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Investing in African Women as Drivers of Growth: Bridging the gender equality gap in Science, Technology and Innovation to fully transform Africa

STI as driver of Africa's development agenda

African governments have declared their intention of developing long-term strategies for accelerated socio-economic transformation based on harnessing science, technology and innovation (ST&I) for sustainable development. Meanwhile, the global agenda emphasises the need for countries to focus their development efforts on eradicating extreme poverty and transforming their economies through sustainable development by 2030. Among the sustainable development goals for eradicating extreme poverty figures is that of empowering girls and women by providing quality education, creating jobs and equitable growth and ensuring good governance, peace and sustainability.

In Africa, science, technology, engineering, and mathematics (STEM) fields have been regarded as development drivers. The African Union (AU) has been encouraging its Member States to spend 1% of their gross domestic product (GDP) on research and development to enhance STEM innovations. In addition, the Continental Education Strategy for Africa (CESA) 2016-2025, and the Science, Technology and Innovation Strategy for Africa (STISA) 2014 – 2024 underpin science, technology and innovation as multi-function tools and enablers for achieving continental development goals. However, if Africa's political leadership is serious about embracing STEM for transforming societies, it must address the biting gender gap that continue to hamper equal participation among its population. The current stock of graduates with secondary and tertiary-level skills is still highly skewed towards humanities and social sciences, while the proportion of students in STEM averages less than 25%.

Africa's capacity to achieve the global sustainable development goals (SDGs) and the continental aspirations of Agenda 2063 will depend on its ability to innovate using ST&I to transform the continent's vast natural and latent human resource capability into value-added products, processes and services. Investing in STEM education must go hand in hand with addressing the gender equality gap. This requires creating a critical mass of both men and women experts in ST&I to drive the development agenda. Unfortunately, there are fewer women pursuing science and engineering programmes at university level than men. In cases where women are present, the big challenge is to retain them. Moreover, the few women who embark on training in scientific disciplines are

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hindered by discrimination and suppressed motivation resulting in very few female scientists on the continent.

Role of the African woman

Women account for over 50% of the available human resources in Africa. In order for the continent to achieve its goal of transforming Africa to a knowledge-based and innovation-led society, it must maximize the inherent potential of the African woman. There is vast evidence to show that empowering women (higher female earnings and bargaining power) in Africa translates into greater investment in childhood education and health and nutrition. This in turn leads to economic growth and development in the long term. Despite the clamour for increased female participation in the areas of STEM related courses and STI professions, and numerous studies revealing that the number of women in science and engineering is growing, men continue to outnumber women, especially at the upper levels of these professions.

A significant number of women and girls in Africa do not participate or perform well in STEM-related courses. Even in cases where high numbers enroll, only a few graduate. The situation becomes more pronounced as the level of education rises. Enrolment statistics indicate that African women are underrepresented in university STEM programs across the African continent and only about 24% of STEM occupations are filled by women. According to a recent study conducted in 14 countries, female students' likelihood of graduating with a bachelor, masters and doctoral degree in science-related fields were 18%, 8% and 2% respectively, while the percentages for male students were 37%, 18% and 6%. Women also represent a minority in research and at high levels of responsibility in science both in academia and in decision-making structures. At the same time, girls continue to be subject to social and cultural restrictions in some communities, while in others, their limited access to education, science and to funding for research continues to curtail their advancement.

Even though women have made great gains in higher education and participation in research globally, only a third of the world's researchers are women. In Africa, as reported by the African Development Bank, the percentage is 34%, but this global number hides huge disparities on the continent. In Cape Verde 52% of researchers are women, 47% in Tunisia, and 40% in South Africa and Uganda. Guinea is on the other hand is extreme with only 6% women researchers, followed by Ethiopia with 7.6%, Mali with 10.6 and Côte d'Ivoire with 16.5%. In as much as gender inequalities in academia and research persist, there is segregation by scientific disciplines and subfields, with engineering, technological and industrial research being most heavily male-dominated. We see also this inequality affecting decision-making in academia, as there are few women in those leadership positions which shape scientific priorities and agendas.

Even when they happen to make it, many women scientists are less geographically mobile than their male counterparts and are proportionately less likely than men to perceive mobility as essential for their career development. The gender difference in mobility decreases as age (and rank) increases, which seems to indicate that, as women advance in chronological age and in their careers, family-related duties become less of an impediment to being mobile and hence career progression, albeit

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when they are getting close to the end of active career practice. They end up occupying the lower echelons of the professions and very few make it to science leadership and decision-making positions. Thus, women participation in STEM education and ST&I practice is palpably an issue of social injustice, implicit bias, subtle stereotyping, wilful ignorance, and blatant discrimination involving an unfair distribution of education and professional growth opportunities.

African women in science and technology face unique challenges that are likely to derail their careers at a much higher rate than their male counterparts. This calls for capacity-building in scientific research, in research in new and emerging fields, as well as advocacy, policy review planning and management. There are also strategic issues, such as the acquisition of skills to anticipate market demands, the role of female networks, mentoring and the use of role models in the promotion of women in science. The underrepresentation of women in university STEM programs and ST&I practice and careers in Africa cannot be attributed solely to a lack of interest, ability, or intellectual capacity. Instead, a traditional presentation of science and mathematics as a male domain; societal cultural practices that prioritize the education of men over that of women; and an unsupportive science and mathematics teaching environment in secondary school contribute to the paucity of African women studying STEM in African universities. The underrepresentation of women and girls in STEM courses in the higher education systems definitely translates into a loss of a critical mass of talent, thoughts and ideas, which hinders African countries in reaching their maximum development potential. These issues need to be discussed and strategies and actions need to be developed to overcome them. It is particular urgent to address this inequity by forging ahead to take advantage of strategic actions suggested for empowering women in implementing the global Sustainable Development Agenda.

There have been a number of innovative approaches in Africa applied by both governments and civil society organizations to address this gap. One such approach is the STEM model designed by the Forum for African Women Educationalists (FAWE) that has received endorsements and technical support through partnerships with national, regional and global stakeholders, including ministries of education, corporates and United Nations agencies. The FAWE STEM model focuses on increasing girls' participation in STEM subjects, improving their test scores, improving instructional materials for STEM subjects to incorporate gender dimensions and encouraging girls to cultivate a positive attitude towards STEM for career progression in related fields.

The model, developed in 2005, builds the capacity of teachers to be gender responsive and enhances their positive attitudes towards girls' abilities and participation in STEM. The model has been implemented in 13 countries in Africa (Burkina Faso, Cameroon, Kenya, Malawi, Mali, Mozambique, Rwanda, Swaziland, Tanzania, Uganda, Zambia, Zanzibar, and Zimbabwe) through FAWE's national chapters. The model among other things involves establishing science camps and clubs, conducting study tours, profiling women achievers in science-based fields, exposing girls to role models and awarding female achievers in STEM subjects. While these bold innovations have created a significant number of young women and girls, it is imperative that governments invest

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heavily in bridging the gender parity gap in STEM to ensure that all women-young and old- fully participate in the science and technology revolution.

Bridging the gender gaps

The Gender Equality Strategy for CESA provides a detailed account on how African governments can bridge the gender gap. Furthermore, the strategy was adopted by African Ministers of Education during the Pan African Conference on Education in April 2018 in Nairobi, Kenya, in what has come to be known as The Nairobi Declaration. Among other perspectives, the strategy encourages State and non-State actors to create an enabling environment to promote innovations for girls and young women and revise regulations and other school requirements linked to time on task, teacher/pupil ratio, class design and class size. The strategy calls for creating and developing a mindset of creative confidence in technology for girls and boys through education and training. One way of boosting the confidence of girls in technology is ensuring that they are linked to successful female mentors in the industry, and this also applies to boys and the youth in general. It is also important to encourage both girls and boys to work cooperatively and consultatively in generating solutions even as they work towards individual aspirations. What will be key is consulting the users of technology, particularly young people, on what their needs are and where they see their respective countries and the African continent going in technology-assisted learning.

The Gender Equality Strategy for CESA also calls for the creation of appropriate interfaces between government bodies that make policies, the university community that trains the workforce and the business community that absorbs the university graduates and translates research into improvements of economic and social sectors. Bringing together STEM partners and stakeholders to share their experiences and good practices will foster replication of successful models across African countries that are at different levels in STEM development. We therefore must create spaces for both teachers and learners, particularly girls and young women, to become creators of information, best practices and educational resources that can be shared among Africans and even with the world at large. Participation of women and girls in science is crucial for Africa's development

Key Messages

Africa needs to ensure that its human resource – both men and women, are fully engaged in the STEM fields in solving its developmental challenges, and thus should make significant investment into women in STEM to increase their contribution to solving the continent's challenges. To address the issue of female participation in STEM fields in Africa, there should be gender mainstreaming in ST&I policies and strategies in African countries. Policies should take into account customs, tradition, and the particular needs of women in the region. These policies should include gender-based affirmative action, which ensures appropriate representation of women in national, regional and international decision making bodies and forums. More programmes to support and mentor women and girls towards full participation in higher education and institutions are needed, moves which call for policy dialogue, strategic interventions and attitude changes. The educational

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curriculum from elementary classes to the university level should also be reviewed to remove gender bias and give equal opportunity to both boys and girls. Gender awareness training in the form of workshops and in-service training for science and mathematics teachers should be an important part of the school curriculum in African countries.

There should be increased mentorship and sponsorship programs for girls in STEM fields. Increasing representation of female role models is a potential way to promote interest in mathematics and science for girls. Female scientists in Africa should be celebrated so they can serve as role models for the next generation. Networking amongst female scientists in Africa should be promoted through publications, meetings and virtual discussion groups. This will promote collaboration with fellow scientists and also create new opportunities to make it easier for the exchange of ideas, knowledge, and information.

Affirmative action strategies of quota admission, priority consideration, academic upgrading, and conditional admission are all important for addressing the underrepresentation of women in STEM programs in African universities. However, they do not make any dent in the fundamental causes of gender disparity in STEM study enrolment. Two major factors, namely girls' enrolment in upper secondary school, and the difficulties of girls studying science and mathematics at that level, must be addressed. African universities should not stand aloof while gender disparity worsens. They should engage in strong advocacy for girls' education and let their voices be heard as development partners.

Upper secondary school is the major source of students to undertake undergraduate STEM programs. Only a few girls do well in courses that enable them to apply to these programs, owing to unsupportive classroom environment; teachers' use of referents outside of girls' daily experiences; a strong preference for boy students; and a patriarchal image of science and mathematics in society. African universities could influence the number of secondary school girls opting for STEM programs by designing and teaching science, mathematics, and technology programs specifically for girls as part of their community outreach programs. Such interventions would help girls to develop interests, skills, and confidence in those areas. Universities have to promote the full participation of women and girls in science by changing their mindsets, and by fighting stereotypes and biases that affect girls' horizons, expectations and professional goals from the early stages in their career.

The STEM curricula at both public and private universities should be aligned with what students will find in the job market. While women and girls can make a difference when given opportunities in STEM fields, most of the available jobs require work experience from graduates, which is often not achieved at the graduate level. This means that postgraduate students compete with undergraduates for the same positions in many instances. The emergence of new areas of science and the skill requirements should not create new gender gaps or widen existing ones.

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Dr Clesensio Tizikara, a Ugandan national, was educated at Ntare School (1972 – 1977), Makerere University (1978 – 1981) and University of Ife, Nigeria (1983 – 1990). Holds a BSc in Agriculture, MPhil and PhD in Animal Science and has trained in areas of policy analysis, strategic planning, monitoring and evaluation, public speaking and agricultural research management. He has taught at Makerere University (1981-83/85), worked with the Agricultural Secretariat of the Bank of Uganda (1989 – 1994); the National Agricultural Research Organisation (NARO) in Uganda (1995 – 2004); the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA), 2004-2008; the Southern Africa Development Community (SADC) Secretariat, in Gaborone, Botswana, (2008-2010); the Ministry of Agriculture of the Republic of South Sudan (2011-2013); and the Forum for Agricultural research in Africa (FARA) Secretariat in Accra, Ghana (2013 – 2016). He is currently an independent monitoring and evaluation consultant and has served on various consultancy teams and supervisory and monitoring missions for the World Bank, DfID, Danida, European Union, USAID, AGRA, African Union, and various other donors and development agencies. Dr Tizikara is a founder member of the Association of Uganda Professional Agriculturalists (ASUPA); Life Member of the International Development Evaluation Association (IDEAS); graduate of the International Programme for Development Evaluation Training (IPDET) 2013.

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