SCIENCE AND TECHNOLOGY PARTNERSHIPS IN AFRICA

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Introduction

The establishment and sustainability of robust science, technology and innovation (STI) sectors correlates directly to a nation's economic growth and prosperity. Indeed, industrialized countries with thriving STI sectors are the world's richest. African countries recognize this correlation, and many are aiming to significantly boost their STI portfolios in an effort to bridge the development divide within a generation. With the right preparation and training, Africa's youth bulge can be leveraged to achieve this ambitious goal.

Increased investment in STI infrastructure, workforce development, and policy will accelerate economic growth on the continent, and yield relevant, timely and deployable solutions for African challenges. Such solutions, exemplified by the mobile technology revolution, will be demand-driven, scalable, lucrative and predominantly developed by Africans. However, African countries need not re-invent the wheel as they augment their STI enterprise, and each country need not establish or grow an independent STI sector single-handedly. Partnerships across borders, sectors and disciplines will facilitate rapid development and deployment of STI solutions and approaches. National science policies can provide the enabling environment for STI initiatives in academia, business and government to take root and flourish.

This paper aims to highlight some policies, practices and partnership models that have the potential to harness the power of science, technology and innovation for accelerated economic growth, social development and socioeconomic mobility across the continent.

Science Policy

The Science, Technology and Innovation Strategy for Africa (STISA-2024) places STI at the center of Africa's economic growth and development. This African Union (AU) strategy identifies several STI pillars including research infrastructure, workforce development and entrepreneurship for successful implementation of the agenda. In order to create enabling environments required for serious, relevant and long-term investments in STI, AU member states must commit to supporting continental, regional and national policies on STI. Already, several countries have pledged to increase their STI investments, including bolstering research ecosystems and enhancing science and technology (S&T) workforce development. The Joint Call for Action in Kigali in 2014 exemplifies such a commitment by the governments of Ethiopia, Mozambique, Rwanda, Senegal,

and Uganda to "adopt a strategy that uses strategic investments in science and technology to accelerate Africa's development into a developed knowledge-based society within one generation."

Investments by many African countries in R&D are typically less than the continentally agreed target of 1 percent of the GDP, although some countries are beginning to take this seriously. For example, Kenya's Science, Technology and Innovation Act of 2013 allocates 2% of the GDP to research and development (R&D). Africa's research productivity has been increasing. Between 2003 and 2012, the number of peer publications authored by African researchers more than doubled, while Africa's contributions to global research increased from 0.44% to 0.72%. The impact factors of research publications coming from the region also rose, with citations increasing from 0.06%- 0.16% to 0.12%-0.28%. Most of the research output is in the areas of health and agriculture. This is unsurprising since most funding has prioritized these areas over traditional science, technology, engineering and mathematics (STEM). Dedicating more funding to STI, including more support for research in all STEM fields, continues to be an important first step. However, such commitments must be accompanied by actionable and sound national science policies that create enabling environment for STI ecosystems to thrive.

National academies of science, engineering and medicine play an important role in advising governments on national science policy, and some African countries are beginning to rely more on these professional societies. The recently launched Alliance for Accelerating Science in Africa (AESA), a collaboration between the African Academy of Sciences (AAS) and the New Partnership for Africa's Development (NEPAD), aims to drive Africa's research agenda and to build scientific capacity across the continent. The African Science Academies Development Initiative (ASADI) is a decade-long collaborative program between academies of science of several African countries and the US National Academies of Science, Engineering and Medicine geared towards "strengthening the capability of African science academies to provide independent, evidence-supported advice to inform African government policy making and public discourse related to improving human health." Such science policy initiatives are encouraging, but more still needs to be done, including governments' increased financial contribution to initiatives such as ASADI and AESA, both of which are mostly funded by grants from foreign donors. Strong national leadership and political will is needed if science policy in Africa is to succeed.

Academic Partnerships

There have been several collaborative efforts directed at STI workforce development in recent years across the continent. The Pan African University, launched in 2011, is a network of four established African universities seeking to build STI capacity at postgraduate levels by offering masters and doctoral programs in Basic Sciences, Technology and Innovation (Kenya), Life and Earth Sciences (Nigeria), Social Sciences (Cameroon) and Water/Energy Sciences (Algeria). This AU program illustrates how a shared vision by African governments can lead to strategic utilization of resources for enhancement of STI capacity and capability at existing campuses. In a separate effort, the World Bank Africa Higher Education Centers of Excellence Project, launched in 2014 is expected to create "specialized world-class higher education institutions on the continent" in seven West and Central African countries: Nigeria, Ghana, Senegal, Benin, Burkina Faso, Cameroon, and Togo.

International bilateral university partnerships are also being established, with the aim of utilizing established resources and networks at foreign universities to train the next generation of Africa's STI graduates at home. For example, the Carnegie Mellon University (CMU) in Rwanda has pioneered the establishment of branch campuses of US research institutions in sub-Saharan Africa, and is similar to models implemented in China and the Middle East. This partnership seamlessly connects students with their peers at the CMU main campus in Pittsburgh, and the Rwandan government offers scholarships to all East African students eligible to attend. The launch of the CMU Rwanda campus in 2012 is an important example of how African countries can partner with leading STI universities to rapidly train a workforce ready for growing STI economies. As Rwanda prepares for leadership in information and communications technology (ICT), its CMU partnership will retain much-needed talent at home, and favor brain gain over brain drain. Such international collaborations should be viewed positively, as they complement existing national university systems.

The Inclusion of Women

Countries with greater gender parity are more prosperous, more peaceful, and enjoy greater politically stability. African countries cannot afford the economic, political and social setbacks that result when women are systematically excluded from full and equitable participation in all segments of society. Exclusion of women from the STI sector wastes precious talent and retards scientific advancement. The future of African economies depends on eliminating this wasteful practice. Providing equal opportunity to girls and women to enroll and succeed in STEM careers is not only morally right, but also the smart thing to do. As President Obama noted in his speech at the Global Entrepreneurship Summit in Nairobi in July 2015, "Any nation that fails to educate its girls or employ its women and allow them to maximize their potential is doomed to fall behind in a global economy."

Several countries have moved swiftly to fully and equitably include women in political, professional and social institutions. Rwanda has the largest proportion of women parliamentarians of any country in the world; 64% compared to the global average of 22%.Africa now has 3 women presidents; Ellen Johnson Sirleaf, Liberia; Catherine Samba-Panza, Central African Republic; and Ameenah Gurib, Mauritius. Similar progress is needed in the STI sector, and greater efforts must made to not only enroll more

girls in STEM tracks early, but to also ensure the success of women working in STI fields. Support in the form of equal opportunity and access to STI careers, mentorship programs at all levels, and family-friendly policies for both public and private sector male and female employees will allow Africa to retain and promote the success of its women working in the STI sector.

Efforts are currently underway across the continent to boost the number of girls enrolled in STEM programs at primary, secondary and tertiary levels. However, the success of these initiatives depends on the availability of role models - professional women who are active in STI fields. The "leaky pipeline" or attrition of women as they advance up the career ladder, continues to plague STI professions everywhere. Mentoring and coaching programs can go a long way in addressing this problem, and several career advancement programs have been established for African women in STI fields. The African Women in Agricultural Research and Development (AWARD) is a mentorship program with programs in 11 African countries (Ethiopia, Ghana, Kenya, Liberia, Malawi, Mozambique, Nigeria, Rwanda, Tanzania, Uganda, and Zambia). AWARD aims to empower more women to pursue and succeed in agricultural science careers through career-development fellowships. In Africa, women comprise over 70% of farm labor in smallholdings, yet only 25% of agricultural researchers in African are women. Recognizing that women scientists are best positioned to work with women agricultural producers, marketers and processors, and that Africa's green revolution depends on sourcing talent from all women in agriculture, AWARD seeks to "make women researchers technically stronger, better networked, and more confident and visible". The program rightly aims to position its fellows as both leading scientists and strong leaders who will support, coach and mentor the next generation of young women in the agricultural sciences.

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Environmental Stewardship

Harnessing STI for economic growth and development should occur in tandem with environmental stewardship. Countless and often irreversible environmental disasters have been wrought by unchecked industrialization and exploitation of natural resources in North America, Europe, and, now increasingly, China. Indeed, the UN Conference on Climate Change in Paris in Nov/Dec 2015 was a collective action aimed at addressing the ills of rampant and irresponsible industrialization, currently the greatest threat to the world's human populations, ecosystems, and economies.

African countries need not follow the paths of western countries, but should seek greener solutions that safeguard the natural and human capital on which Africa's economic growth and prosperity is predicated. Environmental policy in the form of punitive measures against national, business and industrial growth is counterproductive in countries seeking to industrialize, and is not being advocated for here. Rather, African nations should intentionally source and integrate STI solutions in the design and implementation of projects in areas such as (climate-smart) agriculture, (clean) energy, (green) urban planning, and (smart) water.

These solutions are neither obvious nor simple. But with political will and creative approaches, environmental stewardship at the national level is possible. In one generation Costa Rica has more than doubled its forest cover and reduced CO2 emissions, sharply bringing the country close to carbon-neutrality. In the same timeframe, the country has established a growing medical devices industry, and catered to a rapidly urbanizing population. The Costa Rican model is one that could well inform African countries as they develop their STI and sustainable development policies.

Diasporan Engagement

From Chinese in Indonesia to Indians in Silicon Valley, diasporans move money, talent and ideas faster than other groups. The African diaspora is no different: remittances from the African diaspora contribute to economic growth in Africa, and many innovative businesses have been established by diasporans, thanks to their international contacts, training and experience. Arguably, African diasporans are more highly educated than the population in their home countries. Indeed, they often outperform indigenous populations of their resident countries. When diasporans return home, lured by increased democratization and economic opportunity, they bring with them a wide array of skills and expertise. Local and global STI companies looking to recruit talent are tapping this cohort for both leadership and technical positions.

Many African countries recognize the power of their Diasporas as economic

and diplomatic bridges to other countries. Indeed, several countries including Benin, Mali, Somalia and Tunisia have ministerial entities dedicated to diasporan affairs. African diasporan organizations, including those in STI, are increasing their visibility and demonstrating their value as channels to opportunities and resources in Africa. The Africa Gathering is a group of the African digital diaspora (with annual meetings in Africa, the US and Europe) pooling resources, sharing ideas and coordinating efforts to use technology for positive change in Africa. With the belief that "lives of many ordinary Africans can be improved using the benefits of technology, using African solutions for African problems – sometimes with a helping hand from others", this group is challenging the outdated "Aid for Africa" paradigm. Africa Gathering argues that diasporan talent, energy, experience and capital can have greater and longer lasting socioeconomic impact than traditional foreign assistance mechanisms.

Organizations of STEM diaspora professionals also play an important role in facilitating collaborations in STI. The STEM Africa Initiative at the University of Michigan creates a platform for the "engagement of science as a trans-Atlantic affair" by diasporan STEM professionals in the US and their counterparts in Africa. The Carnegie Diaspora Program supports African diasporan professors in the US to teach and conduct research in Ghana, Kenya, Nigeria, South Africa, Uganda or Tanzania. The International Diaspora Engagement Alliance (IdEA) "promotes and supports diaspora-centered initiatives in investment & entrepreneurship, philanthropy, volunteerism, and innovation in countries and regions of diaspora origin."

Just as Indian and Chinese diasporans have contributed to the accelerated growth of STI sectors in their home countries, so can African diasporans enable African countries to leapfrog into competitive STI economies. The next 5-10 years will be critical in revealing the impact of the rapidly increasing diasporan engagement in Africa's STI sector.

Global STI Programs and Investments

African research institutions are increasing their brick and mortar investments through the Pan African initiatives outlined above. However, infrastructural projects take time and significant resources. In the interim, there are opportunities to access research facilities, scholarly networks and complementary expertise in other parts of the world through science and technology partnerships. International research partnerships with North American, European and Asian agencies should be pursued and can bolster the research portfolios of individual scholars, institutions and consortia. Importantly, there should be a greater recognition that these collaborations are mutually beneficial, and western partners benefit from access to resources (expertise, data, research sites) and skilled research assistants (e.g., graduate students in science). As such, these partnerships should be leveraged to develop research activities that are well integrated and relevant to the African researchers' projects allowing for continuation of the scholarly work beyond the lifetime of the grants.

Short-term visits for young Africans, including those working in S&T, are offered by various programs such as the Mandela Washington Fellowship of the Young African Leaders Initiative (YALI) and the MasterCard Foundation Scholars Program. Both programs are aimed at providing the brightest and most promising young Africans the opportunity to access thought leaders, professional networks, and world-class facilities at partner institutions in Africa and North America. The expectation is that these opportunities will catalyze contributions of these exceptional scholars upon their entry or re-entry into the workforce back home.

Africa now has 4 of the top 10 of the fastest growing global economies and its economies are diversifying away from agricultural and minerals commodities. In Nigeria, for example, the banking, mobile phones, and construction now contribute to 60% of the GDP. Africa's middle class is bourgeoning, and there is an increase in workforce ready university STEM graduates, in part due to increased enrolment in STEM fields. Attracted by this environment, global STI companies such as IBM, Hewlett Packard, GlaxoSmithKline, Google, and GE have established regional and country offices as well as state-of-the-art production and research facilities in African countries to increase proximity to markets and competitive talent. This global corporate interest is an indication of Africa's improved investment climate, and should lead to job growth in the STI sector. Several African universities are partnering with the private sector to ensure that their curricula prepare graduates for these anticipated new employment opportunities. In addition to bolstering national efforts in workforce development, such public-private partnerships should also be used to integrate appropriate STI approaches into national development efforts in all STI-relevant sectors.

Conclusion

Africa has been rising over the past decade. While global geopolitics has certainly played a role, the renaissance is in large part the result of a critical mass of progressive Africans taking the helm in politics, civil society, business and, increasingly, STI. The exponential increase in the global exchange of ideas via the Internet and through international travel has invigorated a new generation eager for more peaceful, prosperous and inclusive societies. Africa's growing middle class is changing the landscape in all sectors, including STI. Still, the potential of STI remains largely untapped. Strategic collaboration across the continent and around the world can help harness the power of STI for the overall benefit of African countries. With good governance, robust partnerships, and an enabling environment, STI can be harnessed to transform the continent within a generation. ■

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