Policy brief

Stimulating Science, Technology and Innovation (STI) Development in Africa: An Urgent Post-2015 Agenda

INTRODUCTION

At a time when the global community takes stock of achievements of the Millennium Development Goals and prepares for the post-2015 development agenda, Higher Education (HE) and Science, Technology and Innovation (STI) are poised to play even greater roles in addressing the challenges facing Africa. Indeed, issues such as food security, energy, climate change, water, transport, communications infrastructure and human resources development will require scientific and technological solutions.

Recent commitments made at the Nairobi and Rabat Ministerial Forums in 2012 and 2014 and the ADEA Triennale in 2012 reflect stakeholders' renewed engagement and alignment with international STI policies and strategies. STISA-2024 [see Box 1] represents such a reference framework for member states and Regional Economic Communities (RECs) to design and coordinate their STI development agendas and initiatives in the upcoming decade. Africa's HE and research institutions need to step up their role of scientific knowledge generation and knowledge dissemination in order to meet the increasing demand of labor markets, and the developmental needs of communities and a growing youthful population.

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WHY IS STI IMPORTANT?

A knowledge-based economy is expected to drive sustainable social-economic transformation and underpin the creation of employment opportunities, especially for a bulging youth generation. Africa requires a boost in attention to and development of STI to urgently address challenges posed by climate change, desertification and land degradation, drought, loss of biodiversity and sustainable natural resource management. As the UN prepares to adopt a post-2015 development agenda, a Common African Position (CAP) has been published in 2014. The CAP recognizes rising trends such as population growth and the youth bulge, urbanization, climate change and inequalities. It reiterates the importance of prioritizing structural transformation for inclusive and people-centered development in Africa. According to the document, such a development approach requires the advancement and enhancement of adequate policy space and productive capacities, notably through infrastructure, science, technology development, transfer and innovation. CAP positions STI as the second of its six pillars and commits to:

- Enhancing technological capacities for Africa's transformative agenda,
- Building enabling environment for innovation,
- Increasing support for research and development, and
- Optimal utilization of space and geospatial technologies.

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TAKING STOCK AND MONITORING STI IMPLEMENTATION

Robust and reliable indicators are essential for effective implementation of STI policies and strategies. Such indicators are to be used to monitor global technological trends, conduct foresight exercises, and deter-

This policy brief is produced by the Association for the Development of Education in Africa (ADEA) for the Summit on Higher Education on Revitalizing Higher Education for Africa's future (Dakar, Senegal, March 10-12, 2015)

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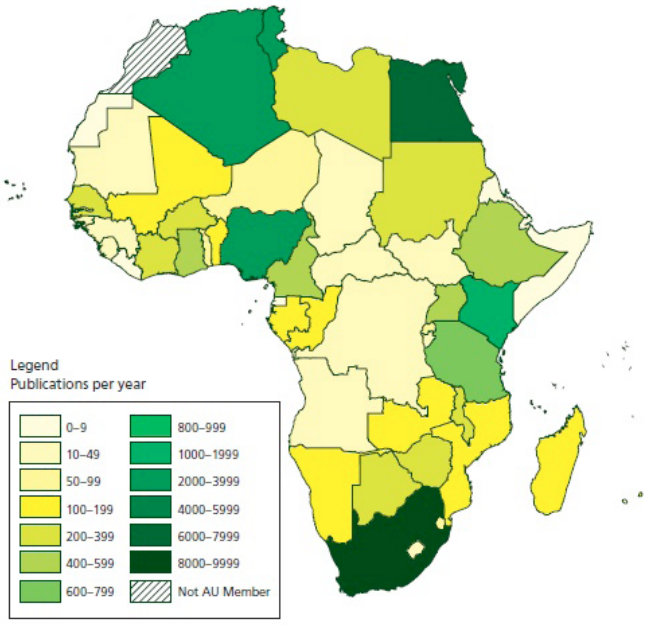
mine specific areas of investment. The African Science, Technology & Innovation Indicators Initiative (ASTII) is a mechanism developed for this purpose and is being implemented through a number of key projects. Firstly, it seeks to promote the adaptation to, and adoption of internationally compatible policy-relevant STI indicators and methodologies; to build upon institutional capacities and to develop an African network for STI indicators. Secondly, it has set-up the African Observatory on Science Technology and Innovation (AOSTI) to stimulate and promote the use of Science & Technology (S&T) in supporting sustainable development in Africa. AOSTI is also designed to be a repository for STI statistics as well as to provide analytical support for evidence-based policy-making in the continent

AOSTI published in 2011 an assessment of Scientific Production in African Union (AU) between 2005 and 2010 through the "African STI Outlook", and in 2014 came out with a second edition. The African Development Bank (AfDB), ADEA and UNESCO have also produced publications and organized regular forums that examine issues pertaining to STI on the continent. In 2014, the World Bank-Elsevier published a report examining the research enterprise, which a particular focus in STEM (Science, Technology, Engineering and Mathematics), over 2003-2012 in the sub-Saharan African region.

Map: Scientific output of the African Union, 2005-201



Source: African Science, Technology and Innovation Outlook 2013 computed with data from the Scopus database.

Box 1

AU/ NEPAD Science and Technology Consolidated Plan of Action (CPA)

The AU had developed Africa's Science & Technology Consolidated Plan of Action (CPA) for 2006-2010. Erected on the three interrelated pillars of capacity-building, knowledge production and technological innovation, the Plan articulates Africa's common objectives and commitment to collective actions to develop and use science and technology for the socio-economic transformation of the continent and its integration into the world economy.

CPA's specific programmes and projects are grouped into two core areas:

1. Research and Development clusters: including themes like energy, water, biotechnology; Biodiversity, Biotechnology and Indigenous Knowledge, known as the African Biosciences Initiative (ABI); and
2. Mechanisms to improve policy and promote technological innovation: including the African Science, Technology & Innovation Indicators Initiative (ASTII), Building public understanding of S&T, and building a common African strategy for biotechnology.

Recent indicators show that Sub-Saharan Africa only accounts for less than 1% of the world's research output, despite having 12% of the world's population. Some modest gains are observed with the region (excluding South Africa) almost doubling their share of global research output from 0.44% in 2003 to 0.72 % in 2012. The recent growth in Africa's research has been overwhelmingly driven by advances in research capacity in the health sciences, which today account for over 45% of all research in Africa.

Overall, research in the physical sciences and STEM-related fields makes up only 29% of all research in the region (when South Africa is excluded) compared to an average of 68% in Malaysia, which had the same research output as Africa in 2003. In fact, the share of STEM research in sub-Saharan Africa has declined by 0.2% every year since 2002. Fewer articles (32% below the global average) cited the continent's science research, and this number has stayed the same since 2003, suggesting less quantity, and quality.

While much has been achieved in regional socio-economic integration, there is very little intra-African collaboration in research and STI development and application

including joint post graduate training. A very large share of the region's research is a result of collaboration with international partners – nearly 80% in southern Africa (excluding South Africa at 45%) and 70% in East Africa. While there are benefits to be had for both partners, it suggests a lack of internal capacity to produce quality research and attain the standards of independent and transparently-funded research. The establishment of the Pan-African University by the AU is expected to address the gap of intra-African collaboration in research.

AFRICA'S LEADERS AND STAKEHOLDERS PRIORITIZE STI

The AU has positioned STI as an integral part of its strategic plans and has instituted several dedicated organs. One of its fourteen Specialized Technical Committees is for 'Education, Science and Technology'. The African Ministerial Council on Science and Technology (AMCOST) is responsible for establishing policies, priorities and strategies for S&T co-operation and has a Steering Committee for the same. The AU Commission (AUC) has a 'Human Resources, Science and Technology' portfolio with its 'Science, Technical and Research Commission (STRC)' mandated to promote S&T.

The New Partnership for Africa's Development (NEPAD), a technical body of the AU, is the pan-African vision and strategic framework for the socio-economic development of the continent and has an Office of Science & Technology that provides overall technical and intellectual leadership in the domain. The AU/NEPAD published in 2005 a policy document entitled "Africa's Science and Technology Consolidated Plan of Action" (CPA), Building on the NEPAD experience, AU is formulating a new long-term development trajectory through Agenda 2063. This is both a vision plan and an action plan over short, medium and long terms, and represents renewed and invigorated efforts to catalyze development of the continent. Science, Technology and Innovation Strategy for Africa 2024 (STISA-2024) [see Box 2], approved by AMCOST and adopted in 2014, is AU's decadal strategic framework for accelerating Africa's transition to an innovation-led, knowledge-based economy within the overall framework of the AU Agenda 2063.

The African Development Bank (AfDB) has also developed a Ten Year Strategy for the period 2013-2022 with one of its operational priorities on 'Skills and technology' highlighting the need for investment in S&T.

Regional co-operation also features in Africa's Science and Technology CPA. Furthermore, AU's officially recognized Regional Economic Communities (RECs) are today important development and political institutions. They have also, to varying extents, developed well-defined objectives, common frameworks and cooperation programs in STI and Higher Education. EAC has established the East African Science and Technology Commission (EASTECO); ECCAS has a Protocol on Cooperation in Science and Technology; ECOWAS has a policy and action plan on Science & Technology (ECOPOST); and SADC has an STI Desk and has adopted a Protocol on STI.

Box 2

AU Science, Technology and Innovation Strategy for Africa (STISA)

Science, Technology and Innovation Strategy for Africa 2024 (STISA-2024), has been developed following an inclusive participatory process involving policy-makers, prominent scientists, and researchers at home and in Diaspora; institutions and organizations including the AUC and NEPAD. STISA-2024 identifies STI tackling six critical socio-economic priority areas, namely: eradication of hunger and ensure food & nutrition security; disease prevention and control and ensuring well-being; communication; protection of our space; live together – build the community and; wealth creation.

It takes into cognizance the need to revamp STI infrastructure in Africa, enhance technical and professional competencies, and also provide the enabling environment for STI as prerequisites to achieve its mission. Flagship research programs and actions with estimated budget and funding sources will be elaborated to respond to the challenges along the key priorities' impact areas by the scientific community and all relevant stakeholders. Both prerequisite actions and flagship programs will take stock of existing initiatives and will build on existing program actions already identified in the CPA.

Foreign Direct investment into Africa continues to diversify beyond commodity producing sectors and regional integration has made significant strides. There is a unique array of natural resources, a rich indigenous knowledge base and potential for an emerging green and blue economy to be tapped. In addition, there is a fast rising broad based African entrepreneurial and middle class and more critically, a youth bulge. All these will drive up the demand for higher education and continuous professional development training in S&T. Africa is thus uniquely positioned at a confluence of factors that present a great

opportunity for rapid development. 'Business as usual' approach will no more serve the purpose. It is time for stakeholders to move to the next gear in terms of action and commitment, and rectify any lacuna.

POLICY RECOMMENDATIONS

Recent reports point to chronic underfunding and lagging investments in research and STI and over reliance on donor funding. Earlier commitments of 1% of GDP spending on research and development have not been met.

The following are policy recommendations for stimulating the development of STI on the African continent

Recommendation N°1: Implement strategies and policies adopted at all levels

There is a critical need to renew commitments to strategies and implementing policies adopted at the continental (AU) and regional levels (RECs). This entails the following:

Develop and strengthen National STI Policies

Some countries still lack or have inadequate national STI policies. Development partners, including AfDB, can provide support in the exercise of instituting and revamping such frameworks. UNESCO, for instance, has been helping to develop national STI policies for African countries still lacking one and is working with others to reform their science systems, assisting them in policy formulation, facilitating the adoption of national policies and accompanying them in elaborating and implementing strategies and programs.

Enhance monitoring mechanisms and evaluations

In addition to development partners and dedicated AU agencies having their own monitoring mechanisms and reports, a structure like the African Peer Review Mechanism (Africa's self-assessment for good governance) could be enhanced to explicitly include STI as one of the thematic areas under consideration. National academies and national/regional STI think-tanks should take the lead and strengthen their roles in assessment and policy formulation. These will further empower Africa to take ownership of her own monitoring agenda.

Adapt to adopt internationally compatible policy-relevant STI indicators

The ASTII mechanism recognizes that quality, relevant and frequently updated data is critical in furthering the STI agenda. National STI institutions need to produce and use policy-relevant STI indicators and contribute to the training of specialists on the same, with the technical help of HE Institutions (HEIs). Member states and Development Partners are urged to provide the necessary technical and financial support to sustain the AOSTI.

Recommendation N°2: Strengthen the teaching and lifelong learning of mathematics, science and technology

Improving the teaching and learning of science and mathematics is the foundation for STI development in Africa. Teaching and lifelong learning of science and technology therefore needs to be strengthened at all levels, starting from basic education. This entails improving the quantity of teachers and the quality of teacher education in science and mathematics. This is fundamental for the successful acquisition of scientific and technological knowledge, skills and qualifications. The development of STI in Africa is therefore dependent on the quality of teachers in mathematics and science, the quality of their in-service training and the professional development provided. HEIs should continue to develop and facilitate such programs to enhance the training capacity and quality.

Recommendation N°3: Sustain policy dialogue

The political commitment has to be maintained, if not increased, with STI placed as an area of national priority. The political goodwill for science in Africa can be boosted by increasing involvement of scientists in the national political sphere. Active participation of scientists in politics or the creation of national positions like Research Chairs or Science Advisor can positively influence STI policies.

Recommendation N°4: Increase and sustain funding

Funding bodies need to be guided by new and independent research that has reconfirmed and quantified some of the economic and societal benefits of public investment in scientific research. These lead to economic growth through an increase in private sector productivity, and create benefits through increased interaction between the academic and private sectors. The UK's "The Campaign for Science & Engineering (CaSE)" report, for instance, calculates that the private sector R&D output rises by 20% per year in perpetuity of the amount invested by the government on R&D through the raising of country's knowledge base. This leads to a virtuous circle of investment that amplifies the economic benefits.

Recommendation N°5: Stimulate and intensify collaboration with the private sector

The potential for private-public sector collaboration in STI in Africa is enormous and there should be a new drive to develop partnerships beyond areas like healthcare and agriculture. To remedy the current small share of collaborations between academics and corporate, avenues for increased cooperation in biotechnology, renewable energy, construction, ocean economy should be further exploited. Fast evolving areas like Big Data, which will spur creative and innovation ways to han-

dle and analyze vast volumes of data, have commercial and medical applications and should attract more support from the private sector. Ideas like 'Corporate Science Responsibility' have been referred to as means to actively engage businesses in the development of STI.

Recommendation N°6 Boost infrastructure and protect intellectual property

Stakeholders should also invest in strategic infrastructure like High Performance Computing (HPC), robust data and internet connectivity and state of the art facilities on campuses. Universities should promote consultancy and spin off companies, and new campuses can be integral part of master plans that include science and technology parks. Generation of knowledge and technology need to be supported and protected by appropriate intellectual property rights (IPR). Support to the Pan African Intellectual Organization (PAIPO) and national framework for IPR is instrumental in the process.

Recommendation N°7: Leverage international partnerships

Flagship international projects are being sited in Africa and HEIs have to make best use of these opportunities. For example, the Square Kilometer Array (SKA), the world's largest and most sensitive radio telescope, will be largely based in South Africa with outstations in Botswana, Ghana, Kenya, Madagascar, Mauritius, Mozambique, Namibia and Zambia. The commissioning and operations will call upon a vast array of skills, including scientists, engineers, computer professionals, construction workers and technicians.

Another example is the African Institute for Mathematical Sciences (AIMS) founded as a partnership between prestigious western Universities and African Universities for post-graduate training and research for talented students from the continent. The first one was set up in South Africa, followed by Senegal, Ghana, Cameroun and Tanzania. The AIMS-Next Einstein Initiative (AIMS-NEI) plans to create 15 centers across Africa, offering opportunities for HEIs to join forces.

Recommendation N°8: Support Pan-African networks and Centers of Excellence

The Pan African University (PAU) is an umbrella education structure designed by the AUC to foster high-quality teaching and research in S&T sectors with focus on key priorities identified in STISA-2024. It has the support of the Association of African Universities and takes shape by bringing together existing African educational institutions under a series of thematic hubs and satellite centers in five geographic regions of the continent.

Other networks in S&T have been instituted or have evolved naturally and they are all synergizing efforts and working towards the vision of an integrated research and development culture. Examples include various Regional Universities Association, NEPAD's Water Centres of Excellence; Africa Biosciences Initiatives (ABI) with four regional networks; the African Network for Drugs and Diagnostics Innovation (ANDI) in health sector. Academic and research networks have the potential of promoting intra-African and south-south collaboration among the next generation of researchers. The Southern African Regional Universities Association (SARUA) knowledge co-production framework in the area of climate change illustrates this.

Recommendation N°9: Tap African Human Capital

Public and private sector schemes are to be devised to curb the brain drain and attract back the Diaspora. Returning scientists bring significant benefits to the national science output. HEIs should maintain an active and productive connection with their alumni network,

Box 3

Strengthening the teaching and lifelong learning of STI – Recommended actions

1. Articulate policies and strategies for capacity building of science and mathematics teachers through pre-service, in-service and continuous professional development, pedagogy and practice.

2. Give increased attention to research on the status of science education at all levels: content, pedagogy and practice.

3. Increase the quality of teaching profession recruits. The quality of science education in Africa will ultimately depend on the quality of those recruited for teacher education, of in-service training and of professional development provided, especially for mathematics and science teachers, and on numbers to meet current and future demand for rapidly increasingly enrolments.

4. Use ICT and Internet in teaching and learning. ICTs enhance access to and dissemination of information as well as reduce time and cost. A number of African countries, including Kenya and Rwanda, have embraced ICT and incorporated it into primary schools as a part of enhancing scientific literacy and building positive attitudes to technology.

5. Develop quality assurance mechanisms. These should be used to validate and certify skills and knowledge acquired, accrediting institutions and making information available.

Source: : Expected action points, Lifelong acquisition of scientific and technological knowledge and skills for the sustainable development of Africa in the context of globalization

where role models can be called upon to guide and advise students into pursuing rewarding STI career paths. Accomplished African scientists operating abroad should be provided with local Visiting faculty positions, where they will also be involved outreach activities to inspire the younger generations. They can also be involved in joint-supervision of post-doctoral researchers, who have to be given the right support to enable them to pursue STI activities in Africa itself.

Recommendation N°10: Promote equality and diversity

Policy makers and HEIs also have to address gender parity in STEM courses, implement quality assurance mechanisms and ensure that a fair share of S&T courses are being offered at post-secondary level. The expansion of higher education unfortunately tends to favor non-S&T courses, most likely due to the substantial infrastructure investment required for running S&T classes. S&T enrolment can be boosted by offering competitive fees on par with non S&T courses, as well as ensuring a minimum quota for STEM fields in any set of scholarships offered by governments or agencies.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Recommendation N°11: Adapt and keep pace with emerging trends

HEIs can formalize multidisciplinary and interdisciplinary research within and among faculty and campuses. Unprecedented opportunities have been heralded through access to online tools and materials; and these should form an integral part of STEM training. Open-access journals, open data and online courses have to complement traditional university systems. Doctoral schools, as established in France for example, pool together resources from two or more HEIs and provide structured training for PhD. This model can be replicated at national or even regional levels to optimize upon limited resources and stimulate collaboration. Faculties can look into mainstreaming entrepreneurship training and innovation exposure into their curriculum. These and activities similar to the 'Co-operative education/internship program' as widely implemented in Canadian Universities promote industry and private sector linkages.

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Association for the Development of Education in Africa (ADEA)

ADEA was created in 1988. Since its founding it has grown from a donor-driven platform for coordinating development aid to a Pan-African Organization working closely with the Africa Union and hosted within the African Development Bank.

ADEA represents a partnership between African ministries of education and development partners. It is also a Forum for policy dialogue bringing together a vibrant network of African Ministries of Education, bilateral and multilateral development agencies, researchers and stakeholders from Africa and around the world.

Collectively the network aspires to the vision of high quality education and training. Programs focus on supporting education systems to develop the critical knowledge and skills needed for Africa's accelerated and sustainable development.

In 2013, the African Union's Heads of State endorsed the Strategic Policy Framework developed by ADEA to guide the transformation of African education and training systems.

ADEA programs are implemented by the ADEA Secretariat, which is based within the AfDB, and by its Working Groups, Task Forces and Inter-Country Quality nodes, which address specific education and training themes and challenges.

Members include 15 bilateral and multilateral development agencies and 18 Ministries of Education.

For more information go to the ADEA web site at www.adeanet.org

First print run: March 2015 - Layout: Marie Moncet

Published by the Association for the Development of Education in Africa (ADEA) for the African Summit on Higher Education