



Enhancing Gender in Science, Technology, and Innovation (STI) for Sustainable Development in Africa

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Africa is naturally endowed with diverse renewable and non-renewable resources, yet it remains one of the least developed regions, and its people among the poorest in the world. The past 15 years have seen several African countries experience significant economic growth; in 2015, Sub-Saharan Africa's average GDP growth is projected to be 4.5%, and 9 of the top 20 fastest growing economies in 2014 were in Africa.¹ Despite these leaps forward in the economic growth of many African countries, the continent is not experiencing commensurate achievements in poverty reduction, job creation, peace, or security. Africa requires a development approach that is based on the sustainable use of natural resources and inclusive growth to solve its multiple challenges and improve the welfare of its citizens.

Sustainable development is defined as development that “meets the needs of the present without compromising the ability of future generations to meet their own needs.”² It is development that takes into account environmental integrity, social justice and equality, the welfare of current and future generations, and public participation in development. Sustainable and inclusive development is incomplete without full consideration of issues of science, technology and innovation (STI). Access to new and appropriate technologies promote steady improvements in living conditions, which can be lifesaving for the most vulnerable populations, and drives productivity gains which, in turn, translates into rising incomes.

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Importance of Science, Technology, and Innovation to Sustainable Development in Africa

Science, Technology, and Innovation (STI)

Science, technology, and innovation—the components that make up STI—have been some of the most important drivers of national growth and development in the modern era and are the underpinnings of a modern economy. Many African leaders believe that reaping the benefits of STI for sustainable development should be an increasingly important priority for their governments and for the people of Africa. For example, in 2008, Liberian President Ellen Johnson Sirleaf reminded delegates at the Science in Africa Summit that “no country on earth has developed without deploying, harnessing, and utilizing STI, whether through technology transfer or homegrown solutions,” while Rwandan President Paul Kagame stressed that “we in Africa must either begin to build our scientific and technological training capabilities or remain an impoverished appendage to the global economy.” Development of national STI capacities has proven to be an important prerequisite for the social and economic transformations that enable sustainable economic growth, human development, and poverty eradication.³ Globally, STI fields are recognized as drivers of increased wealth and have continuously improved the standards of living of humanity. Since the beginning of the Industrial Revolution, scientifically and technologically advanced countries have become continuously wealthier, and their growth rates have not slowed significantly over that time.⁴

Economic Impact in Africa

For STI to drive growth and produce dramatic economic benefits, research must be translated into new and more efficient economic practices and technologies. For example, agricultural productivity has grown sharply through innovation and the application of new research: world food production doubled between 1961 and 1998 with virtually no increase in land under cultivation. Yet during this same period, 60% of increased cereal production in Africa came from increasing the amount of land under cultivation, not from higher yields. From 1980 to 1996, trade in high-tech manufactured goods grew at double the rate of trade in resource-based goods. Some of the East Asian countries that capitalized on these opportunities have transformed themselves into middle-income and high-income economies. Over the last two centuries, the pace of technological development has grown exponentially, leading to the formalization and professionalization of research and development activities. Innovation is now a key determinant of the competitiveness of firms and economies. While resource-based firms (e.g. Exxon Mobil) and financial firms (e.g. Citibank) have historically dominated the list of rich companies in the world, technology-based firms such as Apple (market cap US \$362 billion), IBM (US \$213 billion), and Microsoft (US \$212 billion) have not only overtaken many resource and financial firms, but are also worth more in market value than the gross domestic product (GDP) of a number of petroleum-exporting African countries, including Angola (GDP \$113 billion) and Sudan (GDP \$97 billion).⁵ The main assets of these firms are their intellectual knowledge and technological sophistication.

African companies are increasingly innovating to enhance productivity and create wealth and jobs for millions of Africans. Per the United Nations Economic Commission for Africa’s Science, Technology and Innovation Review report (2013), “As a proportion of total exports, information communications technology (ICT) service exports from the continent increased from less than 0.1% in 1990 to about 1.5% of total exports in 2009, while that of ICT goods grew from 0% of total merchandise exports in 1990 to about 0.4% in 2009.”⁶ As such, the ICT sector is also a major employer in Africa. The growing number of people employed in the mobile technology sector account for approximately 1.4% of the total African workforce, suggesting a total workforce of 5.8 million in that sector.⁷ African companies and innovators such as MedAfrica, a virtual library

of medical information available on smart phones; AgriManagr, an app that assists farmers and middlemen by automating farm produce purchase transactions; and HopStop, a Nigerian-founded app acquired by Apple in 2013, which assisted in getting directions or finding nearby subway stations and bus stops in over 300 cities, are contributing to improved standards of living, creating jobs, and diversifying economies on the continent.

In the field of agriculture, developed countries use dynamic innovation and technology to overcome the constraints posed by geography and natural endowments. African firms must now compete against a growing number of rivals whose competitiveness is anchored in a strong technological advantage. The result is that African firms have not only had a hard time breaking into new markets, they have seen foreign competitors beat them in markets where they should have natural advantages. The palm oil industry is a typical example. Palm oil originated in Western and Central Africa, where cooking oil was first extracted from palms cultivated for their oil, but Malaysia has recently surpassed Africa in palm oil cultivation and processing activities, becoming the lead producer and accounting for about 50% of global production of palm oil, in addition to controlling the industry's value chain.

Status of STI in Africa

Developed countries reinvest a growing percentage of their gross domestic product in further advancement of research and development (R&D) in order to reap the continuing benefits of STI. The 29 member countries of the Organization for Economic Co-operation and Development (OECD) together spend approximately 1.5 times more per year on research and development than the entire annual economic output of Sub-Saharan Africa. Ambitious developing countries like China have followed suit, increasing research capacity and skills development in a variety of science and technology disciplines. Most African countries, by contrast, suffer from a lack of R&D investment and a deficit in the human capital needed to carry out economically beneficial research. In 2010, Africa as a whole accounted for less than 1% of the world's expenditure on R&D, with most African countries spending between 0.2% and 0.48% of their GDP on research and development. In contrast, Asia accounted for 30.5%, North America 37.2%, Europe 27.2%, and Latin America and the Caribbean for 2.9% of the total world expenditure on R&D.⁸ Furthermore, Africa is ranked last in research publications per year, accounting for just 2.0% of the world's total published research in 2010.⁹

African universities and research institutes must take the lead in building STI capacity. These knowledge institutions should expand and upgrade their curriculums and programs in the STEM fields in order to better produce graduates and create research programs equipped to utilize and build on the global stock of STI knowledge and fill the needs of emerging technology and innovation-based African economies.¹⁰

STISA-2024: A Viable Strategy for STI Development in Africa

STISA-2024

In response to the need to harness STI for sustainable development, the African Union established a 10-year strategy in 2014 to build capacity and improve the continent's STI landscape. The plan, called "Science, Technology, and Innovation Strategy for Africa 2024" (STISA-2024) seeks to accelerate Africa's transition to an innovation-led, knowledge-based economy. The adoption of this plan shows a renewed commitment by African leaders to foster social transformation and economic competitiveness through institutional and human capital development, innovation, value addition, industrialization, and entrepreneurship.

STISA-2024 responds to a growing need for knowledge-based economies and evidence-based decision-making and policy measures relating to a variety of sectors, including agriculture, environment, health,

energy, development, and water. STISA-2024 identifies 6 priority areas that need to be addressed over a period of 10 years: (1) elimination of hunger and attainment food security; (2) halting and controlling the spread of diseases; (3) communication (both infrastructure and knowledge-based); (4) protection of Africa's space, including climate change studies; (5) building society, including regional integration, and governance and democracy; (6) wealth creation. STISA-2024 further defines four areas that are prerequisites for its success: "(1) building and upgrading research infrastructures; (2) enhancing professional and technical competencies; (3) promoting entrepreneurship and innovation; and (4) providing an enabling environment for STI development on the continent."¹¹ Continental, regional, and national programs will be designed, executed, and synchronized to ensure that their strategic orientations and pillars are mutually reinforcing in order to achieve the envisaged developmental impact as effectively as possible.

Implementation and Challenges

This strategy, if well implemented, will address major developmental challenges holding back the continent. The poor state of infrastructure in most African countries is one of the most daunting challenges facing development planners. Indeed, efforts such as regional integration initiatives are greatly hampered by poor infrastructure. STISA-2024 prioritizes research of infrastructural development including: upgrading and expanding laboratories; building teaching hospitals; upgrading ICT equipment; establishing research and education networks; and creating space for innovation. Commitment of national governments to funding development of research infrastructure will dramatically increase research output on the continent, and enable the development of African technologies and innovations suited to addressing Africa's challenges, especially in the areas of food security, climate change, disease prevention and control, and insecurity.

Africa has insufficient capacity to drive its STI agenda. The continent accounts for approximately 2.2% of the world's researchers, and has less than 500 researchers per million people.¹² STISA-2024 provides an opportunity for national governments to invest massively in education, from primary schools to doctoral programs. National governments must invest in rapid research capacity building, and encourage programs that develop STEM courses and promote STI research and innovation as viable research paths. African universities should align their training and research programs to the priority areas of STISA-2024 in order to contribute to building human capacity and producing the knowledge needed to ensure effective implementation of the strategy.

For STISA-2024 to achieve its objectives, the following key areas must be considered in the process of implementation: (1) STI and education policies of member countries must be designed to support the implementation of STISA-2024; (2) there must be committed financial support by African governments to fund the strategy; (3) the private sector, both formal and informal, must be included in the process of domestication and implementation of the strategy in member countries; (4) there should be gender mainstreaming in the strategies implemented at the continental, regional, and national levels.¹³

Women and STI development in Africa

STI cannot become embedded in African culture if significant sections of the African population are excluded. Gender equity in science, technology, and innovation is important for sustainable development in Africa. Mainstreaming gender perspectives in STI strategies and policies will enhance social equity and create significant economic and social benefits across the continent. Women account for more than 50% of the available human resources in Africa, and for the continent to achieve its STISA-2024 mission of transforming Africa into a knowledge-based and innovation-led society, it must maximize the inherent potential of the African woman.

African women play vital roles in the six priority areas identified by STISA-2024, especially in key sectors such

as agriculture, water, energy, and transportation. In the areas of agriculture and food security, women are responsible for 70% of crop production, 50% of animal husbandry, 60% of marketing, and nearly 100% of local food processing activities. Despite the huge contribution of women to agricultural production in Africa, their effort is usually unrecognized and unrewarded. Agricultural activities undertaken by African women are typically characterized by a lack of resources and support such as credit, agricultural inputs, and the technologies necessary to increase production.¹⁴ Only 25% of agricultural researchers are women, and just 1 in 7 hold leadership positions in African agricultural research institutions.¹⁵

If the situation is to be reversed, it is critical for women's interests and concerns to be reflected in efforts aimed at harnessing STI to address these challenges. For example, women use water for production, consumption, and domestic purposes, and assume the bulk of the burden of water collection in African countries, yet they are often excluded from decision-making in water management. Women's multiple uses of water and their important roles as livelihood managers and farmers need to be given due recognition by including them in decision-making on various initiatives, such as drip irrigation and multiple-use water management schemes. Women are also the primary users of household energy in rural areas, but African women's energy needs are often overshadowed by commercial, large-scale energy technologies. Efforts are needed to increase their access to small-scale energy technologies, such as renewable energy systems for production and domestic activities. Transportation vehicles and systems in African countries often do not fully consider women as users, including their roles in collecting and transporting water and fuel wood. Future improvements in transportation should take their needs into account, not only to improve the overall system, but to do so in ways that would be of use to citizens of all genders. Other technologies and techniques that can address the priority needs of rural women include improved stoves; rainwater harvesting techniques; intermediate transportation devices that reduce the time spent on collection of fuel wood and water; improved hoes, planters, and grinding mills to increase productivity and reduce energy expenditure; improved farming techniques to reduce the time needed for labor intensive tasks; and food-processing technologies that will increase incomes with less time and energy expended.

In addition to their roles in the agricultural sector, African women provide the bulk of healthcare services in both formal and informal settings, as well as in their households. Data indicates that women comprise over 50% of the health workforce in many African countries; still, women remain concentrated in occupations that are perceived to be of lower status, including working as midwives and community health services providers. Fewer women are among the highly-trained and better-paid healthcare professionals. Despite that, female African health researchers and doctors are contributing enormously to the health sector in Africa, including prominent figures like Dr. Delisile Ndzimandze, the first female neurosurgeon in Africa. Although the number of female health practitioners continues to increase, health issues such as maternal deaths and breast cancer are still ravaging women on the continent. In Sub-Saharan Africa, 252,000 women die annually as a result of pregnancy-related issues, and women account for about 60% of people living with HIV in Africa.¹⁶

Challenges and Solutions

Despite the enormous potential of African women, there are socio-cultural barriers that prevent African women from maximizing their potential in the area of STI. As a result, there is a gender imbalance observed in fields of study in science, technology, engineering, and mathematics (STEM), which form the foundation for STI career paths. Key barriers include inappropriate school environments for girls, safety concerns, teaching methods that favor boys, and varying levels of access to technical and vocational education. Some of these problems can be addressed by promoting gender-relevant teaching methods and materials, and by providing funds to promote girls and women in STEM education. Additional reasons for the gender

gap in STI fields across all levels of education, in laboratories, and at the management level include the lack of female role models in STI fields, the challenges of balancing family and career responsibilities, and inflexible working hours. To increase the participation of women in science, it is necessary to promote female role models in STI fields, allow flexible working conditions, and support women's recruitment, retention, advancement, and leadership in these fields. In order to increase the role of women in innovation, it is necessary to ensure women have greater access to education, capital, and markets to improve their livelihoods. Women need to be supported in entrepreneurial development, not only in micro-enterprises, but also in large-scale enterprises, as a means to promoting their involvement in innovation. This includes providing advice and training, better access to markets and financing, and technology support in production and quality processes. In addition, it means ensuring women's representation at senior management levels, and in assisting their acquisition of business knowledge and intellectual property rights management.

Conclusion

STISA-2024, if properly implemented, can play a huge role in solving the major developmental challenges confronting the African continent and provide economic diversification and prosperity for its citizens. It creates a vital opportunity for African countries to leverage the continent's economic growth in order to chart a new developmental path which can transform African countries from natural resource-based economies to viable industrial giants that can compete in a world driven by knowledge and innovation. This will have a multiplier effect on peace and stability in the continent; it will also provide home-grown solutions to many of the challenges the continent is facing. However, for the strategy to achieve its mission, it should maximize the potential of the African women, who account for over 50% of Africa's population and have been playing vital roles in key sectors of development. To this end, African countries need to do a more effective job of gender mainstreaming in the implementation of STISA-2024 at the local, national, regional, and continental level in order to achieve sustainable development.

For a set of policy recommendations regarding STI and sustainable development in Africa, see the accompanying Southern Voices Network Policy Brief No. 1, by Ayodotun Bobadoye.

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Cover Photo: Young girls and boys attend computer science training for at-risk youth in North Darfur, Sudan. Photo by UNAMID via Flickr, Creative Commons. <https://www.flickr.com/photos/unamid-photo/13506266905/>

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