GOVERNANCE OF SCIENCE, TECHNOLOGY and iNNOVATION

IN THE EAST AFRICAN COMMUNITY

GODBER W. TUMUSHABE
JOHN OUMA-MUGABE

INAUGURAL BIENNUAL REPORT 2012

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Advocates Coalition for Development and Environment

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List of Abbreviations

ACODE	Advocates Coalition for Development and Environment
AEC	African Economic Community
ASTI	Agricultural Science and Technology Indicators
ASTII	African Science, Technology and Innovations Indicators
ASTIO	African Science, Technology and Innovation Observatory
AU	African Union
BRELA	Business Registration and Licencing Agency
CEMAC	Communauté Économiqueet Monétaire des Etats de l'Afrique Centrale
COMESA	Common Market for East and Central Africa
COSTECH	Commission for Science and Technology
DSTR	Directorate of Science Technology and Research
EABC	East African Business Council
EAC	East African Community
EAC East	African Community
EAC-CU	East African Community Customs Union
EACJ	East African Court of Justice
EADB	East African Development Bank
EALA	East African Legislative Assembly
EASTECO	East African Science and Technology Commission
ECCAS	Economic Community of Central African States
ECOWAS	Economic Community of West African States
EU	European Union
FACAGRO	Faculty of Agronomy
FP	Framework Programme
FTE	Full Time Equivalent
GAFTA	Greater Arab Free Trade

GDP	Gross Domestic Product
GERD	Gross Expenditure on Research and Development
GNI	Gross National Income
GSS	Government Support to Scientists
ICTs	Information and Communication Technologies
IFPRI	International Food Policy Research Institute
IGAD	Intergovernmental Authority on Development
IPRs	Intellectual Property Rights
ISABU	Institute of Agronomic Sciences of Burundi
KARI	Kenya Agricultural Research Institute
KBS	Kenya Bureau of Statistics
KENREF	Kenya National Research Fund
KIPI	Kenya Industrial Property Institute
MDGs	Millennium Development Goals
MINEDUC	Ministry of Education, Rwanda
MOST	Ministry of Science and Technology
NARF	National Agricultural Research Fund
NCST	National Council for Science and Technology
NCSTI	National Commission on Science, Technology and Innovation
NEPAD	New Partnership for Africa's Development
NRF	National Research Fund
NSTIP	National Science, Technology and Innovation Policy
NSTP	National Science, Technology and Innovation Plan
OLPC	One Laptop per Child
PSI	Presidential Science Initiative
PSS	Presidential Support to Scientists
R&D	Research and Development

RBS	Rwanda Bureau of Standards
RCA	Regional Cooperation Arrangement
REC	Regional Economic Communities
RIEF	Rwanda Innovation Endowment Fund
S&T	Science and Technology
SACU	Southern African Customs Union
SADC	Southern African Development Community
STI	Science, Technology and Innovation
STIF	Science Technology and Innovation Fund
TBS	Tanzania Bureau of Statistics
TTI	Think Tank Initiative
UBOS	Uganda Bureau of Statistics
UCAF	Universal Commissions Access Fund
UEMOA	West African Economic and Monetary Union (Union Economiqueet Monétaire Ouest Africaine)
ULRC	Uganda Law Reform Commission
UNCST	Uganda National Council for Science and Technology
UNECA	United Nations Economic Commission for Africa
UNESCO	United Nations Educational Scientific and Cultural Organizations
URSB	Uganda Registration Services Bureau
WSIS	World Summit on the Information Society
ZARF	Zonal Agricultural Research Fund

Acknowledgements

In 2009, ACODE launched a process to prepare the biennial report on the Governance of Science, Technology and Innovation (STI) in the East African Community. This effort is premised on ACODE's fundamental belief that science, technology and innovation are critical building blocks for transitioning East African economies from dependence on crude extraction of natural resources to industrial, services and knowledge-based economies. After preliminary work by the lead authors of the report, the first meeting of the Independent Panel of Experts was convened in Kampala on December 1-2, 2010. Since then, the panel has been expanded and has met three more times in Kampala and Bujumbura. ACODE is profoundly grateful to the Think Tank Initiative (TTI) for providing core funding support to ACODE that made this innovative undertaking possible.

During the process of preparing this report, we interacted with numerous persons and institutions who immensely contributed to the process of producing the report. Most importantly, the report would not have been possible without the tireless efforts and contributions of the members of the Independent Panel of Experts. Their commitment to attending the panel sessions, preparing case studies and reviewing the draft chapters account for the scope of the work accomplished. By drawing the members of the panel from the relevant government agencies, the process represents an unprecedented public-private partnership that provides important lessons for the implementation of the Treaty Establishing the East African Community.

We are also indebted to the African Observatory on Science and Technology (OASTI) for sharing information and experiences from the work on the African Innovation Outlook. We are indebted to the Government of Burundi for hosting the Fourth Meeting of the Independent Panel of Experts and to the Government of Rwanda for hosting the launching of the Report. We are further indebted to Stella Muheki and Susan Karungi for providing the research assistance and administration support for the process. Mukotani Rugyendo and Richard Lutalo are acknowledged for copy and technical editing respectively. Ultimately, we take responsibility for any errors or omissions.

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November 22, 2012

Fig 1.1: Powering the rural areas: A 55kw Pico Turbine lighting up Bwindi in south-west Uganda. (Sourec: Ministry of Energy-Uganda)

1 Introduction

It is common knowledge today that science, technology and innovation (STI)—whether embodied in human skills, capital goods, practices and organizations—are the key drivers of economic growth and sustainable development of nations and regions. Indeed, the growth and competitiveness of economies are to a large measure dependent on the production and application of STI. Economic growth differences between developing and developed countries are accounted for by relatively low investments in STI by the former and higher investments in STI by the latter. It is partly because of the recognition of the centrality of STI to national development and regional integration that the Partner States of the East African Community (EAC) have set themselves a fairly ambitious agenda for cooperation this area.

The integration, growth and competitiveness of the economies of the East African Community (EAC) depend on science, technology and innovation (STI). If the five Partner States of the EAC do not make strategic, systematic and significant investments in the generate and application of new knowledge and technological innovations, their ambitions to grow their economies, achieve Millennium Development Goals (MDGs) targets, deepen economic and political integration and attain sustainable development will not be realized. This has been explicitly recognized by leaders of the five Partner States of the EAC. The recognition is pronounced or manifested in provisions of Treaty Establishing the EAC. Since the Treaty was first adopted in 1999, the recognition that STI is pivotal for regional integration and transformation is fully recognized in the Protocol on the Establishment of the East African Customs Union, the Protocol on Science, Technology and Innovation. A number of programmatic initiatives

are also being pursued within the context of regional integration.

The EAC Partner States have a long history of cooperation on STI. The first three Partners States—Kenya, Uganda and Tanzania—of the EAC had established a relatively strong institutional framework for cooperation in scientific research and technological activities prior to the collapse of the first EAC. They had common research programmes in the fields of agriculture, health, forestry, fisheries and technical institutes for industrial research. These countries also had common policies for STI, particularly in the areas of agriculture and health.

The revival of the EAC has come with renewed emphasis on cooperation in STI. The Partner States have integrated STI considerations into a range of policy frameworks and adopted a Protocol on STI. They have also launched a number of regional STI initiatives and, in fact, various regional and international agencies have STI programmes in support of the EAC Treaty. Many of these efforts are unknown to the wide EAC public and their contributions to the attainment of STI goals of the Treaty and human development in the EAC have not been fully analysed.

This report on the *Governance of Science, Technology and Innovation in the East African Community*, is the first comprehensive piece of work that explicitly focuses on STI in the region and sets an agenda for periodic assessment of the progress with regard to the implementation of EAC STI agenda. The report and its subsequent editions which will be published every after two years are designed to achieve two interrelated purposes. First, it is aimed at providing evidence-based analysis of the region's progress in promoting STI for economic change and development. Secondly, it is designed to act as a source of peer pressure among the Partner States to stimulate learning and the systematic implementation of STI programmes at the national level.

The production of this report is stimulated by the following factors. First, is the critical need to ensure that STI provisions of the Treaty and its associated Protocols on STI are effectively implemented. Currently, there are no institutional arrangements or systematic tools that monitor the implementation of the STI provisions of the Treaty and its Protocol. The East African Science and Technology Commission (EASTECO) is yet to be fully established and made operational. This publication is intended to encour-

Fig 1.2: The use of energy saving technologies will be essential in preserving the environment and improve public health outcomes.

age the Partner States of the EAC to fast-track the process of setting up the Commission and ensure its full operationalization.

Second, this report is intended to be a source of evidence for STI policy formulation and implementation. This inaugural edition maps out the context for STI development in the sub-region as well as the normative framework within which a forward-looking agenda on STI will be pursued and delivered. The subsequent issues of the report shall be authoritative sources of information and progress on the development and application of STI in the region.

The biennial reports on the governance of STI will be used as an accountability mechanism to promote compliance with the obligations set out in the Treaty and associated Protocols. For example, governments of the East African states (Burundi, Kenya, Rwanda, Uganda and the United Republic of Tanzania) have committed themselves to spend at least one per cent of their national Gross Domestic Product (GDP) on research and develop-

ment. Today, the information available on whether they are meeting such agreed targets is incomplete, inaccurate or simply inconsistent. There is also no information on the quality of investments in STI by the Partner States. Various stakeholder groups including governments, scientists, donors and civil society will be able to use the biennial reports to ensure that the countries individually and collectively invest in STI for economic integration and human development.

Fig 1.3: Small wind turbine in Koome Island on Lake Victoria: An example of technological innovation in renewable energy. (Ministry of Energy- Uganda)

Thirdly, this report and the subsequent ones in the series will form the basis for collective learning and regional cooperation in STI. There is very scanty information on regional cooperation in STI fields and programmes. Generally, the countries do not know their individual (national) and collective (regional) STI potential or capabilities. They are unable to engage in strategic STI partnerships or cooperation because of lack of information or data on their STI resources and capacity needs.

The reports will enable individual countries to better discover or know their national scientific and technological capabilities as well as those of their partners in the EAC. This will also enable the Partner States to compare their national systems of innovation and to design appropriate policies and programmes for cooperation.

Lastly, there is a paucity of studies with appropriate conceptual metaphors for analysing the role of STI in the economic integration and development of the EAC. Most of the current studies focus on conventional indicators of STI and do not address the critical aspects of the governance of science, technology and innovation. This report focuses on the configuration of institutions and policies for promoting the development and application of STI in the EAC. It analyses the political context for the successful

implementation of STI programmes and discusses the roles of state and non-state actors in ensuring the implementation of agreed commitments and targets on STI.

This report is organized in nine chapters. Chapter One is the introduction. Chapter Two focuses on the political economy of the EAC. It discusses the evolution of economic and political integration and the nature of the economies of the five Partner States as well as the range of EAC institutional arrangements for the promotion of STI. The political preconditions for effective application of STI to achieve growth and integration of the economies are also discussed.

Chapter Three introduces the notion of 'governance of STI' and lays out a framework for analysing STI policies, institutions and programmes in the EAC. The underlying premise of this chapter is that the establishment of the regional STI programmes and institutions as well as any other efforts at promoting STI in the context of EAC integration should be based on a good understanding of the political and economic governance of the individual Partner States and the Community as a whole. It is argued that conventional approaches such as measurement of expenditure on R&D and innovation activities or even measurement of outputs of scientific enterprises do not tell decision-makers much about the quality and effectiveness of policies and institutions for STI. They also focus on a narrow and linear view of institutions for STI and fail to treat STI as part and parcel of socio-political systems on national level and even from the perspective of regions such as the EAC.

Chapter Four is devoted to analysing the provisions of the Treaty Establishing the East African Community and the range of institutions that underpin its implementation. It analyses the scope and implications of the Treaty provisions on STI and the roles of the various institutions established under the Treaty. It is argued that periodic assessment of the progress made by these institutions in the implementation of the EAC STI agenda under the Treaty is crucial for achieving systematic and measurable progress.

Chapter Five examines how well STI considerations are articulated in constitutions and policies of the Partner States while Chapter Six is dedicated to the nature of institutions needed for the effective governance of STI at the national level. Chapter Seven focuses on the kinds of institutions and

instruments that the EAC countries use to fund R&D and innovation activities. All the EAC Partner States have some form of institutional arrangements and instruments for funding R&D and innovation. However, there is a mismatch between intentions to establish appropriate institutions and instruments and the operationalization of those intentions. Chapter Eight and Chapter Nine are a synthesis of emerging issues and recommendations for actions to accelerate the development and application of science, technology and innovation in the sub-region.

Preparation of the Report

This report is the output of an open, participatory and consultative process that involved stakeholders from national governments, civil society and academia in the five EAC Partner States. The process represents a unique public-private-civil society partnership in developing tools and undertaking independent assessments that promote the implementation of the EAC Treaty and its associated protocols.

The lead authors provided the overall intellectual backstopping for the process, including the design of the report's scope, undertaking the main writing assignments based on the inputs from experts participating in the process as well as preparing the final texts that constitute this report.

The process was also supported by a dedicated team of independent experts drawn from public agencies and independent policy think tanks. The Panel comprises 18 members from diverse institutional and academic backgrounds and disciplines. Over the course of preparing the report, the Panel met four times in Kampala and Burundi and held its final meeting in Kigali where the report was launched. Although the members of the Panel of Experts were selected from key institutions with STI-related mandates, the panellists were invited and served on the Panel in their individual capacities and without influence from their respective agencies.

The deliberations of the Panel were conducted in a transparent, frank and open manner through email exchanges and the more formal experts' meetings. It was not possible to conduct wider consultations to include specific constituencies such as the private sector, civil society and the student community. This, in a sense, manifests the kind of bottlenecks that were encountered in the process. Particular attention will be paid to

addressing these bottlenecks in the process of preparing subsequent reports.

The report was enriched by specific case studies focussing on the role of Heads of States in promoting STI at the national level, the role of independent policy think tanks, existing and prospective initiatives of technology cooperation and several other STI-related issues as detailed in this report. Through these case studies, we learnt that while there is a lot or work and progress happening in the area of STI within the Community, very little is known or documented to inform policy and decision-making. Consequently, future reports will address this gap by investing in in-depth analytical work and assessments at both national and sub-regional level.

Finally, this process provides a foundation for more profound evidence-based assessments of the trends in the governance of STI in the sub-region. The process of preparing this inaugural report has divulged a number of things that require systematic inquiry and analysis. Most importantly, a more proactive and systematic engagement with all the organs of the EAC will be critical for the process. Engagement with the relevant of departments of the EAC Secretariat, the relevant committees of the East African Legislative Assembly and more proactive engagement with the ministries responsible for East African Community Affairs will significantly add value to the process and the final outcome.

Secondly, we also learnt that the process is both knowledge and resource intensive. Consequently, more efforts will be put into mobilizing more long-term and predictable funding to support a broader multi-stakeholder engagement and more rigorous and in-depth analytical work as part of the inputs into the report process.

In conclusion, there is no doubt that a systematic, evidence-based assessment of the governance of STI is a fundamental input into the implementation of the Treaty provisions on STI. This initiative will be pursued as a learning process enabling appropriate adjustments along the way and strategically aligning some of the analytical work with key regional policy processes to optimize impact.

2

A Political Economy of the East African Community

Introduction

The relationship between science, technology, innovation (STI) and economic performance has dominated domestic and international policy discourse for decades. Among the East African countries, this discourse gained momentum around the early 1980s with the adoption of major structural reforms of the national economies. Besides key macro-economic adjustments, the centrepiece of these structural adjustment programmes included the scaling down of public service, the scaling back of public expenditure, and the reorganization of research and development (R & D) enterprises, especially agricultural R & D. Since then, individual states have sustained the policy tempo with varying degrees of success. With the rebirth of the East African Community, the public policy discourse on STI at both the national and regional level has been reignited.

This chapter examines the political economy context of STI in the East African Community (EAC). The political economy context of the region is important in explaining how political institutions, the political environment, and the nature of economic systems influence the discourse on STI within the individual countries and the sub-region as a whole. By outlining the political economy of the EAC, this report is able to examine the interactions between politics and public policy making process, while at the same time considering how political institutions structure incentives for political and bureaucratic actors in the STI arena.

Fig 2.1: Leaders of the EAC Partner States at the 3rd East African Community Conference on Investment held in Kampala, Uganda from 26-29 April 2010. From left: Rwanda's Prime Minister Bernard Makuza, Uganda's President Yoweri Kaguta Museveni, Tanzania's President Jakaya Mrisho Kikwete, Burundi's Vice President Dr Yves Sahinguvu and Kenya's Prime Minister Raila Odinga. (www.fullshangweblog.com)

The chapter is organized in six sections including this section. Section 2 describes the geo-ecological features, demographic trends, economic geography of the sub-region in comparison with other African regional economic communities. Section 3 provides a conceptual framework for understanding the political economy of regional integration. Section 4 examines the political landscape of the sub-region and high lights selected political documents where appropriate political narratives on STI policy are to be found. Section 5 analyses the process of EAC regional integration and implications for STI. Section 6 is the conclusion, focussing on opportunities to create policy convergence on building STI capabilities within the sub-region.

Geography and Ecology of the East Africa Community

The East African Community (EAC) region comprises of Burundi, Tanzania, Uganda, Kenya and Rwanda. It is located between 5030"N 120S and 28045"E 410 50" E. The region has a total surface area of about 1,817,945 square kilometres. Tanzania and Kenya border the Indian Ocean coastline, while Burundi, Rwanda and Uganda are landlocked. The EAC has approximately 130 million inhabitants.[1] The EAC is one of the fastest growing areas on the African continent providing tremendous potential for investment, business and other opportunities.Table 1 below provides basic statistics and figures about the EAC in comparison to other regional grouping in Africa.

Table 1. Basic Facts about EAC Compared with Other Regional Groupings

Pillars regional blocs (REC)	Area (km²)	Population	GDP (PPP) ($US)		Member states
			in millions	per capita	
AEC	29,910,442	853,520,010	2,053,706	2,406	54
ECOWAS	5,112,903	251,646,263	342,519	1,361	15
ECCAS	6,667,421	121,245,958	175,928	1,451	11
SADC	9,882,959	233,944,179	737,335	3,152	15
EAC	1,817,945	133.1	104,239	1,065	5
COMESA	12,873,957	406,102,471	735,599	1,811	20
IGAD	5,233,604	187,969,775	225,049	1,197	7
Other African blocs	Area (km²)	Population	GDP (PPP)($US)		Member states
			in millions	per capita	
CEMAC	3,020,142	34,970,529	85,136	2,435	6
SACU	2,693,418	51,055,878	541,433	10,605	5
UEMOA	3,505,375	80,865,222	101,640	1,257	8
UMA	5,782,140	84,185,073	491,276	5,836	5
GAFTA	5,876,960	166,259,603	635,450	3,822	5

Source: Compiled by the authors from numerous reports and internet sources

The East African region has a unique geography. It has the two tallest mountains in Africa: Mount Kilimanjaro and Mount Kenya. Mount Rwenzori located on Uganda's Western border with the Democratic Republic of Congo (DRC) is also unique for its snow peaks astride the Equator. EAC also has two of the world's important lakes: Lake Victoria[2] - the second largest freshwater lake

1 EAC (2011), East African Community—Facts and Figures 2010. East African Community Secretariat, Arusha, Tanzania.

2 Lake Victoria is a trans-boundary resource shared by Kenya, Tanzania and Uganda. About 51 percent of the lake area is owned by Tanzania, 43 percent by Uganda and 6 percent by Kenya. It has a catchment

Fig 2.2: Tourists camping at Lake Bunyonyi in Kabale district, south-western Uganda: tourism is a major economic sector of the EAC countries. (SBI International Holdings Uganda)

in the world,[3] and Lake Tanganyika - the second deepest lake in the world.[4]

The region's geography and ecology were shaped by tectonic forces that created the Great Rift Valley. Its geographical diversity, to a large extent, accounts for its biological diversity. The region has abundance of wildlife, forests, wetlands, fisheries and crops. It is one of the mega-biodiversity regions of the world. It has exceptional diversity of ecosystems and species, high levels of endemism and high concentrations of species.

The economies of the EAC are largely founded on its ecology and biodiversity in particular. They are based on agriculture and tourism. Agriculture accounts for at least a third of the Gross Domestic Product (GDP) of the EAC and offers employment to 50 per cent of the region's population. It is a key driver of economic growth and improvements in the livelihoods of the people of the region. Agriculture also accounts for a significant proportion of trade among the five countries. The five countries' agricultural systems are similar and based on cash crops such as coffee, sugarcane, cotton and tea.

area of 68,800 square kilometers that extends into Rwanda and Burundi.

3 After Lake Superior which is the first largest freshwater lake by surface area in the world.(It is 82,170 square kilometres) and located on the northern edge of Wisconsin, it stretches between the Upper Peninsula of Michigan north to Ontario Canada.

4 After Lake Baikal which is found in Russia.

Fig 2.3: Lake Victoria produces over 800,000 tonnes of fish worth about US$600 million annually. The lake's fisheries support over 3 million people in the region in terms of direct employment. (http-//blog.firelightfoundation.org)

Tourism constitutes a large and growing portion of the economies of the EAC. It is a major foreign exchange earner particularly for Kenya and Tanzania that have big and more developed national parks and game reserves. The tourism sector is growing in the region. In 2009, tourism grew by 4.0 per cent compared to a decline of 7.4 per cent recorded in 2008.[5]

East Africa is also dependent on natural resources for energy. Fuel wood, charcoal, wind and the sun are the main sources of energy for inhabitants of the region. Less than 50 per cent of EAC inhabitants are connected to national electricity grids. Traditional biomass consisting of fuel wood, charcoal and agricultural waste forms the main source of energy. The region as a whole and its five countries rely on a very narrow range of sources of energy. Hydro-generated electricity has not been really developed in the past decades. "Total installed hydro capacity in the region increased marginally (1.5 per cent) in 2009. Since 2003, the hydro-power generation as a proportion of total generation has been declining. This has been compensated by a gradual increase in thermo power generation (a more expensive source of electricity) in the region."[6]

Fisheries are another main economic activity that is dependent on the ecology of the region. In each of the five countries, fisheries is a major economic

5 EAC (2011), East African Community—Facts and Figures 2010. East African Community Secretariat, Arusha, Tanzania.

6 EAC (2011), East African Community—Facts and Figures 2010. East African Community Secretariat, Arusha, Tanzania.

activity. As stated earlier, the fisheries of Lake Victoria are shared by Kenya, Tanzania and Uganda. They provide an immense source of income, employment, food and foreign exchange for the East African region. Lake Victoria annually produces over 800,000 tonnes of fish worth about US $600 million. The lake's fisheries support over 3 million people in the region in terms of direct employment. Other lakes within the EAC also contribute enormously to employment and growth of the five economies.

The Economic Structure of the EAC

EAC countries exhibit differences in their economic activities and growth patterns. However, the region as a whole has experienced considerable economic growth in the past decade or so. The combined GDP of the EAC countries is about US$ 74.5 billion.[7] Over the past five years, the five countries have experienced an average growth of 5 per cent per annum.[8] During this period, Rwanda recorded the highest real growth of 6.1 per cent, followed by Tanzania and Uganda at 6.0 and 5.2 per cent, respectively. However, Kenya is the largest economy with a GNI that is as big as the combined GNI of the other four countries. In aggregate terms, total GDP for the region as a whole amounted to US$ 74,047 million in 2009, compared to US$ 72,998 in 2008. The dominant sector in all the partner states in 2009 was agriculture, followed by wholesale and retail trade and manufacturing.

Table 2: EAC Economic Indicators (2010)

Country	GDP per Capita (US$)	Growth Rate (%)	Imports as % of GDP (US$)	Exports as % of GDP (US$)	GDP trade Surplus/ / Deficit (%)
Burundi	173.0	4	29.3 %	6 %	23.3%
Kenya	833.4	5.6	37.1 %	28 %	9.1 %
Rwanda	540.0	7.5	….	11 %	. . .
Uganda	525.9	5.6	36 %	24 %	12%
Tanzania	546.7	7.0	30.4 %	26 %	4.4%

Sources: EAC Facts and Figures Report, 2011 and World Bank Databank 2011

Trade is an important and in fact integral aspect of EAC economic and political integration. It is the main driver of economic growth and development of

7 EAC (2011), *East African Community—Facts and Figures 2010*. East African Community Secretariat, Arusha, Tanzania.

8 African Development Bank (2010), *African Economic Outlook 2010*.

the region. "The EAC partner states are overly dependent on a narrow range of similar goods that may be affected by more efficient suppliers elsewhere as well as market swings in demand and price. The region exports mainly primary products (mainly agricultural products and minerals)."[9]

Table 3: Top Three Exports of EAC in 2008

Country	Product	Share of total exports (%)
Burundi	Tea, gold and coffee	75
Kenya	Tea, cut flowers, vegetables	30
Rwanda	Tea, coffee and tin ores	62
Uganda	Coffee, fish and cement	40
Tanzania	Gold, metal ores and semi-Manufactured gold	36

Source: IMF (2011), Regional Economic Outlook: Sub-Saharan Africa 2010

EAC's total trade with the rest of the world was about US$ 32,000 million in 2008.[10] Total imports into the EAC region were estimated at US$ 22,574 million. "Total imports accounted for about 70 per cent of total EAC trade during 2008. The share of total intra-EAC trade to total trade increased from 7.5 per cent in 2007 to 8.4 per cent in 2008. Intra-EAC trade was mainly in agricultural commodities and manufactures."[11] In all cases, one of the major policy challenges facing the Partner States is how to accelerate the shift from exports of low value natural resources-based products.

The European Union (EU) is EAC's largest trading partner although there are growing trade relations between EAC and Asian countries. EAC countries have preferential access to EU markets under the Lomé Conventions of the 1970s and the Cotonou Partnership Agreement signed in 2007. The EU bloc accounted for 21.9 per cent in 2007 and 18.4 per cent in 2008 of the share of EAC trade with the world.[12] The trade was mainly in agricultural commodities, capital goods and minerals. According to Nathan Irumba, 'The preferences under both Lomé and Cotonou have not resulted in any significant transformation of the EAC countries and their integration into the world economy. On the contrary, all

9 Irumba, N. 'The EAC's External Trade Relations', p. 277 in Ajulu, R., ed. (2010), *A Region in Transition: Towards a New Integration Agenda in East Africa*. The Institute for Global Dialogue, Midrand, South Africa.

10 EAC (2010), *East African Trade Report 2008*. East African Community Secretariat, Arusha, Tanzania.

11 EAC (2010), *East African Trade Report 2008*. East African Community Secretariat, Arusha, Tanzania.

12 EAC (2010), *East African Trade Report 2008*. East African Community Secretariat, Arusha, Tanzania.

of them, with the exception of Kenya, are still categorised as LDCs."[13]

EAC's trade with Asian countries is intensifying. This is particularly in terms of EAC trade with China and India. All the five EAC countries have trade relations with China. Tanzania's trade with China grew from US$93.4 million in 2001 to US$794 million in 2007. China's trade with Kenya was about US$650 million in 2006. It is estimated that as of September 2012, Chinese investments in the EAC were in the range of US$750 million.

Table 4: EAC Countries, Major Import Partners (% Share of Imports) 2010

	Burundi	Kenya	Rwanda	Tanzania	Uganda
European Union	26.8	18.6		14.4	15.4
India	. . .	10.8	5.5	11.2	14.5
China	12.0	12.6	15.6	10.9	8.8
United Arab Emirates	. . .	12.1	4.9	8.4	8.4
Japan	9.4	. . .	5.6		6.5
Kenya	7.3		9.8		11.6
Tanzania			5.2		1.3
Uganda			12.0		
South Africa		6.2	2.7	9.6	5.3

Source: National Bureaus of Statistics, World Trade Organisation

Intra-EAC Trade

Intra-EAC trade refers to trade which focuses on trade primarily between the Partner States. Intra-EAC trade accounts for a significant portion of EAC total economic growth. "In 2008, total intra-EAC trade increased by 37.6 per cent reaching a record value of US$ 2,715.4 million compared to the previous year. During the period under review, Tanzania recorded high intra-EAC trade flows which more than doubled from US$279.5 million in 2007 to US$ 735.8 million in 2008. Overall, Kenya continued to dominate the EAC regional trade, accounting for 44.8 per cent of total value of trade and recorded a surplus in this area. Uganda and Tanzania accounted for 28.1 per cent and 27.1 per cent of the total intra-EAC trade respectively."[14] Trade imbalances in the EAC have

13 Irumba, N. 'The EAC's External Trade Relations' p. 279 in Ajulu, R., ed. (2010), *A Region in Transition: Towards a New Integration Agenda in East Africa*. The Institute for Global Dialogue, Midrand, South Africa.

14 EAC (2010), *East African Trade Report 2008*. East African Community Secretariat, Arusha, Tanzania.

often caused intra-regional anxiety.[15] Kenya's dominance in EAC trade has caused concern in the other member states. Rok Ajulu refers to this as the "fear factor that is probably at the centre of the slow pace of regional integration in East Africa".[16]

Political Trends and Implications for Policy Making

The member States of EAC have undergone remarkable political and constitutional developments over the last decade. These developments present a wide range of opportunities and challenges for better STI policy articulation and policy implementation.

From Political Instability and Conflict Towards Democracy

Generally, all the 5 Partner States of the EAC are young but emerging democracies. The levels of political development are arguably different. For example, Kenya and Tanzania have developed a predictable succession process whereby one president has been able to hand over power to another president peacefully. On the contrary, Uganda and Rwanda are yet to pass this litmus test, while Burundi is rebuilding its political and public institutions after many years of conflict.

In many ways, each of the countries is afflicted by episodes of instability arising from their political and colonial history. In 2008, Kenya was shaken by post-election violence on a scale never envisaged before. The 1994 genocide in Rwanda annihilated not only its human victims but also the civil and public service institutions that are the foundation of scientific and technological progress. The half a century of conflict in Uganda led to death of thousands of Ugandans, the fleeing of professionals including science professionals and the near collapse of key state institutions. Since independence in 1961, Burundi has been plagued by tensions between its two main ethnic communities. In 1993 to 2005, Burundi suffered a brutal armed conflict which led to the deaths of an estimated 300,000 people.

However, over the last two decades, there have been major developments that in many ways represent a new source of promise and optimism. Multiparty elections and regular elections have increasingly become the norm than the exception. Consistently, all the countries are holding regular elections ensur-

15 See Ajulu, R., ed. (2010), *A Region in Transition: Towards a New Integration Agenda in East Africa*. The Institute for Global Dialogue, Midrand, South Africa.

16 Ajulu, R., ed. (2010), A Region in Transition: Towards a New Integration Agenda in East Africa p 27. The Institute for Global Dialogue, Midrand South Africa.

ing universal adult suffrage principles. Numerous political parties representing a wide range of interests have emerged providing a variety of platforms for different articulations of public policies. For example, all the major Ugandan political parties included specific policy commitments on STI including R & D in their campaign manifestos for the 2011 general elections.[17] There can be no doubt that the contestation for political power among political parties will increasingly become a vehicle for competing policy alternatives and agendas including in the areas of STI policies at the national and sub-regional level.

Constitutional Reforms

The EAC States have been undergoing a series of constitutional reforms to agree on minimum political and governance agendas. Evidence from these constitutional reforms clearly shows that there is a growing tendency to include specific constitutional commitments on STI.[18] For example, the Uganda Constitution adopted in 1995 made explicit references to technology and industrial development.[19] The preamble to the constitution of Rwanda promulgated in 2003 declares that "the people of Rwanda are determined to develop human resources, to fight ignorance, to promote technological advancement and the social welfare of the people of Rwanda." On the other hand, the Kenyan constitution which was just approved in 2010 makes extensive provisions on science, technology and innovation. These include: promotion of all forms of national and cultural expression;[20] enactment of legislation which recognizes and protects the ownership of indigenous seeds and plan varieties;[21] protection and enhancement of intellectual property in, and indigenous knowledge of, biodiversity and the genetic resources of communities.[22] These trends clearly show increasing convergence between the political discourse and public policy making in the area of science, technology and innovation.

17 See The Democratic Party Manifesto 2011, Inter Party Coalition Election Manifesto 2011-2016, National Resistance Movement (NRM)Manifesto 2011 – 2016, Uganda Peoples' Congress 2011-2016 Manifesto Highlights.

18 For more detail on the STI content of national constitutions, see Chapter four.

19 The Constitution of the Republic of Uganda, 1995 (as amended) National Objectives and Directive Principles of State Policy.

20 Article 11(2) of the Constitution of Kenya, Revised Edition 2010 Published by the National Council for Law Reporting with the Authority of the Attorney General.

21 Article 11(3).

22 Article 69(1)(c).

Presidential lLeadership and STI Policy Governance

A new trend has been emerging where major STI initiatives including R & D programmes are increasingly directed and implemented either as presidential initiatives or based on presidential directives. Progressively, major national STI initiatives across the sub-region are located or implemented through the office of the president. Indeed, this trend is not unique to STI but cuts across many other development and social sectors. The tendency is to concentrate institutions in the office of the president mainly as a strategy to attain profiling, political attention and consequentially, appropriate budgetary allocations. This is a major political and policy development with wide-ranging implications for the future governance of STI in the sub-region.

The location of STI policy making and flagship STI initiatives in the office of the president can have both positive and negative implications. From the positive side, presidential initiatives and directives on STI demonstrate growing political commitment to the development of STI in the respective countries. Indeed, programmes run out of the presidents' offices are more likely to get enhanced attention in terms of human resources, budget allocations and public profiling.

However, attaching such policy initiatives and programmes to political offices may also make them liable to unpredictable changes often associated with the changes in the persons holding the office of the president. There is ample evidence to suggest that new political leaders and especially changes in the office of president come with new priorities and particular areas of policy emphasis. Given the long gestation period of STI activities, credible, stable and independent institutions will be required to guarantee predictability in STI policy and the continuity of flagship initiatives. Consequently, countries that will mobilize presidential leadership for STI without concentrating STI policy making and policy implementation in the office of the president are likely to have a more stable and predictable STI governance regime.

The political economy of regional integration and implications for STI

Over the last half a century, there has emerged a multitude of regional cooperation arrangements (RCAs). Africa alone has seven major RCAs and an additional five auxiliary groups commonly referred to as Regional Economic Communities (RECs).

Box 1: Some Case Studies of Presidential Initiatives in EAC[23]

KENYA – The Nyayo Car

The Nyayo car is perhaps one of the oldest presidential initiatives in the EAC. This was a project by the Kenyan government to plan and manufacture cars made in Kenyan. The project was initiated in 1986 when then President Daniel arap Moi asked the University of Nairobi to develop these vehicles referred to as "the Nyayo car." Five prototypes named Pioneer Nyayo Cars attaining a speed of 120 km/h were made. The Nyayo Motor Corporation was established to mass produce these cars. However, due to lack of funds, the car never entered into production! The Nyayo Motor Corporation was later renamed Numerical Machining Complex Limited (NMC), manufacturing metal parts for various local industries. In spite of the apparent failure of the Nyayo car initiative, the NMC has remained in existence and has now been aligned with the national vision 2030 and is a key player in guiding manufacturing industries in achieving their goals by providing solutions to the engineering problems facing the manufacturing sector.

Fig 2.4: The Nyayo Pioneer (www. aada-african-car.blogs)

UGANDA –Presidential support and the birth of Kiira EV

Presidential initiatives are sometimes used in partner states to promote STI. In the case of Uganda, presidential initiatives have been used to support research and innovation in bananas for industrial development, appropriate technologies and technology incubation at Makerere University, and other innovation projects in malaria control and fruit processing.

The Presidential Initiative to support scientists in Uganda can be traced back to around 1999 – 2002 when the Uganda National Council for Science and Technology (UNCST) es-

23 Case studies prepared by E.A Otieno Ndhine (Kenya), Ronald Naluwairo, Nampala Paul, and Julius Ecuru (Uganda) and Remy Twiringiyimana (Rwanda)

tablished a Presidential Award for Scientific Excellence. It is a statutory function for UNCST to recognize outstanding achievements in science and technology, and the Presidential Award is one such mechanism. However, this award was not operationalised until 2004. In 2005 UNCST selected a number of scientists for the Award, and in May 2006, the President presided over the Award-giving ceremony at which nine prominent scientists received plaques, certificates and cash prizes. At this ceremony, the scientists and innovators also exhibited their innovations and during the President's tour of these exhibitions he got interested in the projects, and thus pledged to provide funding for the scientific and technological innovations. This is resulted in the birth of the Presidential Support to Scientists program. In the budget speech of 2006/2007, an initial investment of approximately US$3,200,000 was announced specifically to support malaria research, banana value addition and fruit juice processing. To date, the Presidential Initiative is supporting several innovation projects which among others include the following:

- Banana and other related products processing. This is based on the technology for starch extraction and banana flour processing. The starch is used in confectionary and also in pharmaceutical as a binder. The technology is patented.
- Production and Industrial Application of Phytolacca Dodecandra (PD) to control vector borne diseases. This project is producing a product 'snailtox' which farmers can use to kill snails and prevent the spread of bilharzias.
- The Ecology of Malaria Vectors in Uganda and Control Based on Indigenous Plant Extracts and Larval Pathogens. This project is preparing inventory of biological control agents and also develop-

Fig 2.5: Kiira EV car developed by engineering students at Makerere University, Kampala, which is now on trial.

Fig 2.6 : A prototype of a bus that is being developed by engineering students at Makerere University, Kampala. (Source: Makerere University Digital Library)

ing larvicides.

- Integrated banana juice factory in Uganda. The project was aimed at improving local juice processing technologies and setting up a pilot plant for fresh juice processing from bananas. The technology is patented.
- Fresh Vacuum Sealed Matooke Research Project. The project has a patent on the technology. This project is producing fresh vacuum sealed bananas with shelf life of up to 6 months in frozen state. Other value added products are made such as charcoal briquettes from the peels.
- Malaria Prevention at Household level using Artemisia Annua-Avocado-Lemon Grass blend beverage. The project has a product trademarked ARTAVOL, now almost in the market. The product is used as a herbal tea and prevents malaria. The project has a patent.
- Presidential Initiative Support to Appropriate Technologies. These are a range of innovations such as affordable sanitary pads from local materials, solar systems, interlocking breaks, etc.
- Integrated Intelligent Computer System Project, focusing mainly on have a system to aid diagnoses and treatment of malaria especially in rural health communities.
- Support to innovations at Makerere University College of Engineering, Design, Art and Technology (e.g. the Kiira EV).
- Support to food processing and technology incubation at the School of Food Technology and Nutrition at Makerere University.

Over the years, the Presidential Support to Scientists has been streamlined into Government Support to Scientists, and is expected to become a permanent financing mechanism for research and innovation in Uganda. The UNCST is now managing the initiative although decision-making with respect to certain aspects of the programme remains in the Office of the President.

RWANDA – Race to the top

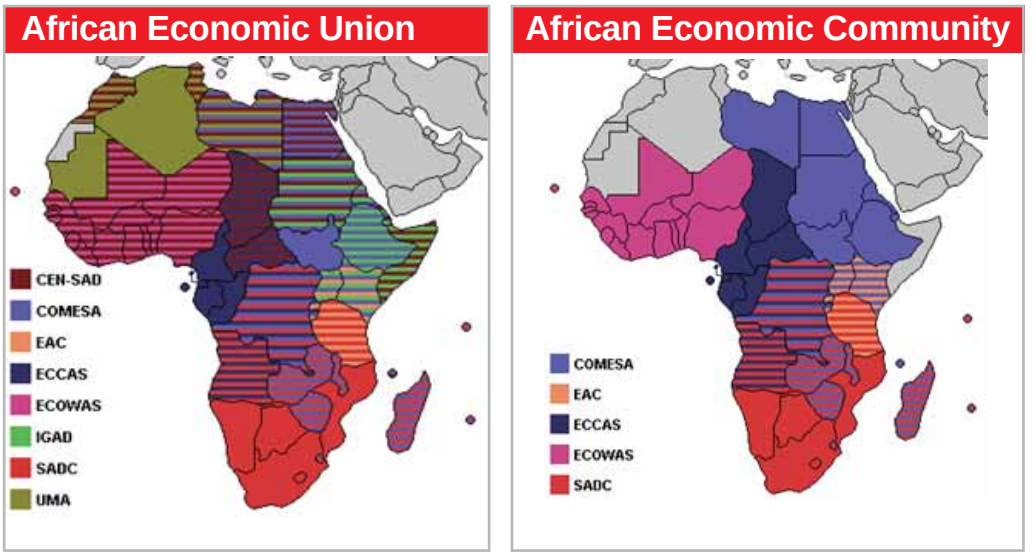
The Office of the President influences the fast implementation of some policies in the area of ST in order to achieve the goals of Vision 2020. Prominent initiatives established through the office of the President include:

- Rewarding best students who perform best in science and Math related subjects in the National Examination of Secondary education: This programme is aimed at promoting science and mathematics in the national examinations at

the secondary school level. The programme offers three levels of prizes: the first category comprises of a presidential scholarships to pursue their studies in the USA Universities the best of the best students in math and science. The second category constitutes prizes for the best students to get full sponsorship to study in local HLIs. In the third category, students get scholarships to cover their tuition and loans to cover living expenses.

- Promotion of girls' education in science and technology fields: Girls with close to the national threshold pass marks, coming from rural areas are admitted and sponsored for Higher Education.
- Rotary University Scholarship Scheme for Rwanda (RUSSR): Under this initiative run in collaboration with the United Kingdom, 18 best students from HLIs in Rwanda in science and technology related fields were enrolled in top universities in Scotland pursue studies leading to the award of Masters of Science. The programme was implemented during the period 2002 to 2008.
- One of the unique aspects of the presidential initiatives in Rwanda is that they have been fully institutionalized and are now implemented through the relevant institutions of Government particularly the Ministry of Education (MINEDUC) through the Rwanda Education Board (REB).

Figure 2.7: Active RECs in the African Economic Union and RECs of the African Economic Community



Generally, the performance of RCAs vary considerably but those that succeed spur remarkable expansion in trade and other areas of cooper-

ation among the Partner States. Variations in performance can often be seen along three basic characters of RCAs: objectives of the integration; balance of power among the states; and political structures and process of decision making among, and within individual member states. Most importantly, extremely skewed balance of power among the member states and antagonistic inter-state relations can hold back the process of regional integration including in critic areas such as trade and, science, technology and innovation.

Balance of Power

Theoretically, the relative size of the countries with regard to geographical area and population, the gross domestic products, the military might and technological capability generally reflect the distribution of power among partnering states. These factors naturally affect the relationships among such countries and in effect determine the level of mutual trust and confidence in negotiating agreements and reaching compromises on the scope and content of regional cooperation. On the contrary, high levels of asymmetry in the balance of power often cause anxiety about the hegemonic tendencies of the partner states that are presumed to be powerful.

The EAC is in a unique position because there is generally less power asymmetry among the EAC Partner States. The only notable exception is Kenya which is presumed to hold a stronger economic position and the other Partner States are concerned about its potential economic hegemony within the Community. Other sources of asymmetry such as the size of area and population are compensated for by the presumed benefits of integration. Most importantly, differences in STI capabilities and readiness are not so pronounced to affect the balance of power among the Partner States. Consequently, deepening cooperation in STI presents a unique opportunity for the EAC countries to mitigate the potential negative impacts of power asymmetry.

National Decision Making

Regional integration in all its dimensions is further affected by the process of decision making by the partnering states. The logic of integration is sometimes based on the assumption that within a state, there is an identifiable decision maker who is responsible for giving a go or –no go decision on all matters regarding the integration process. On the contra-

ry, the decision to participate in regional integration is dependent upon a host of actors and hence the need to balance political and technocratic considerations with the policy preferences of a variety of constituencies.

Within the EAC Partner States, the Executive supported by the public service technical agencies are the main drivers of the regional integration process. At the moment, there is no evidence to suggest that the legislatures of the Partner States play a significant decision making role in the decision-making process of the Community. Indeed, all the key decision organs of the Community – the Summit, the Council of Ministers and the Coordination Committee draw their membership from the members of the Executive and the public service.

More importantly, major constituency groups such as traders, farmers, professional bodies and civil society continue to play a peripheral role in the decision-making process regarding regional integration. There is no compelling evidence to suggest that the "people-centeredness" principle enshrined in the preamble to the Treaty has been actualized. The potential implication is that regional cooperation on STI issues will be pursued largely as a political and technocratic process without the full participation of key constituency groups such as scientists, R & D institutions, students and science policy practitioners outside the formal bureaucracy.

The Role of Governments and Independent Policy Think Tanks

The pursuit of regional integration and its ultimate benefits are not often visible at the inception of the regional integration process. Indeed, regional cooperation involves some erosion of policy autonomy and therefore results in national loss of power and authority in the short-term. There is always potential tension between regional integration institutions and national institutions which ultimately may have to surrender power and authority to the regional structures.

The existence of strategic independent policy think tanks generating and providing evidence-based research and analysis can provide critical support to governments in their pursuit of regional integration. Civil society can also play a major role in mobilizing

citizens to engage in STI activities. The existence of such policy think tanks and citizens' groups can exert significant influence on decision-making through their domain expertise and as opinion-shapers in the public space. Indeed, some of the more advanced areas of regional integration, especially trade, have been advanced through the strong leadership of governments and constituency groups such as the East African Business Council (EABC). Consequently, there is need to develop indicators on how to assess the role of independent policy think tanks and civil society in the development of science, technology and innovation.

Conclusion

The commitment to regional integration creates a new political dynamic that fundamentally affects the governance of science, technology and innovation in the Community. This is because the different levels of integration: customs union, monetary union and ultimately political federation will fundamentally alter the decision-making structures of the Partner States in all areas of development endeavour including in matters of science, technology and innovation.

While the Treaty provides a tremendous opportunity for strengthening cooperation and accelerating the pace of development of science, technology and innovation in the Community, there remain fundamental policy questions that need to be resolved through further negotiations. For example, will regional STI institutions take precedence over national institutions? Can regional policy commitments and targets be a basis for measuring STI progress at the national level? Are the realignments of national STI policies and programmes a matter of voluntary compliance or requirements for strict compliance with the Treaty commitments. Amidst opportunities for STI cooperation, all these questions present unique challenges for STI policy-making and implementation at all levels. In the rest of the chapters of this report, we explore these and several questions and reflect on the future governance of science, technology and innovation in the Community and the changes that may be required to enable the Community pull ahead in the race for knowledge-based and innovation-driven economy, politics and society.

Fig 3.1: Rwandan school children have taken to using computers under the government's One Laptop per Child programme. The programme is intended to position Rwanda as an ICT hub in the region by inculcating ICT knowledge into the young generation. (Source: The Independent Publications)

3

A Framework for Analysing the Governance of Science, Technology and Innovation in EAC

Introduction

In Chapter Sixteen of the Treaty Establishing the East African Community, the Partner States set out an ambitious agenda to cooperate in the areas of human resources, science and technology. Under article 102 dealing with human resources development, the Partner States commit to cooperate in a wide range of issues including: coordination of human resources development policies and programmes; establishing common research and training institutions; industrial training, and harmonization of the education curriculum, among others. In article 103, the Partner States restate their recognition of the fundamental importance of science and technology in economic development.

From the onset, it is important to recognize that the EAC Treaty is in many ways a framework with "best endeavour clauses", statements of intent on issues and areas that the Partner States intend to cooperate on. The finer details of the cooperation are to be developed through the Treaty implementation processes. There are a number of initiatives to promote the implementation of various STI provisions of the Treaty. These include the process to establish the East African Science and Technology Commission (EASTECO) whose remit is to promote regional integration in the development, management and application of STI in the Community. The EASTECO is expected to be the main regional agency through which the Partner States will develop and implement common STI policies and programmes.

Fig 3.2: Busia Information Centre near the Uganda-Kenya border. Increasing use of information technology has made trade easier as people can access market information, pay taxes or make orders on line. (Uganda Communications Commission Library)

This chapter introduces the notion of 'governance of STI' and lays out a framework for analysing the governance of STI in the East African Community. It is based on the premise that the establishment of regional STI programmes and institutions as well as any other efforts at promoting STI in the context of EAC integration should be based on a good understanding of the political and economic governance of the individual Partner States and the Community as a whole. It is argued that conventional approaches such as measurement of expenditure on R&D and innovation activities or even measurement of outputs of scientific enterprises tell us very little about the quality and effectiveness of policies and institutions for STI. These approaches also focus on a narrow range of institutions for STI and fail to treat STI as part and parcel of socio-political and economic systems within individual partner states and the region as a whole.

Therefore, this report does not overly rely on the orthodox approaches that focus on input-output indicators (facts and figures) of assessing the status and productivity of STI in economic systems. It is more concerned with the role of institutions of government, politics, civil society and private sector in promoting the development and application of STI to achieve economic integration and human development. This is not to ignore such indicators as expenditure on R&D, human resources, scientific outputs and other input-output variables. This report examines these indicators in a broader context of what forms of governance enable or will enable the EAC Partner States individually and collectively to engage with STI for integration and development.

It focuses on more qualitative inputs into and outputs of the five national STI systems as well as how these systems can organically grow into one EAC STI system. Indeed, governance of STI is more concerned with issues such as (a) what kinds of policies and institutions have EAC countries formulated and are the policies being implemented and are institutions functioning? (b) what actions are the countries individually and collectively taking to implement STI provisions of the Treaty establishing the EAC and its Protocol on Science, Technology and Innovation? and (c) the roles of various state and non-state actors in promoting STI for regional integration and human development in the EAC.

Science, Technology and Innovation defined

What is meant by science, technology and innovation or the governance of STI? The three words – 'science', 'technology' and 'innovation' -- and even the abbreviation 'STI' are these days commonly used in academic literature, official government policy documents and reports. Their usage has become so common that it is often easy to ignore asking what their precise meanings are. Nowadays, the three words are replacing S&T (science and technology) and R&D (research and development) that have often been titles of policy documents from ministries or departments of education, science and technology. Many policy-makers and even practitioners in the EAC and elsewhere rarely step back to ask what constitutes STI. It is commonplace to refer to STI

Fig 3.3: AGROBIOTEC, a privately owned tissue culture laboratory in Bujumbura.
(ACODE Digital library)

Fig 3.4 New hybrid banana varieties in a nursury at Kawanda Agricultural Research Institute in Uganda. The institute is breeding high yielding and disease-resistant crop varieties using biotechnology. (Lominda Afedraru)

in singular. It is also common to find STI being used interchangeably with R&D in many policy documents and some academic literature.

'Science' is the systematic inquiry into nature and natural things. It is about gaining a deeper understanding or knowledge of the world. 'Technology' is the application of science to modify natural things. Most people, however, tend to think of technology only in terms of hardware or artefacts such as computers. But technology is more than tangible products. The processes used to develop and use technological artefacts also form part of technology. In the majority of cases, technology is confused with innovation. For the purposes of this report, we take the definition of 'innovation' which postulates that innovation is the introduction and diffusion of new ideas, processes and ways of doing things into an economy, society or institution. It is also about the introduction and diffusion of new organizational practices such as improved communications and new marketing techniques.

Indeed, a significant body of the literature defines the term innovation in many different ways. In its broadest sense, the concept of innovation is used generously to refer to forms of changes in processes, institutions, products and social systems. In its narrower sense, and the way it is used in this report, the concept of innovation is used to refer mainly to modern technological innovations that are a result of technological change processes.

STI are coupled and interrelated. Scientific advances are the basis for much of technological developments. For instance, the design of computer chips depends to a large measure on scientific understanding of electrical properties of materials such as silicon. But, technology is also the basis for many of

the scientific research activities. For example, climatologists and meteorologists use supercomputers to run simulations and study climate change. Most scientists cannot operate without the computer, telephone and the Internet.

The Changing Landscape of STI Policy

The context and character of STI policy-making are changing rapidly as a result of or due to forces such as globalization, rapid scientific and technological developments, emergence and growth of civil society, increasing role of private sector in economic governance, and several other geopolitical changes. Globalization and related regionalization of economies are changing the locus of STI policy-making. STI policy-making is increasingly becoming regional and international. This does not mean, however, that national STI policy-making is being displaced. No. There are STI policy issues that were largely or exclusively dealt with at national levels that are now being handled at regional and/or international levels.

The opening up and integration of economies—a phenomena of globalization—is also changing the landscape of STI policy-making. Countries or nation-states can no longer formulate and implement STI policies that just focus on domestic economic goals. STI policies have to be based on principles of economic interdependence among countries. This relates to such issues as the protection of intellectual property, foreign direct investment and trade. One country's STI policies must recognize economic interests of others.

Another major change in the context of STI policy-making relates to the increasing participation and influence of non-state actors, particularly civil society and private sector. Geopolitical changes and political democratization across the world have opened up public policy-making to greater scrutiny by non-governmental organizations, think tanks, private companies and even donors. Government departments and/or ministries of science and technology do not have exclusive control of and cannot easily keep non-state organizations out of policy processes or even related events. Non-governmental organizations, private sector and other non-state actors are increasingly major source of STI information for policy, and many are actively involved in science for policy as well as in the formulation and implementation of policies for STI. The number of actors with various or diverse vested interests in STI policy-making processes has increased, making the management of the processes more complex. National governments require capacity to engage with non-state actors as well as engage them in

Fig 3.5: The EAC STI Panel of Experts during a visit to the Faculty of Agronomy (FACAGRO) at the University of Burundi on August 1, 2012. FACAGRO conducts research in biotechnology in the areas of phytopathology, plant breeding and biofertilizers.
(Source: Acode Digital Library)

policy processes.

The participation of private sector in STI policy-making is critical today more than before for a range of reasons. First, private sector's investment in R&D in areas such as biomedicine and pharmaceuticals, agriculture, mining and information and communications surpasses that of government in many countries of the world, particularly in the industrialized and middle-income countries. For example, in South Africa the private sector accounts for at least 50 per cent of total national expenditure for R&D. The private sector is also undertaking in-house R&D and technology development activities. It is a source and owner of innovations, and holds a large share of the world's patents. Private sector plays an important role in a country's choice of R&D, procurement and diffusion of technologies, and thus is one of the loci of STI policy-making. Governments need to design mechanisms for public-private cooperation or partnerships.

Science, technology and innovation policy-making is also becoming for more complex because of its growing knowledge and information intensity. Many issues involving STI require access to and use sophisticated knowledge and empirical data, and thus expert institutions and individuals have to play a greater role than before in policy making processes. Governments departments or ministries require capacity to identify and engage relevant skilled individuals and expert institutions.

Science, technology and innovation policy converges with numerous other policies such as environment, agriculture, transport, defence, industry and health. This means that many non-STI institutions have to get involved in policy-making on STI issues and vice-versa: STI policy institutions have to be involved in a wide range of other policy regimes. This makes STI policy making even more complex.

The relationship between STI and regional economic and political integration is not adequately considered in both theoretical and policy analysis literature. Indeed, there is a paucity of conceptual and policy discourse on how STI impinges on regional integration and vice-versa. Few attempts at exploring the relationship have tended to focus on the how a single technology or technological system such as information and communication technologies (ICTs) can be used to fast-track integration of economies.[24] There has been some work albeit without clear conceptual frameworks, focusing on how regionalism can be used to promote STI for development.[25] This chapter does not purport to design a conceptual framework for studying the relationship of STI and regional integration. However it assembles various facets of the relationship.

The relationship between STI and regional integration is non-linear and complex. STI are promoters of regional integration and the integration of national economies can also promote STI.

Regional integration—the process of opening up and integration of national economies—is largely driven by science (knowledge and information), technological change (introduction, diffusion and application of technologies) and innovation (introduction new products and services as well as new ways of doing things). It is dependent on STI. Consider that ICTs, for example the diffusion and application of these range of technologies—e.g. mobile phones, computers, email and the Internet—have improved and intensified communications within and between communities, countries and continents. Today it is relatively easy and faster to move information, money and even hardware from one country to another compared to three decades ago.

24 See, for example, Akpan, P. and Parmentier, J. (2007), 'Information Communication Technologies and Regional Integration: Africa and South America'. Proceedings of the 9th International Conference on Social Implications of Computers in Developing Countries, Sao Paulo, Brazil, May 2007.

25 See, for example, Mugabe, J. 'Regionalism and science and technology development in Africa' in Louk Box and Rutger Engelhard, eds., (2006), *Science and Technology Policy for Development: Dialogues at the Interface*. Anthem Press, UK.

The increasing imperative to cooperate in the pursuit of economic objectives calls for a closer examination of the relationship between regional integration and cooperation, development and ICTs. The

Box 2: mPesa: transforming access to financial services

mPesa is a Swahili word for mobile money, a cell-phone-based money transfer service developed by Safaricom. Safricom is a wholly owned subsidiary of Vodafone Group plc, a company incorporated in England. mPesa was registered in Kenya on April 5, 2007 with an expiry date of November 2, 2016.

Fig 3.6: An illustration of mPesa.
(www. safaricom.co.ke)

mPesa is an important technology that facilitates financial transactions where the service allows users to deposit money into an account stored on their cell phones, to send balances using SMS technology to other users and to redeem deposits for regular use. mPesa users are charged a nominal fee for sending and withdrawing money using the service, hence making it one of the cheapest financial service systems for low-income earners. It has been estimated that the product had over 17 million users in Kenya as of 2012.

Unlike traditional banking money transfer services, mPesa transactions are made instantly to both users by using SMS technology. The technology is convenient, secure and cost-effective. mPesa is particularly relevant in EAC countries where there is less penetration of traditional finance infrastructure such as banks. The introduction of mPesa has revolutionalized financial transactions in the sub-region and its potential to capture a share of the money transfer market is clearly evident. mPesa is now used to pay for shopping in supermarkets and payment of utility bills reducing time wastage in terms of cuing and allowing users to avoid cash transactions. The technology has also stimulated the development of spinoff enterprises creating new opportunities including jobs for the youth.

Case study prepared by: Charles Bhariti, Kenya Industrial Property Institute (KIPI)

technologies have become a key variable because all regions, including industrialized economies are deepening their integration through these technologies as well as using them as tools for economic growth. As a result, it is no longer tenable or, indeed, useful to approach the questions of regional integration, economic development and ICTs as discrete research fields.[26]

What Governance of STI Means

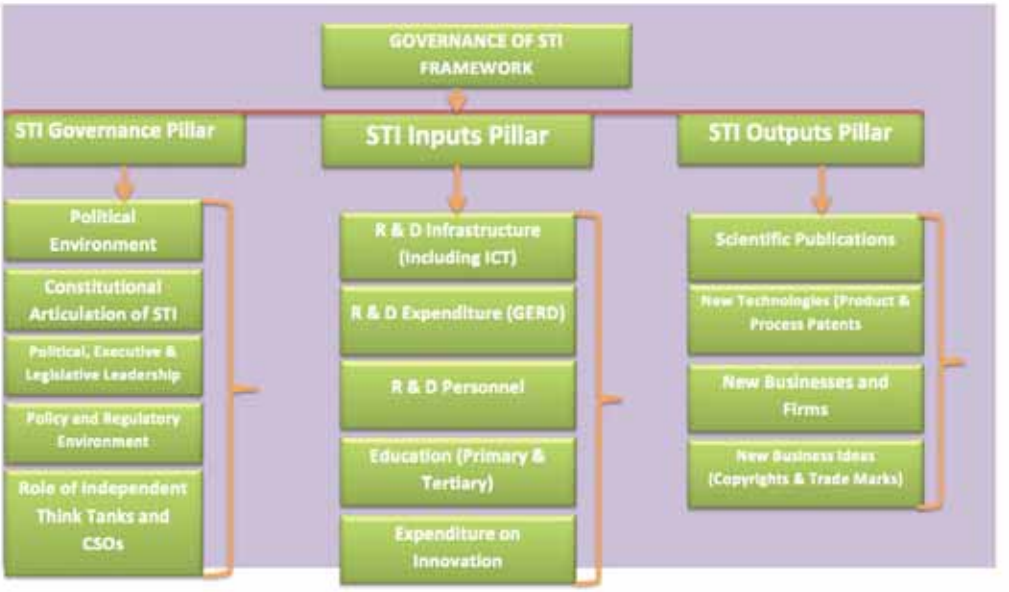
Then what do we mean by 'governance of STI'? Let us start by discussing what governance is. The word governance is used generally in the lexicon of many policy-makers and documents as well as the general public. It is sometimes used to refer to government and sometimes to the management of public affairs of a State. There are numerous publications on governance and its relationship with development. However, there is no common or agreed upon definition of governance. The EAC Treaty in Article 6(d) states thus: "The fundamental principles that shall govern the achievement of the objectives of the Community States shall include: …. good governance including adherence to the principles of democracy, the rule of law, accountability, transparency, social justice, equal opportunity, gender equality, as well as the recognition, promotion and protection of human and peoples' rights in accordance with the provisions of the African Charter on Human and Peoples' Rights."

The East African Court of Justice defines governance in the following terms: "Governance refers to the organization of society and management of its affairs. Governance can be good or bad. The expression "good governance" appears to be a fundamentally political, philosophical and elastic subject; it connotes sound management of societal affairs and what that entails."

Given that there is no generally agreed standard definition of the concept of governance, our task is to ensure that the concept is appropriately used as a conceptual metaphor for studying STI in the Community, and particularly how economic and political integration can be used to promote the development and wise use of STI for human development. Thus 'governance of STI' refers to the design and effective use of specific norms, rules and agencies (or organizations) to promote the development and application of STI across all aspects of the economy and society. It is about the configuration of policies,

26 Akpan, P. and Parmentier, J. (2007), 'Information Communication Technologies and Regional Integration: Africa and South America'. Proceedings of the 9th International Conference on Social Implications of Computers in Developing Countries, Sao Paulo, Brazil, May 2007.

Fig 3.7: Analytical framework for governance of STI.



laws and agencies in a manner that ensures a robust and forward-looking STI agenda, and ensuring the requisite leadership to achieve full implementation of that agenda. Governance of STI also refers to the quality of interactions among various state and non-state actors and their ability to make and implement policies for STI, and facilitate the design and implementation of STI programmes through effective coordination, collaboration and mutual accountability.

Governance of STI has the following facets:

- Normative—overall political and economic context, including political ideologies on STI, the nature of policies, articulation of STI issues in national constitutions, and regulations and laws for STI. The policies, regulations and laws cover such aspects as how to set priorities for and, allocate as well as use resources for R&D and innovation;
- Organizational—the existence, quality and configuration of public agencies that are established to undertake R&D and innovation activities; state agencies for formulating and implementing policies, regulations and laws; legislative bodies for determining budgets for STI as well as for ensuring executive accountability; judicial agencies participating in interpreting STI-related legislation; and political institutions and civil society bodies that participate in setting priorities, monitoring and evaluating the implementation of STI programmes.

The Governance of STI can be assessed using at least six indicators. These are: (a) political conditions or environment of the countries within the regional block and whether an environment exists to enable strong

leadership and certainty; (b) articulation of STI issues or considerations in national constitutions and regional treaties and protocols; (c) the existence and quality of political, executive and legislative leadership for STI; (d) existence and quality of policy and regulatory instruments and related agencies for implementation or enforcement; (e) the existence and vitality of independent STI or related policy think tanks; and (f) existence and vitality of STI policy advocacy and watchdog agencies of civil society. Below we discuss how each of these indicators should be applied when assessing the governance of STI in the EAC.

Fig 3.8a: Ugandan MPs visiting Pipeline Design & Foam Industries in Kampala in November 2012. (JIMMY SIYA)

Fig 3.9b: Plastic products from recycled polythane papers made possible by new technological applications. (JIMMY SIYA)

Indicator 1: Political Environment

Good political conditions of individual countries and the EAC as a whole are very important determinants of whether and how well STI are developed, harnessed and deployed to achieve economic growth, human development and regional integration. By good political environment we mean the existence of peace, political stability and certainty, political liberties and competition, rule of law, and in general democratic governance in each of the five Partner States of the EAC. These elements determine whether each of the countries and the region as a whole can formulate and implement good STI policies, create and fund programmes for R&D, nurture technological innovation and ensure that STI are applied to human development. In the absence of these conditions, it is not conceivable that there can be even development and deployment of STI and the potential for cooperating as envisaged under the Treaty will be diminished.

Indicator 2: Articulation of STI in National Constitutions

National constitutions are the overall and highest policy instruments for the governance of countries. They are often outcomes of political consensus on key aspects of national life and

Fig 3.10: President Yoweri Museveni inspects products made using technology developed by students of Faculty of Food Science & Technology at Makerere University. (Source: Presidential Press Unit)

development. Good constitutions are expected to be frameworks that guide all other national policies and laws and should create predictability and certainty in the management of a nation's affairs. Whether and how well nations' constitutions explicitly articulate the role of STI in national governance is an important indicator of how serious the country recognizes STI as sources of change, growth and development. Constitutional provisions on STI—whether explicit or implicit—should always set the tone of a country's STI policies and programmes. They should be used by the citizenry to invoke governments to establish policies, institutions and programmes for STI. Constitutional provisions on STI are good indicators of the governance of STI.

Indicator 3: Political, Executive and Legislative Leadership for STI

A country's focus on and investments in STI programmes are to a large extent determined by its leadership. National leaders—presidents, prime ministers, members of the legislatures, ministers and leaders of political parties—either directly or indirectly influence whether a country takes STI seriously, what kinds of STI policies are formulated and implemented, what kinds of financial investments are made in STI programmes, and even what specific development priorities STI are deployed to. Thus, it is important to establish whether a country's leaders are actively engaged in promoting STI for national development. This can be done by determining whether the leaders have initiated any

programmes, legislation and policy processes to support or promote STI and their application to development.

Presidents can demonstrate direct political support for STI in a number of ways. First, public statements in support of STI can be used as a basis for the promulgation of relevant national policies as well as the allocation of the necessary budget resources. Secondly, Presidents may also come up with specific initiatives that directly support STI programmes or the application of STI to development. Although the efficacy of such initiatives and their implications for overall public policy on STI have not been fully evaluated, a review of such programmes may provide useful insights on the nature of political support for STI in a particular country.

Besides presidential leadership, ministerial leadership as well as the leadership of key executive agencies is important for accelerated development and regional integration on STI matters. There are a number of indicators that can be used to measure ministerial and executive leadership of STI in each of the countries. These include: evidence of retention of portfolio over a period of time (5- year term) and participation of ministers responsible for STI in the relevant meetings of EAC.

Within the EAC, there are two main levels where the role of parliamentarians can be assessed. At the regional level, the East African Legislative Assembly (EALA) is the main legislative organ on EAC matters. As a regional legislative assembly, EALA can provide legislative leadership in defining common principles to guide the development of national legislation governing STI. Besides the enactment of regional laws in the form of the Acts of the Assembly, EALA can also influence the development of STI through appropriate resolutions and the work of its specialized committees.

National parliaments are also positioned to play a significant role in defining the trajectory of STI at the national level. The most important contribution can be made in the form of enacting appropriate and forward looking legislation that supports and rewards innovation, innovative firms and individuals. Through legislation, Members of Parliament are able to provide the necessary incentives through strategic application of key policy instruments such as tax policy, safeguards, procurement, and competition policy. Legislatures that have appropriate control over the budget can also use the budget as a policy instrument to direct public resources towards key STI areas and priorities.

Indicators that can be used to assess whether and how well national parliaments and the EALA are promoting STI include: (a) number of laws enacted with provisions on STI; (b) number of motions or resolutions of parliaments on STI issues; (c) existence and output of specialized committees or parliamentary groups on STI; and (d) number of meetings held by the committees and the relevance of committee reports to major STI indicators.

Indicator 4: Policy & Regulatory Environment

Policies and regulations—whether national or regional—are critical for the development and application of STI. Policies embody priorities and courses of action for promoting STI while regulations influence whether and how STI are developed and deployed in society. Regional and national status of STI capabilities is guided by or based on its policies and regulations. Some policies and regulations may be STI-promoting and others may be inimical to STI advancement. Some policies and regulations may restrain private companies from funding R&D and innovation activities while others may create incentives for private investment in STI. Similarly, the absence of policies and regulations on such issues as intellectual property protection and bio-safety may act as disincentive for private sector investment in STI. Thus the quality of the policy and regulatory environment is an important indicator for assessing governance of STI. The quality of the policy and regulatory environment can be determined by focusing on factors such as: (a) whether explicit STI policy regimes e.g., national STI policy and strategies exist; (b) business regulations, e.g., process and timeframe for creating new firms; and (c) existence of IPR legislation.

Indicator 5: Existence & activeness of STI policy think tanks

Agencies for independent policy research and analysis are critical sources of evidence, alternative policy options and guidance for national and even regional STI policy formulation and implementation. These agencies are normally independent think tanks operating outside the purview of governments. In fields or policy domains such as environmental policy, social policy and political governance, think tanks have made remarkable progress in stimulating and guiding processes of formulating and implementing policy reforms. They have done this at both national and EAC levels. To assess governance of STI in the EAC, it is important to (a) determine whether and which independent STI policy think tanks exist (b) what specific STI policy issues or areas the think tanks work (c) the vitality and effectiveness of these agencies and (d) the institutional scale—whether national, EAC or international—of their operations.

Indicator 6: Existence & activeness of STI policy watchdogs

In addition to think tanks, the formulation and implementation of STI policies or even the use of STI for policy requires agencies that effectively engage in monitoring and evaluating policy processes and outcomes. We refer to such agencies as STI policy watchdogs. To assess governance of STI in the EAC it is important to (a) determine whether and which STI policy watchdogs exist (b) what specific STI policy issues or areas they advocate for and monitor (c) the activeness and effectiveness of these watchdog agencies and (d) the institutional scale—whether national, EAC or international—of their operations.

From the above analysis, it should be clear that governance of STI is about a range of processes and activities that include how policies are formulated and implemented, and how agencies (both state and non-state) are organized and operate to promote STI. Governance of STI is obtained at local, national, sub-regional, regional and international levels. The biennial assessment of governance of STI focuses on the national and EAC level to examine how national level governance of STI relates to or even is consolidated into an EAC-wide STI governance system that seeks to create systematic reforms, programmes and initiatives to implement the relevant provisions of the Treaty.

Related to the concept of governance of STI is that of 'national systems of innovation'. The concept of national systems of innovation refers to interactions and interdependence of agencies as well as policies of a country or region in nurturing R&D and innovation activities. It "presumes the existence of nation states and this phenomenon has two dimensions: the national-cultural and the etatist-political." This means that national systems of innovation approach is increasingly being accepted as a useful framework for understanding the innovative capacity of countries and regions around the world. Some developing countries are starting to adopt and use the concept of national systems of innovation. However, countries of the EAC have not adopted the systems of innovation conceptual metaphor or at least it is not being used in their STI policy documents.

Complimentary STI Indicators

The indicators that measure governance of STI as described above do not tell us whether governments go ahead to make appropriate investments in promoting STI and what are the dividends of such investments. In many cases, failure to achieve tangible progress in building the innovation capabilities of national and regional economies has less to do with the absence of formal policies and political pronouncements, but whether those policies are actually

implemented. In addition to the governance of STI indicators, this inaugural edition of the EAC STI Outlook Report will also provide empirical data and information on key inputs into and outputs of the STI systems of the EAC Partner States.

The Inputs into the STI System

The input side of the STI system comprises the investments in knowledge creation and diffusion. The bulk of the indicators that measure inputs into the STI system are built around two main issues: Research and Development (R & D) and human capital. Research and Development is generally defined to encompass creative work undertaken on a systematic basis in order to increase the stock of knowledge and the use of this stock to devise new applications.[27]

Research and Development

The first approach to measuring inputs into the STI system is to consider the expenditures on R & D. Indicators to measure R & D expenditure cover the following issues: development of total financial resources dedicated to R & D; evaluation of expenditure on R & D; and focusing on identifying specific trends in the development of total financial resources dedicated to R & D over a period of time. Such data can tell us which countries are putting more emphasis in developing their STI capacity as compared to the rest of the countries in the Community.

The second question to consider from the perspective of investment in knowledge creation is: who invests? In this regard, a distinction is made between public and private investments. The approach of this report is to progressively address a number of critical issues regarding the input side of STI. First, the report analyses trends in the overall levels of expenditure on R & D in the countries of the EAC. The report further examines and compares recent trends in R & D intensity. Other inputs considered by the report will include the structure of R & D as well as human resources in science and technology. Efforts are made to present information on researchers, R & D personnel as well as university students in science and technology as the key indicators for human resources in science, technology and innovation.

However, it is important to recognize that while these input indicators are important sources about the content and direction of technological and innovation endeavour, their ability to measure the general innovativeness of the

27 OECD (Organisation for Economic Cooperation and Development) (2002). *Frascati Manual. Proposed Standard Practise for Surveys on Research and Experimental Development*

Fig 3.11: Ugandan Education Minister Jessica Alupo inspecting low cost sanitary pads made using technology developed by Makerere University engineering students. (Source: Makerere University Digital Library)

economy is rather limited. In many ways, the input indicators do not provide compelling explanations of key trends in innovation activity, economic growth and the productivity. This is why a complementary set of indicators that can be collectively referred to as the output-side indicators are important in order to provide a fuller picture of innovation trends in a particular system of innovation.

The outputs of the STI system

The measurement of the input side of STI by looking at indicators such as expenditure on R & D only provides insights in the differences in efforts of countries to promote innovation activities. Indicators related to human resources also provide indications with regard to the accumulation of knowledge within a country or a particular system of innovation. Countries that invest in systematic evaluations of R & D often tend to put more emphasis on examining inputs rather than the actual innovation performance of the economy. The output or productivity of a functioning innovation system manifests itself in new knowledge, new products introduced to the market, and new production processes employed in the production of goods and services. In order to fully grasp the full characteristics and efficacy of a national innovation system, one must look also to the results or outputs of the system.

Most of the standard indicators for measuring outputs of the STI system are

based on the Frascati Manual and Oslo Manual and a growing scholarship on innovation systems.[28] In this context, there are at least three main indicators that are used to measure the outputs of the innovation system.

Intellectual Property Products

The first of these indicators is the use of patents, copyright and trademarks data. A patent is an intellectual property right (IPR) used to protect technological inventions. The underlying presumption is that a patent system enhances appropriability of inventions, hence giving investors and innovators incentives to create new technological products and processes. Because patents are products of innovation, it is possible to measure a country's innovativeness by looking at the trends in patent applications and grants by the nationals of that country. Trademarks registration and trends data can tell us the level of innovativeness of the population since their business ideas are captured in the form of trade and service marks.

Bibliometric Data

The second indicator is the use of bibliometric data. Bibliometrics are a statistical analysis of scientific publications which highlight the extent and distribution of scientific output in a given field as well as the contributions of specific institutions or individuals. Bibliometrics indicators generally focus on the output of research activity undertaken primarily in universities and public research institutes and address both the quantity and quality of such activity on an assumption that researchers publish their main research results in publicly available literature. In this regard, bibliometrics are a set of analytical concepts and methods used to measure the regularities, structure, dynamics and institutional setting of written knowledge in the research system often reflected by the frequency with which a particular publication is cited in subsequent publications within the same or related fields.

The major weakness of using bibliometrics is that it is based on the premise that the ultimate objective of scientific effort is knowledge production and that this is reflected in relevant literature. It is also worth noting that different scientific fields publish and cite prior work differently. There are also issues of language bias in selected journals and periodicals especially where the language of instruction and scientific communication is not in English. Furthermore, bibliometrics data refer to only productive experimental or labora-

28 OECD (Organisation for Economic Cooperation and Development) (2002). *Frascati Manual. Proposed Standard Practise for Surveys on Research and Experimental Development; and* OECD (2005). *Oslo Manual. Guidelines for Collecting and Interpreting Innovation Data*

tory work, leaving out innovations in important fields including computation or software development. It should also be noted that extended periods of time often elapse between reporting a given research project result and adequate recognition of its value.

Information on scientific publications can be readily accessible through standard indexes such as the Science Citation Index or the Scopus database. The Africa Innovation Outlook 2010 used the Scopus database as the primary source of data for its bibliometric analysis. To ensure consistence with the ASTII initiative, the EAC report on the governance of STI in the EAC will use the same database. However, like with patents, publications tell more about the capabilities of the science system than the ability of the system to create new technological products and processes.

Production of Goods and Processes

The third approach to measuring the outputs of an innovation system is to identify innovative outputs by tracking changes in the product mixes and sales from new or changed product. The Eurostat Community Innovation Surveys take this approach. However, for the EAC, the unavailability of data is a major challenge to using such an indicator. To overcome this challenge, the EAC STI Outlook Report focuses on the set of intellectual property rights that are clear expressions of innovation outputs. The report therefore analyzes trends in the applications and grants of certain IPRs including trademarks, copyrights, plant breeders' rights and geographical indications. Again, data on these rights is still scanty or largely maintained in an irretrievable manner. The inaugural edition of the report will therefore provide a baseline for tracking such data and information.

Conclusion

The articulation of a regional agenda on STI in the Treaty Establishing the EAC is a fundamental building block in building a foundation for accelerated progress in this area at both the national and regional level. However, this report emphasizes the utility of establishing robust governance systems in terms of an appropriate political environment, policy environment and the attendant political leadership. Effective governance is at the heart of any STI agenda and directly impacts on the inputs into and outputs from the STI system. In the next chapter, we explore in greater detail the scope and content of the commitments and obligations of the parties under the EAC Treaty and the implications for regional integration and development of STI within the Community.

4

Legal and Institutional Framework for Co-operation in Science, Technology & Innovation

Introduction

Science, technology and innovation (STI) are the essential foundations of knowledge-based economies and are important at all stages of development. Competitiveness of national economies is in a large measure defined by: capacity to undertake scientific and applied research; to develop, transfer and introduce new technologies and innovations into economic structures; the ability of firms and businesses to develop new products, services and processes; and innovations in design, marketing and organizational leadership. It is therefore instructive to see that the EAC Treaty dedicates considerable text to articulate a regional integration and cooperation agenda on STI.

The emphasis on research, science and technology is clearly highlighted in the extensive use of these terms. The term research is mentioned nine times, science ten times, while technology is mentioned 15 times throughout the treaty's 153 articles.[29] Besides, Chapter 15 which is exclusively dedicated to cooperation in the development of human resources, science and technology, these terms are used in about ten other articles. Clearly, the extensive usage of these terms in the EAC treaty demonstrates the growing consciousness of the important roles played by science, technology and innovation in social, economic, political and human development.

29 It is important to note that in spite of the extensive reference to the goal of promoting innovation in national policies of the partner states, the term innovation is not used in the treaty.

Fig 4.1: A milk processing plant owned by Inyange Industries in Kigali, Rwanda. Investments in technology will boost East Africa's industrial sector. (Source: The Independent Publications)

This chapter examines the evolution of the legal and institutional regime for the governance of STI in the Community. The relevant provisions of the Treaty and other instruments as well as the organs of the Community combining to set the framework for the governance of STI are also examined.

Evolution of the Discourse on STI in the Context of the EAC Treaty

The most significant step towards the revival of the EAC can be traced to the first meeting of the Heads of State of the original EAC countries on November 22, 1991 where agreement was reached to re-activate and deepen cooperation among the three countries in the political, economic, social and security fields. This meeting mandated the ministers for foreign affairs to define in detail the form and character of the revived cooperation. At their meeting in 1992, the ministers agreed to proceed to work on two important instruments that ought to be the starting point in analysing the genesis of the discourse on STI in the Community.[30] First, a Tripartite Committee of Experts was tasked to draw up common text containing the identified areas of co-operation. Secondly, the Committee was also tasked to draw up an agreement for the establishment of the Permanent Tripartite Commission for Co-operation among the three States.

30 The ministers met in Nairobi, Kenya on January 9-10, 1992

Fig 4.2: Waste derived from sisal decortication used in the production of biogas in Tanga region, Tanzania.(www.unido.org)

Fig 4.3: A demonstration of a bicycle-powered Smart Charger used to charge mobile phones at the University of Nairobi. (http://www.voanews.com)

The Permanent Tripartite Commission was established in Arusha, Tanzania, in 1993.[31] In the same year, the three States adopted a common text (Common Text) outlining the areas where they would pursue cooperation.[32] The areas of cooperation were classified under five broad categories: political, security, legal and judicial, economic and, social and cultural. Although issues of science, technology and innovation were not prominent in the Common Text, it was already apparent that cooperation in this area was a matter of necessity if progress in the agreed areas was to be attained.

General references to STI in most of the agreed areas, are more apparent under the economic pillar. In particular, the Common Text recommended co-operation in the "development of sustainable industrial and technological ca-

31 The Commission was formally established in Arusha, Tanzania on November 30, 1993

32 See Common Text on the Identified Areas of Co-operation Between the Republic of Uganda, the United Republic of Tanzania and the Republic of Kenya, th November 30, 1993, Arusha, Tanzania.

pability" as part of the effort to develop the industry sector in the Community. Emphasis on STI is also explicit in the areas of cooperation in agriculture and animal industry, and energy. Under the social and cultural pillar, the Common Text outlines a wide-ranging science and research agenda covering a many areas including agriculture, industry, health and environment.

Since the adoption of the Common Text, the increased focus on science and technology has been evident. In its development strategy adopted in 1997, the EAC placed the development of technological capacity among its top four priority policy orientated programmes.[33] Although the strategy articulates the development of technological capacity in broad terms, emphasizing the attainment of high levels of literacy among the Community states, it provides a snapshot into the future development of the STI agenda of the Community. Indeed, by the time of the 13th meeting of the Permanent Tripartite Commission in 1999, there was already consensus on the need to take concerted measures to accelerate the development of science and technology within the Community.[34] It is this consensus that is clearly reflected in the final text of the Treaty Establishing the East African Community as adopted in 1999.

Science, Technology and Innovation in the Treaty

The EAC Treaty provides a fairly elaborate legal framework for cooperation in the areas of science and technology. By so doing, the Treaty not only sets the agenda in this area, it also outlines a set of common principles and undertakings by the partner states in designing their national science and technology policy priorities and programmes. It is therefore important to examine the nature and implications of the relevant provisions as set out in the Treaty. This analysis is approached at four levels: objectives of the treaty; sectoral focus; subsidiary legal instruments such as protocols to the Treaty; and, programme design and strategy.

Article 5 (1) of the Treaty states the objectives of the Community as: "to develop policies and programmes aimed at widening and deepening co-operation among the Partner States in political, economic, social and cultural fields, research and technology, defence, security and legal and judicial affairs, for their mutual benefit." To attain these objectives, the Partner States committed themselves to establish a Customs Union, a Common Market, a Monetary

33 East African Co-operation Development Strategy (1997-2000). Secretariat of the Permanent Tripartite Commission for East African Co-operation, 1997.

34 EAC, 2000. Science and Technology Policy in East Africa, EAC Studies #1 East African Community Secretariat. Arusha, Tanzania.

Union and ultimately a Political Federation. These institutional arrangements are expected to promote balanced development and equitable distribution or sharing of economic benefits arising out of economic and political integration.

The Community emphasis on the centrality of STI is further elaborated in the substantive provisions of the Treaty dealing with cooperation in the economic and social endeavours. Indeed, STI is at the heart of the Community's industrial development agenda outlined in Article 79 of the Treaty. The Partner States committed themselves to cooperate in promoting self-sustaining and balanced industrial growth, improve the competitiveness of the industrial sector and encourage the development of indigenous entrepreneurs. To achieve this agenda, the Treaty outlines a number of strategic actions that are relevant to STI. These are: promotion of industrial research and development; the transfer, acquisition, adaptation and development of modern technology; establishment of joint industrial institutions and other infrastructure facilities; and dissemination and exchange of industrial and technological information.[35]

Box 3: Main Provisions on Science, Technology and Innovation under the EAC Treaty 1999 (as amended)

ARTICLE 102

Education and Training

1. In order to promote the achievement of the objectives of the Community as set out in Article 5 of the Treaty, the Partner States agree to undertake concerted measures to foster co-operation in education and training within the Community.
2. The Partner States shall, with respect to education and training:

- Co-ordinate their human resources development policies and programmes;
- Strengthen existing and where necessary establish new common research and training institutions;
- Co-operate in industrial training;
- Develop such common programmes in basic, intermediary and tertiary education and a generalprogramme for adult and continuing education in the Partner States as would promote the emergence of well trained personnel in all sectors relevant to the aims and objectives of the Community;
- Harmonise curricula, examination, certification and accreditation of education and training institutions in the Partner States through the joint action of their relevant national bodies charged with the preparation of such curricula;

35 Article 80(e) and (g)

- Revive and enhance the activities of the Inter-University Council for East Africa;
- Encourage and support the mobility of students and teachers within the Community;
- Exchange information and experience on issues common to the educational systems of the Partner States;
- Collaborate in putting in place education and training programmes for people with special needs and other disadvantaged groups;
- Encourage and support the participation of the private sector in the development of human resources through education and training; and
- Identify and develop centres of excellence in the region including universities.

3. For the purposes of paragraph 1 of this Article, the Partner States shall undertake such additional activities in respect of the development of human resources as the Council may determine.

ARTICLE 103
Science and Technology

1. Recognising the fundamental importance of science and technology in economic development, the Partner States undertake to promote co-operation in the development of science and technology within the Community through:

- The joint establishment and support of scientific and technological research and of institutions in the various disciplines of science and technology;
- The creation of a conducive environment for the promotion of science and technology within the Community;
- The encouragement of the use and development of indigenous science and technologies;
- The mobilisation of technical and financial support from local and foreign sources and from international organisations or agencies for the development of science and technology in the Community;
- The exchange of scientific information, personnel and the promotion and publication of research and scientific findings;
- The collaboration in the training of personnel in the various scientific and technological disciplines at all levels using existing institutions and newly established ones;
- The promotion, development and application of information technology and other new ones throughout the Community;
- Establishment of common ethical guidelines for research; and
- The harmonisation of policies on commercialisation of technologies and promotion and protection of intellectual property rights.

2. For purposes of paragraph 1 of this Article, the Partner States shall undertake

such additional activities with regard to science and technology as the Council may determine.

Treat for the Establishment of the East African Community (As amended on 14th December, 2006 and 20th August, 2007)

The commitment to cooperate and support the development of science and technology is also implicit in Article 99 setting the framework for cooperation in the area of telecommunications. In this regard, article 99(e) stipulates that the Partner States shall encourage co-operation in local manufacturing of info-telecommunication equipment, research and development. There are also substantive commitments on STI stipulated in Article 100 on meteorological services, Article 105 on agriculture training and research, and Article 108 on plant and animal disease control.

Besides these provisions of the Treaty that focus on specific sectoral issues, there are at least two important Articles that provide the broad framework for cooperation in science, technology and innovation. These are: Article 102 on research and training and Article 103 on science and technology It suffices to examine these two articles in greater detail in order to understand the full range of their implications for the governance and development of STI within the Community.

Article 102 focuses on education and training as an input into the development of human resources, science and technology. The Treaty, in this regard, outlines general actions with regard to education and training. The Treaty commits Partner States to: coordinate their human resource development policies and programmes; strengthen common research and training institutions; cooperate in industrial training; develop common programmes; harmonize curricula and accreditation of institutions; revive and enhance the activities of the Inter-University Council; encourage and support student and teacher mobility within the Community, among others things. However, these are stated as best endeavour clauses and their relevance and effect can only be assessed based on the decisions that the relevant organs of the Community have made, and the programmatic actions that the Community and individual Partner States have taken since the Treaty was adopted in 1999.

Article 103 specifically addresses the issue of regional integration and cooperation in the areas of science and technology. Here, again, the Treaty seeks to create an enabling legal regime to facilitate cooperation in this area. In this regard, the Partner States commit themselves to, among other things: jointly establish and support scientific and technological institutions; create a con-

ducive environment for the promotion of science and technology; encourage the use and development of indigenous science and technologies; mobilize technical and financial support for science and technology; promote exchange of scientific information; collaborate in training of personnel; promote the development and application of information technology; establish and adopt common ethical guidelines for research, and harmonize policies on commercialization of technologies and the protection of intellectual property.

At a general level, it is important to recognize that Articles 102 and 103, as well as the other sector specific provisions of the Treaty, establish the broad juridical parameters for cooperation in the area of STI. However, the use of best endeavour terms such as mobilize, encourage, exchange or collaborate does not directly render the provisions of the treaty amenable to scientific methods of assessment and evaluation. This implies that a more normative agenda that establishes clearly defined targets and outcomes ought to be pursued by the Partner States. In the absence of such an agenda, appropriate tools and methodology to ensure periodic evidence-based empirical assessment of the implementation of these commitments will be central to the successful implementation of these treaty obligations. It is therefore important to examine how such tools may be developed particularly focussing on the contributions of each of the mandated organs of the Community.

Besides the Treaty, the Protocol establishing the East African Community Common Market seeks to put issues of science, technology and innovation at heart of integration process. Article 42 contains more elaborate provisions on cooperation in matters of STI beyond what is contained in the Treaty itself. In addition, the Partner States commit themselves to establish a “Research and Technology Development Fund”. On the other hand, Article 43 outlines the areas of cooperation in the protection of intellectual property rights and sets out a comprehensive programme of work in this area. This is further enhanced by Article 44 on industrial development which, in relevant parts, requires Partner States to adopt common principles to “promote industrial research and development, transfer, acquisition, adaptation and development of modern technology.”

Read together, the EAC Treaty and the Common Market Protocol represent a comprehensive agenda for regional cooperation in matters of science, technology and innovation in the Community. However, proper mechanisms and tools for monitoring implementation and compliance, especially as envisaged under the Common Market Protocol, remain outstanding.

Box 4: Commitments on STI under the EAC Common Market Protocol

ARTICLE 42:

Research and Technology Development

1. The Partner States undertake to promote research and technological development through market-led research, technological development and the adaptation of technologies in the Community, to support the sustainable production of goods and services and enhance international competitiveness.
2. For the purposes of paragraph 1, the Partner States shall:
   a) disseminate the results of activities in research, technological development and demonstration programmes;
   b) facilitate access to their technological and research facilities by researchers and other experts;
   c) encourage private sector participation in activities relating to intra-regional research and transfer of technology;
   d) adopt measures to develop the human resource of the Community in research and development;
   e) establish and support research infrastructure, facilities and institutions;
   f) collaborate with the East African Science and Technology Commission and other institutions on research, science and technology; and
   g) establish a mechanism for the coordination of the activities specified in this paragraph.
3. Pursuant to the objectives set out in paragraph 1, the Council shall issue directives and make regulations to:
   (a) promote co-operation in research, technological development and demonstration programmes within Partner States, and with regional institutions, foreign countries and international organizations;
   (b) stimulate creativity and excellence in research through the funding of "frontier research" carried out by individual teams competing at the Community level;
   (c) implement research, technological development and demonstration programmes with and between undertakings, including small and medium-sized enterprises, research centres and universities and to assist the undertakings in their research and technological development activities;
   (d) develop technological policies and strategies, having due regard to the importance of technology management and protection of intellectual property rights;
   (e) provide measures for protecting, developing and commercializing indig-

enous knowledge;
(f) promote and ensure sustainability of an information and communications technology culture;
(g) promote and facilitate technology transfer, acquisition and dissemination in order to achieve increased production and productivity; and
(h) establish and develop a technology innovation system for the production sector of the economy of the community.

4. The Partner States undertake to establish a Research and Technology Development Fund for purposes of implementing this Article.
5. The Council shall issue directives and make regulations for the implementation of paragraph 4

ARTICLE 43
Co-operation in Intellectual Property Rights

1. The Partner States undertake to cooperate in the field of intellectual property rights to:
   a) Promote and protect creativity and innovation for economic, technological, social and cultural development in the Community; and
   b) Enhance the protection of intellectual property rights.
2. For the purposes of paragraph 1, the Partner States undertake to cooperate in the following areas:
   a) copyright and related rights;
   b) patents;
   c) layout designs of integrated circuits;
   d) industrial designs;
   e) new plant varieties;
   f) geographical indications;
   g) trade and service marks;
   h) trade secrets;

ARTICLE 44
Co-operation in Industrial Development

1. The Partner States undertake to cooperate in the area of industrial development in the activities related to the production of goods and services in the Common Market, for the attainment of sustainable growth and development in the Community.
2. For the purposes of paragraph 1, the Partner States shall adopt common principles to:

a) promote linkages among industries and other economic sectors within the Community;
b) promote value addition and product diversification to improve resource utilisation;
c) promote industrial research and development, transfer, acquisitions, adaptation and development of modern technology;
d) the establishment of a regional mechanism for developing human capacity for industrial and technological advancement;
e) support for regional fora for Public-Private Partnership and Civil Society dialogue;
f) the development of a regional mechanism to provide sustainable and affordable industrial development finance;
g) support for the development of a regional productive base for capital, intermediate goods, tools and implements; and
h) any other measures that may be necessary.

The Regional Institutional Architecture: Assessing the Contributions of the EAC Organs in the Pursuit of the EAC STI Agenda

Equally important, the EAC Treaty establishes a set of regional level institutions whose mandate could impact the conduct of STI policies and programming at the regional and national level in many different ways. Articles 9 and 10 of the Treaty establishes: (i) the summit of the Heads of State and Government; (ii) the Council of Ministers (responsible for regional cooperation); (iii) the East African Court of Justice (EACJ); the East African Legislative Assembly (EALA) and the Secretariat. Besides, Article 9(3) established the East African Development Bank (EDB), the Lake Victoria Fisheries Organisation and provides that "surviving institutions of the former East African Community shall be deemed to be institutions of the Community and shall be designated and function as such."

The Summit of the Heads of State and Governments

The Summit is the highest decision-making organ of the Community. The general functions of the Summit are set out in Article 11 of the Treaty. In relevant parts, the Summit has the mandate to give general directions and impetus as to the development and achievement of the objectives of the Community. In this regard, the Summit can determine the pace of progress or lack thereof with regard to cooperation and integration in the areas of science, technology and innovation. A set of indicators can therefore be developed to assess the

extent to which the Summit through its decisions has facilitated and accelerated the STI agenda of the Community. Such an assessment would be based on the relevant declarations of the Summit, the proceedings of its meetings as well as the decisions, acts and orders of the summit as published in the official Gazette of the Community.

The Council of Ministers and the Coordination Committee

The Council of Ministers comprises the Ministers responsible for EAC affairs of each of the Partner State, the Attorney General of each Partner State and such other Minister of the Partner States as each Partner State may determine. The Council's mandate is provided for under Article 14. The Council is mandated, among other things, to make policies for the efficient and harmonious functioning and development of the Community; initiate and submit Bills to the Assembly; and give directions to the Partner States and to all other organs and institutions of the Community other than the Summit, Court and Assembly.

The Co-ordination Committee is established under Article 17 of the Treaty. The Committee comprises "the Permanent Secretaries responsible for regional co-operation in each of the Partner States and such other Permanent Secretaries of the Partner States as each Partner State may determine." By the nature of its functions and mandate as stipulated under Article 18 of the Treaty, the Co-ordination Committee is one of the critical organs of the Community especially in so far as the performance of the Council of Ministers is concerned. In the context of its mandate, it makes recommendations to the Council of Ministers and is empowered to follow up on the implementation of the decisions of the Council of Ministers.

The authoritative nature of these two organs is reinforced by Article 16 of the Treaty which stipulates that "subject to the provisions of the Treaty, the regulations, directives and decisions of the Council taken in pursuance of the provisions of this Treaty shall be binding on the Partner States, all organs and institutions of the Community other than the summit, the Court and the Assembly within their jurisdiction, or on those to whom they may under the Treaty be addressed. This particular provision of the Treaty suggests that the directives and decisions of the Council of Ministers can override the decisions of the national institutions hence creating an important window for fostering cooperation and harmonization of STI policies and programmes.

By the nature of the mandate and functions of the Council and the Coordina-

tion Committee, it can be argued that these are the foremost organs that will determine the pace of cooperation and integration in all matters defined by the Treaty including STI. They not only act as the "brain trust" of the Summit; they also give general directions required for all the technical organs of the Community to execute their mandates. Consequently, given the nature of their mandate, indicators to measure their performance should focus on at least 7 critical result areas. These are: negotiation and adoption of additional protocols on STI cooperation; the nature and scope of STI decisions and the status of their implementation; the nature of decisions of the relevant sectorial committees and the status of their implementation; the lead time in implementing agreed decisions and establishing appropriate institutions; the scope and content of the programmes developed; and the scope of the areas of cooperation and progress made.

The East African Legislative Assembly

The East African Legislative Assembly (EALA) is the legislative organ of the Community comprising 27 members elected by the legislatures of the Partner States and seven ex officio members.[36] The mandate of the Assembly is stated in general terms under Article 49 of the Treaty. Among other things, the Assembly is empowered to "discuss all matters pertaining to the Community and make recommendations to the Council as it may deem necessary for the implementation of the Treaty.

Additional powers of the Assembly relevant to the implementation of the commitments are contained in Article 59 of the Treaty which empowers the members of the Assembly to introduce motions or private members bills.[37] In addition, Article 59(3) requires the Council of Ministers to present to the Assembly a general report on the activities of the Community or "request the Council to submit any appropriate proposals on matters on which it considers that action is required on the part of the Community for the purpose of implementing" the Treaty. In effect, the Treaty creates a mechanism where the Assembly can hold the Council to account for the progress or lack therefore including on matters regarding cooperation in the area of STI.

At the moment, the EALA conducts its business through seven standing committees.[38] These are: Legal, Rules and Privileges Committee; Accounts

36 Article 48. The ex officio members include: the ministers responsible for regional cooperation from each of the Partner States, the Secretary General and the Counsel to the Community.

37 This power is restricted by Article 59(2) which sets the limits outside of which private members bills may not be allowed.

38 See article 78 of the Rules of Procedure of the Assembly as amended in February 2003

Committee; General Purpose Committee; Committee in Regional Affairs and Conflict Resolution; House Business Committee; Agriculture, Tourism and Natural Resources Committee; and Communication, Trade and Investment Committee. Chapter Sixteen of the Treaty which covers co-operation in the development of human resources, science and technology falls under the mandate of the General Purpose Committee. The Committee is therefore mandated to provide oversight with regard to the progress made in the implementation of the provisions of the Treaty governing cooperation on STI. The Standing Committees are recognized as the "technical arms" of the Assembly and therefore responsible for the nature and quality of the decisions taken by the Assembly.[39]

Consequently, an assessment of the contribution of the EALA ought to start with an assessment of the work of the General Purpose Committee. Indicators to assess the contribution of the Committee and the Assembly ought cover at least the following areas: the number and quality of decisions taken by the Committee and the Assembly; the implementation of those decisions by the respective organs of the Community and the Partner States; trends in the level of funding provided for STI activities as a percentage of the overall budget of the Community; and the existence of accountability mechanisms for citizens' engagement.

The East African Court of Justice

Finally, the Treaty establishes the East African Court of Justice (EACJ) as the judicial body with the mandate to "ensure the adherence to law in the interpretation and application of and compliance" with the Treaty.[40] Although the jurisprudence of the Court is still developing, there can be no doubt its judicial decisions and interpretation of the relevant Treaty provisions may have far-reaching consequences on the progress of implementation of the Treaty provisions on STI. For example, in its advisory opinion on the application of the principle of variable geometry as provided for under article 7 of the Treaty, the ICJ advised that the principle is "… intended, and actually allows, those Partner States who cannot implement a particular decision simultaneously or immediately to implement it at a suitable certain future time or simply at a different speed while at the same time allowing those who are able to implement immediately to do so." The Court recognized that simultaneous implementation is impractical in some circumstances and Partner States cannot be ex-

39 East African Legislative Assembly, Three Year Strategic Plan 2010-2012. Available at: *http://www.eala.org/key-documents/doc_details/13-eala-strategic-plan-2010-2012.html*. Accessed on November 13, 2012.

40 Chapter 8

pected to operate within such strait jacket or one-size-fits-all situations.[41] By shielding themselves with the principle of variable geometry, Partner States can renege on commitments to cooperate in the area of STI hence undermining the pace of integration on STI matters.

Progress and the Future Trajectory of Cooperation in STI matter

The systematic assessment of the actions to achieve the STI agenda set out in the Treaty will only be possible when appropriate tools of assessment have been developed. However, it can be observed that the Partner States are making some measure, albeit slow progress in the pursuance of this agenda. This progress is mainly apparent in the programmatic and strategy documents of the Community and can be seen in at least two key areas.

First, the adoption of the Protocol establishing the East African Science and Technology Commission (EASTECO) was a major milestone in creating the foundation for future cooperation in matters of science, technology and innovation. The adoption of the Protocol paved the way for the establishment of the Commission to be headquartered in the Rwandan capital Kigali. Although there has been an inordinate delay in establishing the Commission whose idea dates way back to 2006, there is evidence to suggest that the Commission will become operational soon.[42]

Secondly, the current EAC Development Strategy (2006-2010) for the East African Community outlines a specific agenda on the development of science and technology. The Strategy pays particular attention to the development of science and technology and makes explicit reference to the need to strengthen national and regional innovation systems. In relevant parts, the Strategy states: "[s]cience and technology are a key driver of socio-economic development and the achievements of most of the objectives of the EAC Common Market Agenda may be facilitated by scientific and technological solutions. Technological innovation is a key factor in the development and competitiveness of the regional economies, which leads to wealth creation and the improvement of living standards. Most of the challenges such as food security, energy, water, transport, communications infrastructure and human resource development will require scientific and technological solutions. National systems of innovation will be strengthened and developed within the

41 EACJ, Advisory opinion No. 1 of 2008

42 See EAC (2012). 1st Planning Meeting to Operationalize the East African Science and Technology Commission (EASTECO). Arusha, September, 2012

regional framework to form a regional system of innovation."

Specific programmatic activities or initiatives on STI outlined in the Strategy are: (a) formulation of a regional STI policy (b) development of legal instruments to establish an institutional framework for regional cooperation in STI (c) Science & Technology; and (c) identification of and support to centres of excellence in the region.

The Strategy also focuses on human resource development with emphasis on skills development and education. It states: "[h]uman resource development contributes to raising the level of productivity and reduction of poverty, through developing and utilizing human capabilities. It improves the availability of skilled, flexible, productive and efficient human resources, and contributes to the promotion of EAC's equitable economic growth, deeper integration and competitiveness in the global economy."

Conclusion

The development trajectory and global competitiveness of the EAC sub-region and the individual partner states will be more defined by the pace of development in STI than anything else. A forward-looking STI agenda is the bedrock for building a formidable human resource base required to engineer the growth of trade, manufacturing and services as well as the harnessing of the sub-region's immense natural resource capital. The EAC Treaty provides the basic framework for cooperation in matters of science, technology and innovation. The regional planning instruments and decisions also provide building blocks for a comprehensive, measurable and time-bound programme of work on STI.

However, unanswered questions still remain. For example, will regional STI institutions take precedence over national institutions? Can regional policy commitments and targets be a basis for measuring STI progress at the national level? Are the realignments of national STI policies and programmes a matter of voluntary compliance or requirements for strict compliance with the treaty commitments? Amidst opportunities for STI cooperation, all these questions present unique challenges for STI policy making and implementation at all levels. While some of these and other related questions are addressed in this report, it is important to recognize that independent empirical assessment of the actions being taken by the organs of the Community will be central ensuring the systematic pursuit of this agenda.

Fig 5.1: Methane extraction from Lake Kivu, Rwanda: Enhanced technological capabilities will facilitate full harnessing of the sub-region's natural resources. (www.flick.com)

5

National STI Policies: Achieving Convergence and Integration

Introduction

Science, technology and innovation hold the promise of creating opportunities for all segments of the people in the EAC Partner States. In particular, innovation capabilities are a pre-requisite to the transformation of national economies as well as expanding economic and employment opportunities for the Community's young population. Science, technology and innovation are also important tools for improving the learning environment and learning outcomes for children, improving healthcare outcomes, and improving the economic performance of the productive sectors of the economy. However, while the EAC Treaty, its related instruments and regional programmes hold potential for stimulating the pace of STI development in the sub-region, the national domain of policy making remains central to the attainment of regional convergence and integration in matters of science, technology and innovation.

In Chapter Three, the report examines the governance of STI at the regional level as one of the key domains of STI policy making and proposes the critical elements of a framework for assessing progress in the implementation of regional commitments on STI as set out in the Treaty. However, it is important to recognize that most of the policy formulation and programmes designed to support the development of STI initiatives are taking place at the national level. The purpose of this chapter is to map out the key instruments that provide a framework for developing indicators to assess convergence in policy making and implementation at the national level.

Science, Technology and Innovation in National Constitutions

National constitutions are the highest expressions of policy articulation and legal principles in every member state. They establish the broad governance framework and create key institutions for the conduct of state affairs.

With the exception of the Constitution of the United Republic of Tanzania which was promulgated in 1997 and the Constitution of Uganda of 1995, the constitutions of all the other three partner states were adopted after the coming into force of the EAC Treaty in July 2000. These later constitutions contain more elaborate provisions on matters of STI. The closest the current Constitution of the United Republic of Tanzania provides for STI is in article 9 which provides that "the State shall facilitate the building of a self-reliant nation by directing policies and programmes towards ensuring use of national wealth for development." While the Constitution does not contain specific provisions or narratives on STI, it can be argued that facilitating the development of STI is implicit in this particular provision.

On the contrary, the constitutions of Uganda (1995), Rwanda (2003), Burundi (2005) and Kenya (2010) contain more elaborate provisions on science, technology and innovation. In part XI(ii) of the National Objectives and Directive Principles of State Policy, the Ugandan Constitutions provides that "the State shall stimulate agricultural, industrial, technological and scientific development by adopting policies and the enactment of enabling legislation." Article 83 of the Constitution of Rwanda provides that "the members of the Senate shall be highly skilled in the fields of science, among others." The Constitution of Burundi also makes specific reference to STI in article 59 which states that "the state guarantees protection of scientific works of citizens through relevant laws".

In comparison, the newly adopted Constitution of Kenya contains a more comprehensive narrative on science, technology and innovation. These narratives are contained in Article 11 of the Constitution. In this regard, the constitution provides, among other things, that, "the State shall recognize the role of science and indigenous technologies in the development of the nation; and promote intellectual property rights of the people of Kenya." The Constitution of Kenya also enjoins parliament to enact legislation to ensure that communities receive compensation or royalties for the use of their cultures and cultural heritage. Finally, the Kenyan Constitution commits the State to recognize and protect the ownership of indigenous seeds and plant varieties, their genetic and diverse characteristics and their use by the communities of

Kenya. Clearly, it can be argued that the Kenyan Constitution contains the most comprehensive articulation of science, technology and innovation in any national constitution within the Community to-date.

Generally, a number of observations and deductions can be made from the constitutional provisions highlighted above. First and foremost, there is a noticeable trend suggesting that science, technology and innovation are becoming issues of constitutional significance. This is further evidenced by the fact that the articulation of STI narratives in these constitutions is becoming more specific and comprehensive. Secondly, it is clear that the new national constitutions are more likely to contain more elaborate statements on STI than the old ones. Based on this trend, it is important that science and technology policy-making institutions should pay particular attention to constitution-making processes in order to influence the nature of the narratives on STI. Thirdly, although three of the national constitutions were promulgated after the coming into force of the EAC Treaty, there is no evidence to suggest that these constitutional provisions draw from the provisions of the Treaty or are in any way a direct attempt to implement that treaty provisions on STI. In fact, it is astounding that none of these constitutions makes any reference to the East African Community or the Treaty in any way.

The explicit articulation of STI policies in national constitutions is in itself no panacea for moving EAC countries to the global frontiers of STI development. However, national constitutions are often a product of a broader political consensus, making them the most significant legal and political instrument in a country. Given these trends, it is predictable that future constitutional reforms in the EAC member states and particularly in Tanzania and Burundi will provide for more elaborate commitments on promoting STI. One significant way of improving the constitutional articulation of STI is to make explicit commitments on funding and securing the autonomy of STI institutions.

In this regard, it is important that these instruments be the first points of reference in assessing whether there is policy convergence on STI within the Community. Any assessment that focuses on the national constitutions requires the analysis of the content of the provisions on STI, the articulation of the EAC Treaty commitments and obligations as well the elevation of certain STI institutions to constitutional level.

Science, Technology and Innovation Policies

Besides the constitution, the other point of reference for assessing policy

convergence and coherence on STI is the national policy instruments of the Partner States. At the national level, STI policies can be found in a wide range of policy documents and instruments. There are at least three specific levels where we can find national articulation of national policies on science, technology and innovation.

The most prominent of national policy documents where policy convergence and coherence ought to be assessed are the national vision documents and the national development plans. Indeed, all the Partner States of the Community have some form of long-term vision documents and national development plans that are presumably the basis of national development planning. Particularly, the old generation of the national vision documents was developed during the 1990s. For example, the Tanzania Development Vision 2025[43] was formulated during the second half of the 1990s which is the time when the efforts to reinvigorate the East African Community were in their infancy. Science, technology or innovation are not mentioned anywhere in this document.

However, it is clear that discourse on science, technology and innovation within the Community has come a long way to the extent that the new generation of the national vision and planning documents emphasize the importance of STI tools in achieving the national development agendas. For example, Rwanda Vision 2020 emphasizes the central role of science and technology in achieving the country's vision of transforming Rwanda into a middle income country and transitioning the economy from subsistence agriculture to a knowledge-based economy.[44] Science and technology, including ICT, are seen as a cross-cutting issue essential to the attainment of the country's pillars of development including regional and international economic integration.

Kenya's vision 2030 published in 2007, outlines science, technology and innovation as one of the foundations for building the economic, social and political pillars of the Kenyan society. Science, technology and innovation are seen as a central input into the process of raising productivity and efficiency in all the three pillars. In its current Draft of Vision 2040, Uganda commits to re-orient itself to make science, technology, engineering and innovation the main driver of economic growth and the key pillar of competitiveness in

43 Republic of Tanzania, Tanzania Development Vision 2025.Tanzania Planning Commission (Undated)
44 Republic of Rwanda (2000). Rwanda Vision 2020. Ministry of Finance and Economic Planning, July 2000 Kigali

trade.[45] Achieving such orientation will include establishing a robust National System of Innovation, enhancing academia-industry-government linkages, establishing science and technology parks and introducing innovative funding mechanisms to promote science, technology and innovation.

These vision documents are complemented by the national development plans often covering a period of 5 years.[46] Most importantly, the Partner States also have a series of specific national or sectoral policies on science, technology and innovation. The first generation of these policies were promulgated in the 1980s and 90s. These are increasingly being replaced by a second generation of STI policies. These policies are either of a framework nature covering the whole area of STI or are more specific to particular disciplines such as biotechnology or ICT. These policies are more explicit in articulating the relationship between STI, national development and competitiveness. At the same time, this new generation of policies set more specific investment strategies and actions to accelerate national progress in building the requisite capabilities.

However, what is particularly striking is that none of these new generation vision documents, development plans or policy documents makes specific reference to the obligations on STI articulated in the EAC Treaty. They are clearly oblivious that the Treaty establishes a common agenda for cooperation in the development of STI. Direct reference to these treaty obligations is essential in ensuring that the Partner States look at the Treaty as the locus of their development planning and policy making on matters regarding science, technology and innovation.

Consequently, a deliberate action to assess how these national visions, planning or policy documents are directly linked to state obligations under the EAC Treaty is important for ensuring progress in the implementation of those obligations. The purpose of the assessment in this regard is to generate evidence to enable policy makers understand the linkages between their treaty obligations and their national visions, plans and policies. The indicators and the assessment should cover at least 5 key areas: the convergence of the narratives on STI; convergence or lack thereof in the agreed actions; the convergence of timeframes for implementing agreed actions; the convergence of institutions established for governing the STI agenda of the Partner States; and existence and adherence to timely reporting obligations.

45 Republic of Uganda (2012). Uganda Vision 2040, National Planning Authority [Draft]

46 See for example, United Republic of Tanzania (2011). The Tanzania Five Year Development Plan 2011/12-2015/16: Unleashing Tanzania's Latent Growth Potentials. Tanzania Planning Commission, Office of the Present; Republic of Uganda (2010). National Development Plan 2010/11-2014/15

Fig 6.1: A quality assurance laboratory at the Technical Business Incubator in Bushenyi district, western Uganda where technology has been developed to process bananas into other products. (Source: Presidential Initiative on Banana Industrial Development)

Fig 6.2: Primary school children in Kasisi, Bushenyi district, western Uganda, are served porridge made from banana. (Source: Presidential Initiative on Banana Industrial Development)

6

Institutions for Science, Technology and Innovation Development

Introduction

The future competitiveness of the East African Community sub-region is directly dependent on both the national STI systems but also on its ability to develop a robust regional system of innovation. At the national level, the nature of science, technology and innovation policy and decision-making will be crucial in creating a dynamic regional innovation system capable of catapulting the EAC Member States to the frontlines of the global knowledge economy. At the regional level, progress has been made with the establishment of the East African Science and Technology Commission. However, the interaction between regional and national STI institutions will be the key determinant of progress in this regard.

At the national level, institutions for STI can be divided into at least seven categories based on the nature of their mandates. These include: (i) political leadership; (ii) policy development; (iii) legislative and oversight institutions; (iv) regulation and law enforcement, (v) adjudication and dispute settlement; (vi) public Research and Development (R & D) institutions; and (vii) education and training institutions. In addition, there are also auxiliary institutions, especially the private sector, independent policy think tanks and civil society that play important complementary roles in the development and application of STI.

Political and Executive Leadership Institutions

The foremost institutions for the development of STI are those that provide the political and executive leadership functions. Generally, political leadership

implies the tacit and explicit support for STI provided by political leaders. On the other hand, a president is the head of the executive arm of government. By virtue of the constitutional mandates, the executive arm of government collectively exercised through the presidency and cabinet provides leadership on matters of policy and ensures implementation of national policies, development plans and priorities.

Political leadership for STI may be provided through formal channels such as political declarations, formal speeches, and formal political documents such as the campaign manifestos of political parties. As shown in Chapter One, political parties in the EAC are increasingly incorporating STI issues in the campaign manifestos hence creating opportunity for consistence in political leadership. Alternatively, political support can also be discerned from the explicit actions of political leaders such as attendance of major STI fairs and unwritten political statements.

Differences in the quality of STI policy-making and implementation may therefore derive from the quality and consistence of the political articulation of STI from political leaders of a given country. Such articulation is considered to be of quality and consistence if there is evidence of a consistent and predictable pattern of political statements and behaviour. Because policy makers normally want to take into account the interests of political leaders, that consistence and unanimity of the political leaders' provides the "right" signals of political acceptability of a particular course of policy action.

Executive leadership is mainly demonstrated through at least four specific measures or lenses. First, is the manner in which government ministries are organized. The creation of a special ministry designated for STI is in itself a *prima facie* indicator of the government's commitment to put STI at the forefront of the nation's political and policy agenda. Secondly, the designation of such a ministry may then be validated by the appropriateness and quality of ministerial appointments. Indeed, designating a ministry for STI and appointing ministers without the requisite competencies and profile may only satisfy specific political constituencies without furthering the STI agenda of a country. Thirdly, executive leadership can be evidenced by the timely formulation of STI policies and programmes. Finally and most importantly, the very essence of executive leadership evidenced through the ability of the executive to mobilize the required human, financial and material resources and ensuring the full implementation of agreed STI programmes and initiatives.

At the national level, political and executive leadership comes from two sources: presidential leadership and ministerial leadership. Indeed, the future outlook of STI within the EAC Partner States will derive from the quality of political leadership provided at the level of the presidency and the quality of ministerial leadership for STI. Three examples of presidential leadership suffice.

Over his 26 year rule, President Museveni has been at the forefront promoting the development of STI in Uganda.[47] Uganda adopted its first National Science and Technology Policy in 1990 and established the National Council for Science and Technology in 1991.[48] The President remains relentless in articulating his political vision for the role of STI in Uganda's transformation process. He has engaged in consistent advocacy for improving the remuneration of science teachers and the launching of a number of presidential initiatives on STI. For example, the Presidential Initiative on Banana Industrial Development achieved a level of political profiling enabling it to get direct funding allocation from the national budget. President Museveni has also provided explicit political support for STI initiatives including the launching of Kiira EV, a motor vehicle prototype assembled by the College of Engineering, Design, Art and Technology at Makerere University.[49]

Rwandan President Paul Kagame has been at the forefront of STI development articulating a consistent vision for Rwanda's commitment to become the STI hub of the sub-region. In his January 2004 address to the diplomatic corps, President Kagame articulated his vision for STI in the following terms: "*We will continue to invest in our people and strive to open up the frontiers of science, technology, and research as we broaden our trade links with our neighbouring countries and beyond*."[50] This vision is re-echoed in his address to the UK Royal Society in 2006 where he stated thus: '*We in Africa must either begin to build our scientific and training capabilities or remain an impov-*

47 See the State of the Nation Address by H.E. Yoweri Kaguta Museveni, President of the Republic of Uganda at the Opening of the 9th Parliament, Kampala, June 8, 2011 at http://www.statehouse.go.ug/media/speeches p. 20 where the President talked of investing in IT-led initiatives including setting up information centres to enhance electronic communications, instant money transfer and counter automation. (Accessed 07 September, 2012)

48 The Uganda National Council of Science and Technology Statute No.1 of 1990 (Cap 209 of the Laws of Uganda 2002)

49 http://cedat.mak.ac.ug/wp-content/uploads/2011/11/presidents-visit-to-CEDAT.jpg (accessed on March 18, 2012)

50 Excerpt of the speech can be found in Report of the International Research Conference on Biodiversity and the Sustainable Management of Natural Resources held on 23-25th July, 2007 Kigali available at www.nepadst.org/doclibrary/pdfs/ircbsmnr_2007.pdf

erished appendage to the global economy."[51] In his address to the July 2007 African Union Summit, he presented his broad vision for STI stating that STI capacity building "… is about applying science and technology holistically – in all levels of education and training, in commercializing ideas, in developing business and quickening the pace of wealth creation and employment generation, in enabling government to provide better services, and indeed in providing basic tools to society at large for self and collective betterment."

This political articulation of President Kagame's vision is clearly evidenced in the precise nature of STI policies and programmes implemented by the Government of Rwanda. Indeed, Rwanda's National Science, Technology and Innovation Policy (NSTIP) is particularly instructive in the fundamental role of STI declaring that "science, technology and scientific research shall underpin all public and private activities to enable Rwanda's Vision 2020 to be realized".[52]

The President of Kenya, Mwai Kibaki, has positioned STI at the centre of the National Development Plan and Vision 2030. On a couple of occasions the eesident has specifically mentioned the role of STI is to drivng the country's economic development. At a speech delivered on the occasion of the official launch of the development process of Kenya's Vision 2030, President Kibaki stated, "*The economic performance of any country is closely tied to the application of science and technology… It is important that the Vision Strategy which is being developed is geared towards enhancing Kenya's scientific and technological capacity, inculcating scientific culture, and integrating science and technology in our production and services sectors."*[53]

President Kibaki has also consistently emphasized the need to embrace modern science farming and to strengthen institutions for research and innovation in the Agriculture sector.[54] Under his leadership, Mwai Kibaki has su-

51 See Foreword in Watkins Alfred .J &Verma .A 'Building Science, Technology, and Innovation Capacity in Rwanda: Developing Practical Solutions to Practical Problems. ' Africa Human Development Series- World Bank http://books.google.co.ug/books?isbn=0821373560

52 Republic of Rwanda (2006). National Science, Technology and Innovation Policy, Kigali.

53 The speech was made on 30th October 2006. It is available on Kenya's State House website at http://www.statehousekenya.go.ke/see also Speech by President MwaiKibaki, at the Opening Ceremony of The First African Science, Technology And Innovation Forum For Youth Employment, Human Capital Development And Inclusive Growth, Nairobi, 3rd April, 2012 at http://www.statehousekenya.go.ke/

54 President Kibaki's speech made at the Official Opening of Bioscience Eastern and Central Africa Hub, International Livestock Research Institute, Nairobi, 5th November, 2010 at http://www.statehousekenya.go.ke/

pervised the most ambitious infrastructure upgrade programme in the country's history[55] and the development of a robust national road network which is important in enhancing coordination and collaboration activities among STI institutions is underway. The country has also witnessed the growth of world-leading innovations in the area of mobile banking and the development of ICT applications.

These are but examples of how presidential leadership could fundamentally accelerate the pace of development of STI in the Partner States and can be at the vanguard of defining the national STI policy agenda. At the regional level, this leadership can be channelled upwards to challenge the Summit to take more proactive and time bound actions on the implementation of the STI commitments under the EAC Treaty. However, this is only possible when regular empirical assessments of the political leadership provided by the individual presidents within their respective countries. The indicators should be able to discern political rhetoric from action, political patronage from strategic profiling of the STI endeavours, and patronizing politics from institutional autonomy.

Ministerial Leadership

Effective ministerial leadership is indispensable to a country's efforts to accelerate the development of STI. Within the sub-region and elsewhere, ministers serve a number of important functions. First and foremost, they are the face of the sectors to which they are appointed to lead. Secondly, ministers are the direct link of the sector to the Cabinet and the legislature, the two organs responsible for policy formulation and budget appropriation respectively. Thirdly, and most importantly, they are the direct link between the sector and the presidency. In the current regional institutional configuration, ministers are the members of the Council of Ministers and responsible for providing policy direction to the community guiding decision-making by the Heads of State Summit.

Accelerating the pace of STI in the EAC therefore requires a dedicated ministerial leadership that is not only to champion STI issues at the national level but can also provide ministerial leadership at the sub-regional level. Table – below provides basic information on the current location of lead STI issues in each of the EAC Member States.

55 See standard media at http://www.standardmedia.co.ke/?articleID... accessed 28th October 2012

Table 5: Host Ministries for STI in EAC Member States

Burundi	National Committeefor Science and Technology	Ministry of Higher Education and Scientific Research
Kenya	National Council for Science and Technology (NCST)	Ministry of Higher Education, Science and Technology
Rwanda	National Council for Science, Technology and Innovation	Ministry of Science, Technology and Scientific Research
Tanzania	Commission for Science and Technology (COSTECH)	Ministry of Communication, Science and Technology
Uganda	Uganda National Council for Science and Technology (UNCST)	Ministry of Finance, Planning and Economic Development

There can be no doubt that the designation of specific ministries for STI has been a source of progress in pushing the STI agenda of EAC partner states. The ministerial location of STI issues as shown in the table above may have implications both for STI development at the national level but also for the regional integration STI agenda. As can be seen, STI issues in Burundi, Kenya and Tanzania are located in the ministries responsible for higher education. The direct implication of this location is that STI is considered to be a matter for higher education which in itself implies a narrow conceptualization of STI issues. In Uganda, the lead STI agency is located in the ministry responsible for finance and planning. In Rwanda, the responsibility for policy and strategy on science, technology, research and innovation lies with the Ministry of Education (MINEDUC). The ministry is also responsible for capacity development at all levels of formal and informal education. MINEDUC is supported by the Nationa Science and Technology Commission which is an advisory body housed in the Office of the Prime Minister. While this could imply a higher profiling and prioritization of STI, there is generally no evidence to suggest that STI has benefitted from this “strategic” location.

The designation of a ministry specifically responsible for STI is particularly significant in the light of the ministerial functions outlined above. By having a separate ministry, the appointing authorities are able to take into account the profile and professional relevance of the persons to be appointed to hold the relevant ministerial positions. Indeed, a person appointed a minister for finance or for higher education or some other ministry may not be the most qualified or passionate to push the STI agenda. The strategic significance of STI in building the economies of the future requires particular attention and dedicated leadership at the ministerial level.

Legislative Leadership and Oversight

The legislature plays an important role in the development of STI in any country. When done purposefully, legislation enacted by the legislature helps create appropriate institutions for STI, and ensure clear demarcation of institutional mandates and responsibilities. Important measures such as the establishment of appropriate funding mechanisms, prescribing of incentives to inspire innovation and scientific creativity, and creating rights in knowledge through appropriate protection of intellectual property are also secured through legislation. Consequently, the quality of legislative leadership is important to the organization and development of a country's STI enterprise.

In theory, the legislature of a nation is primarily responsible for the enactment of laws governing aspects of society in that nation. The legislature also plays an important oversight function with regard to how the executive and judiciary execute their state functions. It is therefore important to examine the powers of the legislature to enact laws and how the legislature exercises its legislative leadership to promote STI-related legislation and oversight.

The mandate of the legislature to enact laws is pursued through the presentation of bills. Consequently, presentation of bills to the legislature for debate is the single most important power of a legislator to influence any particular policy agenda of government. Through the exercise of legislative power and budget appropriation, parliament can exert its influence on the direction of STI policies both at the national and the regional level. It is therefore important to understand the vesting and exercise of legislative power under the national constitutions of partner states to determine the role that parliaments will play in the future of STI in the sub-region.

With the exception of Kenya whose current constitution was only promulgated in 2010, the constitutions of all the other countries put considerable restrictions on the power of legislators to initiative legislation through the presentation of bills. Yet, presentation of a bill is the most critical step in the legislative process. The Uganda Constitution prohibits members of parliament from presenting a private members bill if it constitutes a charge on the consolidated fund.[56] Further restrictions are imposed under the Parliamentary Rules of Procedure of the Parliament of Uganda which requires that a member seeking to introduce a private member's bill must obtain a certificate of financial implication from the minister for finance.[57]

56 Article 93, Constitution of the Republic of Uganda (as amended)

57 Rule 108 of the Parliamentary Rules of Procedure prohibit a member of parliament from debating any question, motion or amendment of a bill which has financial implications on the consolidated fund of any public funds, unless such a bill has been introduced on behalf of government.

The Rwanda Constitution requires that bills and statutory instruments which have the potential to reduce government revenue or increase state expenditure must indicate proposals for raising the required revenue or making savings equivalent to the anticipated expenditure. Yet, members of parliament may not have access to the resources required to comply with this requirement. The 2010 Constitution of Kenya addresses the interests of the executive by requiring that the debate on such bills may only proceed upon the recommendation of the relevant committee of the assembly and after taking into account the views of the minister responsible for finance.

Indeed, it is questionable whether in the light of these restrictions, the legislatures of Uganda, Tanzania, Rwanda and Burundi can provide the level of legislative leadership envisaged of a national legislature. If for any reason government fails to introduce appropriate bills, parliament may be seen as failing in its legislative leadership for STI. Indeed, looking to the future, a more robust and pragmatic legislative agenda will depend on whether national parliaments liberate their legislative powers from the restrictions described above.

The second important leadership role of legislature which is also relevant to STI is the oversight function. Parliament, especially through its relevant committees, provides oversight over the work of parliament and the executive with regard to the development and implementation of STI policies and programmes. As of 2012, the Parliament of Uganda had a specific Committee on Science and Technology. The Committee was first established in 2008. In Kenya, an 11-member ad hoc committee on education, research and technology handles STI issues. In Rwanda, the Committee on Education, Technology, Culture and Youth is responsible for handling all matters related to technology and research. In Burundi, matters of STI fall under the Committee on Agriculture, Livestock, Environment and Communal Development. In Tanzania, STI issues are dispersed across a number of committees dealing with infrastructure, natural resources and land, agriculture, and industrial development.

Generally, no major studies have been undertaken to better understand the work of these parliamentary committees on STI. However, anecdotal evidence suggests that they have the potential to play a leading role in advocating appropriate policy and legislative support for the sub-sector.

Policy-Making Institutions

The second tier of institutions for the effective development of STI capabilities are those responsible for the initiation and formulation of national science, technology and innovation policies. National STI policy-making and regional integration on STI issues would benefit greatly from a streamlined and coordinated institutional framework for policy-making at the national level.

In principle, promulgation of national policies in all the EAC partner states is the mandate of cabinet. However, the primary responsibility to formulate the relevant policies for presentation to cabinet rests with designated agencies in the relevant sectors. In the case of STI policies, this responsibility rests with: the councils for science and technology in Burundi, Kenya, Tanzania and Uganda, and the council for science, technology and innovation in Rwanda. It is important to recognize that most of these councils were established more than two decades ago.

Over the last decade, the councils have adopted a more proactive role in pushing for the formulation of STI policies and programmes, enhancing coordination among major STI institutions and actors, and playing an increasingly advocacy and promotional role for STI issues. Clearly, the councils are increasingly occupying an important public policy space and there can be no doubt that a more strategic STI engagement driven by proactive councils for science and technology is on the horizon.

However, a more complicated picture arises when considering STI in other domains. There are particularly two important domains that are critical for the full implementation of macro-level STI policy. These are: intellectual property policy; and Information and Communication Technology (ICT). In particular, intellectual property (IP) continues to play an increasing role in the development and application of STI. IP is an important policy instrument for stimulating scientific research and innovation and international and inter-firm transfer of technology. Most importantly, IP is an important policy tool for aligning STI research and the application of new innovations in national development. Consequently, institutional arrangements for IP ought to cover critical areas and in particular: (i) IP policy development; (ii) IP awareness and promotion; (iii) IP regulation, licensing, enforcement and compliance. On the other hand, there is a tendency for policy makers to equate STI with information and communication technology. For purposes of the policy, it is important to ensure a proper delineation of these different policy domains.

The challenge for the EAC countries is that IP and ICT institutions are dispersed across a wide range of public agencies, hence making coordination difficult. In Uganda, for example, the ministry responsible for trade, the Uganda National Council for Science and Technology (UNCST), the Uganda Law Reform Commission (ULRC) and the Uganda Registration Services Bureau (URSB) share mandate for IP policy-making and management.

Regulatory and Law Enforcement Institutions

Another major segment of STI institutions cover those that are charged with regulatory and law enforcement functions relating to the development and application of STI. These institutions are more dispersed across the entire sections of the economy and therefore not easy to describe in detail. For the purposes of this report, we consider institutions that are mandated to play regulatory and law enforcement roles that go beyond specific sub-sectors. These roles include: intellectual property protection; STI statistics and standards. Besides these broad roles, there are a wide range of institutions within specific sectors that play regulatory and law enforcement functions. For example, the sanitary and phytosanitory departments within the ministries of agriculture are responsible for regulating the introduction of new agricultural technologies and innovations.

Data, Statistics and Standards

The primary mandate for data and statistics in each of the partner states fall within the mandate of the bureau of statistics. These include the Uganda

Fig 6.3: East Africa Legislative Assembly members in session. Their role is critical to the promotion and realisation of the regional STI agenda. (http://in2eastafrica.net)

Bureau of Statistics (UBS),[58] the Kenya Bureau of Statistics (KBS),[59] the Tanzania Bureau of Standards (TBS),[60] the Bureau Burundais de Normalisation et Contrôle de la Qualité (BBN) and Rwanda Bureau of Standards (RBS).[61] These agencies are increasingly playing a major role in organizing national statistics and making them available for policy and decision-making. Consequently, member states that achieve better institutional coordination between STI institutions and the bureaus of statistics are likely to attain more progress in using empirical data to make critical public policy decisions in the IP arena. Given the strategic importance of STI, the x may need to align their data with the need for more statistical information to inform national policy and regional STI programming. The work of these bureaux is complemented by standards agencies which could also play key roles in creating common standards that can enhance regional integration.

Technology Incubation, Development and Application

Another important category of institutions relevant to the accelerated development of STI are those that are engaged in the actual promotion and application of technology and innovation. For ease of analysis, these institutions can be divided into three broad categories: incubation and promotion of innovations, public Research and Development (R & D) and application. It should suffice to say that this is not to imply very rigid and linear process flowing from promotion to application. Rather many of these institutions are engaged in the broad range of activities. Yet, bringing new technologies and innovations onto the marketplace may depend so much on how functional and strategic are these institutions.

Conclusion

The Partner States of the Community have a variety of institutions to support policy-making as well the development and application of science and technology. However, it is important that they be regularly assessed on the extent to which they align their programmes and actions in a manner that supports the commitments set out the EAC Treaty and the associated protocols and programmes. The biennial report on the governance of STI process will develop and adopt appropriate indicators for assessing the work programme of each of these institutions and how such a programme contributes to the attainment of regional cooperation and integration in the Community.

58 Cap 327, Laws of Uganda

59 Cap 496, Laws of Kenya

60 Act No. 3 of 1975, Laws of Tanzania

61 See Legal Notice No. 3 of 2002 and Law No. 43 of 2006

7

Investments in Science, Technology and Innovation

Introduction

The objectives and commitments to ensure the development of STI under the Treaty Establishing the East African Community can only be achieved if the Partner States are able to make appropriate investments in sub-regional and national programmes. At the sub-regional level, with the exception of donor funded projects, mechanisms for funding are yet to be designed, elaborated and operationalized. The Research and Technology Development Fund proposed under Article 42 of the Common Market Protocol is yet to become functional. This implies that in the short and medium term, until appropriate sub-regional funding mechanisms are established, the Partner States need to take the lead in implementing their treaty obligations by deploying national funding mechanisms and instruments.

The Partner States of the East African Community (EAC) have designed various national and regional programmes for R&D and technological innovation. They are dedicating some of their resources to funding these programmes. Some countries have also established institutions and instruments for funding R&D and innovation activities. This part of the report provides examples of such institutions and instruments. It also gives a comparative analysis of the countries' expenditure on R&D with emphasis or focus on agricultural R&D. This is because there is comparable statistical information or data on national annual expenditure on agricultural R&D. There is scanty data on general annual gross expenditure on R&D and innovation activities in all the five countries.

Overview of Institutions and Instruments for Funding Research and Development

Each of the EAC Partner States has different institutional arrangements and instruments for funding national R&D activities. None of the countries has established agencies that are specifically dedicated to funding R&D. In Rwanda, Kenya, Uganda and Tanzania, R&D activities are funded through national councils or commissions for science and technology or the national agricultural research organizations. The councils or commissions are policy advisory bodies with limited administrative capacities for resource mobilization and management. The countries' policy documents have provisions that prescribe funding mechanisms. However, most of these provisions are general and are not enforced or implemented.

Burundi

Burundi does not have a national council or commission for STI and also lacks a dedicated mechanism for funding R&D and innovation. The country developed and adopted a national policy for scientific research and technological innovation in June 2011. The policy outlines various actions that the Government intends to take in order to ensure that R&D and innovation activities are adequately funded. The policy actions include the establishment of a national foundation for research.

Kenya

Kenya has several policy, legal and administrative instruments that have provisions determining the funding for R&D and innovation activities. The Science and Technology Act[62] contains provisions on how R&D and innovation activities are to be financed. Section 18 of the Act is about financing and the administration of funds of national R&D institutes. It provides in paragraph 1 that: "Each Research Institute shall be financed by grants in aid through the responsible Ministry, but it may also accept gifts, donations, subscriptions, fees and other moneys for the implementation of approved programmes." This provision is vague on the government's own commitment to funding the institutes. It creates the impression that the institutes are to be funded from or through external aid or grants.

The Science and Technology Act established the National Council for Science and Technology (NCST) in 1977. The NCST is an advisory body but is also mandated to mobilize resources and funding for R&D as well as innovation

62 Cap 250, Laws of Kenya

Fig 7.1: An artistic impression of Konza Technology City in Machakos, south of Nairobi: The home of Kenya's proposed high-tech science and technology park. (www.lantech.co.ke)

activities in the country. The Council receives most of its resources from the Treasury through the Ministry of Higher Education, Science and Technology. Most of the funding by the NCST is directed to individual scientists working in national universities. The Council does not fund national R&D institutes as these receive funding for R&D activities through their parent ministries. For example, the Kenya Agricultural Research Institute (KARI) has its R&D funded through the Ministry of Agriculture and through direct support from donors.

The NCST established Science, Technology and Innovation (ST&I) Grant in 1979 to support important areas of research which are not, for various reasons, being undertaken by publicly funded institutions, and to assist talented researchers who may come up with new ideas of potential importance to the country. In 2009 the Council renewed the funding instrument by issuing new guidelines for STI grants.

In 2008 Kenya adopted a national Science, Technology and Innovation Policy and Strategy that describes several new institutions and instruments to be

established by the government in order to ensure that the country secures "adequate funding streams for the various science, technology and innovation components. The strategy outlines a robust institutional framework that may become a vehicle for mobilizing and managing financial and other resources to support the attainment of Kenya's vision on STI.[63]

The new policy states the government's intentions to establish the Kenya National Research Foundation (KENREF) that will administer or operate a National Innovation Fund and a Kenya National Venture Capital Fund. The Kenya National Venture Capital Fund "is to increase the amount of private investment capital for Kenyan companies in early stage of business development. It aims at securing adequate local and international funding in support of requirements for STI venture capital funding. It will be the main engine for driving techno entrepreneurial growth, job creation and economic prosperity."

Rwanda

In its National Science, Technology and Innovation (NSTI) Policy of 2006, the Government of Rwanda decided to establish a National Research Fund (NRF) to be administered by the National Commission on Science, Technology and Innovation (NCSTI). Resources for the NRF are to be solicited or acquired through the country's participation in bilateral and multilateral research projects. The Policy states that the Government "shall allocate annually 0.5% of the total budget to the NRF to be managed by the NCSTI for research and development activities oriented towards the development goals of Rwanda."

The Ministry of Education through its Directorate of Science, Technology and Research (DSTR) has since 2009 been allocating research grants under a specific budget support initiative. This research granting mechanism is a pilot phase that will evolve into the NRF. The Government of Rwanda has allocated 530 Million Rwanda Francs to the DSTR for the interim research grant mechanism. The grants are provided on competitive basis focusing on the following priority areas: biotechnology, agriculture and animal husbandry, health, water and sanitation, transport and energy, and tourism.

The Government of Rwanda has also committed to establish a specific funding mechanism for innovation activities. The Rwanda Innovation Endowment Fund (RIEF) is administered by the Ministry of Education (MINEDUC) with the

63 Republic of Kenya (2008), *Science, Technology and Innovation Policy and Strategy*. Ministry of Higher Education, Science and Technology (MHEST), Nairobi, Kenya.

support of the United Nations Economic Commission for Africa (UNECA). Its remit is to stimulate the country's economic transformation through technological innovation that generates market-oriented products and processes. The proposed mechanism is also expected to promote the commercialisation of outputs of national R&D institutes and stimulate public-private partnerships for R&D and innovation. Financial resources for the RIEF will be sourced from donors and the Government of Rwanda. The Government of Rwanda has provided 300 Million Rwandan Francs (Approx. US$476,000) and UNECA has provided 75 Million Rwandan Francs (Approx. US$119,000) as seed capital for the Fund.

Tanzania

The National Science and Technology Act of 1986 established the Tanzania Commission for Science and Technology (COSTECH) as a national institutional mechanism "to mobilize funds for support and promotion of scientific research and technological development from both the Government and other sources"[64] The Act provided for the establishment of a National Fund for the Advancement of Science and Technology. The purpose of the Fund is to finance research or studies relating to the development of science and technology; the training of citizens of the United Republic of Tanzania; and innovation projects.

Tanzania has established specific funding mechanisms or instruments for some of the STI areas or sectors. For example, a Rural Telecommunications Development Fund is proposed to be established under the National Telecommunications Policy,[65] and the National ICT Policy.[66] The objective of the Fund is to subsidize investment in rural and under-served urban areas by rolling out connectivity (communications infrastructure and services) in order to promote use of ICT and thus foster social and economic growth, including poverty alleviation.

In 1994 the government established two agricultural research funds: the National Agricultural Research Fund (NARF) and the Zonal Agricultural Research Fund (ZARF). The NARF is used to finance research that cut across several agricultural zones. It has also been used to finance collaborative research that

64 Paragraph 5(h) of the Tanzania Commission for Science and Technology Act, 1986.

65 United Republic of Tanzania (1997). National Telecommunications Policy, Ministry of Communications and Transport. Dar es Salaam.

66 United Republic of Tanzania (2003). National Information and Communications Technologies Policy.

links government researchers and academic researchers. On the other hand, the ZARF is used to fund zone-specific research as part of decentralization and empowerment of local stakeholders to fund and influence research, and move toward financial sustainability. District councils and local stakeholders are encouraged to contribute to this fund.

In 2009, President Jakaya Kikwete announced the government's renewed commitment to increase national annual expenditure on R&D from 0.3% to 1% of GDP.[67] COSTECH is the main institutional mechanism that will ensure that the commitment is realized. However, the government is expected to have a specific STI budget item or line in its annual national budget.

Uganda

Uganda is also experimenting with other instruments and administrative measures for funding STI. These include the Presidential Science Initiative (PSI), Presidential Support to Scientists (PSS), Government Support to Scientists (GSS), and the Millennium Science Initiative. Specific mechanisms for funding STI are outlined in the National Science, Technology and Innovation Policy (NSTIP) of 2009. In 2011 the Government adopted a National Science, Technology and Innovation Plan (NSTP).[68] One of the key actions is the establishment of a national Science, Technology and Innovation Fund (STIF). The Government intends to allocate or provide approximately US$ 20 million as initial capital to the STIF.

National Budgets as STI Policy Instruments

EAC Partner States have harmonized frameworks for national budgeting. Annual national budgets are to be read on the same day in all countries. The budgets are supposed to be important instruments for promoting STI in general and technological innovation in particular. Increasingly, national budgets contain specific funding allocations for promoting various aspects of R&D and technological innovation.

Burundi

Burundi's national budget for 2011-2012 has allocations for agricultural R&D. It also makes allocations for ICT with emphasis on improving infrastructure for

67 Diyamett, B., Szogs, A. and Makundi, H. (2010), 'The Making of the Tanzanian Science, Technology and Innovation System: Past, Present and Proposed Future Direction.' Paper Presented at the Globelics 8th International Conference, Malaysia November 2010.

68 Republic of Uganda (2009). National, Technology and Innovation Plan 2012/13-2017/18. Ministry of Finance, Planning and Economic Development. Kampala.

the application of information and communication technologies. There is no specific budget line dedicated to STI or R&D and innovation.

Kenya

The 2011/2012 budget encourages local manufacturing of solar panels by granting duty remission on inputs for the production of panels. This can stimulate local technological innovation and encourage the use of environmentally sound energy. However, the budget statement does not contain explicit provisions to promote STI in general and R&D in particular. STI considerations seem to be integrated into the general higher education budget line as part of funding research in public universities.

Rwanda

Rwanda's recent budget for 2012/2013 identifies ICT as a priority area or field for more investment. It identifies specific ICT projects that will be funded during the budget period. For example, the Government plans to integrate ICT in Primary Education through provision XO Laptops (OLPC). The budget has specific allowance for development of science and technology policy, development of practical science teaching in primary and secondary education such as building and equipping science laboratories. Research and development and innovation initiatives are funded under the budget for Ministry of Education. The ministry has a dedicated Directorate General to oversee the programmes on STI.

Tanzania

Tanzania's budget for 2012/2013 contains explicit policy measures for promoting STI in general and R&D in particular. It puts emphasis on strengthening scientific research in agriculture, mining, fisheries and health. The budget statement also stresses the importance of improving and building infrastructure for scientific research and technological innovation. Outlined in the budget are proposals to establish a national science park and agro-processing facilities in the country.

Uganda

The country's 2012/2013 national budget makes explicit reference to the importance STI in economic transformation and the achievement of the MDGs. The Government outlines its priorities to include: a) Strengthening of STI infrastructure capacities in universities and research institutions, creating a critical mass of scientists and engineers that are necessary for industrial develop-

ment and economic transformation; b) Increasing research and scientific innovation support through capitalisation of the STI Fund and increased regular budget allocations for research and development activities; and c) Enhancing public-private partnerships and international collaboration." In the budget statement the Government states that it is "committed to implementing the National STI Policy (2009) through the NST Plan".

National Expenditure on Research and Development

Statistics or data on expenditure on R&D in the countries is scanty. None of the five EAC countries has institutionalized STI indicators. The practice of undertaking surveys and collecting data on R&D expenditures is at its infancy although the interest and the commitment are growing. National statistics offices and S&T Councils/Commissions are increasingly picking interest in collecting such data as part of the national and international statistics. At the moment, most of this emphasis is premised on the work of the New Economic Partnership for Africa's Development (NEPAD) also known as the African Science, Technology and Innovation Indicators (ASTII) initiative.

Among the Partner States of the EAC, Kenya, Uganda and Tanzania participated in the first phase of ASTII. The table below provides statistics on Gross Expenditure on R&D. Data for the three countries as obtained from the NEPAD African Innovation Outlook 2010. EAC countries individually spent less than 1% of the GDP on R&D in 2007. Uganda seems to be the exception. According the R&D survey conducted for ASTII, Uganda's expenditure on R&D was 1.10% in 2007. This is just above the target that was set by African countries at the African Union (AU) level.

Table 6: Gross Domestic Expenditure on R&D in EAC

Country	Year	GERD million PPS	GERD per capita PPPS	GERD as % of GDP
Burundi	n/a	n/a	n/a	n/a
Kenya	2007	277.8	7.4	0.48
Rwanda	n/a	n/a	n/a	n/a
Tanzania	2007	234.6	5.8	0.48
Uganda	2007	359.8	11.6	1.10

Source: AU-NEPAD (2010) African Innovation Outlook 2010.

Table… below shows GERD by sector. According to the statistics below, public sector (government and higher education) accounts for more than 50% of expenditure on or funding for R&D in each of the EAC countries. It is

instructive to note that in Kenya NGOs account for 35.8% of the GERD and in Uganda the business accounts for about 15% of GERD.

Table 7: Gross Domestic Expenditure R&D (GERD) by Sector of Performance (million PPP$)

Country	GERD	Business Sector	Government Sector	Higher Education	Private non-profit organizations
Burundi	n/a	n/a	n/a	n/a	n/a
Kenya	277.8	6.8	193.3	41.9	35.8
Rwanda	n/a	n/a	n/a	n/a	n/a
Tanzania	234.6	-	98.8	126.9	8.9
Uganda	359.8	14.8	165.5	179.5	-

Source: AU-NEPAD (2010) African Innovation Outlook 2010.

According to Uganda's National Science, Technology and Innovation Policy of 2009, the country's expenditure on R&D as a percentage of GDP was 0.3% in 2006/2007. However, a recent report by the Uganda National Council for Science and Technology (UNCST) states that the country's expenditure on S&T has considerably increased in the past few years. "Compared to total S&T spending for 2008, expenditure increased by 30.7% in 2009. It should be noted though that in 2008 the final spending outturn increased by 40.5% in comparison to that of 2007." Key components of the S&T budget are R&D, S&T technical services and S&T training.

In 2005/2006 external donors amounted to 52.7% of S&T funding in Uganda. Most of the donor funding is directed to R&D, less to technological innovation. The country's National Industrial Policy of 2008 puts emphasis on measures to stimulate technological innovation for industrial development. It outlines measures for stimulating financing of innovation and industrial activities. Such measures include promotion of public-private partnerships in industrial R&D, provision of incentives (for example tax relief or exemption) to promote private sector investment in R&D and innovation activities.

Human Resources for R&D

A critical form of investment in STI in general and R&D in particular is human resources or R&D personnel. It is thus important to establish the number of personnel available for R&D activities in each country. It is even

more important to know the portion or number of personnel that is actually engaged in R&D. Table 3 below shows that each of the EAC countries has relatively few researchers per population size. In 2007 Uganda had 785 personnel engaged in R&D, Kenya had 3794 and Tanzania had 2755. In general the number of research per a million inhabitants is very low in each of the countries.

Table 8: R&D Personnel and Researchers (headcount)

R&D Personnel	Researchers	Researchers as % of R&D personnel	Population in million	Research personnel per million inhabitants	Researchers per million inhabitants
Burundi					
n/a	n/a	n/a	n/a	n/a	n/a
Kenya					
6799	3794	55.8	37.755	180	100
Rwanda					
n/a	n/a	n/a	n/a	n/a	n/a
Tanzania					
3593	2755	76.7	41.276	87	67
Uganda					
1768	785	44.4	30.638	58	26

Source: AU-NEPAD (2010) African Innovation Outlook 2010.

In terms of qualifications of researchers, there are very few PhD holders among researchers in the EAC countries. In Kenya and Tanzania less than 30% of the researchers have PhD degrees. In Uganda PhD holders constitute just about 20% of the researchers' population.

Conclusion

The EAC Treaty framework provides a tremendous opportunity for harmonizing funding mechanisms and instruments for STI within the Community. However, there is a lot that needs to be learnt on how the national mechanisms described above are being implemented. It is important to track and monitor how Partner States are implementing their national policy commitments with regard to the establishment of special funds and funding mechanism. More empirical inquiry into these funds will constitute part of the future research agenda on the governance of STI in the Community.

The previous chapter provided an overview of the various policy instru-

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Learning to Build Technological Capabilities in the EAC: Lessons from the Developed World

ments that the EAC Partner States have developed and adopted to promote investments in STI in general and R&D in particular. It has shown that national policy regimes for STI have provisions that require the countries to spend at least 1% of the GDP on R&D. However, all the five EAC Partner States have so far not met the target or goal. This chapter discusses how underinvestment in R&D and failure to focus on building competencies for technological innovation undermines the EAC's efforts to grow into a strong system of innovation that produces and uses technologies to solve its developmental challenges.

By comparing countries within the region and with some of the Asian countries, the chapter shows that technological dynamism of national economies is to a large measure dependent on levels of investments in R&D and STI in general. Countries that underinvest in R&D tend to have weak innovation capabilities. Successful integration of the EAC economies depends on building a strong and productive agricultural sector. It also depends on addressing health challenges associated with the high disease burden.

Investments in R&D and Scientific Productivity

The combined R&D expenditure of the five EAC Partner States is less than that of Brazil, India and China together. It is even less than that of China alone. In 2007 China's R&D expenditure as a percentage of GDP was ap-

proximately 1.5% and more than US$100 billion.[69] India's R&D expenditure as a percentage of GDP was 0.8% while that of Brazil was 1.1%. The total GERD of Brazil, China and India together was at least US$140 billion in 2007. The total GERD of all five EAC Partner States was less than US$5 billion in 2007. None of the EAC countries had above 0.5% R&D expenditure as a percentage of GDP in 2007.

According to the UNESCO Science Report 2010 the share of total scientific publications produced between 2002 and 2008 by the all EAC Partner States together is less than that of India alone. For example, in 2008 Indian scientists produced at least 36,000 scientific publications. Most of the publications were in the fields of chemistry, physics, pharmacology and toxicology. The EAC States together produced less than 2000 scientific publications in 2008.[70] The low scientific productivity of the EAC is largely due to low expenditure on R&D.

Brazil and China have each established a wide range of instruments and institutions for funding R&D and innovation activities. In China R&D is funded by the Ministry of Science and Technology (MOST), the Chinese Academy of Science, venture capital funds and other sources. The MOST administers three large funding programmes: the National Scientific Research Programme; the National Basic Research Programme and the National High-Tech R&D Programme with a budget of more than $1 billion. Brazil has three main funding agencies for R&D - the Higher Education Co-ordination Agency (CAPES), the National Council for Scientific and Technological Development (CNPq), and São Paulo State Research Foundation (FAPESP). In 2009 CAPES alone spent about US$50 million on scholarships for scientific research.

The EAC Partner States do not possess institutions and specific functioning instruments for funding R&D. Most of the countries channel their funding through their respective national councils or commissions for science and technology. The Government of Rwanda is experimenting with a new innovation fund with co-funding from the Government and external donors. Burundi has not established a special funding mechanism for R&D. The States have provisions for establishing specialized funding agencies

69 UNESCO (2010), *UNESCO Science Report 2010*. United Nations Educational, Scientific and Cultural Organization, Paris

70 UNESCO (2010), *UNESCO Science Report 2010*. United Nations Educational, Scientific and Cultural Organization, Paris.

and instruments for R&D written in their STI policy documents. But these have stayed as mere statements of intention. Without specific funding agencies and instruments their individual and collective efforts to intensify and consolidate R&D will not easily succeed.

Human Resource Base for R&D

As we stated in the previous chapters a country and region's scientific and technological performance is largely dependent on human capital—the numbers and quality—of scientists, technicians, engineers, and particularly fulltime researchers. Availability of funds without a good stock of human capital in researchers is useless. Countries must ensure that they build stocks of the human capital in order to effectively engage in and benefit from R&D. They have to formulate and implement explicit policies for education and training in scientific, technical and engineering fields.

China and India are well studied and recognized for their strategic investments in training of scientists and engineers.[71] These countries are becoming the world's leaders in producing engineering graduates. In 2005 China had approximately 1.36 million and India had 0.39 million scientists and engineers fully engaged in R&D. In the same year India had 9.06 fulltime R&D personnel per 10,000 labour-force.[72]

"China's production of engineering PhDs is already up to 8,000 per year and doubling every 5 years (NSB, 2006) and will soon overtake the United States. India was auspicious, in a way, since it was already well positioned by major investments two decades ago to build a chain of Indian Institutes of Technology–their version of MIT–that now produce the talented scientists, engineers, and managers that fuel their rapidly evolving knowledge economy. China's leaders, while starting only a decade ago, are just as determined and even more focused to train young people in the science and technology skills necessary to produce world-class scientists and engineers. Perhaps because Chinese leaders have backgrounds and experience in science and engineering themselves (unlike American leaders, most of whom have law and business backgrounds), they also place a far higher priority on engineering research and education"[73]

71 See for example Duderstadt, J.J., (2008), *Engineering for a Changing World*. The Millennium Project, University of Michigan. http://milproj.dc.umich.edu/ for discussion of strategies for and trends in engineering training in China and India compared to the USA.

72 UNESCO (2010), *UNESCO Science Report 2010*, p. 374. United Nations Educational, Scientific and Cultural Organization, Paris.

73 Duderstadt, J.J., (2008), *Engineering for a Changing World*. The Millennium Project, The University of Michigan. http://milproj.dc.umich.edu/

Other recent studies on China's and India's innovation systems observe that the two countries have put emphasis on building human resources and increasing investments in R&D. In a 2007 study Tilman Altenburg et al observe: "India's most important input factor into the innovation system is human capital. The annual enrolment at the level of graduate or above has risen from 6.6 million in 1995/96 to 9.8 million in 2004. Among those the percentage of studying engineering has increased from 6.0% to 11.2%. Each year around 350,000 engineering graduates are released to the labor market. In China, the investment in human resources is even more impressive. The number of researchers increased by 77% from 1995 to 2004. In 2004 around half a million postgraduates were counted in science, medicine and engineering, and 23,500 PhDs awarded, whereof 70% in science-related subjects."[74]

The EAC Partner States all lag behind China and India in terms of science, technology and engineering training. There are less 15,000 fulltime researchers in the EAC. In 2007/2008 Kenya had 3794, Tanzania 2755 and Uganda 785 fulltime researchers.[75] Statistics for Rwanda and Burundi were not available. However, it is assumed that these two countries do not have more 5,000 fulltime researchers. The EAC is under-resourced in science, technology, engineering and mathematics. It may not possess a critical mass of scientific and technical expertise to effectively engage in R&D in priority areas such as agricultural and health sciences.

A recent news article titled 'East Africa hobbled by shortage of skilled oil workers' in the October 2012 *Engineering News*[76]speaks loudly about the impact that the shortage of engineers will have on the economic development of the EAC. The article is reproduced below;

Box 5:

"A shortage of trained oil and gas workers in East Africa is slowing development of new fields following a series of major discoveries and may force governments to relax rules requiring companies to employ local people.

74 Altenburg, T., et. al. (2007), 'Breakthrough? China's and India's Transition from Production to Innovation', *World Development* Vol. 36, No. 2, pp. 325-344, doi:10.1016/j.worlddev.2007.06.011

75 AU/NEPAD (2010), *African Innovation Outlook 2010*. African Union and the New Partnership for Africa's Development.

76 http://www.engineeringnews.co.za/article/east-africa-hobbled-by-shortage-of-skilled-oil-workers-2012-10-30

Governments are now investing in programmes to train skilled oil and gas workers, but they are hampered by weak education systems and the high costs involved.

Rolake Akinkugbe, head of energy research at Ecobank, said it would take at least 10 years of training programmes to make a lasting impact on employment in the oil and gas industries in the region.

"It's a major problem and it will take time to solve," she said.

"I certainly foresee a situation where the East African governments might have to relax their local content rules around employment and contractors, certainly in the early stages of development of hydrocarbons resources."

But any move to weaken laws requiring energy companies to hire a certain percentage of local staff could prove to be a political hot potato as well as reduce the industry's potential benefits to the region's economies and workforces.

If given a choice, foreign companies would prefer to hire local staff because they are substantially cheaper and help them gain political capital.

"As you would expect, getting a skilled workforce is challenging, especially for the highly technical oil and gas fields like well engineering," said Martin Mbogo, country manager for British Africa-focused explorer Tullow Oil Tullow in Kenya. Tullow plans commercial production in Uganda and announced in March that it had struck oil in Kenya.

Global oil and gas producer BG Group, in March announced a vast gas find in Tanzania, has said two-thirds of its 75 member staff in the country are expatriates."

Source: http://www.engineeringnews.co.za/article/east-africa-hobbled-by-shortage-of-skilled-oil-workers-2012-10-30

There are many studies that have emphasized how important it is for African countries and RECs to put more investment in training in science, technology and engineering.[77] The World Bank report observes:

77 See for example Juma, C., (2011), *The New Harvest: Agricultural Innovation in Africa*. Oxford University Press; and World Bank (2010), 'Reform and Regional Integration of Professional Services in East Africa: Time for Action'. Report No. 57672-AFR.

"Weaknesses in education impede the acquisition of professional skills, *particularly in engineering*. The general erosion of mathematical skills in all countries explains the declining number of applicants in science, engineering, and technology courses and hence the shortages in the engineering sector."[78]

The EAC Development Strategy (2011/12-2015/16) recognizes the importance of strategic investments in building the region's capacity in science and technology. It outlines a number of general interventions that the Community will make in education, science and technology. Surprisingly education, science and technology are treated as part of the social sector and a budget of less than US$10 million is allocated for them for a period of 5 years. The strategy does not make specific reference to engineering as well as specific fields of science and technology in which the EAC will focus on.

The EAC needs a body of explicit policies and strategies for building its scientific, technological and engineering capabilities. It will not be able to implement many of its plans in agriculture, pharmaceutical, transport, telecommunications if it does not accumulate the capabilities. Institutions such as the EAC Inter-University Council and the proposed EAC Science, Technology and Innovation Commission need to design a comprehensive plan for training in science, technology and engineering. It is through investments in science, technology and engineering that the Community will be able to grow a regional system of innovation and become technologically ready to procure and use existing technologies.

Technological Readiness and Innovativeness of the EAC

The Global Competitiveness Report 2011-2012 produced by the World Economic Forum defines technological readiness as "the agility with which an economy adopts existing technologies to enhance the productivity of its industries, with specific emphasis on its capacity to fully leverage information and communication technologies (ICTs) in daily activities and production processes for increased efficiency and competitiveness."[79] It is an assessment of a country's preparedness to

78 World Bank (2010), 'Reform and Regional Integration of Professional Services in East Africa: Time for Action', p. v. Report No. 57672-AFR.

79 World Economic Forum (2011), *The Global Competitiveness Report 2011-2012*, p.7. The World Economic Forum (WEF), Geneva, Switzerland.

procure, absorb and use technology.

Technological readiness is determined based on factors such as firm-level technology absorption, laws relating to information and communication technologies, FDI and technology transfer, personal computers per 100 inhabitants, and internet users and mobile phone subscribers. It is separate from innovation capacity which is about the ability of a country to expand the frontiers of knowledge and create new technology. Technological innovation is important for countries with diminishing possibilities of adopting and using existing technologies. In these circumstances firms cannot increase their productivity by relying or using existing technologies or merely undertaking incremental innovations. They must push the frontiers of knowledge and create cutting-edge products and processes in order to be competitive.

The Global Competitiveness Report 2011-2012 ranked the competitiveness of nations based on technological readiness and innovative capacities. The EAC Partner States are ranked very low. They have low levels of technological readiness and innovative capacities. Kenya is ranked at 98 out 142, Rwanda 109, Uganda 111, Tanzania 126 and Burundi 142. Brazil is ranked 54, China 77 and India 93 all above the EAC States.

In terms of innovativeness and innovative capacities, again the EAC States do not compare favorably. The countries are also not generating and growing significant industrial activity and technological dynamism. Industrial output per capita of most of the countries is low and not growing significantly to drive economic change and growth. UNIDO (2005) developed an industrial-cum-technological advance (ITA) index. Based on the industrial-cum-technological advance (ITA) index developed by the United Nations Industrial Development Organisation (UNIDO), EAC as a whole is ranked below other developing regions of the world. Singapore and Malaysia were the first and second ITA leaders respectively in 2002.

If we take Malaysia as a reference country, all EAC countries scored below it in terms of ITA in 1990 and 2002.[80] (See table below).

80 UNIDO (2005), Industrial Development Report 2005, p. 162-163

Table 9: Industrial-cum-technological advance (1990 and 2002)

Country	ITA index	
	1990	2002
Malaysia	0.269	0.457
Kenya	0.081	0.044
Rwanda	-	0.009
Tanzania	-	0.027
Uganda	-	0.029

Source: UNIDO (2005), Industrial Development Report 2005, p. 162-163

The low ITA index of the EAC Partner States is accounted for by a range of factors, including the low expenditure on R&D, shortage of scientists and engineers, weak R&D institutes, weak links between R&D institutes and private sector, poor physical infrastructure such as telecommunications, weak political leadership for STI and poor public articulation of demand for science and technology.

Policy Learning to build the EAC Innovation System

A number of recent studies have emphasized the importance of trans-national policy learning in inducing and stimulating the growth as well as adaptability of innovation systems.[81] There is also growing scholarship on comparative analysis of national and regional innovation systems. In this study we define policy learning as the purposeful engagement of government officials in discovering what public policies promote technological innovation and, why and how different countries adjust their innovation policies to suit their change socio-political and economic conditions. We are also concerned about groups of countries e.g. the EAC learning together to design common or regional innovations policies. They learn from other countries and regions (e.g. the European Union) that have successfully used different innovation policies to achieve common goals.

There are many good policy lessons that the EAC can draw from such countries as Brazil, China and India and regional blocs such as the European Union and SADC. The individual EAC Partner States ought to learn from Brazil, China and India on how these countries have configured or organized their national systems of innovation and the range of policy

81 See for example Borras, S., (2011), 'Policy learning and organizational capacities in innovation policies' p.725-734 in Science and Public Policy November 2011.

instruments they each use to foster technological innovation. The learning can take place through a variety of means or ways, including bilateral cooperation. Each of the five EAC Partner States has development cooperation arrangements with China and India. These arrangements mainly focus on trade and development assistance but provide a framework for policy learning. EAC Partner States can use them to organize for innovation policy learning missions to China and India. In additional, each of the Partner States should enter into specific STI cooperation agreements with China, India, Brazil and other countries in Asia and Latin America.

The EAC as a whole is also engaging with China on various development initiatives, including infrastructure development, trade and energy. Sino-EAC investment and trade stood at US$ 3.89 billion in 2010 and by 2011 China had invested more than US$ 750 million in the EAC Partner States, in areas such as textiles and equipment manufacturing.[82] In 2011 the EAC and China signed the Framework Agreement on Economy, Trade, Investment and Technical Cooperation. Currently the EAC is putting emphasis on China's support to build physical infrastructure—roads, railways and buildings—in the region. STI do not constitute a core part of the cooperation between the EAC and China. It is important the EAC uses this agreement to engage in learning about China's innovation system and the kinds of policy instruments that the country uses to grow the system.

There are also policy lessons for the EAC from the European Union (EU). The EU has also a relatively long history of building European innovation system. The EU (formerly the European Commission) has more than 30 years of experience in designing regional (multi-country) policies for STI. It has had a number of major initiatives such as the creation of a 'European Research Council' and recently the development of a common innovation strategy. The EU has increasingly tried to balance emphasis on R&D with focus on technological innovation. It has used a wide range of policy instruments. In the 1980s the EU establish the *Framework Programme* (FP) approach that is now used to select specific R&D and technology development foci areas for the Union as a whole. The R&D and technology development foci areas must address social and economic needs of Europe's citizens. The 7th Framework Programme 2007-13 has

82 http://www.eac.int/index.php?option=com_content&view=article&id=859:eac-china-framework-agreement&catid=146:press-releases&Itemid=194

a budget of 50.5 billion that is dedicated to the establishment of the European Research Council, an agency to: fund frontier scholarships to build human resource base for R&D and innovation; provide and coordinate funding for improving research infrastructure; and offer funding to promote university-industry partnerships.

Based on lessons from the FP approach, the EU has designed *Horizon 2020* as its new programme for funding research and innovation for 2014-2020. This new initiative has a budget of approximately 80.2 billion that will be available to research institutions, universities, private companies and small businesses. The EU has also developed the *Innovation Union Strategy* that will enable it to remove barriers to technological innovation with emphasis on how to use public sector resources and other interventions to stimulate the private sector to invest in R&D and innovation. The strategy also aims at addressing challenges of fragmented research systems and suggests policies for using public procurement for innovation.

The EAC can learn from EU's experiences in priority setting, how to build funding mechanisms and mobilize resources for common programmes, how to secure political leadership for common R&D and innovation, how to balance national sovereignty and regionalism in innovation policy formulation and implementation, and how to engage civil society and private sector in regional STI policy processes. There are many other issues that EAC's policy learning should focus on, yet, to maximize learning from the EU the EAC will require a good strategy.

Conclusion

EAC Partner States, individually and collectively, have low levels of technological capabilities. Brazil, China and India are building national innovation systems by increasing investments in R&D and human resource development. The EAC, as a whole, should strategically learn from these countries. Regular official and indepedent assesments of the progress made in implementing specific Treaty commitments and STI programmes provide opportunities for learning. Future assessments should entail more analytical work on the lessons that can be learnt from countries that have benefited from advances in science, technology and innovation.

9

Towards EAC System of Innovation

The preceding chapters show that the EAC Partner States have high aspirations to build a regional system of knowledge production for technological innovation. The States recognize that to achieve the goals of political and economic integration as enshrined in the Treaty Establishing the East African Community they need to collectively and individually increase their investments in STI. The Partner States bring together differentiated technological capabilities that they should consciously harness to build a strong regional system of innovation.

The EAC regional system of innovation will evolve from strong dynamic national systems of innovation of the five States. In other words, it is strong national systems of innovation that will cumulatively grow into a regional system of innovation. It is not the element of the existence of independent national systems that matters. It is how these are brought together and inter-linked to grow organically into a dynamic EAC system of innovation. This will require collective leadership and partnerships to build efficient and productive EAC institutions and programmes for STI.

This chapter recommends five actionable programmes of policy and institutional development to grow an EAC system of innovation. It proposes that the EAC secretariat, EALA, the Council of Ministers, and the Summit should over the next three to five years dedicate their attention to:

- mainstreaming STI considerations into national and regional politics and governance
- fast-tracking the establishment and operationalisation of the East African Science and Technology Commission

- designing a comprehensive EAC Innovation Strategy to domesticate and implement the EAC Science, Technology and Innovation Protocol
- fast-tracking the establishment of the Research and Technology Development Fund provided for under Article 42(4) of the Common Market Protocol
- establishing at least two EAC institutes for scientific research in agriculture and human health sciences, and
- fast-tracking the implementation of the EAC Pharmaceutical Manufacturing Business Plan by establishing a transnational public-private enterprise for producing generic medicines and vaccines.

We discuss each of the five recommendations in the ensuing sections. This chapter also proposes specific actions for strengthening national systems of innovation and bilateral STI cooperation among EAC Partner States.

Building Political Leadership and Constituencies for STI

In Chapter Two we argued that the political, bureaucratic and legislative leadership, and indeed leadership from civil society, think tanks and the private sector is critical for the advancement of STI for regional economic growth and integration. We observed that these groups play important roles in STI policy design, implementation, monitoring and evaluation. If they are disengaged from processes of formulating EAC STI policies, programmes as well as efforts to implement the Treaty commitments on STI will be slow or unattainable.

Currently the five presidents, national legislatures, civil society organizations and private sector enterprises of the Partner States are not actively involved in processes to implement STI provisions of the Treaty or its associated Protocols. We have not found any evidence of actions, statements and activities. A review of presidential speeches, reports of national parliaments, and activities of NGOs and private sector in the five countries shows no trace of focus on promoting STI for EAC economic growth and integration. Communiques and reports of previous EAC summits do not contain clear or explicit decisions made by the presidents on how best to implement the STI Protocol. Civil society organizations did not really participate in the formulation of the Protocol and many are likely to be unaware of its existence and importance for regional integration.

To build a strong foundation for the EAC system of innovation, it is important that broad-based political leadership and public constituencies for STI are established in each of the Partner States and in the region as a whole. We recommend that:

- Political parties in each of the five Partner States should develop and commit to implement manifestos that have explicit programmes and policies for STI at national and EAC levels;
- Each of the five presidents of the Partner States should be required by the EAC summit in 2013 to commit to champion at least one programme of work or measures for the implementation of specific agreed upon activities to realize the goals of the EAC STI Protocol and related plans such as the EAC Pharmaceutical Manufacturing Business Plan.

Fig 9.1: International Rice Research Institute in Burundi is experimenting with low cost farm implements. (ACODE DIGITAL LIBRARY)

- Each of the country's national parliamentary committees on STI should develop and adopt plans for promoting integration of EAC STI considerations into national policies and programmes, and should ensure their respective countries' national budgets have resources allocated to national and EAC STI programmes.
- The East African Legislative Assembly should establish a committee on STI and ensure the Community allocates at least 5% of its annual budget to STI programmes and the EAC STI Commission. The Assembly should also be involved in processes that promote the harmonization of national policies and laws for STI.
- The EAC Secretariat and national umbrella bodies for Non-Government Organizations (NGOs) or NGO councils from each of the Partner States should jointly organize an EAC NGOs Forum on STI to explore ways of NGOs participation in the EAC STI programmes and processes.

Fig 9.2: A Robot Programmer developed by students of computer engineering at Makerere University in Uganda. (MAKERERE UNIVERSITY DIGITAL LIBRARY)

Fast-tracking the Establishment of the EAC STI Commission

The establishment of the EAC STI Commission is taking unnecessarily long. It is at least five years since the Partner States made the decision to establish

the Commission. Efforts are being made to build the Commission's secretariat in Kigali, Rwanda. This is commendable. However, it is important that the process be fastened. The Government of Rwanda and the EAC Summit should in 2013 agree on a clear time table for the completion of the establishment of the secretariat so that by 2014 a fully fledged Commission is operational with a strong secretariat. The EAC Council of Ministers and the Assembly should actively monitor progress on the establishment of the Commission and frequently report to the EAC public.

Designing a Comprehensive EAC Innovation Strategy

The implementation of the STI provisions of the Treaty and its associated Protocols will require a comprehensive strategy that explicitly focuses on measures or actions for promoting scientific research (R&D) for technological innovation. As we have argued throughout this report, the Partner States and the Community as a whole should invest in R&D first and foremost to stimulate and generate shared technological change and innovation. They are confronted by common challenges of food insecurity and low agricultural productivity, high disease burden associated with HIV/AIDS, malaria and tuberculosis, and environmental degradation of shared ecosystems such as Lake Victoria. They need knowledge from R&D to be able to produce drought resistant varieties of crops, medicines, diagnostics and other products as well as techniques in order to address these challenges.

The Partner States are individually starting to put emphasis on the role of technological innovation in poverty reduction, human development and economic growth. This is manifested in the new STI policy instruments that are being designed at the national level. They need to do the same at the regional level by balancing or putting policy emphasis on both R&D and technological innovation for regional economic growth and development. To do this they should design an EAC Innovation Strategy that will focus on: ways and means of intensifying problem or goal oriented regional R&D activities; creating transnational enterprises for innovation; harmonizing policies and regulations in fields such as biotechnology and clinical trials for pharmaceuticals; establishing a range of financing instruments for R&D and regional innovative enterprises; sharing R&D infrastructure; commercializing results of regional R&D efforts; and other issues pertaining to the promotion of technological innovation. The proposed strategy should build on and provide a framework for implementing the sectoral action plans such as the EAC Pharmaceutical Manufacturing Business Plan 2012-2017.

We recommend that the EAC Secretariat should establish a high level independent panel or working group of experts to help on the development of a comprehensive EAC Innovation Strategy. It should ensure that by end of 2013 a draft innovation strategy is ready for consideration by the relevant organs of the Community. The Heads of State and Government Summit should adopt the strategy by early 2014.

Fast-track the Establishment of the Research and Technology Development Fund.

The commitment to establish a Research and Technology Development Fund is contained under Article 42(4) of the Common Market Protocol. It is recommended that the Council of Ministers establish an independent high-level working group to develop modalities for the establishment of the Fund. Such modalities should ensure that the process is time bound with in-built mechanisms for reporting and accountability on the part of the Partner States and other relevant state and non-state actors.

Building EAC Institutes for Scientific Research

The old EAC (comprising of Kenya, Uganda and Tanzania) had regional institutes for scientific research in areas such as health, agriculture, fisheries, forestry and veterinary sciences. There is some institutional memory on how these regional institutes were established, funded and governed. The EAC has recognized the need to establish regional institutes or centres of excellence in scientific research focusing on common or shared priorities. This recognition is in the Treaty and the STI Protocol. Article 10(2k) of the Treaty provides that the Partner States will cooperate to "identify and develop centres of excellence in the region including universities."

Already regional EAC institutions such as the Lake Victoria Fisheries Organization and the Lake Victoria Commission have been set up. The EAC should consider establishing new networks or institutes for health and agricultural research. Owing to the importance given to building the region's capabilities in pharmaceutical manufacturing and agricultural biotechnology, we recommend the formation of two new institutes: EAC Institute for Vaccines Research and EAC Centre for Biotechnology Research and Innovation. The EAC Secretariat should develop, with the support of experts, two proposals for establishing the institutes. The proposals should be submitted and considered by relevant bodies of the Community in 2014.

Fast-tracking implementation of the Pharmaceutical Manufacturing Plan of Action

One of the challenges facing the EAC pertains to ensuring effective implementation of development plans. The Community has adopted business plans for areas such as agriculture, fisheries, transport and pharmaceuticals. However, the plans have not been adequately implemented for a range of reasons including limited financial resources, weak institutional capacities and lack of political leadership. The Community has tended to spread its scarce resources across many sectors and plans. It is also relying extensively on external resources from development partners to fund most of its development programmes. It is important for the EAC to focus on and invest resources in certain strategic and priority areas in which it will leverage its current capabilities to address common developmental challenges.

One of the main development priorities agreed upon by the EAC Partner States is to strengthen regional capacity to locally (within EAC) produce medicines, vaccines and diagnostics for HIV/AIDS, malaria and tuberculosis. The Pharmaceutical Manufacturing Business Plan outlines a range of actions including establishing regional facilities. We recommend that the EAC should consider giving more resources for and focus on the implementation of the Business Plan. One specific programmatic initiative for consideration is a public-private partnership for vaccine production and procurement. The EAC secretariat should organize a regional summit of public and corporate leaders to explore the feasibility of a product development partnership focusing on vaccines.

National policy considerations

Previous chapters have shown that there are policy and institutional deficiencies in the national R&D and innovation systems of each of the Partner States. It will not be possible to grow an EAC system of innovation with relatively weak national systems. As we have stated before the regional system of innovation will grow organically from dynamic national systems. Each of the Partner States needs to take actions to strengthen its national R&D and innovation system.

Some of the specific actions that we recommend are:

- With presidential, parliamentary and civil society leadership each country should ensure that it meets the target of spending at least 1% of its national GDP on R&D by 2015.
- Each Partner State should ensure that, by 2015, its national policy instruments for STI contain explicit provisions for strengthening regional cooperation for the implementation of the EAC Treaty and the STI Protocol.

- Each Partner State should adopt the National Systems of Innovation (NSI) as the conceptual framework to guide national STI policy formulation and implementation efforts.
- Each of the Partner State should integrate provisions for promoting STI development into their national constitutions. They should ensure that their constitutions treat STI as the basis for realizing basic and fundamental constitutional rights of their citizens.

Strengthening Bilateral STI Cooperation in EAC

Bilateral cooperation between and among the Partner States is important for the emergence and growth of a dynamic EAC system of innovation. Currently there are few formal bilateral cooperation agreements among the Partner States. Each of the Partner States has some STI cooperation agreements with non-EAC members. For example, although Kenya and Uganda have bilateral S&T agreements with South Africa, there is no such bilateral agreement between the two countries.

In order to intensify cooperation among the EAC Partner States, we recommend that:

- The EAC Secretariat and the EASTECO should develop and promote a common framework for bilateral STI agreements. The States should be encouraged to use the framework to negotiate STI cooperation agreements; and
- Each Partner State should integrate STI cooperation with emphasis on technology procurement and transfer in its bilateral investment and trade policies and regulations.

Conclusion

The aspiration of having an integrated, highly developed and knowledge-based EAC economy will only be attained if the Partner States individually and collectively establish good regimes for governing STI at national and regional levels. It will take more than simply recognizing the critical roles of STI in development to achieve the aspiration. We have argued that primarily political leadership is central to the building national and EAC systems of innovation. If EAC presidents, parliaments and other political actors do not champion STI and cause investments to be made for scientific research and technological innovation, an integrated and economically competitive East African region or community will remain a 'pipe dream' or just in statements of intent. Civil society and private sector will need to play active roles to ensure the commitment of resources to STI and the growth of an EAC system of innovation.

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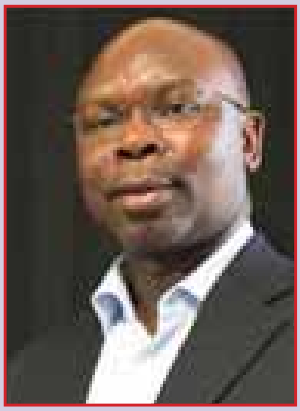

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