Statistics and Applied Economics for Africa and Mauritius (IAMSEA) campus, due to the war in the North of the country.
- 1994: ISAE was temporarily closed due to the war and Genocide in the country.
- 1996: ISAE reopened and relocated to Kigali in its Rubilizi Campus.
- 2003: ISAE re-opened its Main Campus in Busogo.
- 2006: ISAE held its first graduation and awarded Diplomas to 1274 graduates in various fields of agriculture and animal science.
- 2007: ISAE started degree programs in Soil and Water conservation and management, Crop protection, Rural Development and Agribusiness, Veterinary Medicine and Animal Nutrition.
- 2008: ISAE introduced new faculties: The Faculty of Agriculture and Rural Development, The Faculty of Agricultural Engineering and Environmental Sciences, and the Faculty of Veterinary Medicine.

History of the Kigali Health Institute (KHI): KHI is an institute was established in June 1996 by the Ministry of Health in collaboration with the Ministry of Education to solve the problem of inadequate health personnel that was aggravated by the war. In 1996, the situation was that of one doctor per 55 705 people one nurse per 6,365 people. Before the war, there were no qualified physiotherapists, radiology technicians, anaesthetists, laboratory technicians, dentists, hospital managers and Environmental Health Scientists in Rwanda. At its establishment, KHI started with 43 students taking diplomas and certificates in the disciplines of Anaesthesia and Physiotherapy. By 10th of September 2013 when it was disestablished, KHI had 839 students awarding degrees, diplomas and certificates in Nursing and Midwifery, Anaesthesia, Radiology, Laboratory techniques, Dentistry, Physiotherapy, Mental health and Environmental Health Sciences.

History of the Kigali Institute of Science and Technology (KIST): KIST was created in 1997 by the Government of Rwanda with support of the GTZ and UNDP and was located at the located at the premises of the former Rwanda military academy, which was moved from the premises after the 1994 Genocide. KIST was the first Higher Learning Institution focusing of Science and Technology. Until 2005, KIST offered Engineering, Technology and Management programmes. On 4th May 2005, the Rwanda Cabinet decided that the KIST Faculty of Management would be transferred to the School of Finance and Banking. KIST was required to introduce Natural Science disciplines: Biology, Chemistry, Mathematics, and Physics as of January 2006. After that time and until September 2013, KIST offered programmes in Engineering, Science and Technology.

History of the Kigali Institute of Education (KIE): In an effort to meet the demand for adequately qualified primary and secondary school teachers, the Government of Rwanda established KIE at the beginning of 1999 to train primary and secondary school teachers through pre-service and in-service training. KIE is located at the former Institute of Statistics and Applied Economics for Africa and Mauritius and the In-service Teacher Training Centre. Its establishment was supported by various donors to include the World Bank, the Swiss Co-operation, the Belgian Co-operation (Coopération Française de Belgique), a British Government grant, a French Government Grant and a substantial contribution of the Netherlands Government through UNDP Trust Fund and UNDP grant (TRAC). On 4th May 2005, the Rwanda Cabinet decided that the Education Faculty that was part of the University of Rwanda would be transferred to KIE. NUR stopped to enrol Education students as of 2006 and by 2009, the Education disciplines were fully transferred from NUR to KIE.

History of the School of Finance and Banking (SFB): The SFB was established in June 2002 and located in Kigali at the Mburabuturo hill where the Faculty of Law of NUR was located before the Genocide. SFB took up its training mandate on January 5, 2004 offering the MBA of the Maastricht School of Management, the Netherlands with specializations in Banking, Finance, and Project Management. Later, SFB started offering training in the UK - Association of Chartered Certified Accountants professional course. By the cabinet decision of 4th May 2005, the Management Faculty of KIST was transferred to SFB from January 2006. With this transfer, SFB started to offer the Bachelor of Business Administration programme in Accounting, Finance, Human Resources Management and Marketing specializations.

History of Umutara Polytechnic: Umutara Polytechnic was founded in 2004 out of a community initiative and was located in Umutara (now known as Nayagatare) in the Eastern Province. Umutara Polytechnic started its first academic year on 2 May 2006 with 265 students and 16 staff. It was organized into faculties of Agriculture, Commerce and Applied Economics, Information and Communication Technology, and Veterinary Science. On 28 August 2008, the Rwanda Cabinet declared Umutara Polytechnic a public higher education institution.

Table 39 presents the list of undergraduate and graduates programmes, which are available at the different Colleges of the University of Rwanda.

Table 39: Undergraduate and graduate programmes at the University of Rwanda

Faculty	Undergraduate programmes	Postgraduate programmes
College of Agriculture and Veterinary Medicine	• Advanced Diploma in water management • Advanced Diploma in Irrigation and Drainage • Bachelor of Science in water management • Bachelor of Science in Irrigation and Drainage • Bachelor of Science in Agriculture Mechanization • Bachelor of Science in Forestry and Nature Conservation • Bachelor of Science in Animal Production • Bachelor of Science in Crop Science • Bachelor of Science in Food Science and Technology • Bachelor of Science in Rural Development and Agribusiness • Bachelor of Science in Veterinary Medicine • Bachelor of Science in Wildlife and Aquatic Resources Management	• Master of Science in Agribusiness • Master of Science in Agro-forestry and Environmental Management • Masters by Research in Agricultural Sciences and Veterinary Medicine • Doctor of Philosophy by Research in Agricultural Sciences and Veterinary Medicine
College of Arts and Social Sciences	• Diploma of Higher Education in Media Studies • Bachelor of Law • Bachelor of Arts in Journalism • Bachelor of Arts in Communication • Bachelor of Arts in Political Sciences: Comparative Politics • Bachelor of Arts in Political Sciences: International Politics • Bachelor of Arts in Development Studies • Bachelor of Arts in Public Administration • Bachelor of Arts in History • Bachelor of Arts in Sociology • Bachelor of Arts in Social Work • Bachelor of Arts in Translation and Interpretation Studies • Bachelor of Arts in Linguistics and Literature • Bachelor of Arts in Arts and Publishing • Bachelor of Arts in Arts and Creative Industry	• Master of Laws in Business Law • Master of Arts in Development Studies • Master of Arts in Peace and Conflict Studies • Master of Arts in Genocide studies and Prevention • Master of Social Sciences in Gender and Development • Masters by Research in Arts and Social Science • Doctor of Philosophy by in Research Arts and Social Science
College of Business and Economics	• Bachelor of Business Administration • Bachelor in Business Information Technology • Bachelor of Science in Economics with specialization in either of the following; International Economics, Development Economics, Monetary Economics • Bachelor of Science in Applied Statistics	• Master of Science in Economics • Master of Business Administration • Master of Science in Public Procurement Management for Sustainable Development • Masters by Research in Business and Economics • Doctor of Philosophy by Research in Business and Economics

Faculty	Undergraduate programmes	Postgraduate programmes
College of Education	• Diploma in Education • Bachelor of Education in English – Drama – Education • Bachelor of Education in English – Literature in English – Education • Bachelor of Education in French and English • Bachelor of Education in Kinyarwanda and Drama • Bachelor of Education in Kinyarwanda and English • Bachelor of Education in Kiswahili and English • Bachelor of Education in Early Childhood Education • Bachelor of Education in Foundations of Education • Bachelor of Education in English • Bachelor of Education in French • Bachelor of Education in Kinyarwanda • Bachelor of Education in Entrepreneurship • Bachelor of Education in Social Studies • Bachelor of Education in Integrated Sciences • Bachelor of Education in Mathematics • Bachelor of Education in Biology – Chemistry • Bachelor of Education in Biology – Physical Education and Sports • Bachelor of Education in Mathematics – Biology • Bachelor of Education in Mathematics – Computer Science • Bachelor of Education in Mathematics – Physics • Bachelor of Education in Physics – Chemistry – Education • Bachelor of Education in Physics – Geography • Bachelor of Education in English – History • Bachelor of Education in Entrepreneurship – Economics • Bachelor of Education in Geography – Economics • Bachelor of Education in History – Geography • Bachelor of Education in Literature in English – Geography • Bachelor of Education in Literature in English – History	• Postgraduate Certificate in Learning and Teaching in Higher Education • Postgraduate Diploma in Education • Master of Education in Curriculum and Instruction

Faculty	Undergraduate programmes	Postgraduate programmes
College of Medicine and Health Sciences	• Advanced Diploma in Mental Health Nursing; • Advanced Diploma in Midwifery; • Advanced Diploma in Anaesthesia; • Advanced Diploma in Ophthalmology; • Advanced Diploma in Medical Imaging Sciences; • Advanced Diploma in Orthopaedics Technology; • Bachelor of Science in General Nursing; • Bachelor of Nursing Education (BNE) • Bachelor of Science in Biomedical Laboratory Sciences; • Bachelor of Science in Physiotherapy; • Bachelor of Science in Dentistry; • Bachelor in General Medicine • Bachelor in Clinical Psychology • Bachelor of Science in Pharmacy • Bachelor of Environmental Health • Bachelor of Human Nutrition and Dietetics	• Postgraduate Diploma in Professional Counselling • Postgraduate Diploma in Emergency Medicine • Postgraduate Diploma in Infectious Diseases • Master of Medicine in Anaesthesiology • Master of Medicine in Psychiatry • Master of Medicine in Paediatrics and Child Health • Master of Medicine in Obstetrics and Gynaecology • Master of Medicine in General Surgery, Orthopaedic Surgery, Neurosurgery and Urology • Master program in Pharmacy/School of Medicine and Pharmacy • Master of Medicine in Ear, Nose and Throat • Master of Medicine in Internal Medicine • Masters in Clinical Psychology and Therapeutics • Masters in Public Health • Master of Science in Epidemiology • Master of Field Epidemiology and Laboratory Training Program • Master of Hospital and Healthcare Administration • Masters of Science in Heath Informatics • Masters by Research in Medicine • Masters by Research in Pharmacy • Masters by Research in Public Health • Masters in Critical Care and Trauma Nursing • Doctor of Philosophy by Research in Medicine • Doctor of Philosophy by Research in Pharmacy • Doctor of Philosophy by Research in Public Health

Faculty	Undergraduate programmes	Postgraduate programmes
College of Sciences and Technology	• Bachelor of Science in Civil Engineering • Bachelor of Science in Electrical Power Engineering • Bachelor of Science in Electronics and Communication System Engineering • Bachelor of Science in Electronics and Telecommunication Engineering • Bachelor of Technology in Building and Construction Technology • Bachelor of Science in Building and Construction Technology • Bachelor of Technology in Surveying and Geomatic Engineering • Bachelor of Science in Surveying and Geomatic Engineering • Bachelor of Science in Computer Science, • Bachelor of Science in Information Technology • Bachelor of Science in Computer Engineering • Bachelor of Science in Biology • Bachelor of Science in Chemistry • Bachelor of Science in Geography • Bachelor of Science in Mathematics • Bachelor of Science in Physics • Bachelor of Architecture • Bachelor of Science in Construction Management • Bachelor of Science in Creative Design • Bachelor of Science in Estate Management and Valuation	• Master of Science in Information Systems • Master in Biodiversity Conservation • Master in Information and Communication Technology • Master in Water Resources and Environmental Management • Master of Science in Transportation Engineering and Economics • Master of Science in Highway Engineering and Management • Masters by Research in Science • Masters by Research in Engineering and Technology • Doctor of Philosophy by Research in Science • Doctor of Philosophy by Research in Engineering and Technology
Institute of Legal Practice and Development		• Law

Source: University of Rwanda

BOX 18 – UNIVERSITY OF RWANDA: STATUS OF INTRAMURAL SCIENTIFIC RESEARCH

Based on various analyses and initiatives, including the 17–18 July 2014 workshop of the University of Rwanda Research and Postgraduate Studies Committee, a low level of research production was characterised by (but not limited to) the following:

- Limited number of lecturers holding Doctorate degrees: currently the University of Rwanda has only 19% PhD holders among its staff. In absolute numbers, this is 283 out of 1 481 academic staff.
- Academically qualified staff are mostly engaged in teaching and administrative work, although the staff: student ratio of 1:19.5 is favourable. However, staff with the requisite qualifications to supervise and hold leadership positions (Senior lecturer and above) are only 12.5%, which in absolute numbers is 185 out of 1 481. Also 28.5% are Tutorial Assistants, meaning that 423 out of 1 481 cannot do teaching; they only support the lecturers and yet are on the payroll.
- Currently, about 19% of the staff is researching actively; the average per capita research output is 0.08 papers per year, compared to the Inter-University Council for East Africa per capita norm of one paper per year.
- Engaging in research and supervision of postgraduate degrees is considered optional rather than mandatory.
- There are few incentives to do research and supervise postgraduate degrees theses. There are very few Master's and doctoral students; currently the proportion of postgraduate students is only about 2%. In fact, this proportion includes postgraduate certificate and postgraduate diploma students, meaning that the proportion of those doing Masters or PhD work is even lower than 2%.
- There is unclear coordination of research structures and insufficient recognition of managers of Research and Postgraduate Studies.
- Although a legal framework for conducting research at the University of Rwanda exists, some conditions of service discourage staff from undertaking research. For example, there is no possibility of sabbatical leave for staff to join active international research institutions or to conduct research and prepare for publishing.

The Research and Postgraduate Studies Committee workshop concluded that in order to institute a research culture, the University of Rwanda has to:

- Inculcate academic spirit in its community (staff, students and academic units). This entails luring members of the University of Rwanda community (individuals and university units) to conduct research that is driven by curiosity, to undertake initiatives to seek research opportunities, and to engage in innovations and to present their findings to different forums for critique by peers.
- Have a vision that promotes research culture. This includes creating ownership of collectively determined programmes among members of academic units, research projects and associated research teams, and undertaking periodical review of research activities e.g. through retreats.
- Invest in people to ensure there is a critical mass of researchers spread across career stages from PhD students to full professors and promote mentorship of each other without arbitrary hierarchy. For example, the senior experienced researchers could mentor the junior on research methods and content, while the junior researchers mentor the senior researchers on new technologies such as ICT or related advanced tools.
- Put in place structures and systems that promote and support an environment conducive to research.

- Ensure availability of finances for carrying out research through core funding, project grants (e.g. university, research councils, foundations, Collaborations and NGO), own grant awards (e.g. setting up a University research fund) and consultancies.
- Internationalize research, co-publishing, and the postgraduate student body.
- Assist staff to improve their capacities to write successful research grants proposals.
- Make research productivity integral to the performance management system.

It was also agreed that to promote research activeness of staff, students and academic units and publication of research in leading journals, the University of Rwanda has to:

- Promote discussion of research by ensuring academic units run regular seminar series, special (public) lectures, organise workshops and conferences and invite visiting academics to give seminars or research related talks (and benefit from them).
- Facilitate and recognize in-house publication: working paper series, own journal, book series and annual research reports.
- Ensure external publication of research conducted by University of Rwanda staff and students (including as credible international journal articles, books, book chapters and policy reports), and ensure the visibility of these publications, including by citation by academic peers, postgraduate students, policy makers and practitioners.
- Target to create impact within academia (citations, referee activities, advisory and editorial boards) and beyond academia (public relations seminars, etc. with practitioners).
- Introduce an incentive scheme that rewards and encourages staff to engage actively in research and in supervising research by students, besides teaching and other services.
- Increase staff and institutional visibility using the institutional electronic repository and system of Researcher ID.

To develop postgraduate research and publications, with teaching and learning informed by research, the University of Rwanda has to:

- Increase the critical mass of staff with PhD qualification and train them to supervise higher degree research students,
- Increase the number of research students, and introduce scholarships for higher degrees students and post-doctoral fellowships,
- Have in place policy instruments on publications from students' theses and policy instruments for referencing publications by the University of Rwanda staff and students,
- Have in place a higher degrees policy to guarantee the smooth running of a larger number of students registered for higher degrees.
- To ensure that research at the University of Rwanda contributes to Rwanda development and the well-being of the Rwandan society, the university has to:
- Establish research units, research centres and research institutes. These will serve as a focus of scholarly activity and intellectual creativity related to teaching, research and service; provide undergraduate, postgraduate and postdoctoral students with additional research opportunities; establish a strong positive impact on the economic development of the country; and improve the visibility and outreach of the University of Rwanda locally, nationally, and internationally.
- Implement a research communication strategy for the dissemination of publications (e.g. Policy Reports, Annual Research Reports and Books) including improving visibility at external conferences and workshops, and through outreach activities, exhibitions and road shows; using old media (press, radio, TV, and feature articles); and using new media (e.g. websites, Twitter, Face book, blogs, Videos, photos, branding – logo, pens, and stationery).

Source: University of Rwanda (2014)

GISHARI INTEGRATED POLYTECHNIC

Vision: To become the premier centre of excellence and a hub of expansion for product-based TVET within the region.

Mission: To train the Rwanda National Police and civilian personnel in appropriate technical and vocational occupations so as to provide a comprehensive in-house support for effective and efficient management of material resources in the Rwanda National Police and the entire population.

Table 40 presents the list of the undergraduate programmes that are available at the Gishari Integrated Polytechnic.

Table 40: Undergraduate programmes at Gishari Integrated Polytechnic

Institution	Undergraduate programmes
Gishari Integrated Polytechnic	• Advance Diploma in Construction • Advance Diploma in Plumbing & Sheet Metal • Advance Diploma in Masonry • Advance Diploma in Domestic Electrical Installation • Advance Diploma in Electrical Technology and Electronics Technology • Advance Diploma in Electrical Technology • Advance Diploma in Electronics and Telecommunication Technology

Source: Gishari Integrated Polytechnic

INTEGRATED POLYTECHNIC REGIONAL CENTRE – KIGALI

Mission: To provide technical education and vocational training at all levels in order to empower students and to enhance their opportunities for career advancement and success in a global economy.

Core Values: The values promoted by IPRC Kigali: Respect, Excellence, Integrity, Diversity, Learning for life, Responsibility, Loyalty, Patriotism.

Table 41 presents the list of the undergraduate programmes that are available at the Integrated Polytechnic Regional Centre – Kigali.

Table 41: Undergraduate programmes at Integrated Polytechnic Regional Centre – Kigali

Institution	Undergraduate programmes
Integrated Polytechnic Regional Centre – Kigali	• Advanced Diploma in Construction Technology • Advanced Diploma in Electronics and telecommunication Technology • Advanced Diploma in Water Technology and Sanitation Engineering • Advanced Diploma in Quantitative Surveying • Advanced Diploma in Mining Engineering • Advanced Diploma in Engineering surveying • Advanced Diploma in Biomedical Equipment Technology • Production and Manufacturing Technology • Advanced Diploma in Air Conditioning and Refrigeration Technology • Advanced Diploma in Automobile Technology • Advanced Diploma in Information and Communication Technology.

Source: Integrated Polytechnic Regional Centre – Kigali

INTEGRATED POLYTECHNIC REGIONAL CENTRE – SOUTH

Vision: To be a leading TVET provider in the region.

Mission: Implement TVET programmes and facilitate the establishment of adequate, efficient and appropriate TVET offers in the Southern Province.

Motto: Building Sustainable Self-Reliance

Values promoted by IPRC South: Excellence, Dignity, Patriotism, Loyalty, Professionalism, Innovation and Integrity

Core Functions of IPRC-South: (1) To organize technical train-the trainer programs for all technical and vocational schools in the South Region, (2) To organize pedagogic train-the-trainer programmers for all technical and vocational schools located in the South region, (3) To implement TVET courses at all level (up to an Advanced Diploma level) focusing on both knowledge and skills, for both school leavers and the unskilled and unemployed population; (4) To supervise and coordinate with private education providers, NGO-run TVET centres and industry-run training centres on delivery of TVET training in South region, (5) To supervise TVET centres and Polytechnics Campuses (PCs) on the delivery of TVET training in South region, (6) To provide the Competency-Based Training (CBT) curriculum as developed by the Workforce Development Authority (WDA) headquarters to all TVET centres and PCs that are delivering vocation training in South region, (7) To provide quality assurance related to TVET delivery, by ensuring that all curricula are in line with the CBT, ensuring the integrity of examinations, and ensuring that all TVET lectures and instructors are adequately trained.

Table 42 presents the list of the undergraduate programmes that are available at the Integrated Polytechnic Regional Centre – South.

Table 42: Undergraduate programmes at Integrated Polytechnic Regional Centre – South

Institution	Undergraduate programmes
Integrated Polytechnic Regional Centre – South	• Advance Diploma in Civil Engineering • Advance Diploma in Electrical Technology Engineering • Advance Diploma in Electronics • Advance Diploma in ICT

Source: Integrated Polytechnic Regional Centre – South

INTEGRATED POLYTECHNIC REGIONAL CENTRE – WEST (IPRC WEST)

Vision: IPRC West aspires to be the leader in professional training that provides an innovative and excellent education for the knowledge-based economy and sustainable development.

Mission: IPRC West empowers students to develop their knowledge, skills, and potential as critical thinkers. It provides high quality technological, professional and vocational training, develops creative, competitive, innovative and entrepreneurial work force with hand-on experience.

Core values: IPRC West takes great pride in the quality of education that is provided to its students. The community as well as the country expect IPRC West to produce qualified and competitive technicians able to solve technological, social and economic problems facing the community. To meet all of these, IPRC West has identified values to guide in service delivery of every day: (a) hands-on-experience, (b) professionalism, (c) creativity, (d) competitiveness, (e) self–reliance, (f) community engagement.

Motto: Professional Training for knowledge-Based Economy.

Table 43 presents the list of the undergraduate programmes that are available at the IPRC West.

Table 43: Undergraduate programmes at Integrated Polytechnic Regional Centre – West

Institution	Undergraduate programmes
Integrated Polytechnic Regional Centre – West	• Advance Diploma in Electrical and electronics Engineering • Advance Diploma in Mechanical Engineering • ICT

Source: Integrated Polytechnic Regional Centre – West

INTEGRATED POLYTECHNIC REGIONAL CENTRE - EAST

Mission: IPRC East's mission is to implement technical and vocational training courses at all levels focusing on knowledge, technical and entrepreneurial skills for school leavers, unskilled and unemployed population.

Vision: IPRC East aims to be a renowned institution that excels in providing technical, vocational and innovative education for sustainable development of Rwanda and region.

Core Values: The guiding principles that dictate behaviour and actions of IPRC East are the following: integrity, innovative, patriotism, excellence, efficiency and functions.

The core functions of IPRC East are: (1) To implement technical and vocational training courses at all levels focusing on skills for the unskilled and unemployed population as well as students who have completed nine years of basic education; (2) To supervise and coordinate with private education providers, NGO-run TVET centres and industry-run training centre on the delivery of TVET training in the region of the Eastern province; (3) To provide Competency-Based Training (CBT) curriculum developed by WDA to all TVET centres delivering vocational training in the region of Eastern province; (4) To provide quality assurance TVET delivery by ensuring that all curricula are CBT, the integrity of examination protected and all TVET lecturers and instructors are adequately trained; (5) To organize technical train-the-trainer programs for all technical and vocational schools located in the region of Eastern province; (6) To organize pedagogic train-the-trainer programs for all technical and vocational schools located in the region of Eastern province; (7) To supervise and coordinate with all public TVET centres and Polytechnics Campuses on the delivery of training in the region of Eastern Province.

Table 44 presents the list of the undergraduate programmes that are available at IPRC East.

Table 44: Undergraduate programmes at Integrated Polytechnic Regional Centre – East

Institution	Undergraduate programmes
Integrated Polytechnic Regional Centre – East	• Advanced Diploma in Civil Engineering • Advanced Diploma in Mechanical Engineering • Advanced Diploma in Information and Communication Technology

Source: Integrated Polytechnic Regional Centre – East

INTEGRATED POLYTECHNIC REGIONAL CENTRE – NORTH

Vision: To be a centre of excellence in Technical Education in Rwanda and Region.

Mission: To produce highly qualified technical human resources with competent hands-on skills and entrepreneurship culture.

Table 45 presents the list of the undergraduate programmes that are available at the IPRC North.

Table 45: Undergraduate programmes at Integrated Polytechnic Regional Centre – North

Institution	Undergraduate programmes
Integrated Polytechnic Regional Centre – North	• Advance Diploma in Alternative Energy • Advance Diploma in Electronics and Telecommunication • Advance Diploma in Information Technology

Source: Integrated Polytechnic Regional Centre – North

KAVUMU COLLEGE OF EDUCATION

Starting period: Kavumu College of Education started in 2007.

Location: The College is located in Southern Province, Muhanga District, Nyamabuye Sector. This campus opened its doors to the first intake of about 182 students in 2008 as Kavumu College of Education. The College's mission was to train highly skilled, competent and professional secondary school science teachers to consolidate the nine year basic education programme.

In 2010, Government of Rwanda combined Kavumu and Rukara Colleges of Education to form one viable entity called Rwanda Teachers College to be based in Eastern Province, Kayonza District. The Prime Minister's order No.53/03 of 14/07/2013 that harmonized salaries of various government departments established the Rwanda Teacher's College (RTC), Kavumu and RTC Rukara campuses.

One of the major tasks of the college has been to facilitate, support and guide students to achieve their potential to become skilled, competent, knowledgeable secondary school science teachers. RTC Kavumu has and continues to equip its students with skills and competences to make them self-reliant and employable in this dynamic world. Rwanda Teacher's College Kavumu tries to shape its graduates to understand the problems that afflict our society and how to look for solutions to improve life for Rwandans.

The other major role has been to create a conducive academic environment to catalyse the teaching and learning system at Rwanda Teacher's College at Kavumu Campus. With support from Government, international partners and other well-wishers, the college has established academic environment that is very valuable.

RTC Kavumu Campus takes pride in its well-equipped science laboratories, its connection to fiber optics and well-trained science tutors. The human and non-human resources form the basis for the science teacher education at this campus.

Its stakeholders, in particular head-teachers of Secondary schools in Southern, Northern and Western Provinces have acknowledged the skilfulness and professionalism of its graduates. This has given the college management the impetus to work harder to maintain that reputation.

That reputation has been attained due to the team spirit of RTC-Kavumu Campus fraternity. We are a community of academics determined to shape the human resources pool of this country to be change agents. The following Table 46 shows the list of undergraduate programmes available.

Table 46: Undergraduate programmes at Kavumu College of Education

Institution	Undergraduate programmes
Kavumu College of Education	• Diploma in Mathematics and Physics with Education • Diploma in Mathematics and Computer sciences with Education • Diploma in Mathematics and chemistry with Education • Diploma in Mathematics and Biology with Education • Diploma in Biology and chemistry with Education • Diploma in Physics and chemistry with Education • Diploma in Physics and computer sciences with Education

Source: Kavumu College of Education

KIBUNGO SCHOOL OF NURSING AND NYAGATARE SCHOOL OF NURSING

These two schools have programmes on General Nursing and Midwifery.

Nursing and Midwifery schools provide the highest quality and evidence-based education that are making Rwanda trained nurses and midwifery locally and globally competitive utilizing available resources optimally, within a conducive environment by highly competent and motivated staff in collaboration with all stakeholders.

Values: integrity, equity, learning and growth, discipline and quality.

KITABI COLLEGE OF CONSERVATION AND ENVIRONMENTAL MANAGEMENT

The Kitabi College of Conservation and Environmental Management (KCCEM) is located on the outskirts of Nyungwe National Park, 54km from Butare, on the main Kigali – Rusizi road. It is an academic institution, operating under the Rwanda Development Board, with the mandate to develop capacity in Conservation and Environmental Management in Rwanda and the wider Albertine Rift Region. The Kitabi College of Conservation and Environmental Management provides an Advance Diploma in Wildlife Management and an Advance Diploma in Hospitality.

REMERA HOSPITALITY ACADEMY

In order to strengthen the delivery of technical skills in the sector and consequently improve on the quality of service delivery, the Workforce Development Authority has established a world class Hospitality Academy in Remera, Gasabo district ideal for internationally competitive hospitality training consistent with the standards of the twenty first century. The Academy also boasts of skilled trainers and industry experts that deliver the Workforce Development Authority demand-led and competency-based curricula.

The Academy started its operations on the 2nd July, 2012 with the following two-fold purpose that serve as a quick win short-term solution: To upgrade the skills of existing industry workers and to conduct training of trainers in the hospitality sector institutions. So far, 116 employees have graduated and another 138 employees are currently undergoing the same training, which lasts 240 hrs.

The Hospitality Training department also carries out outreach programs, so that all hotels in the country can benefit from the Remera Hospitality Academy.

General Objective: The overall objective for this program is to equip the participants with the hands-on technical skills, knowledge and attitudes for hotel operations, which will focus on the following areas:

Specific Objectives: Each trainee upon completing the course will (a) have good working knowledge of the products and services offered in hotels and Restaurants; (b) acquire hands-on skills underpinning knowledge required for the quality service delivery in their respective areas; (c) be able to deal with their clients with respect, politeness and courtesy; (d) have a sense of self-respect and passion for the job; (e) know the importance of cleanliness in workplace; (f) take good care of their personal grooming and hygiene; (g) be able to communicate and interact positively with guests; (h) have a good sense of team work and organizational skills; (i) know clearly the impact of international travellers (tourists and other groups of travellers) towards the economic growth of Rwanda and (j) have a sense of going an extra mile in satisfying their guests' needs, managing time schedules and coordinating activities in an organized manner.

Private Institutions of higher education

ADVENTIST UNIVERSITY OF CENTRAL AFRICA (AUCA)

Location: The Adventist University of Central Africa is located in Kigali City, Gasabo District, Ndera Sector.

Mission: The Adventist University of Central Africa is committed to provide Christ-centred quality-education founded on holistic approach that prepares people for the service of this life and the life to come.

Vision: The Adventist University of Central Africa is to be a centre of excellence in undergraduate and graduate programmes. Quality shall be the hallmark of all its undertakings, including research and service delivery to its students, faculty, staff and the community at large.

Table 47 presents the list of the undergraduate programmes that are available at the Adventist University of Central Africa.

Table 47: Undergraduate programmes at the Adventist University of Central Africa

Faculty	Undergraduate programmes
Faculty of Business Administration	• Bachelor of Science in Accounting • Bachelor of Science in Management
Faculty of Information Technology	• Bachelor of Science in Information Management • Bachelor of Science in Networks & Communications
Faculty of Education	• Bachelor of Science in Educational Psychology • Bachelor of Science in English & Lang. Lit

Source: Adventist University of Central Africa

AKILAH INSTITUTE FOR WOMEN

Akilah is the first and only higher education institute in Rwanda open exclusively to women. Akilah has graduated 94 alumnae since 2012, with an average 95% job placement rate upon graduation. The Akilah Institute for Women provides undergraduate programmes in Hospitality Management and another one on Entrepreneurship

CARNEGIE MELLON UNIVERSITY – RWANDA

With a century-long history that has hosted 19 Nobel Laureates, Carnegie Mellon University is renowned as one of the world's leading engineering institutions. It has played critical roles on breakthroughs in areas such as artificial intelligence, driverless cars and Wi-Fi.

Carnegie Mellon University recently extended its global reach into Africa with its Center of Excellence in Information and Communication Technology.

Focused on one of the fastest growing economic regions of the world, the Center of Excellence is creating a new generation of graduates able to take advantage of Africa's unique opportunities.

Based in Rwanda, the Center of Excellence benefits from the country's bold ICT strategy and its own culture of innovation to provide a platform for students to become technology thought leaders in emerging markets.

Masters' degrees from Carnegie Mellon University are awarded in two comprehensive programmes, each taught by globally renowned faculty, to the same rigorous standards as at the main Pittsburgh USA campus.

The Master of Science in Information Technology provides students with critical skills, focusing on practical applications in areas such as cyber security, mobile applications, wireless networking and strategic business planning. In internships and practicums, students get the opportunity to develop real-world ICT solutions with international companies like IBM, Microsoft and Visa.

The Master of Science in Electrical and Computer Engineering has a more technically focused curriculum, equipping students with skills in energy systems, mobile computing and telecommunications.

The programmes of Carnegie Mellon University provide a unique opportunity for students to gain a balanced international perspective with an option to spend semesters at Carnegie Mellon's Pittsburgh and Silicon Valley campuses.

Carnegie Mellon's academic programs extend across countries and continents. They are rooted in an academic philosophy that develops its students into responsible global leaders.

Now in Africa, Carnegie Mellon seeks to pioneer a culture of inspiring innovations that change the world.

CATHOLIC UNIVERSITY OF RWANDA (CUR)

Creation period: The Catholic University of Rwanda was created in 2010.

Location: The Catholic University of Rwanda is located in South Province, Huye District, Ngoma sector.

Vision: The Catholic University of Rwanda's vision could be summarized in the following terms: 'Excellence for the promotion of science, education of honest and committed professionals for the social, economic, technological transformation and religious training.'

Mission: (a) to promote top quality education; (b) to install moral and social values through education of citizens free of all forms of discrimination including gender-based; (c) to promote Research-Action and to intercede with the local population in order to help them to familiarize themselves with the new technologies in order to better meet their fundamental needs and to improve their living conditions; and (d) to organize advanced training in the specific domains of the University.

Objectives: (a) to meet the real needs on the job market in the areas of science and technology, commerce, health and nutrition, social work, education and religious sciences; (b) to contribute to the achievement of the objectives of the national policy of sustainable development and notably at the level of the transversal domains of *Vision 2020*: the development of human resources, the promotion of Rwandans' health, the reduction of poverty, the protection of environment, the promotion of ICT, etc.; (c) to promote the spirit of entrepreneurship while exploiting the existing potentialities at national, regional and international level; (d) to educate young scientists who are honest and animated of a spirit of creativity and innovation; (e) to provide teaching allowing various groups of graduates to acquire specialized qualifications; and (f) to attach particular importance to professional practice so as to develop the learners' know-how efficiently.

Table 48 presents the list of the undergraduate programmes that are available at the Catholic University of Rwanda.

Table 48: Undergraduate programmes at the Catholic University of Rwanda

Faculty	Undergraduate programmes
Faculty of Commerce	• Bachelor of Science in Management and Accounting • Bachelor of Science in Commercial Engineering
Faculty of Social Work	• Bachelor of Science in Welfare and Social development • Bachelor of Science in Child and family Studies • Bachelor of Science in Public Health • Bachelor of Science in Human Nutrition
Faculty of Science and Technology	• Bachelor of Science in Computer Science • Bachelor of Science in Biotechnology
Faculty of Education	• Bachelor of Science in Didactics • Bachelor of Science in Educational Management and Administration
Faculty of Catechesis and Religious Sciences	• Bachelor of Science in Catechesis • Bachelor of Science in Religious Sciences

Source: Catholic University of Rwanda

INDANGABUREZI COLLEGE OF EDUCATION

The College's mission is to deepen the understanding about the formation and utilization of human capabilities. This mission permits to focus on teaching and learning in many different content areas and with learners of many different ages, ranging from early childhood to adults.

Table 49 presents the list of the undergraduate and graduates programmes that are available at the Indangaburezi College of Education.

Table 49: Undergraduate a programme at the Indangaburezi College of Education

Institution	Undergraduate programmes
Indangaburezi College of Education	• Advance Diploma in Early Childhood Education • Advance Diploma in Education in English and French • Advance Diploma in Education in English and Swahili • Advance Diploma in Education in English and Kinyarwanda • Advance Diploma in Education in Computer Science and Geography • Advance Diploma in Education in Economics and Geography

Source: Indangaburezi College of Education

INDEPENDENT INSTITUTE OF LAY ADVENTISTS OF KIGALI (INILAK)

Creation period: The INILAK was created on 3 February 1997.

Location: The INILAK is located in Kigali city, Gasabo District, Remera Sector.

Vision: Contribute to the national development by providing well-educated citizens capable of handling developmental challenges, with much emphasis on quality education both on moral and intellectual basis, able to develop the spirit of expertise, creativity and performance in accordance with the *Vision 2020*.

Mission: The core mission of the INILAK is to promote education, scientific and technological research as well as the service to the community.

Table 50 presents the list of the undergraduate and graduates programmes that are available at the INILAK.

Table 50: Undergraduate programmes at the Independent Institute of Lay Adventists of Kigali

Faculty	Undergraduate programmes	Postgraduate programmes
Faculty of Economic Sciences and Management	• Bachelor of Business and Administration in Accounting • Bachelor of Business and Administration in Finance • Bachelor of Business and Administration in Marketing • Bachelor of Business and Administration in Management • Bachelor of Arts in Cooperative Management • Bachelor of Arts in Economics	• MBA in Accounting • MBA in Entrepreneurship • MBA in Finance • MBA in Human Resource Management • MBA in Marketing • MBA in Project management
Faculty of Law	• Bachelor of Law	• LLM in International Environment and Land Use Law • LLM in International Criminal Law
Faculty of Computing and Information Sciences	• Bachelor of Information Technology • Bachelor of Software Engineering • Bachelor of Information Systems and Management	• Master of Science in Information Technology • Master of Science in Management and Information Systems
Faculty of Environmental Studies	• Bachelor of Arts in Emergency and Disaster Management • Bachelor of Arts in Environmental Management and Conservation • Bachelor Degree in Rural Development	

Source: Independent Institute of Lay Adventists of Kigali

INSTITUT CATHOLIQUE DE KABGAYI (ICK)

Background: The ICK is a private Higher Learning Institution founded in 2002 by the Catholic Diocese of Kabgayi, under the name Université Catholique de Kabgayi. It was given recognition by the Ministry of Education by a convention instrument n°001/03/2003 between the Government of Rwanda and the Diocese of Kabgayi.

The Université Catholique de Kabgayi became "Institut Catholique de Kabgayi" by the Ministerial Order n° 03/08.11 of 04/02/2010 (cf. O.G. n°08 of 22/02/2010) and obtained accreditation by the decision of the Cabinet, on March 24th, 2010.

Vision: To be a centre of Academic and Professional Excellence.

Mission: To advance and promote knowledge and development of skills in professionalism and innovativeness through quality education, research and community services for the transformation of society and sustainable development.

Motto: Science – Conscience – Development

Objectives: (a) to provide a scientific and technological higher education by taking into account the needs for the development of the population; (b) to provide a formal framework of continuous training and research in the teaching learning domains which the university provides; (c) to contribute to cultural, civic, moral and Christian education of the population and (d) to promote, through teaching and research, the values of truth, justice and solidarity for the integral promotion of humankind.

Table 51 presents the list of the undergraduate programmes that are available at the ICK.

Table 51: Undergraduate programmes at the Institut Catholique de Kabgayi

Faculty	Undergraduate programmes
Faculty of Social, Economic Sciences and Management	• Bachelor of Science in Sociology • Bachelor of Science in Economics • Bachelor of Science in Management
Faculty of Sciences of Development	• Development studies • Bachelor of Science in Environmental Management
Faculty of Journalism and Communication	• Bachelor of Science in Journalism • Bachelor of Science in Public Relations

Source: Institut Catholique de Kabgayi

INSTITUT D'ENSEIGNEMENT SUPÉRIEUR DE RUHENGERI (INES–RUHENGERI)

Creation period: INES–RUHENGERI was created on 17th November 2003.

Location: INES–RUHENGERI is located in Northern Province, Muzanze District, Muzanze Sector.

Vision: Universality in each individual; Knowledge in order to unite and better serve the world.

Mission: Through the interaction of civil society, private sector and public sector, contribute to the national and regional development, by providing specialized university education enhanced by research, in order to create competitive enterprises and well-paid employment.

This mission and vision of INES–RUHENGERI are what made it choose to strategically be a specialized Institution in Applied Fundamental and Social Sciences. This means that INES–RUHENGERI in its learning methodology seeks to balance theories and practice in order to give to students 'responsive competences' i.e. competences that they can use to provide sustainable solutions to various day-to-day problems of the society.

This is done using several tactics, such us: (a) the choice of departments: all programmes are oriented toward problem solving. Examples are rural economics, statistics and applied economy, biotechnology, and enterprise management which focuses on SMEs; (b) respect of the regulations from the Ministry of Education, (c) promotion of research on the market needs and possible answers to be given; (d) organisation of special programs according to specific needs of the society; and (e) promotion of partnerships with public, private and civil society organisations.

Table 52 presents the list of the undergraduate and graduates programmes that are available at the INES–RUHENGERI.

Table 52: Undergraduate programmes at the Institut d'Enseignement supérieur de Ruhengeri

Faculty	Undergraduate programmes	Postgraduate programmes
Faculty of Applied Fundamental Sciences	• Bachelor of Science in Statistics Applied to Economy • Bachelor of Science in Biotechnologies • Bachelor of Science in Land Survey • Bachelor of Science in Civil Engineering • Bachelor of Science in Computer Science • Bachelor of Science in Land A Bachelor of Science in administration and Management	• Macroeconomics
Faculty of Economics, Social Sciences and Management	• Bachelor of Science in Applied Economics • Bachelor of Science in Enterprises Management • Bachelor of Science in Public Administration and Good Governance	
Faculty of Law	• Bachelor of Science in Law	
Faculty of Languages and Applied Linguistics	• Bachelor of Science in French–English–Education	

Source: Institut d'Enseignement supérieur de Ruhengeri

INSTITUT POLYTECHNIQUE DE BYUMBA (IPB)

Creation period: The IPB was created on 26 January 2006.

Location: The IPB is located in Northern Province in Gicumbi District, Byumba sector.

Vision: The vision of the IPB is to become a regional centre of expertise essential to durable socio-economic development while preserving a healthy environment for the generations present and future in the spirit of the motto *Educatio, Scientia et Ministeria* (Education, Science and Services).

Mission: IPB will provide (1) polytechnic and university higher education of quality, guaranteeing to Rwandans and to the other people of the area a competitive technology developed on the world market. The eduction privileges research for scientific invention and technology, and by means of participative approaches that engage (rural and urban) communities and seek to ensure their development; (2) fundamental scientific and applied research, aiming at promoting original solutions involving scientific, technological approaches to production in rural and urban areas, and (3) multiple services to the community including by using approaches that promote gender equality,development, good governance, tolerance, the respect of the rights of the people, the good of others and the common good, the protection and the conservation of the environment, the fight against hate and against discrimination based on ethnicity, HIV-status or region, and the fight against other societal plagues like corruption.

Table 53 presents the list of the undergraduate and graduates programmes that are available at the Institut Polythechnique de Byumba.

Table 53: Undergraduate programmes at the Institut Polythechnique de Byumba

Faculty	Undergraduate programmes	Postgraduate programmes
Faculty of Social Sciences, Management and Development Studies	• Bachelor of Science in Management and Development Studies • Bachelor of Science in Social Sciences	• Master of Science in Social Sciences
Faculty of Education	• Bachelor of Science in Sciences • Bachelor of Science in Arts and Humanities	

Source: Institut Polythechnique de Byumba

INSTITUT SUPERIEUR PEDAGOGIQUE DE GITWE (ISPG)

Creation period: The ISPG was created in 1993.

Location: The ISPG is located in Southern province, Ruhango District, Bweramana Sector.

Mission: The mission of the ISPG is to offer quality education based on Seventh-day Adventist Church philosophy which is to develop the total person by developing his/her mental, spiritual, physical and social faculties.

Vision: The ISPG has the vision of being a higher learning institution of reference in the sub-region, for sustainable cooperation at national, sub-regional and international levels in training competitive graduates in the job market mainly in Nursing Science, Biomedical Science and Computer Science. The institution tends to extend its programs by establishing new faculties (like Medicine, Education) as they become necessary to contribute to the development of the country.

Table 54 presents the list of the undergraduate and graduates programmes that are available at the Institut Superieur Pedagogique de Gitwe.

Table 54: Undergraduate programmes at the Institut Superieur Pedagogique de Gitwe

Faculty	Undergraduate programmes
Faculty of Nursing Science	• Bachelor of Science in General Nursing Science
Faculty of Computer Science	• Bachelor of Science in Computer Science Engineering • Bachelor of Science in Computer Science Management
Faculty of Medicine	• Bachelor of Science in Medicine
Faculty of Biomedical Science	• Bachelor of Science in Biomedical Sciences

Source: Institut Superieur Pedagogique de Gitwe

INSTITUTE OF AGRICULTURE, TECHNOLOGY AND EDUCATION OF KIBUNGO

Vision: The Institute of Agriculture, Technology and Education of Kibundo aims to influence the transformation of the livelihood using science and technology through an educational centre of excellence.

Mission: The Institute of Agriculture, Technology and Education of Kibundo's ultimate responsibility is to provide a quality education by ensuring teaching quality and conducting research with focus on overcoming community challenges. Thus, the following four major elements are taken into consideration: (a) ensure teaching quality by training professionals; (b) conduct research to solve problems faced by Rwanda and the region; (c) carry out direct community-oriented actions; (d) promote equal access for both men and women to education and participation, as part of promoting of a culture of tolerance.

Values and principles: The motto of the Institute of Agriculture, Technology and Education of Kibundo is *Scientia et Sapientia*. The institute aims to provide knowledge and wisdom. We therefore seek to integrate the following values: (a) excellence, (b) integrity, (c) commitment and (d) team work.

Table 55 presents the list of the undergraduate programmes that are available at the Institute of Agriculture, Technology and Education of Kibundo.

Table 55: Undergraduate programmes at the Institute of Agriculture, Technology and Education of Kibundo

Faculty	Undergraduate programmes
Faculty of Education	• Bachelor of Science in Economics & Management • Bachelor of Science in Arts and Humanities • Bachelor of Science in Clinical Psychology • Bachelor of Science in Psycho Pedagogy • Bachelor of Science in Biochemistry • Bachelor of Science in Math–physics
Faculty of Rural Development	• Bachelor of Science in Agribusiness • Bachelor of Science in Agricultural Engineering

Source: Institute of Agriculture, Technology and Education of Kibundo

JOMO KENYATTA UNIVERSITY OF AGRICULTURE AND TECHNOLOGY

Jomo Kenyatta University of Agriculture and Technology—Kigali Campus is situated along east African road next to bank of Kigali Sonatube (Kicukiro) approximately 2 kilometers from the Kigali International Airport.

At the Jomo Kenyatta University of Agriculture and Technology—Kigali campus, academic programmes are identical with those of the main Jomo Kenyatta University of Agriculture and Technology Campus in Nairobi, Kenya and are highly competitive at regional and continental levels.

One of the principal driving force behind the Jomo Kenyatta University of Agriculture and Technology –Kigali Campus is to ensure that higher quality education is available, disseminated and accessible to the population in the region. The Campus officially started and opened its doors to the first students in September 2013.

The Jomo Kenyatta University of Agriculture and Technology – Kigali Campus is currently offering both undergraduate and postgraduate programmes on fulltime and part time basis.

The university has the following graduate programmes: (1) Human Resource Development, (2) Information Technology, (3) Agricultural Economics & Rural Development and (4) Engineering.

KIBOGORA POLYTECHNIC

The founder of Kibogora Polytechnic is the *Association des Parents Methodistes Libres Pour La Promotion d'Education* (APMLPE) . The Polytechnic represents a unique collaboration between the Free Methodist Church in Rwanda, Kibogora Hospital and local organisations.

The Polytechnic offers vocationally relevant programmes in a wide range of disciplines. Each of these programmes will prepare successful graduates for professional roles in Rwandan society. It will create the employable and enterprising graduates which will transform the Western Province and beyond. However, at the same time it aims to give every student a superlative educational experience, using tutors with practical experience of their subject, modern techniques and equipment. Because of its unique contacts with overseas universities a combination of African and Western, teachers will deliver the programmes so you can be sure they are at the cutting edge of knowledge. The institution is committed to building a reputation as the finest private university in Rwanda.

Table 56 presents the list of the undergraduate and graduates programmes that are available at Kibogora Polytechnic.

Table 56: Undergraduate programmes at Kibogora Polytechnic

Faculty	Undergraduate programmes
Faculty of Health Science	• Advanced Diploma in Nursing/Midwifery
Faculty of Education	• Bachelor of Science in Theology • Bachelor of Science in Education
Faculty of Business & Development Studies	• Bachelor of Science in Economics & Management • Bachelor of Science in Rural Development

Source: Kibogora Polytechnic

KIGALI INDEPENDENT UNIVERSITY (ULK)

Creation period: 1996.

Location: Kigali city, Gasabo District, Gisozi sector.

ULK is a higher learning institution created on 15 March 1996 and accredited by the Convention no 001/98 of 02/02/1998 with the Government of the Republic of Rwanda. ULK received its own status by the ministerial order no 001/17 of 7 June 2002.

Vision: Kigali Independent University ULK is destined to stand out as a remarkable university for excellence at the heart of Africa with highly motivated students and highly qualified personnel endowed with elevated ethical values. ULK also takes pride in its very modern infrastructure and equipment and endeavours to perfectly fulfil its mission before God.

Mission: to provide people with an education, which will enable them to become actors and organisers of a complete development of our nation. In this respect, research work is focused on topics of local, national and regional interests.

Motto: Science and Conscience.

Values: Integrity, Humility, Determination and Excellence

Table 57 presents the list of the undergraduate and graduates programmes that are available at the Kigali Independent University.

Table 57: Undergraduate and graduate programmes at the Kigali Independent University

School	Undergraduate programmes	Postgraduate programmes
School of Economics and Business Studies	• Bachelor of Science in Accounting • Bachelor of Science in Finance • Bachelor of Science in Rural Development • Bachelor of Science in Economics	• Master of Business administration • Master of Business in Finance • Master of Accounting • Sciences in Economics
School of social sciences	• Bachelor of Science in International relation • Bachelor of Science in Development studies	• Master of Governance • Master of Development studies
School of Law	• Bachelor of Science in Law	• Master of Public international law • Master of International Economic law
School of sciences and Technology	• Bachelor of Science in Computer Science	• Master of science in internet systems

Source: Kigali Independent University

KIGALI INSTITUTE OF MANAGEMENT (KIM)

Vision: To nurture, improve, and maintain the Institute's leadership/premiership position as Rwanda's and the Region's Higher Education Institute of excellence.

Mission: The Institute is committed to giving its students higher learning education and training programs with special emphasis on skills and competence development.

The KIM provides the following undergraduate degrees: (1) Bachelor of Business Management – Accounting, (2) Bachelor of Business Management – Finance, and (3) Bachelor of Business Management – Procurement.

MOUNT KENYA UNIVERSITY (MKU)

Creation period: MKU, Rwanda Campus has been created in 2010.

Location: MUK, Rwanda Campus is located in Kigali city, Nyarugenge District, Gitega Sector.

Vision: To be a centre of excellence in training, research and innovation in Science & Technology in Africa.

Mission: To attain excellent standards in training and innovation for sustainable individual prosperity and social development.

Table 58 presents the list of the undergraduate and graduates programmes that are available at the Mount Kenya University.

Table 58: Undergraduate programmes at the Mount Kenya University

School	Undergraduate programmes	Postgraduates programmes
School of Health and Welfare	• Pharmacy • Medical Laboratory sciences • Science in Nursing • Public Health	• Public Health
School of education	• Education • Information service	• Education • Information service
School of Science	• Communication and Mass Media • Social Works and social Administration	
School of Social Sciences, Business and Law	• Business Management	• Business Administration • Arts in Governance and ethics • Arts in International Relations and diplomacy • Arts in Development

Source: Mount Kenya University

MUHABURA INTEGRATED POLYTECHNIC COLLEGE

Vision: To Create a new generation of well-educated Christian entrepreneurial technicians and leaders in Rwanda and beyond.

Mission: The owners of Muhabura Integrated Polytechnic College are dedicated to making the College an institution of higher learning committed to excellence and practical innovation for a generation united by their continent, and the world.

Muhabura Integrated Polytechnic College has the following undergraduate programmes: Advanced Diploma in Engineering and Technology; Advanced Diploma in Hospitality and Tourism and an Advanced Diploma in Business and Economics.

NILE SOURCE POLYTECHNIC OF APPLIED ARTS (NSPA)

Mission: to generate and disseminate high quality scientific, technical and artistic knowledge and promote effective arts skills and information technology for production in applied arts.

Vision is to be dynamic and innovative in teaching programs and methods oriented to jobs creation and professionalism.

Motto: 'Knowledge for Life-Strive for Perfection'

Undergraduate programmes: (1) Bachelor of Science in Public Relations and Office Management; (2) Bachelor of Science in Architectural Technology and Design, and (3) Bachelor of Science in Film Production and Digital Media.

OPEN UNIVERSITY OF TANZANIA (OUT)

Starting period*:* The OUT in Rwanda started in October 2012.

Location*:* The University is located in Eastern Province, Ngoma District.

Vision: To be a leading university in the delivery of affordable quality education through Open distance learning, dynamic knowledge generation and application.

Mission: To continuously provide quality open and distance education, research and public services for sustainable and equitable socio-economic development, of Tanzania in particular and rest of Africa.

Core values*:* Commitment to quality outputs, integrity and pursuit for the provision of quality education for all.

Functions: As provided in the Universities Act No.7 of 2005 and the OUT charter 2007 the functions of the OUT are: (1) to preserve and transmit knowledge by teaching through various means including the use of modern technological means, tuition, residential courses and services; (2) to conduct research and consultancy by addressing social, economic and development problems of the community; (3) to promote the educational wellbeing of the Tanzania community by offering demand driven courses; (4) to provide opportunities for higher Education to a broad segment of the population predominantly trough Open and distance education; (5) to conduct examinations for and to grant degrees, diplomas, certificates and other awards of the University; (6) to promote collaboration and partnership in acquisition provision and application of higher education at institutional regional and international levels; (7) to promote equity and widen access to education to marginalized and disadvantaged groups; (8) to promote gender equity and mainstreaming in the acquisition, provision and application of higher education; (9) to address the HIV/AIDS pandemic in the course of offering higher education.

Table 59 presents the list of the undergraduate and graduates programmes that are available at the Open University of Tanzania.

Table 59: Undergraduate programmes at the Open University of Tanzania

Faculty	Undergraduate programmes
Faculty of Education	• Bachelor of Science in Adult and Distance Education • Bachelor of Science in Curriculum and Instruction • Bachelor of Science in Education Foundation • Bachelor of Science in Planning and Administration • Bachelor of Science in Psychology and Special Education
Faculty of law	• Bachelor of Science in criminal law • Bachelor of Science in Economic law
Faculty of Business and Management	• Bachelor of Science in Leadership and Governance • Bachelor of Science in Accounting and Finance • Bachelor of Science in Marketing and Entrepreneurship

Source: Open University of Tanzania

PREMIER ECDE TEACHERS COLLEGE

Vision: A model institution providing quality early childhood teacher education for Africa and beyond and beyond.

Mission: To attain world-class standard in early childhood teacher education training, research and innovation.

Their programme is giving their students the unique experience of two on-site inclusive child-care facilities for children Two to six years of age and an Early Childhood Education (ECE) Resource Centre filled with educational materials, books and equipment to be used for in-class assignments or field placement experiences. This College provides an Advanced Diploma in Early Childhood Education.

PROTESTANT INSTITUTE OF ARTS AND SOCIAL SCIENCES (PIASS)

Creation period: The Faculty of Theology started in 1970 and PIASS started other faculties in 2010.

Location: The PIASS is located in South Province, Huye District, N Goma Sector.

Vision: The PIASS is a reference university, fostering knowledge development and innovative research that are relevant for the society and inspired by Christian ethics and values.

Mission: The PIASS provides to Rwandan Society and Churches well-trained personnel who are inquisitive, solution-oriented, committed and equipped with intellectual tools, knowhow and ethical values that enable them to meeting specific needs of societies that are on a reconciliation path and moving towards a global, modern and pluralistic world.

The PIASS provides undergraduate programmes in (1) Theology, (2) Common courses, (3) Educational Planning and Management, (4) School Psychology, (5) Rural and Community Development and (6) Peace building and development.

RWANDA TOURISM UNIVERSITY COLLEGE

Rwanda Tourism University College aims at providing all-round quality education, developing a highly qualified human resource, enhancing professionalism and improving standards in the field of hospitality and tourism through training, research and services to the community.

Vision: Rwanda Tourism University College is committed to spearhead the advancement of education through quality teaching, learning, research, consultancy and service to the community by preparing graduates to meet the needs of Rwanda, the sub region and the global community, professional growth in a conducive environment that value cultural diversity and cultivates awareness of ethical issues, gender, fairness, competitiveness and social responsibility.

Mission: To become a centre of excellence in the region for the quality of academic programs, and to be a solution provider in training professionals in the areas of Hospitality, Tourism and Business Information Technology.

Table 60 presents the list of the undergraduate and graduates programmes that are available at the Rwanda Tourism University College.

Table 60: Undergraduate a programme at the Rwanda Tourism University College

Institution	Undergraduate programmes
Rwanda Tourism University College	• Bachelor of Science in Hotel and Restaurant Management • Bachelor of Science in Travel and Tourism Management • Business Information Technology • Advanced Diploma in Airline courses • Bachelor of Science in hotel courses • Bachelor of Science in IT • Bachelor of Science in Travel courses

Source: Rwanda Tourism University College

SAINT JOSPEH INTEGRATED TECHNICAL COLLEGE

Background: Saint–Joseph Integrated Technical College formerly known as Nyamirambo School of Crafts came into existence as a Training Centre in 1970 and started with 15 students. Its establishment was made possible by the efforts of the Josephite Brothers Congregation whose objective was a practical training in order to respond to growing needs of both the capital and the countryside, as the country needed average but fast technical progress. It was urgent to train qualified workers according to modern technical methods instead of following the traditional on-the-job training method. In 1993, the School –then called Institut Léon Paul Classe – adopted the A3 level in its program.

The 1994 Genocide left the School ransacked but it reopened on 27 June 1997. On 25 June 1999 it was officially inaugurated by the then Minister of Education, Emmanuel MUDIDI and was recognized as a private School on 3 September 2000.

The Ninth General Chapter of the Josephite Brothers Institute held in September 2001 decided that all Schools sponsored/managed by this Congregation must have Saint Joseph as patron saint; thus, Nyamirambo School of Crafts became the SaintJoseph Technical School and adopted an A2 level program in Public Works and Construction in 2002.

Despite many challenges, Saint Joseph Integrated Technical College has made a significant progress and is today an essential partner of the Ministry of Education regarding technical options.

Vision and Mission: (1) to equip students with advanced skills with a view to increasing human resources and capacity for national development, (2) to provide consultancy services to the Government, industry, private sector and the community at large, (3) to collaborate with other academic, professional, technical, and research institutions in and outside of Rwanda for educational and technological development, (4) to make provision for the advancement, transmission and preservation of knowledge and to sustain intellectual life in Rwanda, (5) to contribute to the cultural, civic and moral training of its students and to participate actively in the economic and socio cultural development of the country, (6) to develop and promote close collaboration with the private sector and the community, (7) to award diplomas of the categories of the courses it offers and (8) to award certificates concluding short period courses.

Saint–Joseph Integrated Technical College provides an undergraduate programme in Civil Engineering.

SINHGAD TECHNICAL EDUCATION SOCIETY OF RWANDA (STES-RWANDA)

Vision: The mission of STES Rwanda is to be the premier provider of an affordable quality education nationally and internationally.

Mission: Our mission is to do what it takes to foster, sustain and upgrade the quality of education by way of harnessing talent, potential and optimizing meaningful learning facilities. STES–Rwanda endeavours to provide the best learning, conducive environment & equip the students with effective learning strategies.

Objectives: (a) to develop and advance knowledge through education and research, in engineering and also exploring the potential of interdisciplinary studies, (b) to serve all people, community and the human race through the use of their resources both intellectual and material, (c) to promote intellectual excellence and creativity and foster an unfettered spirit of exploration, rationality and enterprise.

Table 61 presents the list of the undergraduate and graduates programmes that are available at the STES–Rwanda.

Table 61: Undergraduate and graduate programme at the Sinhgad Technical Education Society of Rwanda

Institution	Undergraduate Programmes	Postgraduate programmes
Sinhgad Technical Education Society of Rwanda.	• Bachelor of science in Computer Engineering • Bachelor of science in Civil Engineering • Bachelor of science in Mechanical Engineering • Bachelor of science in Electrical • Bachelor of science in Electronics and Telecommunication	• MBA in Accounting • MBA in Finance • MBA in Marketing • MBA in Banking • MBA in Operations Management • MBA in Human Resources Management • MBA in Project Management • MBA in Logistics and Procurement • MBA in International Business Management

Source: Sinhgad Technical Education Society of Rwanda

UNIVERSITY OF KIGALI

Vision: To be a pole of radiance and excellence nationally and internationally, with its quality education, research and provision of innovative services to the community.

Mission: To provide quality higher education programmes that match the labour market and development needs of Rwanda for graduates who are capable of contributing to national economic and social needs and who can compete on the international labour market.

Table 62 presents the list of the undergraduate programmes that are available at the University of Kigali.

Table 62: Undergraduate programmes at the University of Kigali

Faculty	Undergraduate programmes
Faculty of commerce and Business	• Bachelor of commerce • Bachelor of Accounting • Bachelor of Finance
Faculty of Economics	• Bachelor of Economics
Faculty of Information Technology	• Bachelor of Business in Information Technology • Bachelor of Information Technology • Bachelor of Computer Science
Faculty of Management Sciences	• Bachelor of Procurement • Bachelor of Science with Honours in Marketing
Faculty of Law	• Bachelor of science in Law

Source: University of Kigali

GEOGRAPHICAL DISTRIBUTION AND STARTING DATES OF THE HIGHER EDUCATION SYSTEM IN RWANDA

The following Table 63 presents a summary of the higher education institutions in Rwanda showing the geographical distribution (province, district, sector and cell) and the institutions' starting-dates.

Table 63: Geographical distribution and starting dates of the higher education institutions in Rwanda

Higher Education Institutions	Province	District	Sector	Cell	Starting dates
University of Rwanda	Kigali City	Kicukiro	Gikondo	Kinunga	2013
College of Medicine and Health Sciences*	Kigali City	Nyarugenge			
College of Education**	Kigali City	Remera	Kimironko	Nyagatovu	
College of Sciences and Technology***	Kigali City	Nyarugenge	Nyarugenge	Kiyovu	
College of Arts and Social Sciences#	South	Huye	Ngoma	Mamba	
College of Agriculture and Veterinary Medicine##	North	Muzanze			

Higher Education Institutions	Province	District	Sector	Cell	Starting dates
College of Business and Economics###	Kigali City	Kicukiro	Gikondo	Kinunga	
Adventist University of Central Africa	Kigali City	Gasabo	Ndera	Masoro	1984
Akhilan Institute of Women	Kigali City	Gasabo	Kimironko	Kibagabaga	2010
Byumba School of Nursing and Midwifery	North	Gicumbi	Byumba	Nyarutarama	2007
Carnegy Mellon University	Kigali City	Gasabo	Kacyiru	Kacyiru	2011
Catholic Institute of Kabgayi	South	Muhanga	Nyamabuye	Gahogo	2002
Catholic University of Rwanda	South	Huye	Ngoma	Butare	2010
Community Integrated Polytechnic	East	Kayonza	Mukarange	Kayonza	2012
Gishari Integrated Polytechnic	East	Rwamagana	Gishari	Gishari	2013
Grand Séminaire de Nyakibanda	South	Huye	Gishamvu	Nyakibanda	1936
Indangaburezi College of Education	South	Ruhango			2013
Independent Institute of Lay Adventists of Kigali	Kigali City	Gasabo	Remera	Rukili	1997
Institut d'Enseignement Supérieur de Ruhengeri	North	Muzanze	Muzanze	Rwambogo	2003
Institut Polytechnique de Byumba	North	Gicumbi District	Byumba	Nyamabuye	2006
Institut Supérieur Pédagogique de Gitwe	South	Ruhango	Bweramana	Murama	1993
Institute of Agriculture, Technology and Education of Kibungo	East	Ngoma	Kibungo	Karenge	2003
Integrated Polytechnic Regional Center – Kigali	Kigali City	Kicukiro	Niboye	Gatare	2008
Integrated Polytechnic Regional Center – North	North	Rulindo	Bushoki	Kayenzi	2008
Integrated Polytechnic Regional Center – South	South	Huye	Ngoma	Butare	2013
Integrated Polytechnic Regional Center – East	East	Ngoma	Kibungo	Karenge	2012
Integrated Polytechnic Regional Center – West	West	Karongi	Bwishyura	Kiniha	2013
Institute of Legal Practice and Development	South	Nyanza	Busasamana	Nyanza	1996
Jomo Kenyatta University of Agriculture	Kigali City	Kicukiro	Kicukiro	Sovu	2013
Kabgayi School of Nursing and Midwifery	South	Muhanga	Nyamabuye	Gahogo	2007

Higher Education Institutions	Province	District	Sector	Cell	Starting dates
Kavumu College of Education	South	Muhanga	Nyamabuye	Gahogo	2007
Kibogora Polytechnic	West	Nyamasheke	Kanjongo	Kibogora	2012
Kibungo School of Nursing and Midwifery	East	Ngoma	Kibungo	Karenge	2007
Kigali Independent University	Kigali City	Gasabo	Gisozi	Ruhango	1996
Kigali Institute of Management	Kigali City	Kicukiro	Nyarugunga	Rwimbogo	2005
Kitabi College of Conservation and Environmental Management	South	Nyamagabe	Kitabi	Kintobo	2006
Mount Kenya University	Kigali City	Nyarugenge	Gitenga	Kiyovu	2010
Nile Source Polytechnic of Applied Arts	South	Huye	Ngoma	Butare	2013
Nyagatare School of Nursing and Midwifery	East	Nyagatare	Nyagatare		2007
Open University of Tanzania–Rwanda	East	Ngoma	Kibungo	Cyasemakamba	2012
Premier Early Childhood Development Teachers College	Kigali City	Gasabo	Kacyiru	Kamutwa	2014
Protestant Institute of Arts and Social Sciences Faculty of Theology dedication The other faculties dedication	South	Huye	Ngoma	Butare	 1970 2010
Remera Hospitality Academy	Kigali City	Gasabo	Kimironko	Nyagatovu	2013
Rukara College of Education	East	Kayonza	Gahini	Urugarama	2008
Ruli Higher Institute of Health	North	Gakenke	Ruli	Ruli	2013
Rwamagana School of Nursing And Midwifery	East	Rwamagana	Kigabiro	Nyagasenyi	2007
Rwanda Tourism College	Kigali City	Kicukiro	Niboye	Niboye	2007
Sinhgad Technical Education Society–Rwanda	Kigali City	Kicukiro	Gatenga		2013
St Joseph Integrated Technical college	Kigali City	Nyarugenge	Rwezamenyo	Rwezamenyo	2013
University of Kigali	Kigali City	Gasabo	Rukiri I		2013

NOTES: * Former Kigali Health Institute, starting date 1999. ** Former Kigali Institute of education, starting date 1999. *** Former Kigali Institute of Science and Technology, starting date 1997. # Former National University of Rwanda, starting date 1963. ## Former Higher Institute of Agriculture and Animal Husbandry, starting date 1989. ### Former School of Finance and Banking, starting date 2002.

Source: Higher Education Council, Rwanda

Private non-profit research institutions

KARISOKE RESEARCH CENTRE

The Karisoke Research Center is located within Rwanda's Volcanoes National Park. It was founded by Dian Fossey on 24 September 1967, to study endangered mountain gorillas. Fossey located the camp in Rwanda's Virunga volcanic mountain range, between Mount Karisimbi and Mount Bisoke, and named it by combining the names of the two mountains. Karisoke continued to function under the auspices of the Dian Fossey Gorilla Fund International, even after Fossey's murder in December 1985..

A mountain gorilla census published in 1981 found that the population had fallen to 242 individuals, from a 1960 estimate of 400–500. Now, 45 years later, some 480 mountain gorillas are known to inhabit the Virunga mountains (according to a 2010 census), a significant increase. Karisoke survived Fossey's murder as well as years of civil strife, and even expanded tremendously over the past few decades.

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 30 years of experience, and now participate heavily in scientific data collection. The centre has developed a 45-yearrecord of data collection and analysis because of the staff's 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.

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.

INSTITUTE OF POLICY ANALYSIS AND RESEARCH (IPAR)

The IPAR is a non-profit, independent think-tank in Rwanda guided by a fundamental concern for the well-being of all Rwandans. It is dedicated to the promotion of three fundamental values:

Prosperity: beliefin a Rwanda that promotes the well-being of its people to improve quality of lives and to create wealth and employment opportunities.

Opportunity: belief that every Rwandan should have the opportunity to succeed and have their talents nurtured and their hard work rewarded.

Inclusiveness: belief that all Rwandans deserve the chance to share in the fruits of its growing prosperity.

IPAR considers that economic growth and development is impossible without sound policy and responsive governance; it seeks to strengthen the evidence base available to government, civil society and development partners about the pressing social, economic and political issues facing Rwanda, and to provide real-time solutions to the everyday challenges of Rwanda's people.

IPAR conducts rigorous, thought-provoking research, disseminates ideas through workshops and conferences, maintains an accessible information and resource centre, and trains young Rwandan professionals in the skills of policy analysis.

Mission: To contribute to the evidence base available to policy-makers by conducting and commissioning timely, relevant, high-quality and policy-oriented analysis and research, and by building a documentation centre to manage the knowledge that already exists but is often hard to find.

To develop the skills of the policy community by offering targeted capacity development and training in policy analysis and research to external institutions, including ministries, Universities and development partners.

To promote a culture of debate and dialogue by hosting public events, workshops, seminars, conferences and other discussion forums.

Governance: IPAR is governed by a General Assembly and a Board of Directors. The General assembly is the supreme decision-making body of the Institute. It approves the statutes and overall policy direction of the Institute.

The Board of Directors oversees the implementation of the programs and activities of the Institute, and monitors the utilization of resources. Its members represent a diversity of interests including the government, civil society, private sector, development partners and academic institutions.

NGOS RELATED TO SCIENTIFIC AND TECHNOLOGICAL SERVICES

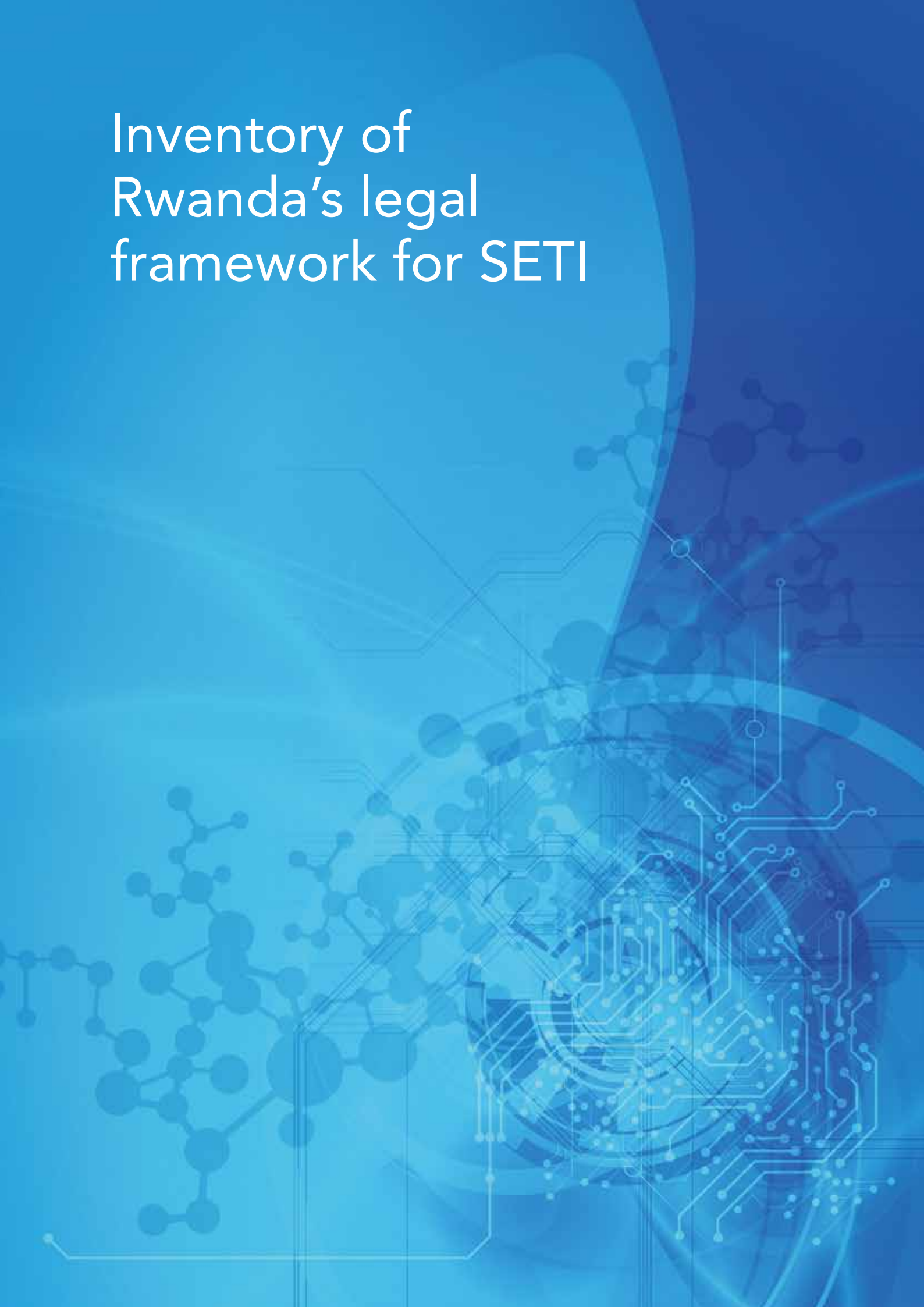
Table 64 presents a selection of non-governmental organizations (NGOs) in Rwanda whose domain of interventions are related to scientific and technological services.

Table 64: Selection of NGO in Rwanda related with scientific and technological services

Non-Governmental Organization	Domain of Intervention	Field of Knowledge
Action for the Promotion of Professional Extension Services	Agriculture	Agricultural Sciences
Action pour le Développement Socio-Economique, la Promotion de L'Education et la Protection de L'Environnent	Socio-Economic	Social sciences
Agribusiness Focussed Partnership Organization	Agriculture Modernization	Agricultural Sciences
Association for Research and Assistance Mission for Africa (ARAMA)	Empower Commission for Development	Social sciences
Association Ibakwe Rural Innovation and Development Centre of Rwanda	Economic Development	Social sciences
Association pour la promotion des foyers améliores et la protection de L'Environnent au Rwanda	Environment	Natural sciences
Association Rwandaise des Ecologistes	Environment	Natural Sciences
Association Rwandaise pour le Développement Endogène	Socio-Economic Development	Social sciences
Centre d'Etude et de Coopération International	Gender equality	Social sciences
International Centre for Tropical Agriculture (CIAT)	Agriculture	Agricultural Sciences

Non-Governmental Organization	Domain of Intervention	Field of Knowledge
GVEP International	Energy/infrastructure	Engineering and Technology
Health and Environment Protection Initiative	Health / Environment	Natural Sciences
Imyumvire Mishya	Irrigation scheme	Agricultural Sciences
Les Compagnons Fontainiers du Rwanda	Infrastructure	Engineering and Technology
NetAfrica	ICT & Network promotion	Engineering and Technology
Organization for support to the Environment Protection and Climate Change Adaption	Environment	Natural Sciences
Programme Régional de Formation et D'Echanges pour le Développent	Cooperatives Capacity Building	Social sciences
Rwanda Development Organization (RDO)	Socio-Economic	Social sciences
Rwanda Health Environment Project Initiative	Environment	Natural sciences
Rwanda Initiative Action	Environment Protection & Social Welfare	Natural Sciences
Sabynyo Community Livelihood Association	Protection	Natural Sciences
Sustain Rwanda	Environmental conservation	Natural Sciences
Tubyiteho-Ruvubu	irrigation scheme	Agricultural Sciences
Venture Strategies innovation (VSI)	Maternal Health	Medical and Health sciences
Wildlife conservation society	Environmental conservation	Natural Sciences
Women Investment Fund	Socio-Economic	Social sciences

Inventory of Rwanda's legal framework for SETI



A country's legal framework represents a collection of legal processes and legal instruments, which embody a given policy, or parts of it, in the form of a law, decree or policy regulating an area of activity. Formal agreements, contracts and international SETI co-operation treaties may also be included in this category. A legal instrument elaborates a policy by stipulating obligations, rights, rewards and penalties connected with its observance. The SETI legal framework of the Republic of Rwanda is presented hereafter.

NATIONAL LAWS AND ACTS

Acts and laws pertaining to research and innovation

LAW OF ESTABLISHING THE NATIONAL COMMISSION OF SCIENCE AND TECHNOLOGY AND DETERMINING ITS MISSION, ORGANIZATION AND FUNCTIONING

Date Enacted: 11 September 2013 (N°80/2013, Gazette No. 42 bis of 21 October 2013)

Description: This Law establishes the National Commission of Science and Technology and it determines its responsibilities, organization and functioning. It provides that the National Commission of Science and Technology has a legal personality, administrative and financial autonomy, and that it will be governed in accordance with legal provisions governing public institutions. The Law stipulates the missions of the National Commission of Science and Technologyare: (i) to advise the Government on policies, legislation and regulation in the fields of science, technology, research and innovation and monitor the implementation of such policies and legislation; (ii) to collaborate with competent organs with intention to advise the Government on educating and training people in matters relating to national needs in the fields of science and technology and to make a follow up on the organization and productivity of such training; to ensure that people who are educated or trained in Rwanda or abroad in the fields of science and technology are facilitated to enter the labour market in order to work professionally and stay productive for the benefit of their country; (iv) to examine, identify and support new initiatives that may be useful for the country in the fields of science and technology through investment in people's potential; (v) to carry out an analysis of the nature and effective use of national resources and infrastructure in order to support science and technology as well as their innovative use in a sustainable manner; (vi) to establish, update and disseminate specific database of skills available and those needed in the country in the fields of science and technology; (vii) to cooperate and collaborate with other advanced regional and international institutions of excellence with similar mission; and (viii) to prepare and disseminate annual report on the state of science and technology.

LAW OF ESTABLISHING THE NATIONAL INDUSTRIAL RESEARCH AND DEVELOPMENT AGENCY (NIRDA) AND DETERMINING ITS MISSION, ORGANIZATION AND FUNCTIONING

Date Enacted: 10 September 2013 (Law No. 51/2013, Gazette No. 38 of 23 September 2013, and repealed Law n° 06/1989 of 15 March 1989, repealed Law No. 42/2007 of 10 September 2007). Having reviewed Law No. 06/1989 of 15 March 1989 establishing and organizing the Institute of Scientific and Technological Research and Law No. 42/2007 of 10 September 2007 determining the attributions, organization and functioning of the Institute of Scientific and Technological Research.

Description: This Law establishes the National Industrial Research and Development Agency and it determines its responsibilities, organization and functioning. It provides that the National Industrial Research and Development Agency has a legal personality, administrative and financial autonomy that it will be governed in accordance with legal provisions governing public institutions. The Law stipulates the missions of the National Industrial Research and Development Agency are: (i) to implement the national industrial development policy, patent inventions and traditional knowledge in relation to industrial development and promote the trade of research products; (ii) to carry out industrial and technology development research through the establishment of technology incubation centres and pilot plants and

rural industrialisation; (iii) to contribute to establishment of trade companies of research products; (iv) to train business entrepreneurs who wish to invest in new or improved industrial research products; (v) to establish and develop industrial research and development partnership with international, regional and national institutions, whether private or public; (vi) to facilitate the vertical growth of small and medium enterprises for them to enter new markets and increase new improved products; (vii) to advise the Government on the national industrial research and development policy if necessary; and (viii) to build the capacity of small and medium enterprises by providing prototype development, reverse engineering, manufacturing facilities and business incubation.

LAW ESTABLISHING RWANDA STANDARDS BOARD (RSB) AND DETERMINING ITS MISSION, ORGANISATION AND FUNCTIONING

Date Enacted: 10 September 2013 (Law No. 72/03, Gazette No. 38 of 23 September 2013, having reviewed Law No. 23/2006 of 28 April 2006 governing the organisation and functioning of the National Council of Higher Education)

Description: This Law establishes the Rwanda Standards Board and it determines its responsibilities, organization and functioning. It provides that the Rwanda Standards Board has a legal personality, administrative and financial autonomy that is governed in accordance with legal provisions governing public institutions. The Law stipulates the missions of the Rwanda Standards Board are: (i) to establish and publish national standards; (ii) to disseminate information on standards, technical regulations relating to standards and conformity assessment; (iii) to raise awareness and promote the importance of standards and quality service as tools to improve market access, technology transfer and sustainable development; (iv) to carry out research in the areas of standards and metrology for the setting up of measurement standards and reference materials in the field of chemical metrology; (v) to participate in monitoring standardization at national, regional and international level; (vi) to participate in putting in place technical regulations relating to standards; (vii) to provide products and quality service certifications and monitor conformity for issued certifications; (viii) to provide legal, scientific and industrial metrology services; (ix) to represent the country at the regional and international standardisation organizations; (x) to establish laboratories capable of conducting tests and offering testing services; (xi) to act as reference laboratory in the quality domain; (xii) to carry out measurement and comparison of proficiency with same level regional and international institutions; (xiii) to organize training programs in the area of standardization, metrology and conformity assessment; (xiv) to advise the Government on defining, devising and implementing the standardization policy; and (xv) to establish and develop relations and collaboration with other institutions at national, regional and international levels with similar mandate, whether public or private.

Acts and laws pertaining to higher education

LAW GOVERNING ORGANISATION AND FUNCTIONING OF HIGHER EDUCATION

Date of Enactment: 24 May 2013 (Law N°27/2013 of 24 May 2013, repeals Law n° 20/2005 of 20 October 2005, Gazette No. Special of 29 May 2013)

Description: This Law governs the organisation and functioning of higher education in Rwanda. It stipulates the types of higher education institutions; their powers, autonomy and responsibilities, form and internal organization; higher education institutions; and the property and finance of each institution. The Law provides for the following three types of institutions of higher learning with distinct forms of management: (i) Public institutions of higher learning: these will be established by law, and the Government shall be responsible for their organisation, functioning and management. Furthermore, public institutions of higher learning shall have a supervising public authority specified by the law establishing it. (ii) Government-subsidized institutions of higher learning: these shall be established in accordance with the agreement

between the Government and its private partner and shall be given legal personality by an Order of the Minister in charge of higher education and they shall be managed in accordance with the agreement between the Government and its private partners. (iii) Private institutions of higher learning: these are established by an individual or a private legal entity. The legal status of each private institution of higher learning shall be determined by its owner in accordance with relevant laws. An accreditation to a private institution of higher learning shall be granted by an Order of the Minister in charge of higher education basing upon the report by the Rwanda Higher Education council.

LAW ESTABLISHING HIGHER EDUCATION COUNCIL AND DETERMINING ITS RESPONSIBILITIES, ORGANISATION AND FUNCTIONING

Date Enacted: 10 September 2013 (Law No. 72/03, Gazette No. 38 of 23 September 2013, having reviewed Law No. 23/2006 of 28 September 2006 governing the organisation and functioning of the National Council of Higher Education)

Description: The Law establishes the Higher Education Council and it determines its responsibilities, organization and functioning. It provides that the Higher Education Council has a legal personality, administrative and financial autonomy that is governed in accordance with legal provisions governing public institutions. The Law stipulates the missions of the Higher Education Council to be: (i) to enhance education and research in the higher learning institutions; (ii) to improve the organization and functioning of higher learning institutions; (iii) to advise the Government in all matters related to higher education policy and strategies; (iv) to set norms and standards for accrediting private higher learning institutions; (v) to monitor the adherence of norms and standards in higher learning institutions; (vi) to compare, evaluate and give equivalence to degrees and certificates of higher education level delivered by foreign institutions and those delivered in Rwanda that need authentication including those awarded through distance learning; and (vii) to coordinate and follow up all activities.

LAW ESTABLISHING THE UNIVERSITY OF RWANDA (UR) AND DETERMINING ITS MISSION, POWERS, ORGANISATION AND FUNCTIONING

Date of Enactment: 10 September 2013 (Law N° 71/2013, Gazette No. 38 of 23 September 2013) repealed the following laws: Law of 12 May 1964 establishing and organizing the National University of Rwanda (NUR); Law n° 22/2008 of 21 July 2008 determining the structure, organisation and functioning of NUR; Law n° 48/2001 of 26 December 2001 establishing and organizing the Kigali Institute of Science, Technology and Management; Law n° 23/2008 of 22 July 2008 determining the structure, organisation and the functioning of Kigali Institute of Science and Technology (KIST); Law n° 49/2001 of 27 December 2001 establishing and determining the functioning of Kigali Institute of Education; Law n° 20/2008 of 18 July 2008 determining the structure, organisation and functioning of Kigali Institute of Education (KIE); Law n° 26/2003 of 16 August 2003 establishing and organizing the Higher Institute of Agriculture and Animal Husbandry (ISAE); Law n° 49/2008 of 09 September 2008 governing the structure, organisation and functioning of the Higher Institute of Agriculture and Animal Husbandry(ISAE); Law n° 21/2002 of 28 June 2002 establishing and organising the School of Finance and Banking; Law n° 24/2009 of 08 September 2009 determining the organisation and functioning of the School of Finance and Banking (SFB); Law n° 21 bis/2009 of 29 July 2009 establishing "Umutara Polytechnic (UP)" Higher Institute and determining its structure, organisation and functioning; Law n° 07/2002 of 22 February 2002 establishing and organizing the Kigali Health Institute (KHI); Law n° 54/2010 of 25 January 2011 establishing Rwanda Biomedical Centre (RBC) and determining its mission, organization and functioning as modified and complemented to date especially in Articles 3 and 13.

Description: The Law establishes the University of Rwanda, abbreviated as "UR" which is created from seven Rwandan public Institutions of Higher Learning: NUR, KIST, KIE, ISAE, SFB, UP and KHI. It also determines its mission, powers, organization and functioning. UR shall be a special organ, which shall have legal personality, administrative, teaching, research and financial autonomy and shall be governed in accordance with the Law governing organisation and functioning of higher education. Also the Law stipulates that UR shall be comprised of the following colleges: (i) College of Education; (ii) College of Science and Technology; (iii) College of Arts and Social Sciences; (iv) College of Business and Economics; (v) College of Agriculture, Animal Sciences and Veterinary Medicine; and (vi) College of Medicine and Health Sciences. The Law de-establishes the seven former institutions.

Acts and laws pertaining to intellectual property rights

RWANDA INTELLECTUAL PROPERTY RIGHTS LAW

Date of Enactment: 26 October 2009 (Law N° 31/2009, Gazette n°50 bis of 14 December 2009), Modified the 2004 on code of civil, administrative and commercial procedures of Rwanda; reviewed Law of 25 February 1963 on Patents; reviewed Law of 25 February 1963 on Factory or Trademarks; reviewed Law of 25 February 1963 on Industrial Designs; reviewed Law no 27/1983 of 15 November 1983 governing the Copyrights; reviewed Decree Law no 41/63 of 24 February 1950 on the elimination of unfair competition.

Description: This Law protects inventors; innovators; creators of industrial designs; creators of layout designs of integrated circuits; creators of distinctive signs used in trade; authors of literary, artistic and scientific works, performers, phonogram producers; and any other author of an original intellectual creation. It also protects owners of distinctive signs used in trade; and broadcasting organisations. The Law provides the protection of all matters affecting the availability, acquisition, scope, maintenance and use of the intellectual property rights. It stipulates penalties to be applied in cases of infringement and any other procedures for the protection of intellectual property rights.

Other IPR-related Laws enacted by the Legislature

- Law No. 51/2010 of 10 January 2010: Establishing the Kigali International Arbitration Centre and Determining its Organisation, Functioning and Competence (2011)
- Law No. 19/2010 of 9 June 2010 on the Organization of the Craft Sector (2010)
- Law No. 18/2010 of 12 May 2010 Relating to Electronic Messages, Electronic Signatures and Electronic Transactions (2010)
- Law No. 07/2009 of 27 April 2009 relating to companies (2009)
- Organic Law establishing the commercial courts and determining their organisation, functioning and jurisdiction (2007)
- Law No. 21/2006 of 28 April 2006 Establishing the Customs System (2006)
- Law No. 12/99 of 12 June 1999 relating to the Pharmaceutical Art (1999)
- Decree-Law No. 26/78 on the Creation of the Office for Tea (1978)
- Decree-Law No. 27/78 on the Creation of the Office for Coffee (1978)
- Penal Code of Rwanda (1977)

Acts and Laws Pertaining to Environmental Management and Protection

ORGANIC LAW DETERMINING THE MODALITIES OF PROTECTION, CONSERVATION AND PROMOTION OF ENVIRONMENT IN RWANDA

Date of Enactment: 8 April 2005 (Organic Law N° 04/2005 OF 8 April 2005, Gazette year 44 No. 9 of 1 May 2005).

Description: This Organic Law determines the modalities of protecting, conserving and promoting the environment in Rwanda with the aim of conserving the environment, people and their habitats. It provides fundamental principles related to protection of environment, with the intention of promoting natural resources, and to discourage any hazardous and destructive activity that may degrade the environment. In addition, the Law provides ways of promoting the social welfare of the population considering equal distribution of the existing wealth; considering the durability of the resources with an emphasis especially on equal rights of present and future generations; and a guarantee to all Rwandans of sustainable development that does not harm the environment and the citizens' social welfare. Furthermore, the Law provides for the setting up of strategies for protecting and reducing negative effects on the environment and for restoring the degraded environment.

Other related Laws & Regulations:

Prime Minister's Instructions preventing air pollution (N°005/03OF27/12/2013, Official Gazette No. 3 of 20 January 2014); Law determining the mission, organization and functioning of Rwanda Environment Management Authority (REMA) (Law N°63/2013 of 27 August 2013), Law n°16/2006 of 3 April 2006 and other prior legal provisions inconsistent with this law are repealed; Law relating to the prohibition of manufacturing, importation, use and sale of polythene bags in Rwanda; Law governing biodiversity in Rwanda (Law No. 70/2013 OF 2 September 2013, Gazette No. 38 of 23 September 2013); Law determining the use and management of land in Rwanda (Organic Law No. 08/2005 of 14 July 2005, Gazette Year 44 No. 18 of 15 September 2005); Law determining the organisation, functioning and responsibilities of National Forests Authority (2006); Law establishing Rwanda Natural Resources Authority (RNRA) and determining its mission, organisation and functioning (Law No. 53/2010 of 25 January 2011, Gazette No. 10 of 7 March 2011); Ministerial Order relating to the requirements and procedure for Environmental Impact Assessment; Ministerial Order establishing modalities of inspecting companies or activities that pollute the Environment; Ministerial Order determining the length of land on shores of lakes and rivers transferred to public property; Ministerial Order regulating the importation and exportation of ozone layer depleting substances products and equipment containing such substances; Ministerial Order establishing the list of protected animal and plant species; Ministerial Order preventing activities that pollute the atmosphere; Ministerial Order determining the list of chemicals and other prohibited pollutants; Ministerial Order on the establishment of the National Man and Biosphere Committee. Law No 10/2010 of 20 April 2010 authorising the ratification of the grant Agreement N° TF94928-RW signed in Kigali, Rwanda, on 8 February 2010, between the Republic of Rwanda and the International Bank for Reconstruction and Development (IBRD) acting as an Implementing Agency of the Global Environment Facility (GEF) relating to the grant. Law No 50/2011 of 5 December 2011 authorising the ratification of the financing agreement n° 4973-RW signed in Kigali, Rwanda, on 2 September 2011, between the Republic of Rwanda and the International Development Association (IDA) relating to the credit of nine million three hundred thousand Special Drawing Rights (SDR 9 300 000) for the Lake.

LAW DETERMINING THE ORGANIZATION, FUNCTIONING AND MISSION OF THE NATIONAL FUND FOR ENVIRONMENT (FONERWA)

Date of Enactment: 22 May 2012 (Law N° 16/2012, Gazette No. 26 of 25 May 2012, (Having reviewed Law, N° 47/1988 of 05 December 1988, Law n° 62/2008 of 10 September 2008).

Description: This Law provides for mobilization and management of (i) resources used in activities aiming at protecting environment and natural resources and (ii) funds to be used in the fight against the climate changes and its impacts. The Law also sets out to support public institutions, associations and individuals to carry put activities to protect the environment, conduct research and manage climate change.

LAW OF GOVERNING BIODIVERSITY IN RWANDA

Date of Enactment: 02 September 2013 (Law N° 70/2013, Gazette No. 38 of 23 September 2013)

Description: This Law determines modalities for management and conservation of biological diversity within Rwanda. In order to promote biodiversity, the law stipulates that competent authority shall conduct research on the protection and conservation of biodiversity and its sustainable use.

LAW RELATING TO THE PROHIBITION OF MANUFACTURING, IMPORTATION, USE AND SALE OF POLYTHENE BAGS IN RWANDA

Date Enacted: 10 September 2008 (Law No. 57/2008)

Description: This Law prohibits the manufacturing, using, importing and selling of polythene bags in Rwanda. An Order of the Prime Minister shall establish a list of polythene bags necessary to be used in exceptional cases in Rwanda. The list shall be up dated at any time where it is deemed necessary. Any person who requires to manufacture, to use, to import and to sell polythene bags shall apply for a written authorisation from Rwanda Environment Management Authority, indicating the reasons for the request and the ways through which he or she will manage the polythene waste. Institutions in charge of controlling the use of polythene bags are Judicial Police, Custom officers, Rwanda Environment Management Authority staff, Rwanda Bureau of Standards staff, Security Organs, Local Authorities and other necessary personnel authorized by an Order of the Minister in charge of justice. The Law provides a heavy penalty for any person or company that contravenes its terms.

Acts and laws pertaining to energy

LAW GOVERNING ELECTRICITY IN RWANDA

Date of Enactment: 23 June 2011 (Law No. 21/2011, Gazette n° Special of 12 July 2011)

Short Description: This Law governs all activities of electric power production, transmission, distribution and trading within or outside the national territory of the Republic of Rwanda. It specifies the activities in electricity sector that are subject to license, and provides the requirements and procedures for granting licenses, as well as the rights and responsibilities of the license holders provisioning the electricity market. The Law also governs the determination of tariffs and illustrates rights and responsibilities of electricity customers.

Link: http://www.mininfra.gov.rw/uploads/media/Electricity_Law.pdf

LAW ESTABLISHING RWANDA ENERGY, WATER AND SANITATION AUTHORITY

Date of Enactment: 7 December 2010 (Law No 43/2010, Official Gazette No. 4 bis of 24 January 2011).

Short Description: This Law establishes the Rwanda Energy, Water and Sanitation Authority (EWSA) and determines its responsibilities, organization and functioning.

Link: http://itegeko.com/en/

STATUTE ESTABLISHING THE INTERNATIONAL RENEWABLE ENERGY AGENCY

Date of Enactment: 27 July 2011 (Law No 28/2011, Official Gazette n° 34 of 22 August 2011)

Short Description: This Statute ratified the Convention establishing the International Renewable Energy Agency (IRENA) signed in Bonn on January 26th, 2009.

STATUTE ESTABLISHING THE INTERNATIONAL ATOMIC ENERGY AGENCY

Date of Enactment: 27/7/2011 (Law No 29/2011, Official Gazette n° 34 of 22 August 2011)

Short Description: This Statute ratified the Convention establishing the International Atomic Energy Agency signed in New York on 23 October 1956.

AGREEMENT N° TF94928-RW

Date of Enactment: 20 April 2010 (Law No 10/2010)

Short Description: This Statute ratified the grant Agreement N° TF94928-RW signed in Kigali, Rwanda, on 8 February 2010, between the Republic of Rwanda and the International Bank for Reconstruction and Development (IBRD) acting as an Implementing Agency of the Global Environment Facility (GEF) relating to the grant.

AGREEMENT N° TF95444

Date of Enactment: 20 April 2010 (Law No 9/2010, Official Gazette n° 18 of 03 May 2010)

Short Description: The Statute ratified the grant Agreement N° TF95444 signed in Kigali, Rwanda, on 8 February 2010, between the Republic of Rwanda and the International Bank for Reconstruction and Development (IBRD) and the International Development Association (IDA) acting as an administrator of the Africa Renewable Energy Access Trust Fund (AFREATF) relating to the grant of three million eight hundred thousand American Dollars (USD 3,800,000) for the Sustainable Energy Development Project.

TRUST FUND FOR HEALTH RESULTS INNOVATION

Date of Enactment: 22 December 2010 (Law N°48/2010)

Description: The Law authorises the ratification of the Grant Agreement N° TF096936 signed in Kigali, Rwanda, on 25 June 2010, between the Republic of Rwanda and the International Development Association (IDA) acting as Administrator of the Multi-Donor Trust Fund for Health Results Innovation, Relating to the Grant of Four Million American Dollars (USD 4 000 000) for the Co-Financing of the Second Community Living Standards Grant.

NATIONAL REGULATIONS AND POLICIES

THE REPUBLIC OF RWANDA POLICY ON SCIENCE, TECHNOLOGY AND INNOVATION

Date Enacted: July 2005

Description: This Law provides guidance for the development of Science and Technology in partnership with the growth of an innovative, modern and competitive Private Sector geared towards revival of industry and the service sector. It sets out the development of Science and Technology sector which shall (i) Stimulate a steady growth in GDP, (ii) advance the quality of life for all the citizens of Rwanda, (iii) improve skills and knowledge among the population, and (iv) integrate technical education with commerce, industry and the private sector in general. The policy it represents focuses on the following challenges of *Vision 2020*: (1) the reconstruction of the nation; (2) an efficient State, capable of uniting and mobilizing its population; (3) human Resources development; (4) urban and rural planning and development; (5) basic infrastructures; (6) development of entrepreneurship and the private sector; and (7) modernization of agriculture and animal husbandry.

RWANDA NATIONAL QUALIFICATIONS FRAMEWORK FOR HIGHER EDUCATION

Date of Enactment: 2007, approved by Cabinet 2010 — Rwanda Higher Education Council

Description: The Framework sets out the requirement for the awards of the higher education institutions in Rwanda. Rwanda Higher education institutions' are running the Credit Accumulation and Modular Scheme (CAMS) System. The Framework enables awards to be benchmarked to internationally recognised standards. The Framework provides academic quality assurance systems to be put in place to ensure that all programmes are developed and delivered in conformity with this Framework. Two measures are used to locate qualifications within the Qualifications Framework: the level of learning outcomes to be achieved, and the volume of the programmes in terms of student credit. The Framework has seven levels. Changes in level are marked by changes in descriptors such as: knowledge and understanding (complexity and depth); professional practice (the range and sophistication of applied knowledge and understanding and the extent to which it can be applied in unfamiliar circumstances); generic cognitive skills (e.g. analysis, evaluation and critical skills); communication, numeracy and IT skills; and autonomy, self-reliance, the ability to take responsibility, the ability to work with others and the ability to judge and take action to satisfy one's further learning needs. Level 1 corresponds to the first year of a full-time undergraduate course; Level 2 to the second year; Levels 3 and 4 cover the third year; Level 5 corresponds to the fourth and final year of a full-time undergraduate course; Level 6 is Masters-level work; and Level 7 is doctoral level.

NATIONAL POLICY ON ACADEMIC WORKLOAD PLANNING

Date of Enactment: 2007, approved by Cabinet 2010 — Rwanda Higher Education Council

Description: This Policy regulates the academic staff workload in relation to all academic activities that are related to professional duties and responsibilities. The areas of regulation include: contact time and notional time for preparation for lecture delivery; lectures & tutorials, assessments (coursework, final exams, deliberations of exams); supervising laboratory classes/excursions/practical; distance education- face-to-face sessions; school or clinical practice/internship/supervision of placements; module writing/programmes development/short courses; research project supervision; research; service activities (professional consultancy, delivery of workshops/seminars and conferences, participation on various institute standing and ad hoc committees, leadership in professional and civic organizations etc.); guidance and counselling and partaking in Leadership/administrative responsibilities/academic administration. In addition, the Policy allows time for personal and professional maintenance – answering emails and correspondence, talking to colleagues, filing, talking to students, professional reading and web browsing.

CODE OF PRACTICE: THE CONDUCT OF EXAMINATIONS

Date of Enactment: 2007, approved by Cabinet 2010 — Rwanda Higher Education Council

Description: The Code outlines minimum standards for the handling of examination papers and the conduct of examinations. The Code is implemented together with the Higher Education Council's Assessment and Conduct of Examinations Section's *General Academic Regulations*.

CODE OF PRACTICE: CROSS-BORDER/TRANSNATIONAL PROVISION

Date of Enactment: 2007, approved by Cabinet 2010 — Rwanda Higher Education Council

Description: Foreign institutions offering higher education programmes in Rwanda must fulfil requirements of the Rwanda Higher Education Council. Rwandan higher education institutions operating outside Rwanda must fulfil the Rwanda Higher Education Council requirements and requirements of the countries in which they are operating. This Code of Practice is designed to: (i) encourage international co-operation in the provision of higher education in Rwanda; (ii) protect students and other stakeholders in Rwanda from low-quality and ensure that qualifications awarded in Rwanda are benchmarked to the Rwandan national qualifications framework for higher education; (iii) facilitate the recognition of qualifications awarded through transnational arrangements in Rwanda; (iv) ensure that all higher education delivered in Rwanda is subject to Higher Education Council requirements; (v) ensure that higher education delivered in Rwanda meets the social, economic and cultural needs of Rwanda; (vi) ensure that Rwandan higher education institutions who deliver award bearing qualifications abroad meet the requirements of the quality assurance agency of the country in which they operate as well as the requirements of Higher Education Council; and (vii) protect the reputation of Rwandan higher education and the standing of its awards.

CODE OF PRACTICE FOR OPERATING PRIVATE HIGHER EDUCATION INSTITUTIONS

Date of Enactment: 2007, approved by cabinet 2010 — Rwanda Higher Education Council

Description: The Code provides clear guidance to private higher education institutions as to the expectations of the Government about how they should operate in order to ensure they conform to the law of Rwanda, the requirements of the Ministry of Education and the Rwanda Higher Education Council, and provide clear and honest information to potential and actual students. This Code forms part of the Code of Practice for Higher Education in Rwanda and unless otherwise indicated the precepts are mandatory. This Code does not cover the requirements for cross border higher education, which is presented in a separate code. This Code incorporates statutory requirements as set out in Law No 20/2005 of the 10 October 2005 governing the Organisation and Functioning of Higher Education and Law No 23/2006 of 28 April 2006 governing the Higher Education Council. It should be read in conjunction with these laws and (i) the *Qualifications Framework for Higher Education*, (ii) the *Code of Practice for Higher Education*, (iii) the *Handbook for Academic Quality Assurance and Enhancement*, and (iv) the maintenance of standards in higher education.

HIGHER EDUCATION POLICY

Date of Enactment: 2008, Ministry of Education

Description: The Higher Education Policy guides the transformation of higher education so as to establish a higher education sector that meets development needs of Rwanda for an educated and trained workforce, research and knowledge transfer to support social and economic development and which is internationally competitive. The Policy points in the direction of establishing a stable, underlying structure that will enable institutions to develop their strategies for supporting the realization of Rwanda ambitions for higher education.

HIGHER EDUCATION INSTITUTIONAL INFRASTRUCTURE AND ACADEMIC STANDARDS

Date of Enactment: 2007, approved by cabinet 2010– Rwanda Higher Education Council

Description: These Standards are designed to provide guidance to institutions on what is likely to be judged acceptable by the Higher Education Council for the granting of provisional and definitive operating licences to private providers in terms of physical and institutional resources. It also provides a guide to the minimum expected quality and standard of academic delivery. The Standards also provide broad guidelines on the level of infrastructure likely to be necessary to meet the requirements of institutional audit and subject reviews for all providers. The Standards should be read in conjunction with the *Institutional Audit and Subject Review Handbooks.*

NATIONAL EQUALITY AND DIVERSITY POLICY FOR HIGHER EDUCATION

Date of Enactment: 2007, approved by cabinet 2010– Rwanda Higher Education Council

Description: The Policy seeks to eradicate unfair and discriminatory practices whenever they occur, and to actively promote a culture of equality and diversity, where all staff and students may contribute as fully as possible. This olicy has a role in shaping and informing all activities, and as such should not be viewed as a stand-alone policy.

NATIONAL LEARNING, TEACHING AND ASSESSMENT POLICY

Date of Enactment: 2010 Rwanda Higher Education Council

Description: The Policy provides a broad framework within which all Rwandan higher education institutions can guide the support and continued enhancement of the learning experience they provide. It aims to ensure support and enhancement of student learning across Rwandan higher education institutions. It provides broad strategies in Learning, Teaching and Assessment (LTA), which will work to inform individual institutional strategies according to their priorities. It covers the support and development of staff that are involved in teaching, the support of students learning and the development of student skills. Central to the Policy are the principles of the relationship between research and teaching and the promotion of equality through the development of an inclusive learning culture.

NATIONAL STAFF DEVELOPMENT POLICY FOR HIGHER EDUCATION

Date of Enactment: 2007, approved by cabinet 2010– Rwanda Higher Education Council

Description: The Policy commits Rwandan higher education institutions to support the development of their entire staff and to ensure continuous staff training. The higher education institutions have to give their staff the opportunity to participate in staff development that will enable them to improve the skills and competencies necessary to carry out their role and, as agreed with their line manager, to develop themselves for promotion. Staff training and staff development include all activities aimed at the improvement of skills and knowledge to enhance the institution's capacity to be a centre of excellence. The policy recognizes that staff development can be offered and undertaken in a number of ways, including but not limited to taking academic qualifications, attending seminars, conferences and workshops, learning in post (work-based learning), by 'acting up' and by role swap. There is a need in all higher education systems for staff development. This paper sets out the Staff Development Policy for Public Sector Higher Education Institutions. The Policy stipulates four types of staff development: (i) opportunities for academic and other staff to take accredited higher education programmes; (ii) early career academic staff development for teaching and learning and research and, continuing professional development for academic staff; (iii) management training for senior staff; and (iv) generic development to build staff capacity to enable them to improve performance and build capacity. The policy provides for funding mechanisms for postgraduate training of staff to attain PhDs and Masters Degrees.

RECRUITMENT, SELECTION AND APPOINTMENT POLICY AND PROCEDURES

Date of Enactment: 2007, approved by cabinet 2010– Rwanda Higher Education Council

Description: The Policy regulates recruitment and selection activities so that they are carried out in a fair, effective, consistent and professional manner. The policy aims to provide managers and employees with information on procedural requirements. The policy stipulates how the operation of the procedure will provide a fair, systematic and effective process for recruitment and selection; it (i) ensures the appointment of the best candidate for the post on the basis of objective criteria which include qualifications, competencies, skills, knowledge and experience; (ii) enables the filling of vacancies within agreed timescales in a cost-effective manner; (iii) eliminates discrimination and (iv) recognises internal redeployment requirements.

EDUCATION SECTOR STRATEGIC PLAN 2013/14 – 2017/18

Date of Enactment: October 2013, Ministry of Education

Description: The *Education Sector Strategic Plan* (ESSP) 2013 – 2018 is an update of the ESSP 2010–2015 and alignment of plans for Rwanda's education sector in line with the 2013 – 2018 *Economic Development and Poverty Reduction Strategy* (EDPRS II). The Plan is focusing on expanding access to education at all levels, improving the quality of education and training, and strengthening the relevance of education and training to meet labour market demands. The planned ten outcomes include increased equitable access to (i) nine years of basic education for all children, (ii) education for students with special educational needs, (iii) relevant, high-quality, demand-driven TVET programmes, and (iv) affordable, relevant, academically excellent higher education that also delivers quality research outputs. Others are (v) expanding access to 12 years of basic education, (vi) improved quality and learning outcomes across primary and secondary education, (vii) qualified, suitably-skilled and motivated teachers and trainers to meet the demands of expanding education access, and (vii) expanded access to three-years of early learning for four-to-six-year olds. (viii) strengthened performance in science, technology and innovation at all levels of education, and application of science, technology and innovation in relevant sectors of the economy, (ix) increased access to Adult Basic Education to improve adult literacy and numeracy, and (x) improved administrative and management support services, including the management of policy, information, finances, and human resources across the education sector.

FRAMEWORK AND REGULATIONS FOR HIGHER DEGREES BY RESEARCH AND REGULATIONS ON CHEATING AND PLAGIARISM IN RESEARCH DEGREES

Date of Enactment: 28 October 2014 (repealed the 2008 one)

Description: The Framework regulates the Awards of Doctor of Philosophy and Masters by research; conditions for registration for higher degrees by research, examinations, ethics issues, transfer of registration from Masters to PhD and from PhD to Master of Philosophy (MPhil). The Framework also regulates the supervision, procedures for examinations, and the types and formats of theses. Furthermore, the framework includes rules and regulations on plagiarism and cheating in research degrees as well as preparation and conduct of a formal hearing.

GENERAL ACADEMIC REGULATIONS FOR UNDERGRADUATE PROGRAMMES

Date of Enactment: 20 October 2014

Description: The General Academic Regulations and Programmes provide rules for the following: application procedures, general admission criteria, midway admissions and transfer of credits, procedures for registration, documents required for registration, change of names, withdrawal/cancellation of registration, and suspension of registration. The regulations also stipulate rules and conditions for Academic Programmes, modules, module credits, module coding, and delivery of modules. They also provide for assessment, continuous assessment, final examination, internal and external moderation, conflict of interest, registration for examinations, and conduct of examinations. The regulations have rules or the use of unauthorized materials in an examination room, cheating and other examination irregularities, failure to sit for an examination, and the management of special examinations.

GENERAL ACADEMIC REGULATIONS FOR OPEN AND DISTANCE LEARNING PROGRAMMES

Date of Enactment: 20 October 2014

Description: The General Academic Regulations for open and distance learning Programmes provide rules for the following: application procedures, general admission criteria, midway admissions and transfer of credits, procedures for registration, documents required for registration, change of names, withdrawal/cancellation of registration, and suspension of registration. The regulations also stipulate rules and conditions for Academic Programmes, modules, module credits, module coding, and delivery of modules. They also provide for assessment, continuous assessment, final examination, internal and external moderation, conflict of interest, registration for examinations, and conduct of examinations. The regulations have rules or the use of unauthorized materials in an examination room, cheating and other examination irregularities, failure to sit for an examination, and the management of special examinations.

UNIVERSITY OF RWANDA (UR) FRAMEWORK AND REGULATIONS FOR HIGHER DEGREES BY RESEARCH AND REGULATIONS ON CHEATING AND PLAGIARISM IN RESEARCH DEGREES

Description: This Framework is a modification, to suit the UR context, of the national Framework and Regulations for Higher Degrees by Research and the national Regulations on Cheating and Plagiarism in Research Degrees. The Framework regulates the Awards of Doctor of Philosophy and Masters by research; conditions for registration for higher degrees by research, examinations, ethics issues, transfer of registration from Masters to PhD and from PhD to Master of Philosophy (MPhil). In addition, the Framework regulates the supervision, procedures for examinations, and types and formats of theses. Furthermore, the Framework includes rules and regulations on plagiarism and cheating in research degrees as well as on the preparation and conduct of a formal hearing.

RWANDA ENVIRONMENTAL POLICY

Date of Enactment: 2003

Description: This Policy governs improved management of the environment, at central and local government's level. It sets out institutional and legal reforms for coordination of sector and cross-cutting environmental policies. The Policy gives a provision for the establishment of a Rwanda Environment Management Authority and setting-up of committees responsible for environmental protection at the decentralized levels – province, district, and town. Furthermore, the Policy previews the enactment of a legal framework for improved management of the environment, and the principles for citizens' participation in environmental protection. Included in this Policy are policy statements and strategic options with regard to population and land-use management, management and utilization of natural resources, and management of other socio-economic matters, as well as the necessary arrangements for the implementation of the Policy itself. In addition, while ensuring quality of life and environment the Policy aligns with poverty reduction policies; it provides a framework for reconciling environmental, social, and economic aspects of issues.

IPR IMPLEMENTING RULES AND REGULATIONS

- Ministerial Order No. 05/10/Minicom of 25/08/2010 Determining the Timeframe provided for Granting of Unilateral Licence, a Compulsory Licence and Opposition to Registration of Intellectual Property (2010)
- Ministerial Order No. 06/10/Minicom of 25/08/2010 determining the fees payable for registration services of an intellectual property (2010)
- Ministerial Order No. 07/10/Minicom of 25/08/2010 determining the structure and functioning of the Council of Appeal in charge of settling disputes related to intellectual property (2010)
- Ministerial Order No. 01/10/MINISPOC of 20/08/2010 determining the content of the application for suspension of procedures of clearing goods suspected to have been pirated (2010)
- Ministerial Orders on Companies (2009)
- Presidential Decree No. 277/14 on the Establishment of the Commission for collection and distribution of copyright. (1985)
- Presidential Decree No. 275/14. Tariff of copyright on the lucrative use of works of folklore. (1985)
- Presidential Decree No. 276/14. Price and conditions of the resale right (1985)
- Ministerial Decree No. 5/10/67 on the Measures implementing the Law on Patents (1967)
- Ministerial Decree No. 3/10/67 on the Measures implementing the Law on Trademarks (1967)
- Ministerial Decree No. 4/10/67. Measures implementing the Law on Industrial Designs (1967)

INTERNATIONAL AGREEMENTS ON SETI MATTERS

Table 65 presents an inventory of international agreements, memoranda of understanding, protocols and minutes on SETI matters.

Table 65: Inventory of international agreements, MoUs*, protocols and minutes on SETI issues

No.	Code	Collaborators	Type	Ministry	Agreement Dates	Project Title	Country
1.	COM/5 13 01	MoU* between Ministry of Education and INTEL	MoU*	Ministry of Education	03/03/2009	INTEL	Republic of South Africa
2.	COM/5 13 02	MoU* between Ministry of Education and ESRI Geoinformatik GmbH	MoU*	Ministry of Education	14/05/2009	ESRI Geo-informatik GmbH	Germany
3.	COM/5 13 03	Amendment to the supply agreement signed between the Government of Rwanda and the OLPC Association Inc. on the 27th January 2009	Protocol	Ministry of Education	01/03/2011	One Laptop per Child	United States of America
4.	GOV/6 13 01	Procès-verbal des travaux de la 4è commission mixte Rwanda-Gabon tenue à Kigali les 18 et 19 Mai 2011	JPC Minutes	Ministry of Foreign Affairs and Cooperation	19/05/2011	Republic of Gabon	Gabon
5.	GOV/6 13 02	MoU* between Ministry of Education and Economic Development and Employment Promotion Programme supported by GTZ, DED and CIM, co-funded by Germany Federal Ministry for Economic Cooperation (BMZ) and Royal Netherlands Embassy	MoU*	Ministry of Education	09/12/2010	GTZ/GIZ, Economic Develop-ment and Employ-ment Promotion	Germany
6.	GOV/6 13 03	MoU* between the Government of Rwanda and the Government of India for solar electrification of 35 schools in rural Rwanda	MoU*	Ministry of Foreign Affairs and Cooperation	15/02/2012	Republic of India	
7.	GOV/6 13 04	Agreement between the Government of Rwanda and the G o Republic of South Africa on Cooperation in the field of higher Education and Training	Agreement	Ministry of Education	15/08/2011	Republic of South Africa	Republic of South Africa
8.	GOV/6 13 05	The implementation of the Uganda- Rwanda 8th Joint Permanent commission Kigali 21st March 2011	JPC Minutes	Ministry of Foreign Affairs and Cooperation	21/03/2011	Republic of Uganda	Republic of Uganda
9.	GOV/6 13 06	Memorandum of Agreement on Exchange Programme in Education between the Government of Rwanda represented by Ministry of Education and the Government of Djibouti represented by the Ministry of National Education and Higher Education	MoU*	Ministry of Education	18/08/2007	Republic of Djibouti	Republic of Djibouti

10.	GOV/6 13 07	MoU* between the Government of the Republic of Haiti and the Government of Rwanda and Haiti-Rwanda Commission relative to the Haitians studying in Rwanda	MoU*	Ministry of Education	17/01/2011	Republic of Haiti	Republic of Haiti
11.	GOV/6 13 08	Agreement between the Government of Rwanda and the Republic of South Africa on Cooperation in Education	Agreement	Ministry of Education	19/10/2000	Republic of South Africa	Republic of South Africa
12.	GOV/6 13 09	Agreement between the Government of Rwanda and the Government of the Republic of Korea on the Korea Overseas Volunteers Program	Agreement	Ministry of Foreign Affairs and Cooperation	26/10/2005	Republic of Korea	Republic of Korea
13.	GOV/6 13 10	Agreement between the Government of Rwanda and the Government of the Republic of Korea on Economic, Scientific and Technical Cooperation	Agreement	Ministry of Foreign Affairs and Cooperation	26/10/2005	Republic of Korea	Republic of Korea
14.	GOV/6 13 11	MoU* between the Government of Rwanda represented by Ministry of Education and the Government of Kenya represented by Ministry of Education, Science and Technology	MoU*	Ministry of Education	18/04/2006	Republic of Kenya	Republic of Kenya
15.	GOV/6 13 12	Exchange Programme of Cooperation in Education Area between the Government of Rwanda and the Government of the Republic of India	Agreement	Ministry of Education	25/07/2006	Republic of India	Republic of India
16.	GOV/6 13 13	MoU* between the Government of Rwanda and the Government of the Republic of India	MoU*	Rwanda Embassy in India	05/04/2007	Republic of India	Republic of India
17.	GOV/6 13 14	Minutes of the meeting regarding SIDA (Sweden) support to University of Rwanda	Other Coopera-tion documents	Ministry of Education	19/11/2010	SIDA (Sweden)	Sweden
18.	HLI/7 13 01	MoU* on cooperation between the Ministry of Education, Rwanda and the University of Scotland	MoU*	Ministry of Education	01/10/2009	University of Scotland	United Kingdom
19.	HLI/7 13 02	Cooperation Letter on exploring possibilities on admission of Rwandan student from Rwanda in Pandit Deendayal Petroleum University on mutual understanding subject to terms and conditions of national statutory bodies	Agreement	MININFRA	13/01/2011	Pandit Deendayal Petroleum University	Republic of India
20.	HLI/7 13 03	Confirmation of scholarships for nationals of Rwanda: Proposal for HE President Paul Kagame Scholarship Awards for Rwandan Nationals	Agreement		25/02/2011	Jain University	Republic of India
21.	HLI/7 13 04	MoU* between the Ministry of Education, Rwanda and the University of Virginia	MoU*	Ministry of Education	02/04/2012	University of Virginia	United States of America
22.	HLI/7 13 05	MoU* on support to enhance quality Education in Higher Education Institutions in Rwanda through the Exchange of Academic Programme between Des Moines University and higher education institutions in Rwanda	MoU*	Ministry of Education	09/09/2011	Des Moines University (DMU)	United States of America

23.	HLI/7 13 06	Cooperation agreement between the Witwatersrand, Johannesburg. (Wits) and the Government of Rwanda on cooperation in the training and development of Higher level graduates in the field of Education, Health, Engineering, Commerce, Law and Management	Agreement	Ministry of Education	27/08/2009	University of Witwaters-rand	Republic of South Africa
24.	HLI/7 13 07	Addendum to Rwanda-CBU Presidential Education Scholarship	Protocol	Ministry of Education	19/05/2011	California Baptist University (CBU)	United States of America
25.	HLI/7 13 08	MoU* between the University of Liverpool and the Government of Rwanda represented by the Ministry of Education on behalf of Private and Public Higher Learning Institutions	MoU*	Ministry of Education	27/06/2012	University of Liverpool	United Kingdom
26.	HLI/7 13 09	Agreement between CMU and the Government of Rwanda to establish and operate the Carnegie Mellon University in Rwanda	Agreement	Rwanda Development Board	01/09/2011	Carnegie Mellon University (CMU)	United States of America
27.	HLI/7 13 10	Rwanda - California Baptist University	Agreement	Ministry of Education	18/12/2007	California Baptist University (CBU)	United States of America
28.	HLI/7 13 11	Partnership Contract on Higher Education with Technical University of Kaiserslautern	Contract	Ministry of Education	07/02/2012	Technical University of Kaiserslautern	Germany
29.	HLI/7 13 12	MoU* between Ministry of Education and Cambridge Commonwealth Trust (CCT) on the establishment of the Rwanda Cambridge Scholarship	MoU*	Ministry of Education	15/02/2011	Cambridge Commonwealth Trust (CCT)	United Kingdom
30.	HLI/7 13 13	Rwanda - Oklahoma Christian University Education Agreement on Rwanda Presidential Scholarship	Agreement	Ministry of Education	01/01/2006	Oklahoma Christian University	United States of America
31.	HLI/7 13 14	Amendment No1 MoU* between the Ministry of Education, Rwanda and William Penn University dated September 2011	Protocol	Ministry of Education	29/10/2012	William Penn University	United States of America
32.	HLI/7 13 15	MoU* between UKTA and the Government of Rwanda for the Transfer of Knowledge from United Kingdom to Rwanda	MoU*	Ministry of Education	13/09/2011	United Kingdom Telecommunication Academy (UKTA)	United Kingdom
33.	HLI/7 13 16	MoU* between the Government of Rwanda represented by Ministry of Education and Tulane University operating in Rwanda as Tulane International LLC		Ministry of Education	29/09/2010	Tulane University	United States of America
34.	HLI/7 13 17	MoU* on grant of scholarship by William Penn University	MoU*	Ministry of Education	26/09/2011	William Penn University	United States of America
35.	HLI/7 13 18	Collaboration agreement between Maastricht School of Management (MSM) and School of Finance and Banking on Master of Business Administration Program	Agreement	School of Finance and Banking	04/06/2007	Maastricht School of Manage-ment	Netherlands

36.	HLI/7 13 19	Memorandum of Understanding between Henrix College of Conway, Arkansas and the Ministry of Education, Rwanda	MoU*	Ministry of Education	30/04/2007	Hendix College of Conway, Arkansas	United States of America
37.	HLI/7 13 20	Agreement for professional services between the William Davidson Institute at the University of Michigan and the School of Finance and Banking	Agreement		18/06/2006	William Davidson Institute	United States of America
38.	INT/8 13 01	Convention portant statut du Conseil Africain et Margache pour l'Enseignement Superieur (CAMES)	Convention	Ministry of Foreign Affairs and Cooperation	07/02/1987	CAMES (Conseil Africain et Malgache pour l'Enseignement Supérieur)	Madagascar
39.	INT/8 13 02	Contribution Agreement between UNICEF-Child Friendly Schools Project (CFS), Commonwealth of Learning (COL) and Ministry of Education	Agreement	Ministry of Education	18/06/2010	Common-wealth of Learning	
40.	INT/8 13 03	MoU* to support the establishment of Rwanda Innovative Endowment Fund	MoU*	Ministry of Education	07/07/2011	UNECA	
41.	INT/8 13 04	The Inter University Council for East Africa Act, 2008	Convention	Government of Rwanda	12/2/2012	Inter University Council for East Africa (IUCEA)	East Africa Countries
42.	INT/8 13 05	MoU* between the New Partnership for Africa's Development (NEPAD) e-Africa Commission and the Government of the Republic of Rwanda and Sysco Systems International	MoU*		26/08/2005	NEPAD E-AFRICA COMMISSION	
43.	NGO/9 13 01	MoU* between Ministry of Education and ESTHER's AID and ABANDONED CHILDREN Inc.	MoU*	Ministry of Education	08/09/2011	ESTHER'S AID	
44.	NGO/9 13 02	Memorandum of Understanding between the Ministry of Education and Rwanda Girls Initiative	MoU*	Ministry of Education	29/04/2010	RWANDA GIRLS' UNITIATIVE	United States of America
45.		MoU* Between the Government of Rwanda and the Dassault Systèmes SolidWorks Corporation	MoU*	Ministry of Education	2014	Support the teaching of Graphic Design at both Secondary and Higher education Levels	United States of America

*Memorandum of Understanding.

Source: Ministry of Education

IIPR TREATY APPROVALS

- Presidential Order No. 16/01 of 16/02/2011 Ratifying the Patent Cooperation Treaty done at Washington, United States of America on 19 June 1970 (2011)
- Presidential Order No. 17/01 of 16/02/2011 ratifying the Additional Protocol on the Agreement of Lusaka, Zambia of 09 December 1976 on the Creation of the African Regional Intellectual Property Organization (ARIPO) on Patents and Industrial Designs within the Framework of the African Regional Intellectual Property Organization (ARIPO) Adopted on 10 December 1982 at Harare, Zimbabwe (2011)
- Law No. 27/2009 of 07/09/2009 Authorising Ratification of the Madrid Agreement relating to the International Registration of Trade Marks Adopted in Madrid, Spain on 27 June 1989 (2009)

WIPO–ADMINISTERED TREATIES

- Protocol Relating to the Madrid Agreement Concerning the International Registration of Marks (August 17, 2013)
- Hague Agreement Concerning the International Registration of Industrial Designs (August 31, 2011)
- Patent Cooperation Treaty (August 31, 2011)
- Brussels Convention Relating to the Distribution of Programme-Carrying Signals Transmitted by Satellite (July 25, 2001)
- Berne Convention for the Protection of Literary and Artistic Works (March 1, 1984)
- Paris Convention for the Protection of Industrial Property (March 1, 1984)
- Convention Establishing the World Intellectual Property Organization (February 3, 1984)

IPR–RELATED MULTILATERAL TREATIES

- Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity
- United Nations Convention on the Law of the Sea ...
- Convention for the Safeguarding of the Intangible Cultural Heritage (April 21, 2013)
- Convention on the Protection and Promotion of the Diversity of Cultural Expressions 2005 (October 16, 2012)
- International Treaty on Plant Genetic Resources for Food and Agriculture (January 12, 2011)
- Convention on the Rights of Persons with Disabilities (January 14, 2009)
- Optional Protocol to the Convention on the Rights of Persons with Disabilities (January 14, 2009)
- International Plant Protection Convention (August 26, 2008)
- Convention relating to the Status of Stateless Persons (January 2, 2007)
- WHO Framework Convention on Tobacco Control (January 17, 2006)
- Kyoto Protocol to the United Nations Framework Convention on Climate Change (February 16, 2005)
- Cartagena Protocol on Biosafety to the Convention on Biological Diversity (October 20, 2004)

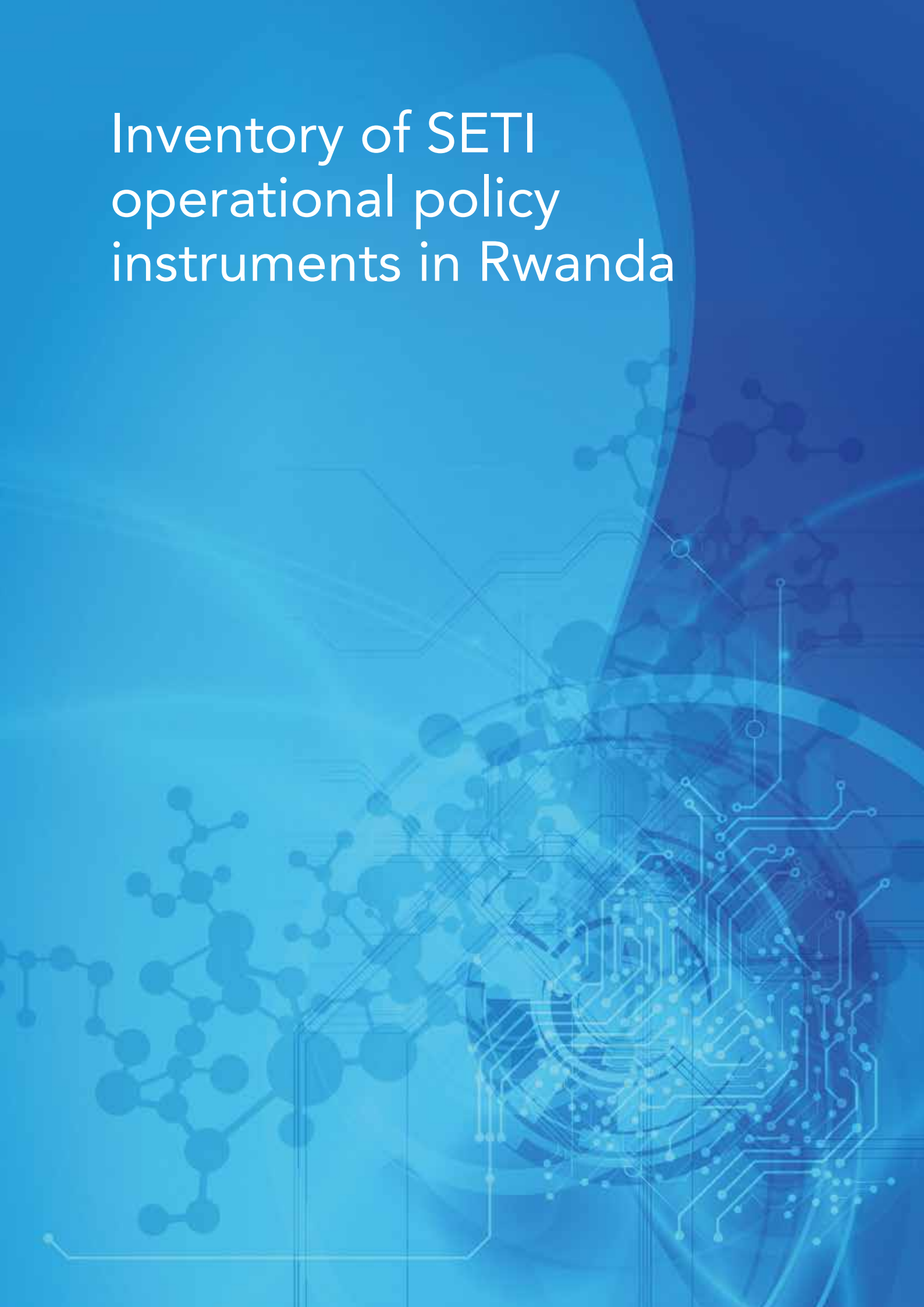
- Stockholm Convention on Persistent Organic Pollutants (May 17, 2004)
- Convention on the Means of Prohibiting and Preventing the Illicit Import, Export and Transfer of Ownership of Cultural Property (December 25, 2001)
- Convention concerning the Protection of the World Cultural and Natural Heritage (March 28, 2001)
- Convention for the Protection of Cultural Property in the Event of Armed Conflict (March 28, 2001)
- United Nations Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa (January 20, 1999)
- United Nations Framework Convention on Climate Change (November 16, 1998)
- Convention on Biological Diversity (August 27, 1996)
- Agreement establishing the World Trade Organization (WTO) (May 22, 1996)
- World Trade Organization (WTO) – Agreement on Trade–Related Aspects of Intellectual Property Rights (TRIPS Agreement) (1994) (May 22, 1996)
- Universal Copyright Convention as revised on 24 July 1971, with Appendix Declaration relating to Article XVII and Resolution concerning Article XI (November 10, 1989)
- Universal Copyright Convention of 6 September 1952, with Appendix Declaration relating to Article XVII and Resolution concerning Article XI (November 10, 1989)
- Protocol 1 annexed for Universal Copyright Convention as revised at Paris on 24 July 1971 concerning the application of that Convention to works of Stateless persons and refugees (August 10, 1989)
- Protocol 1 annexed to the Universal Copyright Convention as signed at Geneva on 6 September 1952 concerning the application of that Convention to works of stateless persons and refugees (August 10, 1989)
- Protocol 2 annexed for Universal Copyright Convention as revised at Paris on 24 July 1971 concerning the application of that Convention to works of certain international organizations (August 10, 1989)
- Protocol 2 annexed to the Universal Copyright Convention as signed at Geneva on 6 September 1952 concerning the application of that Convention the works of certain international organizations (August 10, 1989)
- Protocol 3 annexed to the Universal Copyright Convention as signed at Geneva on 6 September 1952 concerning the effective date of instruments of ratification or acceptance of or accession to that Convention (August 10, 1989)
- Protocol (I) Additional to the Geneva Conventions of 12 August 1949, and relating to the protection of victims of international armed conflicts (May 19, 1985)
- Protocol (II) Additional to the Geneva Conventions of 12 August 1949, and relating to the Protection of Victims of Non-International Armed Conflicts (May 19, 1985)
- International Covenant on Economic, Social and Cultural Rights (January 3, 1976)
- Convention on Transit Trade of Land-locked States (September 12, 1968)
- Convention on International Civil Aviation (March 4, 1964)
- Agreement on the Importation of Educational, Scientific and Cultural Materials (July 1, 1962)
- Convention and Statute on Freedom of Transit (July 1, 1962)
- Convention (I) for the Amelioration of the Condition of the Wounded and Sick in Armed Forces in the Field (July 1, 1962)

- Convention (II) for the Amelioration of the Condition of Wounded, Sick and Shipwrecked Members of Armed Forces at Sea (July 1, 1962)
- Convention (IV) relative to the Protection of Civilian Persons in Time of War (July 1, 1962)

IPR REGIONAL TREATIES

- Harare Protocol on Patents and Industrial Designs within the Framework of the African Regional Industrial Property Organization (ARIPO) (September 24, 2011)
- Lusaka Agreement on the Creation of the African Regional Intellectual Property Organization (ARIPO) (June 24, 2011)
- Cultural Charter for Africa (September 19, 1990)
- Regional Economic Integration Treaties (Entry into force of the Treaty for the Contracting Party)
- Treaty for the Establishment of the East African Community (July 1, 2007)
- Constitutive Act of the African Union (May 26, 2001)
- Treaty Establishing the Common Market for Eastern and Southern Africa (December 8, 1994)
- Abuja Treaty Establishing the African Economic Community (AEC) (May 12, 1994)
- The Georgetown Agreement (formally establishing the African, Caribbean and Pacific Group of States, the "ACP Group"), since 1975 (ACP) (February 12, 1976)

Inventory of SETI operational policy instruments in Rwanda



By January 2015, Rwanda the authorities had identified only three SETI operational policy instruments[31]. These are presented in the tables overleaf. In general, each individual SETI operational policy instruments has either one or several specific objectives and goals, which correspond to the standard categories adopted within the GO→SPIN methodological approach. Figure 43 shows the distribution of SETI operational policy instruments by strategic objectives and goals in Rwanda which are now in operation.

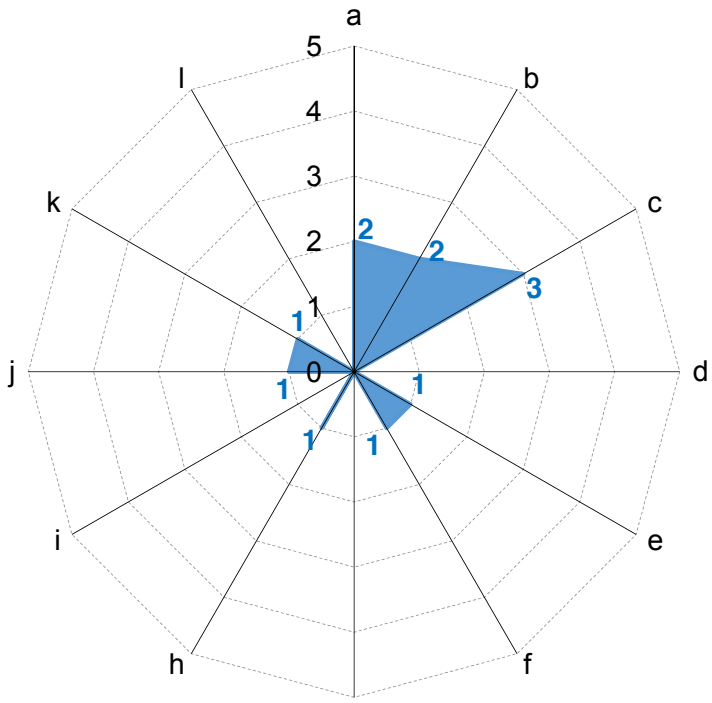


Figure 43: Distribution of SETI operational policy instruments in Rwanda, according to the GO→SPIN categories of objective and goal. Source: UNESCO

Key

a. Strengthening the production of new endogenous scientific knowledge
b. Strengthening the infrastructure of research laboratories in the public and private sectors
c. Human resources for research, innovation and strategic planning. Capacity building, education and training of specialized human capital for (1) the production of new scientific knowledge, (2) development of new technologies, (3) promotion of innovation within the productive and services systems and (4) management of the knowledge society
d. Strengthening gender equality for research and innovation
e. Strengthening the social appropriation of scientific knowledge and new technologies
f. Development of strategic technological areas and new niche products and services with high-added value. Promotion and development of innovation in the production of goods and services. Promotion of start-ups in areas of high technology
g. Strengthening programmes on science education at all levels (from primary school to postgraduate)
h. Promotion of the development of green technologies and social-inclusion technologies.
i. Promotion of indigenous knowledge systems
j. Research and innovation eco-system: strengthening co-ordination, networking and integration processes which promote synergies among the different actors of the national scientific technological and productive innovation system (i.e. government, university and productive sectors)
k. Strengthening the quality of technology foresight studies to: assess the potential of high-value markets; develop business plans for high-tech companies; construct and analyse long-term scenarios and; provide consulting services and strategic intelligence
l. Strengthening regional and international co-operation, networking and promotion of SETI activities.

31 NOTE OF THE EDITOR: there should be some other operational policy instruments which were not identified (e.g. within the Ministry of Trade and Industry, Ministry of Health, Ministry of Agriculture and Ministry of ICT and Youth, etc.).

SETI OPERATIONAL POLICY INSTRUMENT I

Title of the SETI operational policy instrument: **FONERWA** – Environment and Climate Change Fund of Rwanda

- **Keywords**: Environment, climate change, conservation, natural resources management, energy, environmental impact assessment
- **Overview**: The Environment and Climate Change Fund is a cross-sectoral financing mechanism through which environment and climate change finance is channelled, programmed, disbursed and monitored. It is a national basket fund financed through external aid and domestic finance. Access to the fund is open to line ministries and districts, charitable and private entities, including businesses, civil society and research institutions.
- **Objective**: The Environment and Climate Change Fund has the overarching objective of contributing to sustainable wealth creation and poverty reduction in Rwanda, through sustainable management of natural resources, climate resilient and green economic growth
- **Specific objectives**: a. Strengthening the production of new endogenous scientific knowledge; b. Strengthening the infrastructure of research laboratories in the public and private sectors; c. Human resources for research, innovation and strategic planning, Capacity building, education and training of specialized human capital for (1) the production of new scientific knowledge, (2) development of new technologies, (3) promotion of innovation within the productive and services systems and (4) management of the knowledge society; h. Promotion of the development of green technologies and social-inclusion technologies.
- **Sectoral or horizontal approach of the instrument**: Sectoral
- **Mode of support/Type of mechanism**: Funding mechanism consists of the four Thematic Financing Windows and priority investment areas:

  Window 1: conservation a sustainable natural resources management: (a) ecosystem rehabilitation; (b) sustainable land management; (c) integrated water resource management; (d) sustainable forestry management; (e) sustainable mines and quarries; (f) promotion and protection of biodiversity

  Window 2: (a) energy, R&D and technology transfer and implementation; (b) renewable energy and energy efficiency technology; (c) pollution management; (d) water storage, conservation and irrigation technologies; (e) applied and adaptive research (agroforestry, waste, urban planning); (f) disaster risk reduction; (h) data collection, monitoring and management information system

  Window 3: (a) environment and climate change mainstreaming; (b) strategic environment and climate assessments; (c) sector-specific adaptation and mitigation; (d) support to implementation of cross-sectoral integrated planning

  Window 4: (a) environmental impact assessment monitoring and enforcement; (b) monitoring implementation of environment management plans for capital projects; (c) environmental auditing
- **Conditions for applying for the instrument**: n/a
- **Target groups/Beneficiaries**: Targeted beneficiaries are line ministries, government agencies, districts, civil society organisations, academic institutions and the private sector.
- **Eligibility/Selection criteria**: The fund can be accessed by line ministries, government agencies, Districts, civil society organisations, academic institutions and the private sector, as long as the proposed activities are in compliance with Fund eligibility criteria, and the project/ programmes are screened through various steps.

- **Eligible costs**: At least 20% of total resources will be earmarked for the private sector for use across Thematic Financing Windows, and at least 10% of fund resources will be earmarked for districts.
- **Source of funding**:
- **Domestic capitalisation sources include**: (1) Environmental fines and fees, (2) EIA fees (mentioned above), (3) Proceeds from Forestry and Water Funds, (4) Other environmental revenue and (5) Seed financing from domestic stakeholders (line ministries). In fact, FONERWA is the only fund in Rwanda that mobilises resources from the Government of Rwanda's own revenue sources, making it less vulnerable to external aid shocks.

    a) External capitalisation sources include bilateral and multilateral development partners' contributions and access to international environment and climate funds.

    b) Private sector contributions will be considered in the form of grants and project co-financing in the short-term (0–1 years), and investment (e.g. equity) in the long-term (> 5 years), among others.
- **Mode of disbursement of financial resources**: In the short-term (0–1 years), public and private beneficiaries will be given (i) technical assistance for proposal development and (ii) performance-based grants. In the medium-term (2–5 years) beneficiaries will be given low interest and/or concessional loans. While in the long-term (> 5 years) financial instruments such as equity investments are expected to be introduced.
- **Annual budget**: n/a
- **Geographical coverage**: national
- **Results, outcome and evidence of success of a given measure**: The outcome of the Environment and Climate Change Fund is to sustainably and equitably finance and further strengthen national programmes and private sector initiatives in the areas of current and future environment and climate change, and development related challenges and opportunities. FONERWA will deliver the following results: (a) conservation and management of natural resources strengthened and sustained; (b) R&D and technology transfer and implementation facilitated and utilized; and (c) environment and climate change issues mainstreamed into policies, programmes, plans, budgets and activities for public and non-public agencies.
- **Relevant Link**: www.fonerwa.org

SETI OPERATIONAL POLICY INSTRUMENT II

Title of the SETI operational policy instrument: Rwanda Innovation Endowment Fund

- **Keywords**: entrepreneurship and innovation, R&D and innovation, innovation and business, innovation and marketing
- **Overview**: The Rwanda Innovation Endowment Fund supports teams of young graduates and academic researchers who demonstrate entrepreneurship inspiration to start innovative businesses. The emphasis is on the application of knowledge to the innovation being-proposed.
- **Objective**: The objective of this Fund is to stimulate economic transformation through R&D in innovative market-oriented products and processes in priority areas of the economy, thereby increasing prosperity and the competitiveness of the Rwandan economy. The orientation can be for economic growth, social development or combination of the two.

- **Specific objectives**: a. Strengthening the production of new endogenous scientific knowledge; b. Strengthening the infrastructure of research laboratories in the public and private sectors; c. Human resources for research, innovation and strategic planning, capacity building, education and training of specialized human capital for (1) the production of new scientific knowledge, (2) development of new technologies, (3) promotion of innovation within the productive and services systems and (4) management of the knowledge society; e. Strengthening the social appropriation of scientific knowledge and new technologies; f. Development of strategic technological areas and new niche products and services with high-added value, promotion and development of innovation in the production of goods and services, promotion of start-ups in areas of high technology.
- **Sectoral or horizontal approach of the instrument**: Sectoral
- **Mode of support/Type of mechanism**: the fund focused on four priority areas: Agriculture, Manufacturing, ICT and Energy
- **Conditions for applying for the instrument**: (i) application led by a young graduate (as a guide, someone who graduated in the past five years) possibly leading a team whose member skills will include entrepreneurship/innovation, R&D, and business/marketing. (ii) the application can be made by an academic researcher possibly from a higher education Institution or a research and development institution possibly leading a team whose member skills include entrepreneurship/ innovation, R&D, and business/marketing.
- **Target groups/Beneficiaries**: all Rwandans, however priority is put on young graduates and academic researchers
- **Eligibility/Selection criteria**: an individual or a group of individuals whose skills include entrepreneurship/innovation, R&D, and business/marketing.
- **Eligible costs**: n/a
- **Source of funding**: Government of Rwanda, United Nations Economic Commission for Africa (on behalf of One United Nations),
- **Mode of disbursement of financial resources**: The first phase was planned to be a proof of concept involving 300 000 000 RWF seed funding from the Government of Rwanda and 75 000 000 RWF counterparts funding from UNECA in 2012. The Government of Rwanda added 150 000 000 RWF in 2013 and plans to add 50 000 000 RWF in 2014 for the implementation of the second phase of the grant. The total amount available on Account is 525 000 000 RWF. The Award for successful project ranges between 10 000 US$ and 50 000 US$.
- **Annual budget**: varies
- **Geographical coverage**: national
- **Results, outcome and evidence of success of a given measure**: (i) Phase 1: 370 applications were received from 29 (out of 30) districts; 8 projects were awarded follows: 3 in Manufacturing (1 male, 2 female); 3 in Agriculture (1 male, 2 female), 2 in ICT (2 male, 0 female). Out of the eight recipients, six innovations are being implemented successfully. Four of them have already produced prototypes. One project has been delayed while another has been abandoned. (ii) Phase 2: A National Awareness and Sensitization campaigns was held and Phase 2 received 299 applications from 29 districts, 46 promising applications were selected, applicants got trained on how to write a fundable innovation business plan. Twenty best innovations were selected from the 46 projects. Preparations for Final Oral Interviews are ongoing. It is expected that the second phase will fund 10 innovation projects at an estimated budget of 300 000 000 RWF.
- **Relevant Link**: http://mineduc.gov.rw/rief/

SETI OPERATIONAL POLICY INSTRUMENT III

Title of the SETI operational policy instrument: Skills Development Facility

- **Keywords**: human resources, skills
- **Overview**: The Skills Development Facility plans to finance training providers with the aim to rapidly reduce skills gaps and promote employment in the following 8 priority areas of training

  1) Hospitality and Tourism sector such as culinary art, Food and beverage service, housekeeping service, tour agency operation, tour guide training retail sales
  2) ICT sector such as programmes, networking and cabling, web designing, database management and IT security
  3) Construction and building services sector such as electrical installation, plumbing, air conditioning and refrigeration, masonry, painting, carpentry
  4) Agricultural sector such as food processing, irrigation, commercial cultivation
  5) Technical servicing sector such as Electronics Servicing, Automotive Technology (Light and heavy Vehicle)
  6) Clean and sustainable energy sector such as Bio-mass technology and solar technology
  7) Water resources sector such as recycling and treatment
  8) Arts and Crafts *such as* basket weaving, handicraft and tailoring

  About 100 sub-grants will be awarded during this project phase, benefitting approximately 10 000 – 12 000 trainees. The sub-grants will range from a minimum of US$ 10 000 to a maximum of US$ 100 000.

- **Objective**: The objective of the Skills Development Facility is to minimize skills gaps by rapidly increasing the supply of skills in high demand in the labour market. To achieve this objective, the SDF will aim to expand the number of individuals with the relevant skills in critical sectors and improve the quality of individual's skill sets in key occupations and sectors, The Skills Development Facility plan is to finance about 100 sub-grants during this project, benefitting approximately 10000–12000 trainees. Other objectives: stimulate competition and delivery of innovative programme offerings; promote collaboration between enterprises and training centres and institutions; increase skills acquisition among disadvantaged groups; and improve the efficiency of training provision.
- **Specific objectives**: c. human resources for research, innovation and strategic planning, capacity building, education and training of specialized human capital for (1) the production of new scientific knowledge, (2) development of new technologies, (3) promotion of innovation within the productive and services systems and (4) management of the knowledge society; g. Strengthening programmes on science education at all levels (from primary school to postgraduate); j. Research and innovation eco-system: strengthening co-ordination, networking and integration processes which promote synergies among the different actors of the national scientific technological and productive innovation system (i.e. government, university and productive sectors); k. Strengthening the quality of technology foresight studies to: assess the potential of high-value markets; develop business plans for high-tech companies; construct and analyse long-term scenarios and; provide consulting services and strategic intelligence.
- **Sectoral or horizontal approach of the instrument**: horizontal
- **Mode of support/Type of mechanism**: n/a
- **Conditions for applying for the instrument**: Priority will be given to proposals that focus on the occupations identified by the Workforce Development Authority. Other occupations could be considered based on compelling evidence from the labour market. The eligible programmes include: (i) Short-term programmes ranging from 1 to 3 months maximum. (ii) Training programmes that are directed at meeting urgent skills requirements in the labour market, either improvements of existing programmes, expansion of existing programmes or development and delivery of new programmes.

- **Target groups/Beneficiaries**: (a) Young adults (not enrolled and not gainfully employed) to receive job entry training in critical skills. Target groups will include young adults who have completed either primary or lower secondary education or graduates from vocational centres who may need to upgrade their skills; (b) Public and private technical and vocational training centres and institutions to upgrade their technical and operational capacity to deliver relevant t and quality training programmes; and (c) Trade associations, Cooperatives, Non-Governmental Organisation and enterprises to expand their capacity to deliver industry relevant training programmes for current and prospective workers.

- **Eligibility/Selection criteria**:

  a) Public education/training providers (to add or expand short-term training offerings)
     - Government-aided education/training institutions
     - Private education/training providers (for-profit)
     - Private education/training providers (not-for-profit)

  b) Other entities that would act as providers by adding or expanding
     - Associations and Cooperatives
     - National and international Non-Government Organisations
     - Enterprises

  Sectors/Areas that are not eligible for financing include the following: (a) Literacy training; (b) General education; (c) Higher education; (d) Health occupations; and (e) Public administration. Also Cross sector skills such as ICT and English language communication are not eligible as stand-alone training programmes. They will only be considered when proficiency of these skills is part of a curricula and a requirement for successful performance in priority occupations.

- **Eligible costs**:

- *Services:* consulting services (national and international); master trainers to upgrade trainers to deliver programmes; trainers to deliver training programme; insurance for trainees; local labour market studies and tracer studies;

- *Goods:* training materials, workshop materials; workshop consumables; and equipment, *Infrastructure*: minor refurbishing of immediate training facilities (ceiling for minor rehabilitation is 10% of the sub-grant),

- *Operational:* administrative overhead (5% of the Sub-Grant), vehicle rental and repair, rental of training premises, Internal travel for training purposes (e.g. enterprise visits) staff and students, training abroad only in exceptional circumstances (where costs are lower than organizing domestic training);

- **Source of funding**: n/a

- **Mode of disbursement of financial resources**: Disbursements will be made on three instalments, following a 30%, 40%, and 30% schedule. The first instalment of 30% will be advanced upon contract signature. The second instalment of 40% will be advanced upon the completion of a third of the envisaged activities to the satisfaction of the Skills Development Fund Secretariat. The request for second disbursement will be accompanied by an implementation status report and documentation of expenditures from the first instalment. The final instalment of 30% will be advanced upon the successful completion of activities, submission of final report and documentation of expenditures from the second instalment.

- **Annual budget**: n/a

- **Geographical coverage**: national

- **Results, outcome and evidence of success of a given measure**: n/a

- **Relevant Link**: www.wda.gov.rw

BOX 19 – IMPLICIT OPERATIONAL POLICY INSTRUMENTS: PROCUREMENT LAW ACTING AS A RESEARCH DISINCENTIVE

Sometimes there are existing policies (intended to regulate other domains) the implementation of which, through their operational policy instruments, produces negative or positive effects for scientific and technological productivity. These may be called 'implicit policies' that regulate the research and innovation system.

As an example of one such implicit policy, here we present the case of national procurement laws as implemented in the context of university research. Procurement laws aim to ensure that:

1. the procurement of all goods and services is conducted in an honest, competitive, fair and transparent manner;
2. the procured goods and services deliver the best value for money outcome whilst at the same time protecting the reputation of the university; and
3. the procurement takes into account the required: (i) specifications, (ii) quality, (iii) service, (iv) delivery, (v) reliability, (vi) environmental and social issues, and (vii) the total cost of ownership.

However, in its application, the Rwanda Public Procurement Law has created a disincentive in research and postgraduate training.

Below are examples of challenges reported at the former National University of Rwanda especially in collaborative projects dealing with research, publication and staff capacity building (PhD training):

a) Tendering raises costs of conducting research: As an example, the procurement law requires that a researcher use vehicles hired from companies selected via tender, despite that such researcher may have access to a private car. By putting fuel in own car he or she would use RWF 10 000 RWF; it would cost 66 500 to hire an equivalent car for the same use, a cost that is 6.5 times more. For projects in which a central activity is data collection in the field, this requirement alone is a strong disincentive for researchers. They may respond by restricting sample size; but this can seriously affect the study's quality.

b) Increased costs for services or equipment procured through the tendering system: Due to advertisement costs and perhaps other reasons, equipment and services procured through tendering system are priced much higher than the market. For example an air ticket to a given destination, which costs US$ 400 on the market, it costs US$ 900 when supplied by the company that won the tender. In one report, a laptop whose cost is US$ 300 costs US$ 771 440 when supplied by the intermediary which won the tender. Conference services e.g. catering, rooms and accommodation cost about 3 times more than market prices. For grants with a budget ceiling which include travelling, workshops, retreats, equipment purchase e.g. PhD studies or postdoctoral and other research, inflated prices force researchers to cut down research activities. In addition, the entire funding programme cuts down the number of grants to be offered and must increase budget ceilings for the individual grants, so as to ensure the quality of the researches.

c) Lack of flexibility in specifications: The providers that won tenders are appointed to supply items with precise specifications for fixed prices for a fixed period. It is not possible for someone requiring an item with specifications different from those to obtain the non-conforming item. This has resulted in big problems for research. There was a project on Geographical information systems and remote sensing that required two laptops of certain specifications for long-term data collection, capable of handling certain gadgets. The laptops were supposed to collect continuous data for two years. The researchers were forced to purchase laptops with specifications approved in the tender, not the best adapted to the task. They attached the gadgets, started data collection and after a few months the laptops crashed; data were lost and the project was abandoned.

d) Poor quality: Despite that procurement laws seek to ensure quality, standards etc., items procured through tender systems are reported to have inferior quality. In most cases, these suppliers deliver a poorer quality of goods with a higher cost compared with goods that could be purchased directly from market suppliers.

e) Delay in deliveries: The process of awarding tenders and delivery of procured items takes time. There are many cases reported in which ordered goods were delivered after the research projects have expired or even when the research has ended, and this has negatively affected the planning of research activities.

Another big challenge has to do with suppliers who sign contracts with the University but at the end they fail to deliver as per contract. It is believed that they use the contract to get a loan, then use the money to carry out other projects, hoping to use the profit of such other activities to eventually buy the items to be delivered to the University. This concerns the big tenders to procure ICT infrastructure (cabling, networks, software, etc.) and library books.

Verdiana Grace Masanja.
University Level Research and Postgraduate Studies Unit, University of Rwanda

SWOT analysis of Rwanda's research and innovation system

This section focuses on the strengths, weaknesses, opportunities and threats (SWOT) which characterize Rwanda's research and innovation system. These characteristics are summarised in Table 66 on page 239. The analysis which follows is based on the information and data in preceding sections.

Strengths

- **Strong improvements of governance indicators**: During the post-Genocide period, an explicit political will and efforts for reconciliation were established to improve the governability of the country. Several social innovations were implemented, such as: the incorporation of indigenous values and systems to solve conflicts (see Box 2), policy dialogues and interuniversity debates (see Box 3) and the consolidation of *Rwanda Vision 2020* through EDPRS I and EDPRS II (see pages 16–17). Having positive values for the indicators of political stability and government effectiveness (see Figure 10, page 28) are prerequisites for effective implementation of SETI policies, or any other public policy for that matter. On the contrary, negative values (see Figures 11 and 12, pages 29 and 32) for both governance indicators promote incoherence and poor co-ordination among the various stakeholders, laxity in law enforcement, discourage foreign direct investment and private long-term investment, create lengthy procedures for investment registration and limit negotiating skills on contracts (i.e. mining, international conventions, agreements with international companies). This in turn diminishes national productivity and augments the risk of failure in attaining policy goals. During the post-Genocide period, the political stability and the government effectiveness indicators have evolved favourably, particularly over the past decade (see Figure 11), but the indicators still show negative values for the last entire period. The Corruption Perception Index places Rwanda more than 55th worldwide over the same period (see Figure 13, page 32).
- **Positive long-term trends in human development indicators since 1994**: life expectancy at birth has increased from 26.7 years in 1993 to 63.5 years in 2012 (see Figure 4, page 10). The Human Development Index has progressed in a quasi-parabolic fashion over decades increasing their value from 0.23 (1995) to 0.506 (2013) (see Figure 3, page 10). Enrolment in primary and secondary education has risen almost exponentially (see Tables 14 and 15 pages 63–64). Primary school has a net enrolment rate of 96.6% (2013) and the secondary school of 41.1% (2013). The secondary school enrolment was almost doubled between 2008 and 2013.The proportion of students enrolled in science and technology fields in the upper secondary level reached 59% in 2013/2014. The public expenditure in education is 4.8% of the GDP.
- **Good environment for doing business**: the country has made the big strides in becoming very business-friendly by introducing reforms in seven out of the 10 categories (see page 42). In 2008 the Government established the Office of the Registrar General under the Rwanda Development Board, and mandated it to maintain an efficient business register and promote a competitive business environment. The Office has the responsibility for the implementation of applicable commercial laws, such as the Companies Act, and the registration and deregistration of businesses. In 2009, it had set up a one-stop shop, streamlining company name checking, payment of incorporation fees, and tax and company registration procedures. During that year alone, 3 028 new limited liability companies were formed —almost equivalent to the total for the previous five years, when 3 374 new limited liability companies had been registered. By year 2012 the number reached 6 655 new companies. In 2015, Rwanda was included within the top-3 countries in Africa where it is easy for doing business (see Table 11). It has also implemented some specific policy instruments to promote credit for SMEs (see Table 12).

- **SETI as a cross-cutting pillar for sustainable development**: In 2000, through *Rwanda Vision 2020* SETI became a cross-cutting pillar to achieve a knowledge economy by 2020. When the *Poverty Reduction Strategy Plan* (2002–2005) was in place, the Government formulated the 2005 National STI Policy. In the period 2006–2009 the Ministry of Science, Technology and Scientific Research was in operation under the Office of the President. In 2008, Rwanda embarked on the implementation of the second-generation poverty reduction strategy termed the *Economic Development and Poverty Reduction Strategy* (EDPRS). The text of EDPRS I (2008–2013) included a great variety of specific policy interventions on scientific and technological research, science education, promotion of innovation and transference of technology to the private sector (see pages 16–17).

- **Boost to research and innovation**: In 2013, by introducing a series of regulatory and institutional reforms, the Government gave a new boost to research and innovation activities in Rwanda. Among these measures taken are: (i) the introduction of EDPRS II (see page 17); (ii) ICT SMART Rwanda Master Plan (see page 55–56); (iii) the revision of the National STI Policy (see pages 140–141); (iv) the creation of the University of Rwanda by merging a group of higher education institutions (see page 69); (v) the creation of the National Science and Technology Commission as a SETI think tank; (vi) the creation of the National Industrial Research Agency to focus on the promotion of innovation in the private sector (see page 152); (vii) the creation of the National Standards Board (see page 201); (viii) the implementation of the Innovation Endowment Fund (see pages 157–158) and (ix) the implementation of the Environmental and Climate Change Fund (see pages 224–225).

- **Expansion of the tertiary education**: After three decades of almost zero growth, the enrolment in tertiary education is passing through an exponential expansion, both as a fraction of gross and as a percentage of the whole population (see Figures 24 and 25). Rwanda is reaching a value of 8% of the gross and a rate of 913 higher education students per 100 000 inhabitants (see footnote 14, page 69). These values are comparable with those in Zimbabwe (UNESCO, 2014a). In 2013, 32% of the university graduates were in science and engineering (see Table 19). A large amount of Rwandan students are also having undergraduate and postgraduate studies abroad (see Tables 21 – 24).

- **Expansion of ICT infrastructure**: Rwanda began to relentlessly develop its ICT in 2000 after it adopted the National Information Communications Infrastructure policy and created a long-term plan to achieve full digitization in four five-year stages. In the last years, Rwanda registered one of the highest internet user growth rates in Africa (8.9%) compared with the continent's growth rate of 2.4%. Another relevant element is the One Laptop per Child programme—an ambitious plan launched in 2008 to distribute laptops and electronic tablets in primary schools. By late 2012, about 115,000 laptops had been distributed to primary school children across the country. Since 2011, the national fibre-optic backbone network, which connects to an undersea network, already has links to all 30 districts of the country and nine border posts. The Government also negotiated with three fibre-optic submarine cable companies SEACOM, TEAMS and the Eastern Africa Submarine Cable System (EASSy) to finance the extension of fibre-optic cables to every part of the country and to increase fibre bandwidth capacity to benefit schools, health centres and other institutions. The Rwanda Information Society Agency (RISA) is the proposed new structure for the governance, management and delivery of the goals and objectives of the new national ICT Strategy, the SMART Rwanda Master Plan 2015–2020 (see pages 55–57).

- **Trilingual**: In 2008, the Rwandan government ordered education to be provided in English. In 2009, Rwanda joined the Commonwealth of Nations and opened itself not only to Western Anglophone economies but also to economically stable geographic neighbours like Tanzania and Uganda.

Weaknesses

- **Small economy and inequality**: Taking into consideration all the countries in the world with populations around +/-10% the population of Rwanda (10.5 million in 2012), Rwanda and Guinea have the smallest real GDP within this group of countries. For example, the GDP of Chad is 2 times higher, that of Bolivia 4 times, Tunisia 6 times, Cuba 11 times, Czech Republic 28 times, Greece 33 times and Belgium 70 times higher. On average, a country with a similar population size will have a GDP 16 times bigger. Real GDP per capita in constant 2012 US$ has remained almost constant between 1960 and 1995 (see Figure 7, page 19), then it started to increase smoothly. However, the gap with the rest of sub-Saharan Africa remained constant over the past two decades. The Gini coefficient is an indicator of the distribution of income in a given society. A Gini coefficient of zero expresses perfect equality, where all values are the same, for example, where everyone has the same income. A Gini coefficient of one expresses maximal inequality among values, for example, where only one person has all the income or consumption of nation and all others have none. In 1985, the Gini coefficient of Rwanda was 0.29 (see Table 3, page 13). Two decades later (c. 2006) the value was 0.53 (presenting Rwanda as one of the most uneven societies in the world). The last measurement taken in 2011 showed a Gini coefficient of 0.5.

- **SETI policy coordination and implementation**: The fact that in 2009 the Ministry of Science, Technology and Scientific Research was dissolved and its mandate transferred to the Directorate of Science, Technology and Research within the Ministry of Education, diminished the power for policy coordination among different line ministries that perform R&D and scientific and technological services (e.g. Ministry of Agriculture and Animal Resources, Ministry of Health, Ministry of Trade and Industry, etc.) This fact had direct consequences on the SETI policy implementation. For example had a direct effect within the implementation policies included at EDPRS II (2013–2018) where no reference to science or scientific research was included in the document (see pages 15–17). The only policy interventions which remained are those related to innovation within SMEs (Ministry of Trade and Industry), innovation and extension services in agriculture (Ministry of Agriculture and Animal Resources); and policy interventions in the ICT and health sectors (Min. of Health and Min. of ICT & Youth). The GO→SPIN analysis of the 2014 Revised National STI Policy (see pages 140–141) also showed the absence of important items than any SETI policy should include. The Policy contains no policy mission, no policy goals, no normative planning strategies (there are no explicit SETI goals to be achieve in any specific time in the future), no policy-interventions to address the SETI supply side (there is neither a funding plan nor a human resources plan for R&D), no policy interventions to create incentives for R&D within the private sector; no gender policy, and no policy for international and regional cooperation.

- **A small pool of researchers**: Rwanda has an estimated 35 FTE researchers per million population (see Figure 28, page 87). In other to achieve the *Vision 2020* goal of transforming the country into a knowledge-based economy, it should be a priority to drastically increase this number. From a global perspective, the critical mass, which triggers innovation on a national scale, is at least 1200 FTE researchers per million population (i.e. Brazil, China, Malaysia, etc.). For Rwanda, this critical value is 35 times the present one. Developed countries have between 130 and 150 times more FTE researchers per million inhabitants than Rwanda. No formal system of government scholarships is in place for completing PhDs in science and engineering, nor any other incentive or policy instrument guaranteeing the career promotion by performing research and innovation activities. No explicit SETI human resources policy is mentioned in the 2005 National STI Policy, nor in its 2014 Revised text.

- **Absence of a SETI gender policy**: Despite the fact that only around 20% of researchers are women today, there is no single mention to any gender issue neither within the 2005 National STI Policy nor within its 2014 Revised text. With the exception of some attempts made at the University of Rwanda (see Box 8, pages 74–76) no policy intervention had been explicitly planned to change this situation. There is no single operational policy instrument to promote gender equality within scientific and technological research activities nor specific incentives (i.e. scholarships). In 2013, the female tertiary enrolment at public universities was only 34% (see Table 17, page 70), while within the private

universities (see Table 18, page 71) it was 53%. Among 2013 university graduates, women as a share of the total graduates, by field of knowledge, (see Table 19, page 72) were the following: natural sciences 27%; engineering and technology 21%; medical and health sciences 57%; agriculture sciences 29%; social sciences 36% and humanities 41%. The share of female teachers within tertiary education is around 18%, a number even below the value obtained in 1974 (see Figure 27, page 74).

- **Absence of any explicit human resources policy for science and engineering**: There are no specific targets for increasing the number of scientists and engineers to achieve the *Vision 2020* goals, nor any targets concerning the staffing requirements of industry and other productive sectors. Research and innovation are dependent on having the requisite stock of human capital, defined as the knowledge, skills, competencies and attributes that facilitate the creation of personal, social and economic well-being. Policy measures can be designed to ensure a healthy supply of human resources to SETI, such as through incentives like fellowships for poor students to increase student enrolment in scientific, technological and engineering disciplines at undergraduate and postgraduate levels.

- **Low research and innovation productivity**: Although Rwandan researchers published 210 scientific articles in mainstream journals in 2013, this represents just one scientific article per FTE researcher every 3.4 years, or 0.29 scientific articles per FTE researcher annually. The number of articles per million population has been increasing in a constant way since 2004 (when *Vision 2020* and EDPRS I were already in operation), reaching 16 in 2013, but the starting point was very low. This is 243 times smaller than the productivity of Switzerland, 90 times smaller than the Czech Republic, 27 times smaller than that of Tunisia, nine times smaller than that of Botswana and two times smaller than that of Kenya or Ghana, to cite just a few examples. The past decade has seen a positive trend: an extraordinary increase in the number of co-publications with foreign countries, which now represent 75–90% of all Rwandan scientific articles listed at the Web of Science (see Figure 33). In the past two decades, 49% of publications have been in medical sciences, 16% in natural sciences, 17% in agricultural sciences, 14% in social sciences and just 8% in engineering, even though the latter is a major driver of innovation. In comparison, in emerging economies like China or the Republic of Korea, where there are linkages between research and innovation, 80% of all publications are in natural sciences and/or engineering. As for patents, during the past five decades the number of applications by residents (and non-residents) was extremely low (see Figures 36 and 37) even compared to other sub-Saharan countries (UNESCO, 2013, 2014a, 2014b).

- **A small SETI demand pull**: Macro-economic conditions today hamper research and innovation demand in the business and industry sector. In developed and emerging economies, the business sector provides between 50% and 70% of GERD. In other words, the SETI demand-side tracks the type of research done by governmental research centres and higher education institutions (SETI supply side). Businesses also typically need to adapt technologies and innovate in order to meet needs of the customers at local and international levels and to remain competitive; this implies that businesses will address firm-level constraints by investing in human resources, technology and R&D. In spite of that the 2005 National STI Policy, the 2014 Revised version, EDPRS I and EDPRS II sought to promote public–private partnerships, there is no operational policy instrument in place to foster networking among the business, government and university sectors.

- **Low participation of the business/enterprise sector in R&D**: Within the historical R&D surveys conducted by UNESCO (see pages 86–88) it was never possible to detect any R&D activity performed by the business/enterprise sector. In emerging economies such as China or the Republic of Korea, the business sector employs more than 60% of national researchers. Linkages between universities, R&D centres and the business/enterprise sector in Rwanda are very weak. New policy instruments are in place to promote innovation (i.e. Rwanda Innovation Endowment Fund and some incentives to promote FDI are in place) but there is an absence of appropriate policy instruments to stimulate strong interaction between the SETI supply and demand sides. In spite of what it is explicitly said in EDPRS II, there is a need for capacity-building and a stronger human capital policy to support innovation and entrepreneurship in the business sector.

- **Inadequate set of SETI operational policy instruments and funding mechanisms**: The GO→SPIN survey has identified only three operational policy instruments in Rwanda (see pages 222–227). A country the size of Rwanda should have between 10 and 20 times more, of a diverse nature and adequately funded. The absence of some policy instruments impinges on research and innovation. There are no policy instruments in place promoting linkages between the SETI demand and supply, nor any funding mechanism addressing the research priorities set by the 2014 Revised National STI Policy (see pages 140–141). Only the Innovation Endowment Fund is in place (see Box 6 and pages 48–49). The National Research Fund, a proposal originally formulated in the eighties, was included in the 2005 National STI Policy, but unfortunately was never implemented (see pages 130–132).

- **Indigenous knowledge remains largely disregarded**: Knowledge is the key input to innovation (see Boxes 11, 12 and 15). It can come from a formal process, such as R&D, but also in the form of indigenous knowledge developed over centuries of learning from the environment. Indigenous knowledge can play a central role in transforming and modifying technologies to suit local conditions and the local context, as well as in developing indigenous home-grown technologies. To play these roles, indigenous knowledge needs to be documented, protected and efficiently managed. Rwanda needs to incorporate indigenous knowledge in the formulation of R&D strategies. There is scant input from indigenous knowledge in the present SETI policies and within research programmes.

- **Erratic energy supply is derailing progress in SETI**: A small fraction of the population has access to electricity. Power cuts which occur in the middle of a scientific experiment or new technological development, or when a critical innovation is being implemented in a factory, can disrupt activity and erode the morale of scientists and entrepreneurs.

Opportunities

- **Improve synergism and policy coherence through new institutional framework**: The new set of SETI institutions created in recent years (i.e. NSTC, NIRDA, UR, RAB, RSB, etc.) have the opportunity to coordinate its activities and policies in order to promote coherence among the different research and innovation policies proposed at different Ministries, such as Ministry of Education, Ministry of Health, Ministry of Agriculture and Animal Resources, Ministry of Trade and Industry, Ministry of ICT and Youth, and Ministry of Finance and Economic Planning (see page 133). NSCT will work as a think tank, having an advising role is planning to create some sort of inter-ministerial council to consolidate the different approaches on research and innovation activities taken by the different ministries. At present, this coordination role is missing. On the other hand, the University of Rwanda is planning to implement a series of incentives and operational policy instruments to promote research, scientific publications and the transfer of technologies (embodied and disembodied) to the public and private sector. Likewise, NIRDA is planning to implement a series of mechanisms to boost innovation within the private sector. New institutions like RAB are also coordinating R&D with extension services, in the agriculture and agribusiness sector. These new institutions have the opportunity to develop a coherent set of operational policy instruments to achieve the *Vision 2020* and EDPRS II goals.

- **Human capital development in science and engineering**: Rwanda's population is dominated by youth (43% of the population is less than 14 years old) who are eager to study and develop their potential (see Figure 1, page 7). Following the guidance of *Rwanda Vision 2020* and the policies taken by the Ministry of Education to improve the education of science and mathematics at all levels, there is an opportunity to expand the training of young people in science and engineering. An explicit human resources policy to expand the number of scientists and engineers for promoting research and innovation is indispensable. For doing so, adequate SETI policy instruments to provide incentives

are required, for examples: scholarship programmes to encourage students to embark on PhDs and a system of competitive grants for young researchers in fields that national policies prioritize. SETI research programmes designed to develop human capital should be associated with the portfolio of strategic areas identified by EPDRS II and by the Ministry of Public Services and Labour. SETI human capital development should be tailored to the country's strategic development projects defined in the 2014 Revised National STI Policy (i.e. education; health; agriculture; environment; water and sanitation; energy; transport, ICT; tourism; industry and private sector).

- **Improve gender equality in science and engineering**: Gender equality is one of the eight United Nations Millennium Development Goals. It will be possible to improve the participation of women in science and engineering by introducing appropriate SETI policy instruments and incentives in both the education system (from primary school to postgraduate studies) and in the terms of reference of advertised posts or calls for research and innovation proposals. A specific policy for gender equality within the higher education sector and the research and innovation system, setting specific targets and activities should be formulated. Specific operational policy instruments must be in place to guarantee the implementation of these strategies.

- **National Research Fund**: The 2005 National STI Policy proposed the creation of a National Research Fund (NRF) and it was suggested that the Government should allocate 0.5% of the total national budget to the NRF. This idea was not new, it was originally proposed in the early eighties (see pages 128–130). The Government of Rwanda agreed to the Decision of the Assembly of the African Union 8th ordinary session in 2007, which recommended allocating at least 1% of the national GDP to R&D activities. The fund still lacks an operational manual, as well as an adequate set of operational policy instruments to determine, strategically, towards which missions the fund will be oriented.

- **Availability of special external funding mechanisms for environmental R&D**: EPDRS II defined environment and climate change as a cross cutting priority issue. In addition, EPDRS II proposed the creation of a Centre of Excellence on Green Urbanisation to support research and skills development and another Centre for Environment and Climate Change Innovation (Rep. of Rwanda, 2013a). Rwanda has already put into operation the Environment and Climate Change Fund (see pages 223–224). The country has also access to external funding in support of environmental projects. One such source is the Global Environment Facility (GEF), which is a partnership for international co-operation whereby 183 countries work together with international institutions, civil society organizations and the private sector to address global environmental issues. Several NGOs and research groups in Rwanda are promoting a series of projects on environmental management, waste recycling and value addition to waste; combined with appropriate expertise generated by the academic sector, these projects can promote the emergence of new green technologies and environmental best practices for Rwanda (see page 54). The country has a long tradition developing bio-digestion energy plants (see Box 7 and Tigabu *et al.*, 2015).

- **Networking at national, regional and international levels**: Rwanda has a long tradition of successful international scientific collaboration (mainly in the health and agriculture sectors) and at business level (mainly with ICT). Based on this experience, appropriate policy instruments and special mechanisms can be designed to promote synergies and networking among national laboratories, universities and the manufacture sector. Other policy instruments should improve the participation of the diaspora (see Tables 21–24) in strategic research and innovation projects in Rwanda, in tandem with an amelioration of national networking between public and private research institutions and enterprises. There are many Rwandan PhD holders working in Rwanda and abroad in leading research institutions. Collaboration and networking in research and innovation oriented to national development projects (i.e. ICT, mining, health, environment, energy, agribusiness, etc.) among those both within and outside Rwanda can lead to a better higher education system, greater scientific productivity and stronger linkages between the SETI supply and demand.

- **Interconnectivity initiatives for educational institutions**: Opportunities may be created by linking the National ICT and youth policies (see pages 55–57), or by linking strategies applied by the Ministry of Education to improve ICT facilities at all education levels and recent national and regional initiatives to expand the diffusion of endogenous R&D and regional co-operation. Examples are the Africa Connect project, which aims to establish a high-capacity Internet network for research and education in Southern and Eastern Africa, and UbuntuNet, the regional backbone network that interconnects National Research and Education Networks (NRENs). These projects can be linked with ICT innovation and entrepreneurship strategies, where Rwanda is taking the regional leadership.

- **R&D and value-addition**: Besides the portfolio of strategic areas identified to promote FDI in Rwanda (see page 26), value-addition across all sectors in Rwanda remains low. Rwanda is still a net exporter of raw materials. There is a wide margin of manoeuvre for using SETI to add value across sectors and for using innovation to add value to Rwanda's agribusiness, tourism, and other natural resources.

- **Legal instruments to protect indigenous knowledge**: Neither the 2005 National STI Policy nor the 2014 Revised version addressed indigenous knowledge systems and their need for protection. The indigenous knowledge basis for traditional medicine, for example, needs to be understood, preserved, further developed and protected for the country's benefit. As it was shown (see Boxes 11 and 12), a large group of traditional medicines, based on natural local flora, can be an important source of innovation. Intellectual property rights law, which adequately covers the body of knowledge that may generally be classified as 'Western' today in Rwanda is weak when it comes to protecting indigenous knowledge, in part because the latter is owned collectively (by extended families, clans and communities) and because substantial parts of indigenous knowledge are transmitted orally. Rwanda can follow the example of Botswana (UNESCO, 2013), which already has a legislative instrument to protect traditional knowledge and handicrafts. In Botswana, the IP law has been changed. Under this law, traditional knowledge may give rise to intellectual property that can be owned by a group of people or by a community. This is not possible with other forms of intellectual property or intellectual property rights. The terms of protection in Botswana expire only when the traditional knowledge has lost its value as: (a) an element of cultural identification; (b) a result of wilful and expressed abandonment by its owner or owners; or (c) as a result of non-use or use in a distorted manner by third parties of which the owner or owners are aware. This type of good practice can be easily implemented in Rwanda.

Threats

- **Limited human carrying capacity**: The annual average population growth rate in Rwanda over the past five decades has been around 3% (see Figure 2) and total fertility (4.6 children per woman c. 2013) remain high, constraining poverty reduction efforts. This fact combined with a population of around 11.8 million in a least developed country of only 26 338 km^2, introduce a serious limitation to the human carrying capacity (see pages 6–8). The strategic options for reducing population growth proposed by *Vision 2020* have so far failed to slow the growth rate. Unless this trend can be reversed, rapid population growth will sap Rwanda's efforts to reach long-term sustainability. There are policy interventions successfully applied in other countries (Ruxin and Habinshuti, 2011) that can be taken to avoid this dangerous situation in Rwanda. SETI policies should address this problematic in an interdisciplinary and transdisciplinary way, and should suggest specific policy interventions as well as appropriate technologies (embodied and disembodied).

- **Adverse effects of climate change**: A recent study analysed Rwanda's vulnerability to climate change (Patta *et al*. 2010). This study took into account both potential changes in African counties' exposure to climatic extreme events and trends in socio-economic development that influence a country's adaptive capacity. The results suggest that Rwanda's vulnerability will increase most rapidly between now and 2050 but that socio-economic development may begin to offset the country's growing exposure to climate change in the second quarter of the century. This implies an urgent need for international assistance to finance adaptation. Policy interventions are needed to mitigate potential disasters by building SETI capacity and promoting the use of appropriate technologies.

- **Overdependence on foreign consultants to design domestic SETI policies**: Since the early seventies all domestic SETI policies were designed systematically by a series of foreign consultants (see pages 128–132) sponsored by international organizations and foreign development organizations. The results were not always positive, promoting the lack of internal coherence within the proposed policies. The agendas of international organizations and other donor organizations introduce themes in the consultancies, which are not necessary the most appropriate for the country. The experience of new emerging economies indicates that they were able to transform the reality of their countries only when strategies and paths were designed by their own people. It is time for Rwanda to initiate this process.

- **The plethora of SETI strategic priorities dilutes policy effectiveness**: The 2014 Revised National STI Policy proposes four policy objectives. An analysis of their content (see pages 140–141) reveals that there are, in fact, eleven different sectoral strategic priorities and several associated policies (i.e. ICT, IPR, Agriculture, Health, SMEs, etc.). Combined with a lack of common strategies with new foreign investment policies and funding mechanisms (i.e. Rwanda Innovation Endowment Fund), the absence of adequate operational policy instruments, the scarce funding allocation, and the multiplication of sectoral priorities may endanger the smooth implementation and effectiveness of the proposed policy interventions. There is a need to improve co-ordination among the institutions responsible for the different tasks associated with the SETI policy cycle (see pages 136–137).

- **Regional competition**: The East African region has been leading the charge in collaborative regional infrastructure planning and execution. One of the outcomes of the joint cooperative strategies is access to a bigger market. Larger populations offer potentially bigger markets. Countries like Nigeria and Ethiopia have 175 and 99 million inhabitants respectively, unlike smaller countries like Rwanda or Burundi. To compete, smaller nations such as Rwanda are compelled to negotiate with neighbours like Kenya and Uganda, in order to harmonise immigration and infrastructure plans so as to help investors view the East African region as an economic hub of some 100 million people. However, there still are major infrastructure deficits and geographical disadvantages. Access to the ocean gives Kenya and Tanzania a big trade advantages over landlocked countries like Uganda and Rwanda, which have recently openly spoken about their frustration with the ports and the high cost of transporting goods across the region's borders. Rwanda's lack of an explicit policy to supply new generations of engineers who could solve these logistic and infrastructure problems put the country in a weak position for regional negotiations. At regional level, Kenya and Tanzania have been implementing very strong policies to support entrepreneurship and innovation in comparison with Rwanda (see page 39).

Table 66: SWOT analysis of Rwanda's research and innovation system

Strengths	Weaknesses
• Strong improvements of governance indicators • Positive long-term trends in human development indicators since 1994 • Good environment for doing business • SETI as a cross-cutting pillar for sustainable development • Boost to research and innovation • Expansion of the tertiary education • Expansion of ICT infrastructure • Trilingual	• Small economy and inequality • SETI policy coordination and implementation • A small pool of researchers • Absence of a SETI gender policy • Absence of any explicit human resources policy for science and engineering • Low research and innovation productivity • A small SETI demand pull • Low participation of the business/ enterprise sector in R&D • Inadequate set of SETI operational policy instruments and funding mechanisms • Indigenous knowledge remains largely disregarded • Erratic energy supply is derailing progress in SETI

Opportunities	Threats
• Improve synergism and policy coherence through new institutional framework • Human capital development in science and engineering • Improve gender equality in science and engineering • National Research Fund • Availability of special external funding mechanisms for environmental R&D • Networking at national, regional and international levels • Interconnectivity initiatives for educational institutions • R&D and value-addition • Legal instrument to protect indigenous knowledge	• Limited human carrying capacity • Adverse effects of climate change • Overdependence on foreign consultants to design domestic SETI policies • The plethora of SETI strategic priorities dilutes policy effectiveness • Regional competition

References

Abbott, P.; Malunda, D. and Festo, N. (2013) European Report on Development: Rwanda Case Study.

Adams, J.; King, C.and Hook, D. (2010) *Global Research Report: Africa*; Thomson–Reuters: Leeds.

ADB *et al.* (2014) *African Economic Outlook 2014: Global Value Chains and Africa's Industrialisation.* African Development Bank, Developing Centre of the Organisation for Economic Co-operation and Development, United Nations Development Programme, UN Economic Commission for Africa: Paris.

Al Ali, H. (2014) *The Agriculture Sector in Rwandan Economy: An Empirical Impact Analysis,* USAID-funded Human and Institutional Capacity Development Project in Rwanda, USAID and Ministry of Agriculture and Animal Resources: Kigali.

AOSTI (2013) *Assessment of the state of science and technology in the African Union: 2005–2010.* African Observatory of Science, Technology and Innovation: Malabo.

Arnold, E. (2004) Evaluating Research and Innovation Policy: a Systems World Needs Systems Evaluations. *Research Evaluation*, 13 (1): 3–17.

Altbach, P. G. (2006) Globalization and the university: Realities in an unequal world, in J. J. F. Forest and P. G. Altbach, eds., *International handbook of higher education.* Springer: Dordrecht, pp. 121–139.

Audretsch, D (2004) Sustaining innovation and growth: Public policy support for entrepreneurship, *Industry and Innovation*, 11 (3): 167–91.

Auger, P. (1961) *Current Trends in Scientific Research: Survey of the Main Trends of Inquiry in the Field of Natural Sciences, the Dissemination of Scientific Knowledge and the Application of such Knowledge to Peaceful Ends.* United Nations and UNESCO: New York and Paris.

AU–NEPAD (2011) *African Innovation Outlook 2010.* African Union–New Partnership for Africa's Development: Pretoria.

Berg, G and Fuchs, M. (2013) Bank Financing of SMEs in Five Sub-Saharan African Countries: The Role of Competition, Innovation, and the Government, *Policy Research Working Paper 6563*, The World Bank Africa Region, Finance and Private Sector Development Unit, The World Bank: Washington DC.

Bozeman, B. and Sarewitz, D. (2011) Public value mapping and science policy evaluation. *Minerva,* 49: 1–23.

Bundervoet, T. (2014) What Explains Rwanda's Drop in Fertility between 2005 and 2010? *Policy Research Working Paper 6741.* The World Bank Africa Region Poverty Reduction and Economic Management Unit. The World Bank: Washington DC.

Cohen, J.E. (1995) *How many people can the Earth support?* W.W. Norton & Co.: New York.

Commonwealth Secretariat (2014) *The Commonwealth Yearbook 2014*, Nexus Strategic Partnerships: London. See: http://www.commonwealthofnations.org/country/Rwanda/

De Moya-Anegón, F. and Herrero-Solana, V. (1999) Science in Latin America: a comparison of bibliometric and scientific–technical indicators. *Scientometrics*, 46 (2): 299–320.

El Hares, H. (1992) *Evaluation du secteur recherché-développement*, No de série: FMR/SC /STS/92/111, United Nations Educational, Scientific and Cultural Organization: Paris.

Fiasse, R. (1960) *The teaching of science in Rwanda-Urundi,* UNESCO/NS/ST/1960/10, United Nations Educational, Scientific and Cultural Organization: Paris.

Flanagan, K; Uyarra, E.; Laranja, M. (2011) Reconceptualising the 'policy mix' for innovation. *Research Policy*, 40: 702–713.

Freeman, C. and Soete, L. (2009) Developing science, technology and innovation indicators: what we can learn from the past. *Research Policy*, 38: 583–589.

Gahakwa, D. *et al*. (2014) A Decade of Agricultural Research in Rwanda: Achievements and the Way Forward, in Vanlauwe *et al*. (eds.), *Challenges and Opportunities for Agricultural Intensification of the Humid Highland Systems of Sub-Saharan Africa*, Springer: Cham, Heidelberg, New York, Dordrecht & London, pp. 69–80.

Gall, T.L. and Hobby, J.M.; eds. (2007) *Worldmark Encyclopedia of the Nations*. Twelfth Edition, Vol. 2: Africa; Thomson-Gale: Farmington Hills.

GKI and the Faculty of Agriculture at the National University of Rwanda (2012) *LINK Analysis Rwanda: Critical Insights for Forging Purpose-Driven Knowledge Networks*, Global Knowledge Initiative: Washington DC.

Godin, B. (2008) The information economy: the history of a concept through its measurement 1945–2005. *History and Technology*, 24 (3): 255–287.

Grebmer von, K. *et al* (2013) *Global Hunger Index: the Challenge of Hunger: Building Resilience to Achieve Food and Nutrition Security*. International Food Policy Research Institute, Concern Worldwide, Institute of Development Studies: Bonn /Washington, DC /Dublin.

Griliches, Z. (1990) Patent statistics as economic indicators: a survey. *Journal of Economic Literature*, 28: 1661–1707.

Hartzenberg, T. (2013) Competition policy in Africa. In: C. Herrmann *et al*. (Eds), *European Yearbook of International Economic Law*, 4: 147–200, Springer Verlag: Berlin/Heidelberg.

Herrera, A. O. (1971) *Ciencia y Política en América Latina*. Siglo XXI Editores: México.

Herrera, A. O. (1972) Social determinants of science policy in Latin America: explicit science policy and implicit science policy. *The Journal of Development Studies*, 9 (1): 19–37.

Hidalgo, C.A.; Klinger, B.; Barabási, A. L.; Hausmann, R. (2007) The product space conditions the development of nations. *Science*, 317: 482–487.

Hirsch, J.E. (2005) An index to quantify an individual´s scientific research output. *PNAS,* 102 (46): 16569–16572.

Howlett, M. and Ramesh, M. (2003) *Studying Public Policy: Policy Cycles and Policy Subsystems*. Oxford University Press: Toronto.

Husbands Fealing, K.; Lane, J.I.; Marburger III, J.H.; Shipp, S.S. eds (2011) *The Science of Science Policy.* Stanford University Press: Stanford, California.

IMF (2014) *World Economic Outlook: Legacies, Clouds, Uncertainties*; International Monetary Fund: Washington DC

INSEAD, Cornell University and WIPO (2014) *The Global Innovation Index 2014: The The Human Factor in Innovation.* S. Dutta; B. Lanvin and S. Wunsch-Vincent (eds), INSEAD: Fontainebleau.

Kassim, H. and Le Galés, P. (2010) Exploring governance in a multi-level polity: a policy instruments approach. *West European Politics*, 33 (1): 1–21.

Karen, C. and Thomas, P.A. (1979) The interrelationship between information systems and science policy formulation. *Journal of Information Science*, 1: 85–90.

Kaufman, D.; Kraay, A.; Zoido-Lobato, P. (1999) *Governance Matters*. World Bank Policy Research Working Paper No. 2196.

Konrad, N. and Wahl, D. (1990) Science, technology and development indicators for third world countries –possibilities for analysis and grouping. *Scientometrics*, 19 (3-4): 245–270.

Kurian, G.T. ed. (2007) *Encyclopedia of the World's Nations and Cultures.* Facts On File: New York.

Kutchoukov, I. (1978) *Pour une politique scientifique et technologique nationale: République Rwandaise*, Aide aux Etats membres pour le renforcement de leur politique scientifique et technologique; RP/1977/78/2.1211.6/Rapport technique, UNESCO: Paris.

Lee, Y.S. and J.S. Kim (2009) The present status and analysis of science and technology Information service policy in Korea, centred on representative national STI institute. *Government Information Quarterly*, 26: 516–524.

Lemarchand, R. (1966) Power and Stratification in Rwanda: A Reconsideration, *Cahiers d'Études Africaines,* 6 (24): 592–610.

Lemarchand, G.A. (2010) Science, technology and innovation policies in Latin America and the Caribbean during the past six decades. In: G.A. Lemarchand (ed.), *National Science, Technology and Innovation Systems in Latin America and the Caribbean*. Science Policy Studies and Documents in LAC, Vol. 1; UNESCO: Montevideo, pp. 15–139.
See: http://unesdoc.unesco.org/images/0018/001898/189823e.pdf

Lemarchand, G.A. (2012) The long-term dynamics of co-authorship scientific networks: Iberoamerican countries (1973–2010). *Research Policy*, 41: 291–305.

Lemarchand, G.A. (2013) Science, Technology and Innovation Information-Platform (STIIP) for Namibia: a Resource for the Formulation, Monitoring and Evaluation of Research and Innovation Policies. A Proposal. UNESCO-AECID: Paris. See: www.unesco.org/new/fileadmin/MULTIMEDIA/HQ/SC/pdf/STIIP-Namibia_UNESCO_2013.pdf

Lemarchand, G.A. (2015) The scientific productivity and the dynamics of self-organizing networks: Iberoamerican and Caribbean countries (1966–2013). In: M. Heitor, H. Horta and J. Salmi (eds), *Building Capacity in Latin America: Trends and Challenges in Science and Higher Education.* Springer: New York.

Marburger III, J.H. (2011) Why policy implementation needs a science of science policy. In: K. Husbands Feeling, J.I.B. Lane, J. Marburger III and S.S. Shipp (eds), *The Science of Science Policy.* Stanford University Press: Stanford, pp. 9–22.

Marcelle, G. (2009) Technology policy for small economies: continued relevance for the contemporary Caribbean. *Social and Economic Studies*, 58 (2): 47–76.

Masanja, V. G. (2010) *Increasing Women's Participation in Science, Mathematics and Technology Education and Employment in Africa*, EGM/ST/2010/EP.8, UNDAW and UNESCO: Paris.

Millot, V. (2009) *Trademarks as an Indicator of Product and Marketing Innovations*. OECD STI Working Paper *2009/6*. Statistical Analysis of Science, Technology and Industry. Organisation for Economic Co-operation and Development: Paris.

Mudacumura, G. M. (2014) Accountability and Transparency: Cornerstones of Development and Democratic Governance in G. M. Mudacumura and G.Morçöl, Eds. *Challenges to Democratic Governance in Developing Countries*, Springer: Cham, Heidelberg, New York, Dordrecht & London, pp. 37–56.

Morand, G. (1981) Structures et priorités de la politique scientifique et technologique nationale: République Rwandaise, UNESCO Rapport Technique RP/1979–80/2/4.2/01, United Nations Educational, Scientific and Cultural Organization: Paris.

Morand, G. (1983) Planification, programmation et budgétisation des activités scientifiques et technologiques, UNESCO Rapport Technique RP/1981–83/2/4.2/01, United Nations Educational, Scientific and Cultural Organization: Paris.

Morand G. (1984) Structures et fonctions de la communauté économique des pays des Grands Lacs dans le domaine de la science et de la technologie, UNESCO Rapport Technique RP/1981–1983/4.2/04, United Nations Educational, Scientific and Cultural Organization: Paris.

Murenzi, R. and Hughes, M. (2005) Africa in the global knowledge economy, in C. Juma, ed., *Going for growth: Science, technology and innovation in Africa*. The Smith Institute: London.

Mukazayirea, M.J; Minanib, V.; Ruffob, C.K; Bizuruc, E.; Stévignya, C. and Dueza, P. (2011) Traditional phytotherapy remedies used in Southern Rwanda for the treatment of liver diseases; Journal of Ethnopharmacology 138: 415–431.

Nature Index Africa (2014) *Nature* (supplement 7526), 515: S92–S93.

Ngaboyisonga, C. *et al*. (2014) Agricultural Innovations That Increase Productivity and Generates Incomes: Lessons on Identification and Testing Processes in Rwandan Agricultural Innovation Platforms, in Vanlauwe *et al*. (eds.), *Challenges and Opportunities for Agricultural Intensification of the Humid Highland Systems of Sub-Saharan Africa*, Springer: Cham, Heidelberg, New York, Dordrecht & London, pp. 371–384.

Neelameghan, A. and J. Tocatlian (1985) International co-operation in information systems and services. *Journal of the American Society for Information Science*, 36 (3): 153–166.

Nemet, G. F. (2009) Demand-pull, technology-push and government-led incentives for non-incremental technical change. *Research Policy*, 38: 700–709.

Nill, J. and Kemp, R. (2009) Evolutionary approaches for sustainable innovation policies: from niche to paradigm? *Research Policy*, 38: 668–680.

NPCA (2014) *African Innovation Outlook 2014*. NEPAD Planning and Co-ordinating Agency: Pretoria.

OECD (2002) *Frascati Manual. Proposed Standard Practice for Surveys of Research and Experimental Development*. Organisation for Economic Co-operation and Development: Paris.

OECD (2005) *Guidelines for Conducting Innovation Surveys: Oslo Manual*. Organisation for Economic Co-operation and Development: Paris.

OECD (2010) Improving governance and measurement. In: *The OECD Innovation Strategy: Getting a Head Start on Tomorrow*. Organisation for Economic Co-operation and Development: Paris.

OECD (2012) *Measuring R&D in Developing Countries: Annex to the Frascati Manual*, DSTI/EAS/STP/NESTI (2011) 5/FINAL. Organisation for Economic Co-operation and Development: Paris. See: www.oecd.org/dataoecd/17/22/49793555.pdf

Onyancha, O. and Maluleka, J. R. (2011) Knowledge production through collaborative research in sub-Saharan Africa: how much do countries contribute to each other's knowledge output and citation impact? *Scientometrics*, 87:315–336.

Padirac, B. de (2006) Hard talk: the controversy surrounding UNESCO´s contribution to the management of the scientific enterprise, 1946–2005. In: *Sixty Years of Science at UNESCO 1945–2005*. UNESCO Publishing: Paris. pp. 476–481.

Patta, A.G.; Tadross, M.; Nussbaumer, P.; Asante, K; Metzgere, M.; Rafael, G.; Goujona, A. and Brundrit, G. (2010) Estimating least-developed countries' vulnerability to climate-related extreme events over the next 50 years. *PNAS*, 107 (4): 1333–1337.

Pavitt, K. (1996) National policies for technical change: where are the increasing returns to economic research? *PNAS*, 93: 12693–12700.

Polinière, J.P. (1975) Situation and Needs of National Information Systems in Science and Technology in East Africa (Burundi, Kenya, Rwanda, Tanzania, Uganda and Zambia), Restricted Technical Report RP/1973–74/2.13.6; United Nations Educational, Scientific and Cultural Organization: Paris.

Pouris, A. (2010) A scientometric assessment of the Southern Africa Development Community: science in the tip of Africa; *Scientometrics* 85:145–154.

Rahija, M. and Gatete, A. (2014) *Rwanda: Agricultural R&D Indicators Factsheet*, International Food Policy Research Institute and Rwanda Agriculture Board. See: www.asti.cgiar.org/

Rath, A. (1990) Science, technology and policy in the periphery: a perspective from the centre. *World Development*, 18 (11): 1429–1443.

Republic of Rwanda (2000) *Rwanda Vision 2020*, Ministry of Finance and Economic Planning: Kigali.

Republic of Rwanda (2006) *The Republic of Rwanda Policy on Science, Technology and Innovation*, Ministry in the President's Office in Charge of Science, Technology and Scientific Research and United Nations University Institute for Advanced Studies: Kigali.

Republic of Rwanda (2007) *The Economic Development and Poverty Reduction Strategy 2008–12 (EDPRS I)*, Ministry of Finance and Economic Planning: Kigali.

Republic of Rwanda (2009a) *Rwanda Intellectual Property Policy*, Ministry of Trade and Industry: Kigali.

Republic of Rwanda (2009b) *Strategic plan for the transformation of agriculture in Rwanda – Phase II (PSTA II)*, Ministry of Agriculture and Animal Resources: Kigali.

Republic of Rwanda (2010a) *Education Sector Strategic Plan 2010–2015*, Ministry of Education: Kigali.

Republic of Rwanda (2010b) *Agriculture Gender Strategy*, Ministry of Agriculture and Animal Resources: Kigali.

Republic of Rwanda (2011) *National Industrial Policy*, Ministry of Trade and Industry: Kigali.

Republic of Rwanda (2012a) *Health Sector Research Policy*, Ministry of Health: Kigali.

Republic of Rwanda (2012b) *The Evolution of Poverty in Rwanda from 2000 to 2011: Results from the household surveys (EICV)*. National Institute of Statistics of Rwanda, Department of International Development, United Nations Rwanda: Kigali.

Republic of Rwanda (2012c) *EDPRS: Lessons learned*, Ministry of Finance and Economic Planning: Kigali.

Republic of Rwanda (2013a) *The Economic Development and Poverty Reduction Strategy 2013–18 (EDPRS II): Shaping our Development*, Ministry of Finance and Economic Planning: Kigali.

Republic of Rwanda (2013b) *Education Sector Strategic Plan 2013/14–2017/18*, Ministry of Education: Kigali.

Republic of Rwanda (2013c) *Five year program for priority skills development to deliver EDPRS II (2013–2018)* Ministry of Public Service and Labour: Kigali.

Republic of Rwanda (2013d) Cabinet Manual, Office of the Prime Minister and Ministry of Cabinet Affairs: Kigali.

Republic of Rwanda (2014a) *2014 Rwanda Statistical Yearbook,* National Institute of Statistics of Rwanda: Kigali.

Republic of Rwanda (2014b) *SMART Rwanda Master Plan 2015–2020: A prosperous and knowledgeable society through SMART ICT*, Ministry of Youth and ICT: Kigali.

Republic of Rwanda (2104c) Education Sector Annual Report 2013–2014, Ministry of Education: Kigali.

Republic of Rwanda (2014d) *National Human Resources for Health Policy*, Ministry of Health: Kigali.

Republic of Rwanda (2014e) *Revised National Science, Technology and Innovation Policy*, Ministry of Education: Kigali.

RICYT (2001) *The Bogota Manual: Standardisation of Indicators of Technological Innovation in Latin American and Caribbean Countries*. Interamerican/Iberoamerican Network of Science and Technology Indicators (RICYT)/ Organisation of American States CYTED Programme: Bogotá.

Roolaht, T. (2012) The characteristics of small country national innovation systems. In: *Innovation Systems in Small Catching-up Economies*. Innovation, Technology and Knowledge Management, vol.15, E.G. Carayannis *et al*. (Eds). Springer: New York, pp. 21–38.

Ruxin, J. and Habinshuti, A. (2011) Crowd control in Rwanda, *Nature*, 474: 572–573.

Rwanda Governance Board (2013) Governance Month 2013, *Rwanda Governance Review*, 3:11–13.

Sagasti, F. and Aráoz, A. (1976) *Science and Technology Policy Implementation in Less-Developed Countries: Methodological Guidelines for the STPI Project*. International Development Research Centre: Ottawa.

Schott, T. and Jensen, K.W. (2008) The coupling between entrepreneurship and public policy: Tight in developed countries but loose in developing countries, *Estudios de Economia*, 35 (2): 195–214.

Sheriff, M. and Muffatto, M. (2014) Reviewing existing policies for unleashing and fostering entrepreneurship in selected African countries, *Journal of Developmental Entrepreneurship*, 19 (3): 1450016–1–36.

Simiyu, K.; Daar, A.S.; Hughes, M. and Singer, P.A. (2010) Science-based health innovation in Rwanda: unlocking the potential of a late bloomer, *BMC International Health and Human Rights*, 10 (Supplement 1) S3: 1–11.

Steinmueller, W.E. (2010) Economics of Technology Policy. Handbooks in Economics, vol. 2, Chapter 28, Springer: New York, pp. 1181–1218.

Stern, S., Porter, M.E. and Furman, J.L. (2002) The drivers of national innovative capacity. *Research Policy*, 31 (6): 899–933.

Tigabu,A. D.; Berkhout, F. and van Beukering, P. (2015) Technology innovation systems and technology diffusion: Adoption of bio-digestion in an emerging innovation system in Rwanda, *Technological Forecasting & Social Change*, 90: 318–330.

Tizikara, C.; Wilcock, D. and Habyarimana, P.C. (2007) *Needs assessment and action plan for improving agricultural research and technology transfer: Final report*. Republic of Rwanda and World Bank: Kigali and Washington, D.C.

Toivanen, H. and Ponomariov, B. (2011) African regional innovation systems: bibliometric analysis of research collaboration patterns 2005–2009. *Scientometrics*, 88:471–493.

Tocaltlian, J. (2006) Organizing information: the origins and development of UNISIST. In: *Sixty Years of Science at UNESCO 1945–2005*. UNESCO Publishing: Paris. pp. 129–130.

Trippe, A. (2003) Patinformatics: Tasks to tools. *World Patent Information*, 25 (3): 211–221.

Tumushabe, G.W. and Ouma-Mugabe, J. (2012) *Governance of Science, Technology and Innovation in the East African Community*, ACODE Policy Research Series, No. 51, Advocates Coalition for Development and Environment: Kampala.

UNCTAD (2015) *World Investment Report: Global Value Chains: Investment and Trade for Development*. United Nations Conference on Trade and Development: Geneva.

UNDP (2014) *Human Development Report*, United Nations Development Programme: New York.

UNECA, African Union and UNDP (2013) *MDG Report 2013, Food Security in Africa: Issues, challenges and lessons*. United Nations Economic Commission for Africa: Addis Ababa.

UNESCO (1960) Requirements and resources *of* scientific and technical personnel in ten Asian countries. *Statistical Reports and Studies*, No. 6, United Nations Educational, Scientific and Cultural Organization: Paris.

UNESCO (1972) *UNESCO Statistical Yearbook*. United Nations Educational, Scientific and Cultural Organization: Paris.

UNESCO (1974a) National Science Policies in Africa. *Science Policy Studies and Documents*, vol. 31; UNESCO and the Imprimerie Rolland: Paris.

UNESCO (1974b) *Recommendation on the status of scientific researchers, adopted by the General Conference at its eighteenth session, held in Paris, 20 November 1974*. United Nations Educational, Scientific and Cultural Organization: Paris.

UNESCO (1978) Recommendation Concerning the International Standardization of Statistics on Science and Technology. Records of the General Conference, Twentieth Session, Paris, 24 October to 28 November 1978, vol. 1 Resolutions, Imprimerie des Presses Universitaires de France: Vendome.

UNESCO (1982a) *UNESCO Statistical Yearbook*. United Nations Educational, Scientific and Cultural Organization: Paris.

UNESCO (1982b) *National Scientific and Technological Potential Survey*. UNESCO/NS/ROU/ 527; United Nations Educational, Scientific and Cultural Organization: Paris.
See: http://unesdoc.unesco.org/images/0004/000493/049303eb.pdf

UNESCO (1984a) *Manual for Statistics on Scientific and Technological Activities*, ST–84/WS/12. UNESCO Division of Statistics on Science and Technology, Office of Statistics: Paris.
See: http://unesdoc.unesco.org/images/0006/000620/062017eb.pdf

UNESCO (1984b) *Guide to Statistics in Science and Technology*, ST–84/WS/12. UNESCO Division of Statistics on Science and Technology, Office of Statistics: Paris.
See: http://unesdoc.unesco.org/images/0006/000635/063537eo.pdf

UNESCO (1987a) *Second Conference of Ministers Responsible for the Application of Science and Technology to Development in Africa, CASTAFRICA II: Final Report*. UNESCO: Paris.

UNESCO (1987b) Comparative Study on the National Science and Technology Policy-Making Bodies in the countries of Eastern and Southern Africa. *Science Policy Studies and Documents*, vol. 66, United Nations Educational, Scientific and Cultural Organization: Paris.

UNESCO (1988) Proposed International Standard Nomenclature for Fields of Science and Technology, UNESCO/NS/ROU/257. United Nations Educational, Scientific and Cultural Organization: Paris. See: http://unesdoc.unesco.org/images/0008/000829/082946eb.pdf

UNESCO (1990) World Directory of National Science and Technology Policy Making Bodies. *Science Policy Studies and Documents*, vol. 71, United Nations Educational, Scientific and Cultural Organization: Paris. See: http://unesdoc.unesco.org/images/0008/000881/088166mb.pdf

UNESCO (1998) *UNESCO Statistical Yearbook*. United Nations Educational, Scientific and Cultural Organization: Paris.

UNESCO (2010a) *UNESCO Science Report 2010: the Current Status of Science around the World*. S. Schneegans (ed.), UNESCO Publishing: Paris.
See: http://unesdoc.unesco.org/images/0018/001899/189958e.pdf

UNESCO (2010b) *Engineering: Issues Challenges and Opportunities for Development*. T. Marjoram (ed.), UNESCO Publishing: Paris.

UNESCO (2012) Proposed Standard Practice for Surveys of Science, Engineering, Technology and Innovation (SETI) Policy Instruments, Governing Bodies, Legal Frameworks and Policies: Template for a Country Policy Profile. United Nations Educational, Scientific and Cultural Organization: Paris.

UNESCO (2013) *Mapping Research and Innovation in the Republic of Botswana*. G. A. Lemarchand and S. Schneegans (eds). GO→SPIN Country Profiles in Science, Technology and Innovation Policy, vol. 1, UNESCO Publishing: Paris.
See: http://unesdoc.unesco.org/images/0022/002247/224725E.pdf

UNESCO (2014a) *Mapping Research and Innovation in the Republic of Zimbabwe*. G. A. Lemarchand and S. Schneegans (eds). GO→SPIN Country Profiles in Science, Technology and Innovation Policy, vol. 2, UNESCO Publishing: Paris.
See: http://unesdoc.unesco.org/images/0022/002288/228806e.pdf

UNESCO (2014b) *Mapping Research and Innovation in the Republic of Malawi*. G. A. Lemarchand and S. Schneegans (eds). GO→SPIN Country Profiles in Science, Technology and Innovation Policy, vol. 3, UNESCO Publishing: Paris. See: http://unesdoc.unesco.org/images/0022/002288/228807e.pdf

UNESCO and UNECA (1966) *Scientific Research in Africa, National Policies, Research Institutions*. UNESCO, in association with United Nations Economic Commission for Africa: Paris.

UNESCO Institute for Statistics (2010) *Measuring R&D: Challenges Faced by Developing Countries*. Technical Paper No.5. UIS: Montreal.
See: http://unesdoc.unesco.org/images/0018/001899/189958e.pdf

UNESCO Institute for Statistics (2012) New Patterns in Mobility in the Southern African Development Community. *Information Bulletin,* No. 7, UIS: Montreal.

UNESCO Institute for Statistics (2014) Guide to Conducting an R&D Survey: for Countries Starting to Measure Research and Experimental Development. *Technical Paper* No.11. UNESCO Institute for Statistics: Montreal.

UNIDO (2011) *Independent Country Evaluation: Rwanda*. United Nations Industrial Development Organization: Vienna.

United Nations (2013) *Rwanda United Nations Development Assistance Plan (UNDAP) 2013–2018*. Office of the United Nations Resident Coordinator: Kigali.

University of Rwanda (2014) *Strategy to increase the production of quality and relevant research at the University of Rwanda*, UR: Kigali.

Verwimp, P. (2013) Peasants in Power: The Political Economy of Development and Genocide in Rwanda. Springer Science + Business Media: Dordrecht.

Watkins, A. and Verma, A. eds. (2008) *Building Science, Technology and Innovation Capacity in Rwanda: Developing Practical Solutions to Practical Problems.* The World Bank: Washington, DC.

WIPO (2014) *World Intellectual Property Indicators*, World Intellectual Property Right Organization: Geneva.

World Bank (2014a) *Africa Pulse*. Vol. 9, The World Bank: Washington, DC.

World Bank (2014b) *Rwanda Country Opinion Survey Report (July 2013 – June 2014)*, Country Opinion Surveys – The World Bank Group: Washington, DC

World Bank and Elsevier (2014) *A decade of Development in Sub-Saharan African Science, Technology, Engineering & Mathematics Research*. Elsevier B.V. and The World Bank: Washington DC.

World Economic Forum (2014) *The Global Competitiveness Report 2013–2014*. K. Schaub (ed.), World Economic Forum: Geneva.

Glossary

I. Glossary of main terms used in R&D surveys

Sectors covered by R&D surveys

Business enterprise sector: (a) all firms, organisations and institutions whose primary activity is the market production of goods or services (other than higher education) for sale to the general public at an economically significant price, including both public and private enterprises; (b) the private non-profit institutions mainly serving them.

Government sector: (a) all departments, offices and other bodies which furnish, but normally do not sell to, the community, those common services, other than higher education, which cannot otherwise be conveniently and economically provided, as well as those that administer the state and the community's economic and social policy; (b) public enterprises mainly engaged in market production and the sale of goods and services are included in the business enterprise sector; (c) non-profit institutions controlled and mainly financed by government, not administered by the higher education sector.

Higher education sector: (a) all universities, colleges of technology and other institutions providing tertiary education (see below for details), whatever their source of finance or legal status; (b) all research institutes, experimental stations and clinics operating under the direct control of, or administered by, or associated with, higher education institutions.

Private non-profit sector: (a) Non-market, private non-profit institutions serving households (i.e. the general public) and (b) private individuals or households.

Definition of research and experimental development

***Research and experimental development* (R&D)**: comprises creative work undertaken on a systematic basis, in order to increase the stock of knowledge, including knowledge of humanity, culture and society, and the use of this stock of knowledge to devise new applications. The term R&D covers three activities: basic research, applied research and experimental development.

Basic (or fundamental) research: is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundation of phenomena and observable facts, without any particular application or use in view.

Applied research: is also original investigation undertaken in order to acquire new knowledge. It is, however, directed primarily towards a specific practical aim or objective.

Experimental development: is systematic work, drawing on existing knowledge gained from research and/or practical experience, which is directed towards producing new materials, products or devices, towards installing new processes, systems and services, or towards improving substantially those already produced or installed. R&D covers both formal R&D in R&D units and informal or occasional R&D in other units.

Definition of personnel

R&D personnel: all persons employed directly in R&D, as well as those providing direct services such as R&D managers, administrators and clerical staff. Persons providing an indirect service, such as canteen and security staff, should be excluded.

Head count: data reflect the total number of persons employed in R&D, independently of the focus of their work. These data allow links to be made with other data series, such as education and employment data, or the results of population censuses. They also serve as the foundation for calculating indicators which analyse the characteristics of the R&D labour force, with respect to age, gender or national origin.

Full-time equivalent (FTE): may be thought of as one person-year. Thus, a person who normally spends 30% of his/her time on R&D and the rest on other activities (such as teaching, university administration and student counselling) should be considered as 0.3 FTE. Similarly, if a full-time R&D worker is employed at an R&D unit for only six months, this results in an FTE of 0.5. However, for reporting purposes, the total sum of FTEs should be rounded to the next integer to avoid the reporting of decimals.

Researchers: are professionals engaged in the conception or creation of new knowledge, products, processes, methods and systems and also in managing the projects concerned. Postgraduate students at the PhD level engaged in R&D should be considered as researchers.

Technicians: and equivalent staff are persons whose main tasks require technical knowledge and experience in one or more fields of engineering, physical and life sciences (technicians) or social sciences and humanities (equivalent staff). They participate in R&D by performing scientific and technical tasks involving the application of concepts and operational methods, normally under the supervision of researchers.

Support staff: includes skilled and unskilled craftsmen, secretarial and clerical staff participating in R&D projects or directly associated with such projects (or providing services to researchers involved therein).

International Standard Classification of Education (ISCED) levels

UNESCO developed the International Standard Classification of Education (ISCED) to facilitate comparisons of education statistics and indicators across countries on the basis of uniform and internationally agreed definitions.

The ISCED levels that were in use at the time of the Government of Malawi's 2013 *National Survey of Research and Innovation* were those from the 1997 revision of ISCED levels, namely:

ISCED 6 programmes: tertiary programmes leading to the award of an advanced research qualification. The programmes are therefore devoted to advanced study and original research and are not based on coursework only. They typically require the submission of a thesis or dissertation of publishable quality which is the product of original research and represents a significant contribution to knowledge. They usually prepare graduates for faculty posts in institutions offering ISCED 5A programmes, as well as research posts in government, industry, etc.

ISCED 5A programmes: tertiary programmes that are largely theoretically based and are intended to provide sufficient qualifications for gaining entry into advanced research programmes and professions with high skills requirements. They must satisfy a sufficient number of the following criteria: (a) a minimum cumulative theoretical duration (at tertiary) of three years' full-time equivalent, although typically they are of four or more years; (b) faculty with advanced research credentials; (c) may involve completion of a research project or thesis; (d) provide the level of education required for entry into a highly skilled profession (theoretically based/research preparatory, such as history, philosophy, mathematics, etc., or giving access to highly skilled professions, e.g. medicine, dentistry, architecture, etc.) or an advanced research programme. This level includes all the research programmes which are not part of a doctorate, such as any type of master's degree.

ISCED 5B programmes: are tertiary programmes which are typically shorter than those in 5A and focus on giving participants occupational skills and a relevant qualification for the labour market, although some theoretical foundations may be covered. The content of ISCED level 5B programmes is mainly designed to give participants the practical skills and know-how needed for employment in a particular occupation or trade, or class of occupations or trades.

ISCED 4 programmes: are post-secondary, non-tertiary education programmes that straddle the boundary between upper-secondary and post-secondary education from an international point of view, even though they might clearly be considered as upper-secondary or post-secondary programmes in a national context. ISCED 4 programmes cannot, considering their content, be regarded as tertiary programmes. They are often not significantly more advanced than programmes at ISCED 3 level but they serve to broaden the knowledge of participants who have already completed a programme at level 3. Typical examples are programmes designed to prepare students for studies at level 5 who have completed ISCED 3 but did not follow a curriculum which would allow entry to level 5, i.e. pre-degree foundation courses or short vocational programmes. Second-cycle programmes can be included as well.

ISCED 3 programmes: are (upper) secondary education programmes typically beginning at the end of full-time compulsory education for those countries that have a system of compulsory education. The entrance age to this level is typically 15 or 16 years. The educational programmes included at this level typically require the completion of some nine years of full-time education (since the beginning of level 1) for admission, or a combination of education and vocational or technical experience, with, as minimum entrance requirements, the completion of level 2 or a demonstrable ability to handle programmes at this level.

The new International Standard Classification of Education

In 2011, UNESCO member states formally adopted a revision of ISCED. The product of extensive international and regional consultations among education and statistical experts, ISCED 2011 takes into account significant changes in education systems worldwide since the last ISCED revision of 1997.

ISCED 2011 counts four levels of tertiary education, as compared to two in the current version. The aim of the revision is to reflect the tertiary education structure found around the world better (bachelor's, master's and doctorate). This structure has been generalised across Europe since the Bologna Process got under way in 1999.

The first data collection based on the new classification began in 2014. The UNESCO Institute for Statistics is working closely with Member States and partner organisations (such as OECD and Eurostat) to map education systems using the new classification and revise statistic-gathering instruments.

The four new levels of tertiary education (effective as of 2014) are:

ISCED level 5 – Short-cycle tertiary education;

ISCED level 6 – Bachelor's degree or equivalent level;

ISCED level 7 – Master's degree or equivalent level;

ISCED level 8 – Doctoral or equivalent level.

Source: UNESCO Institute for Statistics (UIS) - UIS/RD/2012M
For details of ISCED 2011, see: www.uis.unesco.org/Education/Documents/isced-2011-en.pdf

II. Glossary on intellectual property rights

Applicant: An individual or other legal entity that files an application for a patent, utility model, trademark or industrial design. There may be more than one applicant in an application. For the statistics presented in the present publication, the name of the first-named applicant is used to determine the owner of the application.

Application abroad: For statistical purposes, an application filed by a resident of a given state/jurisdiction with an IP office of another state/jurisdiction. For example, an application filed by an applicant domiciled in France with the Japan Patent Office (JPO) is considered an 'application abroad' from France's perspective. This differs from a 'non-resident application', which describes an application filed by a resident of a foreign state/jurisdiction from the perspective of the office receiving the application.

Industrial design: applies to a wide variety of industrial products and handicrafts. It refers to the ornamental or aesthetic aspects of a useful article, including compositions of lines or colours or any three-dimensional form that gives a special appearance to a product or handicraft. The holder of a registered industrial design has exclusive rights concerning unauthorised copying or imitation of the design by third parties. Industrial design registrations are valid for a limited period. The term of protection is usually 15 years for most jurisdictions. However, differences in legislation do exist, notably in China (which provides for a 10-year term from the application date) and the USA (which provides for a 14-year term from the date of registration).

Intellectual property (IP): refers to creations of the mind: inventions, literary and artistic works, symbols, names, images and designs used in commerce. IP is divided into two categories: industrial property, which includes patents, utility models, trademarks, industrial designs and geographical indications of source; and copyright, which includes literary and artistic works such as novels, poems and plays, films, musical works, artistic works such as drawings, paintings, photographs, sculptures and architectural designs. Rights related to copyright include those of performing artists in their performances, producers of phonograms in their recordings and those of broadcasters in their radio and television programmes.

Invention: a new solution to a technical problem. To obtain patent rights, the invention must be novel, involve an inventive step and be industrially applicable, as judged by a person skilled in the art.

Non-resident: for statistical purposes, a 'non-resident' application refers to an application filed with the IP office of, or acting for, a state/jurisdiction in which the first-named applicant in the application is not domiciled. For example, an application filed with the JPO by an applicant residing in France is considered a non-resident application from the perspective of this office. Non-resident applications are sometimes referred to as foreign applications. A non-resident grant or registration is an IP right issued on the basis of a non-resident application.

Patent: a set of exclusive rights granted by law to applicants for inventions that are new, non-obvious and commercially applicable. It is valid for a limited period of time (generally 20 years), during which patent holders can commercially exploit their inventions on an exclusive basis. In return, applicants are obliged to disclose their inventions to the public in a manner that enables others, skilled in the art, to replicate the invention. The patent system is designed to encourage innovation by providing innovators with time-limited exclusive legal rights, thus enabling innovators to appropriate a return on their innovative activity.

Patent Co-operation Treaty (PCT): an international treaty administered by WIPO. The PCT system facilitates the filing of patent applications worldwide and makes it possible to seek patent protection for an invention simultaneously in each of a large number of countries by first filing a single 'international' patent application. The granting of patents, which remains under the control of the national or regional patent offices, is carried out in what is called the 'national phase' or 'regional phase'.

Registration: a set of exclusive rights legally accorded to the applicant when an industrial design or trademark is 'registered' or 'issued'. (See also Industrial design or Trademark.) Registrations are issued to applicants so that they can make use of, and exploit, their industrial design or trademark for a limited period of time; in some cases, registration can be renewed indefinitely, particularly in the case of trademarks.

Resident: for statistical purposes, a 'resident' application refers to an application filed with the IP office of, or acting for, the state/jurisdiction in which the first-named applicant in the application has residence. For example, an application filed with the JPO by a resident of Japan is considered a resident application from the perspective of the JPO. Resident applications are sometimes referred to as domestic applications. A resident grant/registration is an IP right issued on the basis of a resident application.

Trademark: a distinctive sign that identifies certain goods or services as those produced or provided by a specific person or enterprise. The holder of a registered trademark has the legal right to exclusive use of the mark in relation to the products or services for which it is registered. The owner can prevent unauthorised use of the trademark, or a confusingly similar mark, so as to prevent consumers in particular and the public in general from being misled. Unlike patents, trademarks can be maintained indefinitely by paying renewal fees. The procedures for registering trademarks are governed by the rules and regulations of national and regional IP offices. Trademark rights are limited to the jurisdiction of the authority that registers the trademark. Trademarks can be registered by filing an application at the relevant national or regional office(s), or by filing an international application through the Madrid system.

Utility model: a special form of patent right granted by a state/jurisdiction to an inventor or the inventor's assignee for a fixed period of time. The terms and conditions for granting a utility model differ slightly from those for normal patents (including a shorter term of protection and less stringent patentability requirements). The term 'utility model' can also describe what are known in some countries as 'petty patents', 'short-term patents' or 'innovation patents'.

Source: WIPO (2013)

The Global Observatory of Science, Technology and Innovation Policy Instruments (GO→SPIN) series of country profiles is designed to expose – through the rigorous application of an assessment lens—usable insights about science, technology, engineering and innovation (SETI) policies and their context. This is meant to encourage choices that can help focus SETI efforts toward shared national goals: to harness research and innovation so as to eradicate poverty and achieve sustainable development.

In 2000, following the harrowing disruptions of the war and Genocide (c. 1994), through *Rwanda Vision 2020* SETI became a cross cutting pillar to achieve a knowledge economy by 2020. The country has made big strides in becoming very business-friendly. The Human Development Index has progressed increasing its value from 0.23 (1995) to 0.506 (2013). Nevertheless, are policies–particularly those affecting SETI—going to bring about the transformation?

The present study shows that while aspects of the base of the economy and the education system are changing with time, there is room for sharpened efforts. In the last two years, several institutional reforms took place to speed up the generation of knowledge and innovation. There is clearly a wide margin of manoeuvre for SETI to add value in productive sectors: value-addition across all sectors remains low, Rwanda is a net exporter of raw materials, and indigenous knowledge—which as yet may have its own contribution—is not yet efficiently managed.

In 2014, the Government of Rwanda appealed for UNESCO's assistance in preparing an evidence-based policy analysis of its unique situation. *Mapping Research and Innovation in the Republic of Rwanda* is the result. The present profile has been produced within the Global Observatory of Science, Technology and Innovation Policy Instruments (GO→SPIN), a UNESCO initiative which stresses the importance of having a wide range of policy instruments to ensure effective policy implementation, although this is not yet the case in Rwanda. GO→SPIN is applying a new methodology to mapping research and innovation at country level, in order to inform reform processes and improve monitoring of national innovation systems.

United Nations
Educational, Scientific and
Cultural Organization

Natural
Sciences
Sector

9 789231 001260