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Regionalism and science and technology development in Africa

John Mugabe[1]

Regional integration offers new and increasing prospects for Africa's scientific and technological development. If well organized and used, integration could provide the basis for developing and sharing infrastructure for research and development, and for mobilizing and using scarce expertise and financial resources. This chapter examines how science and technology considerations are being handled in the renewed efforts to promote regional economic and trade integration in Africa, and discusses new and emerging regional science and technology programmes.

1 Introduction

In the past four decades or so, most, if not all, African countries have adopted a large number of regional cooperation and integration schemes. There are currently more than 20 regional agreements concerning cooperation and economic integration at sub-regional and continental levels in Africa, with aims ranging from limited cooperation among neighbouring countries in specific areas of political and economic development, to the creation of a continental African Common Market. A common feature of these agreements is their appreciation of the role of science and technology (S&T) in national and regional economic development. Indeed, most regional trade, economic, political, environment and security agreements include provisions for S&T cooperation.

The integration of S&T considerations into regional agreements is based on the recognition that their individual economies are small and unable to marshal scientific and technological resources for development. Many countries are poorly endowed with the human, physical and financial resources necessary to develop and harness science and technology for economic change and growth. Thus, as economists would contend, economies of scale dictate that such countries pool their resources.

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Despite the recognition of the importance of regional cooperation, there are so far very few tangible or concrete examples of how African countries have collectively harnessed and applied S&T to solve common development problems. S&T cooperation provisions have largely remained statements of intent. They have not been given practical expression through concrete projects and programmes. The few attempts to make the transition from policy (as embodied in regional treaties or agreements) to action have not been successful.

This chapter examines the reasons for the poor performance and limited levels of regional cooperation in science and technology. It shows that it is the absence of appropriate regional institutions and the failure to adjust regional economic bodies that make it difficult to realize or implement the S&T provisions of agreements or treaties. The situation is starting to change, however, with a new wave of regionalism characterized by deliberate efforts to design and implement plans for the application of S&T to development.

Section 2 describes the evolution of regionalism and its successes in sub-Saharan Africa. Section 3 discusses the various regional cooperation and integration instruments – treaties, protocols and programmes – and in each case highlights their S&T content. Section 4 examines two regional initiatives, and the R&D partnerships and networks that have evolved as a result. Section 5 focuses on the factors that make regionalism an effective mechanism for promoting S&T, and section 6 argues that the emphasis should be on institutionalizing science and technology within regional economic communities, rather than including such programmes as 'add-ons' to the broader agendas of economic and political integration.

2 The evolution of regionalism in Africa

Regionalism – the process of opening up and integrating national socio-economic and political systems – is receiving renewed interest in many African countries.[2] It is a cooperative process that is being used to build inter-state security and promote cross-border economic activities and exchange. Regionalism is not a new phenomenon in Africa, but can be traced to the 1960s when the newly independent states saw opportunities for economies of scale in production and trade from a larger regional economic bloc. In 2000 the African Development Bank (ADB) noted that '[t]he fragmentation of Africa into many nation states with scant economic coherence led African leaders, following political independence, to embrace regional integration as a central element of their development strategy'.[3]

By engaging in regionalism, particularly economic integration, African countries wanted to overcome three major barriers to development – the small size of their individual economies, their dependence on imports of high-value or finished goods, and their

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2 For a conceptual discussion of regionalism see Weiss (1999).

3 ADB (2000).

dependence on exports of a narrow range of low-value primary products, mainly natural resources.

Regionalism in Africa also emerged out of the pan-African political aspiration for a continental identity and unity, as well as the need to build hegemony that would intimidate the former colonial masters. The newly independent states wanted to ensure that the vestiges of the colonial past were dismantled or overcome. This aspiration was pronounced, and to some extent realized, with the creation in 1963 of the Organization of African Unity (OAU), which in 2001 was transformed into the African Union (AU). The process of transformation started in 1999 with the drafting and negotiation of a legal framework (now the Constitutive Act of the AU) to address Africa's development challenges. The Constitutive Act, adopted in 2001, provides for greater political unity and economic integration, and commits African countries to principles of democracy, respect for human rights, good governance, gender equality and people-centred development.

Following the creation of the OAU a plethora of regional treaties and institutions aimed at promoting regionalism emerged in the mid-1960s to the 1980s. These included the Customs and Economic Union of Central Africa (UDEAC, 1964), the East African Community (EAC, 1967–77; re-established in the early 1990s), the Southern African Development Community (SADC, 1980),[4] the Economic Community of West African States (ECOWAS, 1975), the Common Market for Eastern and Southern Africa (COMESA, 1995),[5] and the Arab Maghreb Union (AMU, 1989).

The UN Economic Commission for Africa (ECA), established in 1958, was instrumental in establishing the regional economic groupings and gave the bodies an economic orientation. The ECA acted as a catalyst in the movements that stimulated governments to take practical measures to promote economic cooperation. The main objectives of these regional groupings were the eventual elimination of all tariffs and barriers between members, the establishment of a customs union, a unified fiscal policy and coordinated regional policies in areas such as transport, communication, energy and other infrastructural facilities.

Many other factors have stimulated the regionalization of Africa, including the opening up of national economies, which has allowed for the natural pull of geography, common culture and tastes to take place. But policy-induced regionalization, or regionalism, has also played a role through the creation of regional integration agreements that have provided for, among other things, preferential elimination of tariffs among partners and more secure market access than that offered by the rest of the world.

Despite the aspirations and efforts of the 1960s and the 1970s, regional integration has remained elusive. A variety of institutional, political and geographical factors have made its attainment difficult if not impossible. These factors include weak regional institutions, rigidity in leadership's appeal to nationalism, intra-state conflicts and wars, the Cold War

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4 Formerly the Southern African Development Coordinating Conference (SADCC).

5 Formerly the Preferential Trade Area (PTA), established in 1981.

that pulled African countries to one or the other side of the East-West divide, and the structural barriers to trade and industrialization. As noted in a recent ECA report,

> 'Increased capacity to produce and trade manufactured goods is a cornerstone of regional economic communities' integration efforts – and one that should help boost Africa's unenviable 2% share of world trade in manufactures. Ultimately, Africa's regional integration efforts will be judged by the extent to which they help the continent pool its rich, and often rare, resource endowments to enhance economic prosperity, alleviate poverty, and improve its position in the world. The absence of industrial sophistication is one of Africa's greatest weaknesses'.[6]

With regard to structural adjustment, Mkandawire and Soludo have argued that '[t]he debate on regional integration concentrates much more on complementarities than it does on product differentiation and competition within the larger market. There is a need to move away from the extreme emphasis on complementarities to a recognition that within the various regional schemes an array of products already exists that could be the basis for competitive markets. Regional arrangements can be used as a collective agent of restraint'.[7]

On the whole, past efforts to promote and use regionalism in Africa have not contributed to the economic transformation of the continent. The limited potential for increased trade among African states is frequently mentioned as an explanation of the lack of success of regional integration. The effectiveness of any economic integration effort is seen in terms of the relative size of gains owing to trade creation and losses from trade diversion. For intra-African trade to be mutually beneficial, in line with economic integration goals, the potential for trade among member countries should be substantial. If African countries are competitive in their production of similar goods, there will be many opportunities for the substitution of the commodities of one country for another, thus leading to more trade creation than diversion. Technology and technological change play a major role in stimulating and sustaining economic diversity and trade creation, and thus they underpin regional integration. Trade creation is unlikely to occur without technological progress.

Although their main objective is to promote economic integration of the continent, the various regional economic communities have spent the last three decades or so resolving political and social conflicts in some of its member countries, such as Angola, Burundi, Guinea Bissau, Liberia, Niger, Rwanda and Sierra Leone.

3 Science and technology in regional agreements and treaties

Regionalism is receiving renewed attention throughout Africa. The past several years have witnessed a growing number of regional economic and trade agreements, as well as a plethora of proposals for new bilateral and multilateral preferential trade arrangements.

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6 UNECA (2004: 95).

7 Mkandawire and Soludo (1999).

There is also greater recognition of the need for bilateral and multilateral S&T cooperation, and provisions for this purpose are increasingly being written into economic and trade agreements.

It is worth noting that the renewed interest in and efforts to promote regionalism are taking place at a time of the globalization of economic production and the associated rapid advances in technology.[8] Regionalization is being driven by advances in transport, information and communications technologies (ICTs), as well as in policy and politics. This is evident in the increasing transboundary movements of people, finance and products across the region. Intra-regional foreign direct investment flows are also increasing.

Africa has a wide range of regional instruments – policies, programmes, protocols and treaties – that articulate the importance of S&T cooperation. Most regional and sub-regional economic, political and trade treaties make explicit reference to the need to strengthen cooperation in various fields of science and technology. Article 13 of the Constitutive Act of the African Union gives authority to the executive committee of the AU to formulate policies that promote S&T cooperation.

The declaration and treaty establishing the Southern Africa Development Community (SADC) aims at promoting the development, transfer and mastery of technology. Article 21 (areas of cooperation) makes explicit reference to SADC member countries cooperating in science and technology. SADC's Protocol on Education and Training, ratified by at least eight countries, aims at promoting the development of a common S&T policy, establishing joint research facilities and regional centres of excellence, and facilitating the movement of scientists in SADC countries.

The treaty establishing the East African Community (EAC) contains several provisions on science and technology. Articles 5 (objectives of the Community), 80, and 103 are explicit on the role of cooperation in fostering the sub-region's scientific and technological development. Article 80(e) provides that the EAC shall 'promote industrial research and development and the transfer, acquisition, adaptation and development of modern technology, training, management and consultancy services through the establishment of joint industrial institutions and other infrastructural facilities'. In Article 103, member states commit themselves to 'promote cooperation in the development of science and technology within the Community through: (a) the joint establishment and support of scientific and technological research and of institutions in the various disciplines of science and technology; (b) the creation of a conducive environment for the promotion of science and technology within the Community; [...] and (i) the harmonisation of policies on commercialisation of technologies and promotion and protection of intellectual property rights'.

Similar provisions are to be found in the treaty creating the Common Market for Eastern and Southern African (COMESA). Article 100(d) calls on member countries to cooperate to promote 'industrial research and development, the transfer, adaptation and

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[8] Goldstein (2002).

development of technology, training, management and consultancy services through the establishment of joint industrial support institutions and other infrastructural facilities'. The treaty also aims at promoting cooperation in the creation of an enabling environment for foreign, cross-border and domestic investment, including the joint promotion of research and adaptation of S&T for development.

Regionalism offers platforms on which scientifically and technologically weak countries can articulate their demand for technology, innovation policy and related institutional adjustments. If carefully configured and governed, such platforms provide a good foundation for restoring and enlarging Africa's confidence in its own abilities to generate and manage knowledge for economic change and human development.

African countries have signed and ratified a wide range of other multilateral agreements that contain provisions on international scientific and technological cooperation. At least 45 African countries are contracting parties to the Convention on Biological Diversity, the UN Framework Convention on Climate Change, and the Montreal Protocol on Substances that Deplete the Ozone Layer. Many are also members of the World Trade Organization (WTO), where issues of technical cooperation and technology transfer preoccupy most of the negotiations.

International cooperation in S&T is increasing in intensity and complexity. Several studies have shown that collaborative S&T activities have increased among developed countries and between some developed and developing countries.[9] This growth has been stimulated by a variety of factors, including globalization and increasing recognition of the benefits of collaboration. Most recent international and regional economic, trade, security and environmental agreements or treaties contain provisions on cooperation in S&T.

At the international level, many treaties emphasize cooperation in S&T, including the Vienna Convention for the Protection of the Ozone Layer (1985), the Montreal Protocol (1987), the Convention on Biological Diversity (1992), the UN Framework Convention on Climate Change (1992), the UN Convention to Combat Desertification (1994), the WTO Agreement on Trade-related Intellectual Property Rights (TRIPS, 1994), the Kyoto Protocol (1997) and the Cartagena Protocol on Biosafety (2001). They create obligations for their contracting parties to invest in joint S&T programmes and engage in cooperation through exchanges of expertise and information as well as sharing research facilities.

Agenda 21 – the United Nations programme on sustainable development adopted at the UN Conference on Environment and Development in Rio de Janeiro in 1992 – devotes a lot of attention to the need for international cooperation in S&T. For example, its chapter 31 (on the scientific and technological community) and chapter 34 (on transfers of environmentally sound technology, cooperation and capacity building) are largely dedicated to measures that promote such cooperation.

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[9] See the Advisory Council on Science and Technology (2000) and Wagner *et al*. (2000).

The Convention on Biological Diversity contains similar provisions. In particular, Article 18(2) states that 'each contracting party shall promote technical and scientific cooperation with other Contracting Parties, in particular developing countries, in implementing this Convention, *inter alia*, through the development and implementation of national policies. In promoting such cooperation, special attention should be given to the development and strengthening of national capabilities, by means of human resources development and institution building'. Article 18(5) requires the parties to 'promote the establishment of joint research programmes and joint ventures for the development of technologies'.

The Plan of Implementation of Agenda 21, adopted by governments at the World Summit on Sustainable Development in Johannesburg in 2002, is about the role of S&T in meeting sustainable development goals. Many of its recommendations are about mobilizing and directing science and technology to solve problems associated with energy deficiency, food insecurity, environmental degradation, diseases, water insecurity and many other sustainable development challenges. The plan calls on the international community to 'promote technology development, transfer and diffusion to Africa and further develop technology and knowledge available in African centres of excellence; and support African countries to develop effective science and technology institutions and research activities capable of developing and adapting to world class technologies'.

On the whole, there is increasing recognition and articulation of the role of cooperation in fostering the application of S&T for sustainable development. Scientific and technological development is a learning process that is largely achieved through cooperative or collaborative efforts of sharing experiences, information, infrastructure and other resources, such as human and financial. Today, no country can achieve scientific advances and technological progress without interacting with its peers and neighbours. The ability of countries and firms to innovate, both in technical and managerial ways, is largely determined by strategic alliances forged both within their industrial landscapes and across sectors. Furthermore, for industrial firms to become successful in generating new innovations, they often have to form strategic partnerships with public R&D institutions (this is clearly the case in such fields as biotechnology).

Cooperation in S&T can take various forms, including joint projects, sharing of information, conferences, building and sharing joint laboratories, setting common standards for R&D, and exchanges of expertise. For developing countries, particularly those in Africa, such cooperation can bring many advantages, including:

- providing access to new knowledge, foreign skills and training opportunities that may not be available at the national level;
- offering access to large and often expensive research facilities, including laboratories and libraries;
- avoiding the costs of duplication of research;
- enriching the political and social relations between countries;
- providing opportunities to establish multidisciplinary research activities and teams;
- creating a favourable basis for international funding; and

- building or strengthening domestic R&D institutions.

The importance of cooperation in S&T is also articulated in a wide range of declarations, statements and national policies. Many African countries have entered into bilateral cooperation agreements. For example, by 2002 Egypt had entered into at least 18 agreements, South Africa at least 27, Nigeria at least nine and Kenya at least five. South Africa's agreement with Nigeria, signed in early 2001, aims at enhancing cooperation between the two countries in fields such as biotechnology, environmental observation systems, materials science, space science, etc., and provides for exchanges of scientists engaged in joint projects.

South Africa has entered into bilateral cooperation agreements with at least seven other African countries, as well as with the European Union, Belgium, France, Germany, Hungary, India, Italy, Norway, Poland, the UK, the USA, etc. To implement its agreement with the EU, South Africa established a special Lead Programmes Fund and designated national institutions to be responsible for specific activities. This fund was established to enhance existing cooperation in the fields of biotechnology, new materials, ICTs, environmental management, rural development and urban renewal. During the first round (1999–2001), the fund successfully leveraged international R&D support and established viable consortia between South African Science Councils and Cirad (France), Alcoa (USA), Rolls Royce (UK), and IVL (Sweden), among others. The National Research Foundation (NRF) services the implementation of the agreements. Between January 2000 and March 2003 South Africa spent more than US$1.2 million servicing more than 27 bilateral and multilateral agreements.

Most, if not all, African countries recognize that international cooperation in S&T matters. With the exception of a few countries, however, there is no evidence that they have set up specific programmes or made institutional arrangements to implement the provisions of the agreements. Some of the reasons for this include the inadequate financial resources devoted to international and regional activities, the lack of explicit linkages between the S&T policies and foreign policies of most African countries, the limited capacity to negotiate effectively and monitor the implementation of cooperation agreements, and generally weak national S&T systems.

For African countries to be able to achieve high levels of scientific and technological development and thereby reap the benefits in terms of economic growth, poverty reduction, environmental sustainability, improved health, etc., they must place greater emphasis on pursuing S&T in regional and international contexts. Isolated national approaches, de-linked from regional and international programmes, will deny these countries opportunities to benefit from the globalization of science and related technological innovations.

African countries can benefit through increased regional cooperation because many scientific and technological advances are made in other regions of the world. A large proportion of scientific articles and patents are generated outside Africa. Most African countries do not have the necessary research facilities in areas such as genomics, since these tend to be relatively expensive. International and regional collaboration is

necessary in order to enable African scientists to access such facilities. However, in order for Africa to be able to utilize and benefit from discoveries made and facilities located elsewhere, it needs world-class researchers who can communicate and collaborate with the best scientists around the world. The challenge for the continent, therefore, is to invest in creating a cadre of scientists who will be able to work with developed country scientists on specific international projects.

African policy makers and scientists recognize the importance of regional cooperation in S&T. This is explicit in the provisions of regional and sub-regional treaties, in the decisions of regional meetings and various statements. As noted above, however, little has been done to translate these provisions into concrete processes and S&T activities. Many African countries continue to work with isolated R&D systems, often with limited expertise and financial resources. The continent as a whole has spread its limited resources too thinly across the various fields. In many cases the existing science infrastructure of the better-off countries of the region is not accessible to others that desperately require it.

4 From policy intentions to practice: two examples

This section describes two examples of regional collaboration in Africa, involving agricultural research and laser technology.

ASARECA

The Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA) is a non-political organization of the national agricultural research institutes (NARIs) of ten countries: Burundi, Democratic Republic of Congo, Eritrea, Ethiopia, Kenya, Madagascar, Rwanda, Sudan, Tanzania and Uganda. Based in Entebbe, Uganda, ASARECA's mission is 'to strengthen and increase the efficiency of agricultural research in East and Central Africa, and to facilitate economic growth, food security and export competitiveness through productive and sustainable agriculture'.[10]

This regional collaboration in agricultural research can be traced back to the early 1980s when scientists from national programmes began working together. To run these networks, and to consider and approve annual work plans, regional steering committees were put in place. The committee members included research coordinators and scientists from the NARIs. Over time, as these early networks evolved, they came to be regarded as one way to achieve economies of scale and to facilitate technology spillovers across national boundaries. This led to the idea of creating and building up a regional association.

ASARECA was established following the approval of the Framework for Action for Agricultural Research in Eastern and Central Africa, which was developed by the Special Programme for African Agricultural Research (SPAAR) in consultation with NARI leaders. ASARECA's three broad objectives were to improve the relevance, quality and cost-effectiveness of agricultural research; to establish and support regional mechanisms to reinforce and improve collaboration among the national agricultural research systems;

[10] See www.asareca.org.

and to improve the delivery of new appropriate information and technology. Given the many commodities and factors that each national system had to handle, and the need for greater efficiency and effectiveness in utilizing scarce resources, it was agreed that a regional strategy for agricultural research and research-related training be implemented. In September 1994, the Memorandum of Agreement that established ASARECA was signed, and in October the Executive Secretariat, based in Entebbe, Uganda, became operational

ASARECA carries out its activities through regional research networks, programmes and projects. However, it is important to note that there was already some collaborative research within the region before ASARECA was created. This was brought under the ambit of ASARECA and was continued by the first-generation research networks on potato and sweet potato, agroforestry, root crops and beans. The second-generation networks, established in 1990s, focus on banana, post-harvest processing, animal agriculture, maize and wheat, highlands, technology transfer, agricultural policy analysis, and improving access to agricultural information.

The African Laser Centre

The African Laser Centre (ALC), created in 2003, is another example of how regionalism is being used to promote technology development. Although originally an initiative of a few countries, the ALC has acquired a continental outlook and attention. Established on the basis that Africa can derive benefits from laser technology, the ALC's vision is to 'boost Africa into the forefront of science and technology'. Its mission is to 'enable African nations to collaborate with each other and internationally to play a major role in utilising light to advance science and technology, thereby contributing to the strengthening of their economies, their global competitiveness, education and welfare of their people. This cooperation will take place in the spirit of NEPAD and the African Union'.[11]

The ALC is a virtual centre of excellence for the continent. It has been designed as an open non-exclusive partnership to stimulate innovation, research and technology development in lasers and their applications. The ALC is actively promoting collaboration among laser researchers throughout Africa and between African institutions and their international counterparts. The six ALC facilities and their fields of specialization are listed in the table below.

Facility	**Field of specialization**
National Laser Centre, Pretoria, South Africa	Manufacturing, machining, and materials processing
University of Cheikh Anta Diop, Dakar, Senegal	Atomic and molecular physics and laser spectroscopy and processing
Laser and Fibre Optics Centre, Cape Coast, Ghana	Agricultural and environmental science
National Institute of Laser Enhanced Science, Cairo, Egypt	Medical and biological applications of lasers
Tunis el Manar University, Tunis,	Plant and environmental science and molecular

[11] See www.csir.co.za and www.africanlasercentre.org.

Tunisia	spectroscopy
Advanced Technologies Development Centre, Algiers, Algeria	Laser spectroscopy and surface studies

One of the novel aspects of the ALC is its reliance on African governments as the main sources of funding. The Centre was launched largely with funding from the countries that are hosting the facilities.

5 Harnessing science and technology for development

Africa entered the new millennium with a renewed determination to achieve sustainable development. After many decades of economic and social marginalization, political instability and conflicts, overdependence on the rest of the world for knowledge and finance, the continent and its people are now even more determined to eradicate poverty and to become fully integrated into the global knowledge economy. African leaders have set ambitious but realizable sustainable development goals, which are embodied in a new framework: the New Partnership for Africa's Development (NEPAD).

The creation of NEPAD is a clear indication of the determination of African leaders to institute measures to increase agricultural production and food security, stem environmental degradation, improve infrastructure and communications, fight disease, end conflicts and wars, and increase industrial production. In addition to setting the NEPAD agenda, African leaders have subscribed to the United Nations Millennium Development Goals (MDGs) and their targets. Realizing NEPAD's goals and the MDGs will require science and technology. Indeed, S&T can play a central role in meeting human development needs while maintaining the integrity of the natural environment. There is an explicit correlation between a country's scientific and technological status and its economic performance and affluence; indeed, the real income gap between poor and rich countries is largely accounted for by differences in the accumulation and utilization of S&T. Closing this gap will require deliberate measures to build the scientific and technological capabilities of poor countries.

In the past, African countries have done little to harness S&T for their development. This is demonstrated by the continent's enormous development challenges, which are largely a result of seven factors.

First, in most countries in Africa the links between scientific and political institutions are weak. Political organizations have not accorded S&T much attention in their manifestos and parliamentary activities. Yet technological change is a complex process that is influenced by many political factors. To engage in and manage this process, countries require the support of high-level political institutions. These institutions often determine the nature and levels of resources that go into public R&D activities, and the overall governance of science and innovation. There is, thus, a need to build strong political constituencies for S&T development in Africa.

Second, most African countries formulated their S&T policies in the 1970s and 1980s when development imperatives and technological opportunities were difficult, so that many of these policies focused on organizational rather than on programmatic issues. In recent years countries have been preoccupied with creating commissions or secretariats to promote S&T, and have paid little attention to the long-term programmatic aspects of S&T development. These commissions and secretariats have emerged to give an administrative view of the role of S&T in national affairs but they have failed to put in place the necessary programmes to anticipate and respond to emerging developments. Over time, some of these institutions have lost touch with reality – it takes more than administrative oversight to promote S&T development.

Third, African countries have devoted too little, and in many cases declining, funding to R&D. Most spend less than 0.5% of their GDP on R&D. This is so despite the declaration in the Lagos Plan of Action and in national S&T policies that each country would allocate at least 1% of its GDP to R&D activities. In agriculture, R&D funding has declined dramatically in the last decade or so, to the extent that the region's ability to achieve and sustain food security is being impaired. The low and declining expenditures on R&D are a clear indication of the low priority that countries have given to S&T.

Fourth, associated with the above three factors, the quality of science and engineering education is declining at all levels in Africa. Student enrolments in science and engineering subjects at primary, secondary and tertiary levels are also falling. These developments undermine the continent's aspiration to build up its numbers of scientists, engineers and technicians.

Fifth, Africa is losing some of its best scientific and technical expertise to other regions of the world. Growing numbers of African scientists and technicians are joining this 'brain drain', and are leaving the continent to work abroad for a variety of reasons, including the inadequate research infrastructures and poor remuneration packages. While other regions, particularly Asia, have developed and adopted strategies to mobilize and utilize their diasporas, Africa has not. The region can no longer afford to ignore this human capital – it needs to design ways to tap and use the enormous range of talents of Africans abroad for its own scientific and technological development.

Sixth, a further challenge faced by African countries relates to strengthening and/or building institutions dedicated to scientific and technological innovation. As a result of all the above factors, the R&D institutions in many countries are getting weaker. Most countries have not organized and mobilized their institutions in such ways to utilize their scarce financial and human resources in specific fields of science and technology. They have tended to spread their resources too thinly across the institutional terrain. As a result, the region has a whole has not been able to grow 'centres of excellence' in such areas as biotechnology, space science and ICTs.

Seventh, the links between public R&D institutions and private industry are generally weak. The results of public R&D activities are not often accessed and used by local industries, particularly small and medium enterprises (SMEs). In many cases there is a

mismatch between R&D activities and national industrial development goals and strategies. For example, while the industrialization policies of most African countries have emphasized building and strengthening SMEs, the links between these enterprises and R&D institutions are weak.

6 Sources of optimism: commitments and actions

African policy makers and politicians have recognized that the barriers to the continent's scientific and technological development need to be removed if NEPAD's goals are to be realized. Thus, in November 2003, at the first NEPAD ministerial conference on science and technology, they embarked on a collective effort to develop a plan of action for S&T.[12] The conference generated a number of specific commitments and actions, as described below.

The first action was to establish the African Ministerial Council for Science and Technology. This high-level forum has started to critically examine and discuss emerging S&T questions and their implications for Africa's sustainable development. The Council provides policy and political guidance on the development and application of S&T in Africa.

The second major set of actions involved the creation and strengthening of networks and centres of excellence in science and technological innovation. In addition to establishing the African Laser Centre, which has received high-level political support, African countries launched the NEPAD Biosciences Initiative,[13] which aims to develop and apply bioscience research expertise to produce technologies that may help poor farmers to improve agricultural productivity. NEPAD has been instrumental in mobilizing resources to create or upgrade a network of world-class laboratories across Africa. The first of these centres of excellence, the Biosciences East and Central Africa (BECA), was launched in 2003 with an initial grant of C$30 million from the Canadian government. The reason for creating BECA was the fact that in the biosciences a critical mass of infrastructure, equipment, services and support technicians is needed to provide a suitable environment for high-quality research of an international standard. In view of the lack of such facilities in the subregion, it was recognized that it was not realistic in the short term to develop individual national institutions, and this led to the concept of a shared hub.

In subsequent discussions, spearheaded by NEPAD, it was recognized that for the hub to produce research outputs that would impact on development, a range of other laboratories with complementary capacities would also be required to transform those outputs into concrete products. The biosciences network was thus envisaged as composed of a hub, nodes and a broader set of members. The nodes would provide certain services to other members and receive critical investments to make them effective in their specific field. Members are entitled to access the nodes and the hub. BECA is an investment to enable the region to do strategic research that will have an impact on poverty. A similar effort

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12 NEPAD (2003).

13 See www.nepadst.org/programmes/prog_biosci.html and www.biosciencesafrica.org.

has been initiated in Southern Africa, with laboratories dedicated to research and innovation in such areas as genomics and proteomics.

In addition to the above efforts, African countries have also committed themselves to improving science, technology and innovation policies. Specific actions they are undertaking include the establishment an advisory panel on biotechnology, a working group to design common African indicators or benchmarks for assessing the status of S&T, and a task force to encourage more African women to engage or participate in science and engineering. Each country has also committed itself to increasing national annual public expenditures on R&D to at least 1% of GDP. These efforts will be bolstered with the proposed establishment of a continental financial mechanism for regional research and innovation programmes.

Concerted efforts are now being made to promote S&T in Africa. Political and civil constituencies for S&T are emerging. African leaders have pronounced their commitment to ensure that science and technology are harnessed and applied to promote human development and the continent's integration into the global economy. What are needed are measures to sustain and build upon these developments in order to halt the growing human deprivation within the continent and its marginalization from the rest of the world.

7 Strengthening the S&T focus of regional economic communities

One of the reasons why past African aspirations to use regionalism for technology development have not materialized is the failure to institutionalize S&T programmes into the regional economic communities (RECs). Bodies such as SADC, ECOWAS and the EAC do not have offices or departments dedicated to S&T matters. Most of them have not created programmes to translate the provisions of their respective treaties into concrete actions. To enable them to build capacity for S&T, NEPAD has facilitated a series of regional workshops to identify specific projects and programmes. A key outcome of these workshops has been the establishment of 'science desks' in each of the RECs that will serve as vehicles for ensuring that regionalism is S&T driven. NEPAD plans to mobilize and provide resources for the establishment and maintenance of these science desks.

Another important factor is regional leadership. Achieving good governance of African economies and related politics will require investments in technology. Technology is crucial to increase the region's economic productivity and political stability. It is in this regard that African leaders need to put more emphasis on the role of technology in national and regional development. Establishing a culture committed to technological innovation and development requires political leadership. The experiences of many Asian countries in the process of industrialization and attaining economic competitiveness have shown that political leaders play a crucial role in establishing and sustaining a national

vision and developing a strategy for technology-led development.[14] At present there is there is no such political leadership in any African country for such a strategy evolve or for technology considerations to be integrated into national economic and social strategies.

NEPAD is starting to play a role in building national political leadership for technological development. To play that role effectively, however, it will require support in terms of policy research and analysis. UN agencies and international universities, as well as regional centres such as the African Technology Policy Studies Network (ATPS) and the African Centre for Technology Studies (ACTS), can support NEPAD by making available policy papers on specific S&T issues.

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[14] See Anyang' Nyongo and Coughlin (1991).