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TOWARDS WOMEN PARTICIPATION IN SCIENTIFIC RESEARCH IN AFRICA

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by

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Overview

This book is structured into two parts. The first part is a review of the GER of Male and Female cutting across Primary, Lower Secondary, Upper Secondary and Tertiary Institutions; from gender disparity to gender equality bringing about a paradigm shift in support for women in science. The second part is a strategic analysis conducted on a focus group that identifies the root cause and effects of less participation of women in scientific research which also portrays the methodology and analysis of the problem, with an overall objective of enhancing technical and professional competencies to accelerate Africa's transition to innovation led knowledge based economy. This overall objective is the second pillar of STISA-2024 for building a critical mass of technical and professional competencies. The analysis shows that there is need to carry out key activities that will spearhead a paradigm shift in women participation in scientific research.

Statistics from existing literatures have proven that ratios of female to male enrollments rate has recorded slight increase between 1990 – 2012; and it is generally observed that there is no gender parity considering the enrolment ratio of female to male as seen for instance in Sub-Saharan African tertiary education where the GER rose from 4% to 10% for men and from 2% to 6% for women between 1990 – 2012. It is noted, that fields such as education, health, welfare, humanities and arts are more populated with women than men the reason being that women tend to face more challenges in fields of study known to be men dominated like engineering, construction, manufacturing among others. There are ongoing initiatives and mechanisms being initiated by the African Union to support women education and participation which includes the Continental Educational Strategy for Africa (CESA 2016) that recognizes and supports women education and training in Africa among others.

The identification of the causative factors as to why women participate less in science was derived from a methodical gathering of

root cause problems which were developed into an inventory hierarchically arranged to establish the cause and effect relationship on the problem tree. The problems identified were converted into solutions and as positive achievements that should be achievable on all areas that builds up the society to enable the achievement of the second pillar of STISA-2024.

The authors in this book have identified intervention mechanisms to be put in place for the enhancement of women participation in science.

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Acronyms

AGRA	Growing Africa's Agriculture
ASRIC	African Scientific, Research and Innovation Council
AU	African Union
AUC	African Union Commission
AUKNSA	African Union Kwame Nkrumah Scientific Award
CESA	Continental Education Strategy for Africa
CIEFFA	International Centre for the Education of Girls and Women in Africa
COMESA	Common Market for East and Southern Africa
CTA	Technical Centre for Agricultural and Rural Cooperation
Dr.	Doctor
EAC	Eastern African Community
ECOWAS	Economic Community of West African States
EFA	Education for All
GDP	Gross Domestic Product
GER	Gross Enrollment Ratio
GPI	Gender Parity Index
ICPD	International Conference on Population and Development
ICT	Information Communication Technology
ITU	International Telecommunication Union's
MDGs	Millennium Development Goals
NEPAD	New Partnership for Africa's Development
NER	Net Enrolment Ratio
PhD	Doctor of philosophy
Prof	Professor
R&D	Research and Development
RUFORUM	Regional Universities Forum for Capacity Building in Agriculture
SADC	Southern African Development Community
SDGs	Sustainable Development Goals
STEM	Science Technology Engineering and Mathematics

STI	Science Technology and Innovation
STISA	Science, Technology, Innovation Strategy for Africa
UPE	Universal Primary Education

Part 1

From Gender Disparity to Gender Equality

1. From Gender Disparity to Gender Equality

Gender mainstreaming for long has been a central focus of many international organizations and African Union Member States to ensure policies are designed with the knowledge that the society we live in is not gender-balanced, often favouring one gender over the other, usually women taking the disadvantageous position, and that all the policy components address these gender equality issues. There had been a plethora of policies on the promotion and advancement for the cause of women.

The convention on the elimination of all forms of discrimination against women adopted in 1979 by UN General Assembly is among the comprehensive conventions addressing gender and women issues, it recognizes that discrimination against women violates the principles of equality of rights and respect for human dignity. The International Conference on Population and Development (ICPD) held in Cairo in 1994 where platform for action was drawn and adopted that considered 'women empowerment' by ensuring enhancement of women's contribution to sustainable development through their full involvement in all aspects of production, employment, income-generating activities, education, health, science and technology, sports among others.

The Fourth World Conference on Women, held in Beijing in 1995 adopted the plan of action that contained 12 critical areas, including women education. Along the line there were concerted pressure to address women's/gender equality issue from organization s and UN Member States hence the United Nation Development Fund for women was made and later established to be the UN Women presently championing the course for women.

The setting of the Millennium Development Goals (MDGs) adopted by world leaders in 2000 was a new impetus to the support for gender, in which its 'goal 3' focused on promoting gender equality and the

empowerment of women. Its mandate ended in 2015 and the review of the implementation recommended that it should be continued while taking note of the lessons learned. Presently the MDGs is succeeded by the Sustainable Development Goals (SDGs)[1] adopted in 2015. SDG 3 is to promote gender equality and empower women to further build on the success and gains of the MDGs.

On the other hand, the World Bank Gender Strategy 2016 – 2023[2] considered gender equality as the key pathway to achieve lasting poverty reduction and prosperous growth. While the African Development Bank's Strategy 2013 – 2022[3] considers gender as an area of special emphasis to increase the capabilities and opportunities to boost productivity and participation of the half Africa's Population. The Bank has special envoy on gender to ease propagation and implementation and have anchored many programmes on women and girls including scholarship, innovation contest, empowerment, celebration of women day among others.

At the continental level; the Fifth Regional conference on women 1994, Dakar, Senegal recognized some critical areas of concern for African women especially poverty, education and health. The Heads of States and Governments of the African Union adopted the solemn declaration on gender equality in Africa in 2004. The solemn declaration covers and reiterated on the earlier commitment on gender issues made by Member States some of which are the implementation of gender specific items on parity principle adopted regarding the Commission of the African Union to all other organs of the African Union.

The protocol to the African Charter on Human and People's Rights on the Rights of Women in Africa stated that the parties shall combat all

[1] http://www.un.org/sustainabledevelopment/development-agenda/
[2] http://documents.worldbank.org/curated/en/820851467992505410/pdf/102114-REVISED-PUBLIC-WBG-Gender-Strategy.pdf
[3] https://www.afdb.org/fileadmin/uploads/afdb/Documents/Policy-Documents/2014-2018_-_Bank_Group_Gender_Strategy.pdf

forms of discrimination against women through appropriate legislative measures. Furthermore the African Union Agenda 2063 in its transformation framework considered that development must be people driven based on equal opportunities and including participation of women in the development process of the continent.

At the regional level, the declaration by the Heads of States and Governments of the Southern African Development Community (SADC) in 1997 reaffirming the Member States commitment to implement all international instruments on women and similar statement were echoed by the ECOWAS, EAC and COMESA. In furtherance to this there are plethora of national policies and initiatives for implementation of gender equality in development plan including Burundi's vision 2025; Chad's national policy on gender; Ethiopia's growth and transformation plan 2011-2015; Gabon's national gender equality and equity policy; Kenya's policy brief in 2014 on mainstreaming gender in the national STI policy; and some Member States saw creation of ministries of gender and family promotion in Rwanda; ministry for the promotion of women and integration of women in national development in Republic of Congo; ministry of women affairs in Nigeria among others.

There are many initiatives and mechanism initiated by the African Union supporting women education and participation among which; the establishment of the International Centre for the Education of Girls and Women in Africa (CIEFFA) following the AU Assembly Decision; (Assembly/AU/Dec.44 (III)) in January 2016; and the Continental Education Strategy for Africa (CESA 2016) that recognizes and supports the role of women education and training in Africa.

The African Union Commission, Department of Human Resources Science and Technology in 2008 in the implementation of its programmes on science realized that recognizing and appreciating the contribution of women scientists to the scientific community in the

continent will promote their participation. Hence, it initiated in place a programme to recognize the contribution of women scientists to the growth and development of the continent. The programme is the Kwame Nkrumah Regional Award for Women Scientist in the field of Life and Earth Science; and Basic Science, Technology and Innovation.

1.1 On the Road to Marie Curie in Style

The contribution of African women to knowledge society and scientific community can never be over emphasized, as women aspire in the front burners of science and technology and their achievement are realized in different fields. Women scientists have a critical role to play in Africa's development, including pushing the envelope on gender equality.

Prominent among African women and their contributions are the likes of:

Fatima al-Fihri who in 859 AD in Morocco founded the University of Al-Qarawiyin that is arguably believed to be the world's first university and still exists today over 1,100 years[4].

Sameera Moussa is Egyptian and had her doctorate degree in atomic radiation and ardent advocate peaceful application of nuclear use and its affordability to all. She organized the Atomic Energy for Peace Conference and sponsored a call for setting an international conference under the banner "Atoms for Peace.

Prof. Tebello Nyokong, is South African and a 2009 UNESCO L'Oréal- Award for Women in Science for her pioneering research work on photodynamic therapy which looks at harnessing light for cancer therapy and environmental clean-up. She is presently engaged

[4] http://www.allafrica.com/stories/20164010938.html

in ground-breaking research on a new cancer diagnosis and treatment methodology called "photo-dynamic therapy" which is intended as an alternative to chemotherapy. She is awarded an African Union Kwame Nkrumah Scientific Award (AUKNSA) Continental Award in 2016 with an envelope of US $100,000.00. She is from Rhodes University in South Africa.

Prof. Quarraisha Abdool Karim is another South African Scientist and one of the exceptional laureates of the 2016 prestigious L'Oréal-UNESCO for Women in Science Award in Africa and she is also an awardee of the African Union Kwame Nkrumah Scientific 2009 regional women award– Prof Karim of the University of KwaZulu Natal was honoured recently for her "remarkable contribution to the prevention and treatment of HIV and associated infections, greatly improving the quality of life of women in Africa".

H.E Prof. Ameenah Gurib-Fakim, a Mauritian, is currently and the first Female President of the Republic of Mauritius. She is a recipient of the L'Oreal UNESCO Prize for Women in Science (2007); laureate for the National Economic and Social Council (2007); the CTA / NEPAD / AGRA / RUFORUM for 'African Women in Science' and the African Union Award for Women in Science (2009). She has also been elevated to the Order of the Commander of the Star and Key by the Government of Mauritius and admitted to the Order of the Chevalier dans l'Ordre des Palmes Academiques (2010) by the Government of France.

Dr. Lee-Anne McKinnell, is South African and a research professor of Rhodes University, and a Managing Director of SANSA Space Science, formerly the Hermanus Magnetic Observatory. She worked in the field of ionospheric research. She manages the Grahamstown ionosonde, as well as the archiving and quality assurance for South African ionospheric data. Her interests lie in the use of this data for the improvement and development of ionospheric models both locally

and globally. She is an awardee of the African Union Kwame Nkrumah Scientific Award (AUKNSA) Regional Award 2009.

Dr. Sanaa Botros, is Egyptian and a professor of Pharmacology at Theodor Bilharz Research Institute. She worked on efficacy/resistance of anti-schistosomal drugs in Pharmacodynamics and pharmacokinetics of drugs for prevalent endemic diseases. She is a Task Force Member of UNICEF/UNDP/World Bank/WHO Sponsored Helminth Drug Initiative 2007-2010. She is awarded state award in basic medical sciences 1997, the Arab woman organization award for Science and Technology in biological sciences "2008" and she is an awardee of the African Union Kwame Nkrumah Scientific Award (AUKNSA) Regional Award 2013.

Prof. Yvonne Bonzi-Coulibaly is the first and only full professor in Chemistry at Ouagadougou University. She is on the Technical and Scientific Editorial Boards of journals, special committees and Scientific Advisory Committees at Burkina Faso and other international institutions like International Research Development Center (IRDC), Agence Universitaire pour la Francophonie (AUF), International Foundation of Science (IFS), etc. She was coordinator of EXCEED NETWORK on water (2011-2014) and advocates in 2013 for HOPE Project a UNESCO Initiative. She works on preparation of photosensitive phospholipidic probes and large spectrum of pyrylium salts with their precursors. She is an awardee of African Union Kwame Nkrumah Scientific Award (AUKNSA) Regional Award 2013.

Prof. Isabella AKYINBAH QUAKYI is Ghanaian and a professor of Immunology and Parasitology and the Foundation Dean of the School of Public Health, College of Sciences, University of Ghana (UG). Her research provided direct immunological evidence that the 230kD a gametocyte antigen (Pfs 230) is a major target of transmission blocking immunity. Her work was also central to the cloning, sequencing and vaccine development of the 25kDa (Pfs25) cokinete

protein of P. falciparum. She mapped B cell and T cell epitopes on Pfs25 by the use of synthetic peptides more immunogenic by the use of adjuvant and cytokine IL2.

She is UNESCO's Association of African University Chair for Women in Science and Technology in West Africa, 2004 to date and an awardee of African Union Kwame Nkrumah Scientific Award (AUKNSA) Regional Award 2014.

Prof. Wangari Maathai is Kenyan and was the first African woman to receive the Nobel Peace Prize. She was also the first female scholar from East and Central Africa to take a doctorate degree (in Biology), and the first female professor ever in her home country.

Prof. Nadine Gordimer is a literary writer and political activist from South Africa. Her writing is mostly on racial issues and inequalities prevalent in South Africa that permeated the very fabric of the society during the apartheid regime. She was active in the anti-apartheid movement triggered by Sharpeville massacre of black population by the whites. She is a recipient of the 1991 Novel Prize of Literature due to her literary works on racism.

H.E Ellen Johnson Sirleaf is a Liberian and Liberia's bloody civil wars ravaged the country between 1989 and 2003, women often suffer most when wars and conflicts erupted. After the war guns fell silent, she worked to promote peace, reconciliation and social and economic development. She became politician and served as the 24th and current President of Liberia since 2006. Sirleaf is the first elected female head of state in Africa. In June 2016, she was elected as the Chair of the Economic Community of West Africa States, making her the first woman to occupy that position since it was formed. Sirleaf was conferred the Indira Gandhi Prize by the President of India Pranab Mukherjee.

Sirleaf was jointly awarded the 2011 Nobel Peace Prize with Leymah Gbowee of Liberia. The women were recognized "for their non-violent struggle for the safety of women and for women's rights to full participation in peace-building work.

Ms. Leymah Roberta Gbowee the co-awardee of the Nobel Peace Prize for Peace their peaceful struggle for the safety of women in rebuilding Liberia. She is also Liberian, peace activist, social worker and women's rights advocate. She is well known for leading a nonviolent movement that brought together Christian and Muslim women to play a pivotal role in ending Liberia's devastating civil war. It was believed that her movement paved the way for the election of Africa's first female head of state, Liberian President Ellen Johnson Sirleaf.

There are many of such African women who have contributed in different endeavours of life in the continent. However, persisting gender inequality often severely limits women from achieving their potential and effectively contributing to development challenges. Even though there are significant progresses made in science, this could be witnessed by the achievements aforementioned above.

1.2 Women and Girls in Education and Learning

Empowering women through education is an important factor in promoting economic well-being of Africans. Many literature sources have shown that there are strong links between educating women and girls and positive outcomes for economic empowerment, social mobility, and maternal health. It is also believed that women unemployment in a nation’s workforce was a waste of valuable human capital that has a negative impact on economic prosperity and national development.

The girl, who attends school and learns, receives skills to improve her future livelihood and in turn champion education for her family,

community and nation. However, the opportunities must be present and ripe for the taking.

Recalling the UN slogan "Equality for Women is Progress for All" sends a clear message on the importance of girls' education and women's empowerment. There must be a concerted effort at all fronts to improve the lives of women and girls in Africa and urged Member States to double their efforts at all stages. By not providing boys and girls an equitable opportunity to learn, women's empowerment and education continue to suffer hence the emphasis here must not only be equality but also equity so that rural girls and boys and marginalized populations are not left behind. These can only be achieved by developing policies that must address security and cultural norms around girls attending school and learning.

1.2.1 Primary School Enrolment in Africa

The launching of the MDGs in 2000 by the UN was a birth of a new era in Universal Primary Education (UPE) where many of the AU Member States are committed to working towards attaining its development goal of UPE.

The Sub-Saharan Africa has demonstrated greater improvement in primary education enrollments compared to other regions of the world by abolishing school fees and introducing others incentives like school feeding programme. This improvement can be confirmed by the increase in the Net Enrollment Ratio "The Net Enrolment Ratio (NER) is defined as enrolment of the official age-group for a given level of education expressed as a percentage of the corresponding population5" presented hereafter in figure 1.

[5] United Nations Educational, Scientific and Cultural Organization Institute for Statistics (http://uis.unesco.org)

The Net Enrollment Ratio NER in 1999 was 25% in Niger, 30% Eritrea, 33% Burkina Faso while in 2012 had rising to 63%; 38% and 65% respectively. Meanwhile, Burundi has catapulted from about 40% to above 90%, Rwanda from 76% to 90% while Equatorial Guinea declined from the 1999 of 70% to 60%.

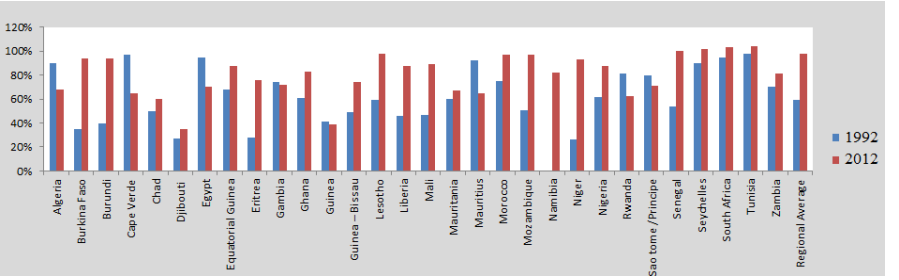


Figure 1: Changes in Primary Adjusted Net Enrolment Ratios, 1999 to 2012
(Source: Education for All Global Monitoring Report 2015; Regional Overview – Sub-Saharan Africa)

These vagaries and variation in the ratio and rate of the enrolment is attributed to many factors among of which are infrastructural, financial and other indices of development. Despite the appreciable gains in primary school enrollment between 1999 and to 2012, no African country has achieved UPE because for a country to achieve UPE, all children must have completed a full course of primary schooling[6].

The trend can be illustrated in the percentages of out-of-school children (Figure 2). It shows that between 2000 and 2007, the primary out-of-school rate fell from 15% to 10%, and declined only to 9% in 2014[7].

[6] State of Education in Africa Report (2015) by Africa-America Institute. 420 Lexington Avenue, Suite 1706 / New York, NY 10170-0002
[7] UNESCO Policy Paper 27/Factsheet 37 ED/GEMR/MRT/2016/PP/27 REV4)

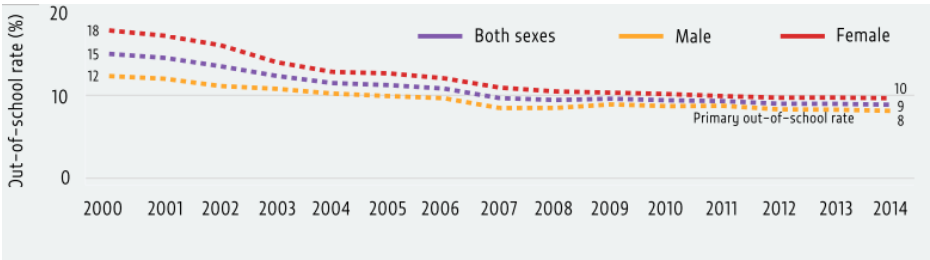


Figure 2: Global out-of-school rate primary age 2000-2014
(Source: UNISCO Institute of Statistics Database and UNESCO Policy Paper 27/Factsheet 37 ED/GEMR/MRT/2016/PP/27 REV4)

The Sub-Saharan Africa has the highest rate of exclusion, with 21% of primary school children age denied the right to education. The continent also have the widest gender gaps 23% of all girls and 19% of all boys are out of school[8]. In terms of the ratio of boys to girls in primary education, moderate progress has been made over the past decade towards gender parity in Africa.

In sub-Saharan Africa only 16 of the 43 countries with adequate data have so far achieved parity, and 17 countries still have a gender parity index under 0.9 and many countries in the region without further concerted action for girls' education[9]. It is further confirmed by the EFA Global Monitoring Report 2015 that the Sub-Saharan Africa is 0.92 in parity at best, this represent improvement since 1999, but parity has not yet been achieved. There has been a clear trend of reducing gender disparity in primary gross enrolment ratios for a majority of Member States in Africa, often starting from a point of severe disadvantage for girls.

[8] UNESCO Policy Paper 27/Factsheet 37 ED/GEMR/MRT/2016/PP/27 REV4)
[9] State of girls' education in Africa: Achievements since 2000, challenges and prospects for the future. Paper for the Civil Society pre-COMEDAF V meeting, Abuja, 20-21 April 2012.

1.2.2 Secondary School Enrollment in Africa

Secondary education is essential in preparing students for higher education and important life skills and tools to help meet a country's growing demands for highly skilled and educated workforce in a globalized world. The Sub-Saharan African region has seen a remarkable rise in secondary school enrolment over the past decade.

More children nowadays are reaching the last grade of primary school with the aspiration of going onto secondary education, but there are adequate places to accommodate only 36% of the children at the enrollment age[10]. Another challenge is that after graduating from primary school, many students are finding it difficult to attend secondary schools close to home i.e. young people living in rural communities are more likely to have limited access to secondary education compared to youth in urban areas.

According to the UNESCO Institute for Statistics (2011) there was widespread expansion of secondary education level in all regions of the world between 1999 and 2009. Globally, the Gross Enrollment Ratio (GER) for lower secondary education increased from 72% to 80% while for SubSaharan Africa the GER rose from 28% to 43%[11].

Figure 3A and Figure 3B below are changes in lower and upper gross enrolment ratios, 1999 to 2012 while c is gender parity in GERs for the same years. (Source: Education for All Global Monitoring Report 2015; Regional Overview – Sub-Saharan Africa)

[10] UNESCO Institute for Statistics: GLOBAL EDUCATION DIGEST 2011 Regional Profile: Sub-Saharan Africa
[11] UNESCO Institute for Statistics: GLOBAL EDUCATION DIGEST 2011 Regional Profile: Sub-Saharan Africa

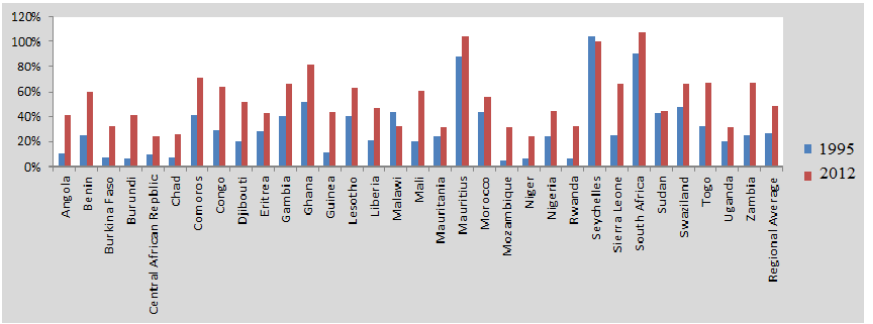


Figure 3: Enrollment in Secondary Education in Africa

A: Lower gross enrolment ratios, 1999 to 2012

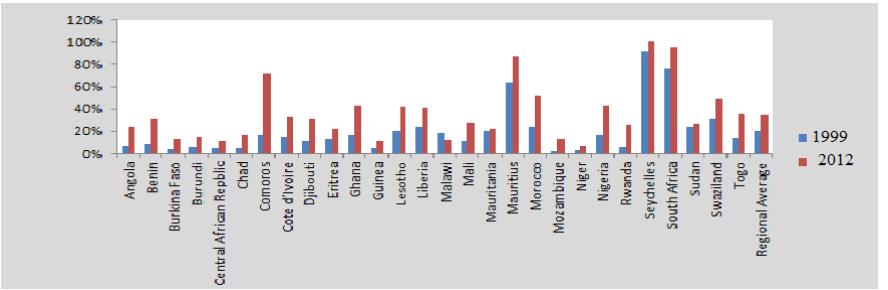


Figure 3: Enrollment in Secondary Education in Africa

B: Upper gross enrolment ratios, 1999 to 2012

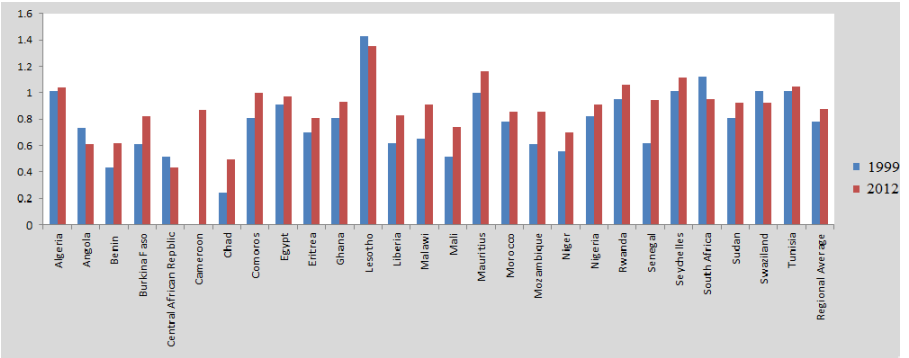


Figure 3: Enrollment in Secondary Education in Africa

C: Gender Parity in GERs, 1999 to 2012

Some Member states show a remarkable/significant increase in their GER for lower secondary education such as Zambia, Mali, Comoros and Ghana. On the other hand countries like Niger, Central Africa Republic, Chad, Uganda, Mozambique, Burkina Faso, Rwanda, Burundi, Angola, Malawi, Eretria, Guinea, Nigeria, and Liberia are far below the regional average; while South Africa, Seychelles and Mauritius have the highest GER in Sub-Sahara Africa.

Carefully examining Figure 3B it is easy to observe an increase in the GER for higher secondary education with a regional average ranging from 6% at 1999 to 28% at 2012[12]; these increase were quite appreciable but there are not anywhere better compared to the high net enrollment ratio of other regions of the world. Obviously the same conclusion can be easily drown i.e. South Africa, Seychelles and Mauritius have the highest GER for higher secondary education in Sub-Sahara Africa while Niger, Central Africa Republic, Chad, Uganda, Mozambique, Burkina Faso, Rwanda, Burundi, Angola, Malawi, Eritrea, Guinea, Nigeria, and Liberia are having lower GER than the regional average.

The above analyses need to be examined against the fact that at least half of all those aged 15 to 17 in sub-Saharan Africa are not in school; which is the highest in comparison to any region i.e. half of those who should, by now, be fine-tuning the skills they need for the job market, or to progress to tertiary education are not in classrooms. On other words the out-of-school rate in sub-Saharan Africa is 34% for youth of lower secondary school age 12-14 years and 58% for youth of upper secondary school age 15-17 years[13]. The reason for that was argued to their exclusion from primary schools in the first place.

No remarkable progress towards gender parity in secondary education has been realized between 1999 and 2012, where the average Gender

[12] Education for All Global Monitoring Report 2015; Regional Overview – Sub-Saharan Africa
[13] https://gemreportunesco.wordpress.com/2016/07/20/missing-from-school-the-education-challenge-in-sub-saharan-africa/

Parity Index (GPI) increased from 0.82 to 0.84 respectively[14]. Gender disparities at this level remain widespread as shown in figure 3C, Swaziland, South Africa, Mauritius, Seychelles and Rwanda meeting gender parity.

It is also interesting to note that in Cabo Verde and Lesotho important gender gaps at the expense of boys were observed. In Lesotho, only 71 boys were enrolled for every 100 girls in 2012, a ratio unchanged since 1999[15]. In Lesotho and in other southern African countries, including Botswana and Namibia, boys are taken out of school to herd cattle. In Angola, the situation has actually worsened, from 76 girls per 100 boys in 1999 to 65 in 2012[16]. However, some Member States drop in the gender parity as a result of conflict such as Central African Republic and Chad.

The enrollment of the girls trails that of boys. The female secondary school enrollment rates remain below those of males in most of the Member States. The AU Member States are making concerted effort to attain gender balance at secondary education level by subsidizing secondary education, yet enrollment for girls remains lower than that of boys.

This has direct implications on the agency of women, as the longer girls stay in school the less likely they are to enter into early marriage and get pregnant. There are a multitude of factors that force girls to give up on secondary education, such as parents' preference for educating boys, lack of financial resources to pay school fees, sexual harassment, pregnancy, and early marriage[17].

[14] https://gemreportunesco.wordpress.com/2016/07/20/missing-from-school-the-education-challenge-in-sub-saharan-africa/

[15] Education for All Global Monitoring Report 2015; Regional Overview – Sub-Saharan Africa

[16] EFA GMR No country in sub-Saharan Africa has achieved gender parity in both primary and secondary education (http://en.unesco.org/gem-report/sites/gem-report/files/SSA%20Press%20Release%20English%20Gender%20Report%202015_0.pdf)

[17] Natasha L. F. and Grace M. M. 2016: An Assessment of Gender Mainstreaming in STI and the Knowledge Society in Kenya. Report submitted to African Centre for Technology Studies

1.2.3 Tertiary or Higher Education Enrolment in Africa

Tertiary/Higher education institutions in the Sub-Saharan African countries have gone through various reforms and witnessed considerable level of growth that has serious policy implications for the continent. The system comprises the universities, polytechnics, colleges of education and professional/specialized institutions. At the heart of the system are the universities, which represent the highest institutions of learning and research in the continent.

Tertiary education builds on secondary education and imparts knowledge and skills as well as qualifications in specialized fields. It also brings extensive social and private benefits. At the individual level, pursuing and completing a tertiary education yields significant benefits for both African young people and the African society as it opens up employment opportunities and prospects.

The enrolment in tertiary education in sub-Saharan Africa grew faster than any other region of the world in the last four decades. While there were fewer than 200,000 tertiary students enrolled in the region in 1970, this number soared to over 4.5 million in 2008 that is more than 20-fold increase as shown in figure 4 below.

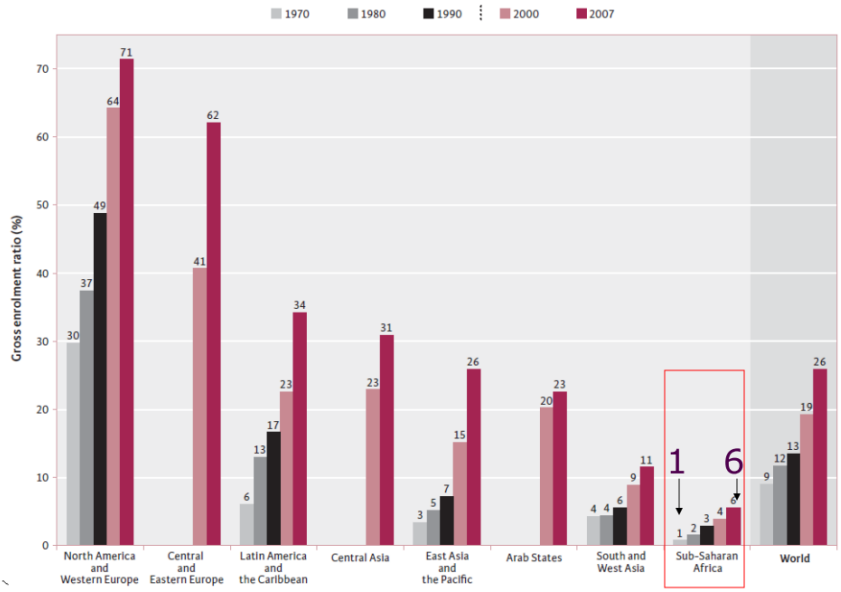


Figure 4: Trends in Tertiary Education: Sub-Saharan Africa

(Source: Michael Bruneforth (2010) Higher Education in Sub-Saharan Africa – A Statistical Approach. Paper presented at the UIS Workshop on Education Statistics. Windhoek, Namibia 17 October, 2010)

This growth rate in comparison to a global average of 4.6% over the same period was a dramatic growth for the African region. This indicates that the gross enrolment ratio for tertiary education grew at an average rate of 8.6% for each year between 1970 and 2008[18]. The rising population profile of the region has contributed to the increased enrolment rate that gave room for the proliferation of private higher education institutions.

The 2008 estimated population is projected to grow by more than 50 per cent by 2030. Even if recent high rates of expansion are maintained for the next two decades, rapid population growth will

[18]UNESCO Institute of Statistics, Facts Sheet December, 2010 No.10 - Trends in Tertiary Education: Sub-Saharan Africa

dampen the gains in terms of gross enrolment ratio[19]. However, the growth rate was difficult to be contained or maintained in terms of infrastructure, teaching material, equipment, teachers/lecturers and adequate funding for the institutions by the Member States.

On the other hand, steady growth rate differs from country to country, For instance, in 2009 the tertiary GER exceeds the regional average in the following countries: Cameroon (9.0%), Cape Verde (14.9%), Côte d'Ivoire (8.4%), Guinea (9.2%), Mauritius (25.9%), Namibia (8.9%) and Senegal (8.0%). However, the ratio remains quite low in countries such as: Burkina Faso (3.4%), Burundi (2.7%), Central African Republic (2.5%), Chad (2.0%), Eritrea (2.0%), Ethiopia (3.6%), Madagascar (3.6%), Malawi (0.5%), Niger (1.4%) and Uganda (3.7%)[20].

This differences in the Member States growth rate as the Anglophone countries have higher GER than Francophone countries. The tertiary education gross enrollment rate for Anglophone countries averaged 6.7%, in comparison to the 2.9% that characterized Francophone countries[21].

Despite the significant progress made in the tertiary GERs for women and men remain low in comparison to other regions of the world. In sub-Saharan Africa, it only rose from 4% to 10% for men and from 2% to 6% for women over the period 1990-2012[22] as shown in figure 5.

[19] Can higher education solve Africa's job crisis? Understanding graduate employability in Sub-Saharan Africa. Accessed at www.britishcouncil.org/education/ihe on 6th March, 2017
[20] ISPI Working Paper No.49-May 2013
[21] Lalla Aïcha BEN BARKA (2013) Tertiary Education in Africa by and post- 2015. Paper Presented at Budapest, Hungary, 6 June, 2013
[22] The World's Women 2015: Trends and Statistics. Chapter 3 by United Nations Statistics Division (https://unstats.un.org/unsd/gender/worldswomen.html) accessed 20 March 2017

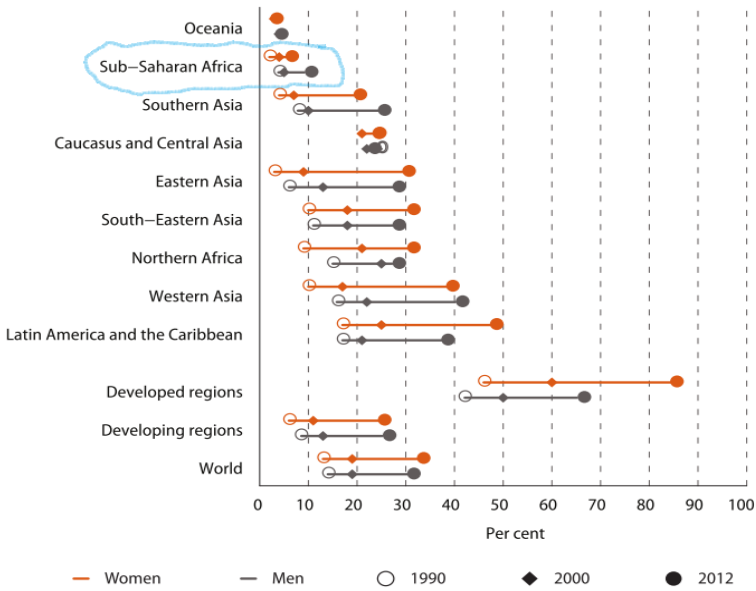


Figure 5: Tertiary gross enrolment ratios by sex and region, 1990, 2000 and 2012 (*Source: The World's Women 2015: Trends and Statistics. Chapter 3 by United Nations Statistics Division)*

The irony is that the changing patterns of enrollment in tertiary education between 1990 and 2012 shifted gender disparity from a male to female advantage in the world and is clearly depicted in the most regions of the world (Figure 5). Women outnumber men in tertiary enrollment in almost all countries in developed regions and the enrollment ratios of men and women reached parity around the year 2000.

Subsequently, women enrollment exceeded that of men, drifting to gender disparity from a male to female advantage, but in Sub-Saharan Africa female remain disadvantaged in terms of access to tertiary education and their enrollment rate remains the lowest. According to World Women 2015 that women's participation in tertiary education was less than half that of men's (GPI of less than 0.50) in several

countries with low tertiary enrolment in sub-Saharan Africa, including Benin, Chad, Eritrea, Ethiopia, Guinea, Mauritania and Niger.

Nevertheless, the region (Sub-Sahara) made significant progress towards gender parity, from 1970 to 1990, the GER for women barely improved, amounting to less than one-half of the ratio reported for men. This translated into an adjusted gender parity index (GPI) that ranged from 0.45 and 0.50 over the decades. In 2000, women started to catch up, with an adjusted GPI of 0.68[23].

Generally the field of studies is regarded as critical factor to Africa's economy; there are growing concerns about Africa's ability to be competitive in the global economy in terms of technical competencies. Tertiary education itself has an impact on individual future; the field of study that men and women choose has an impact on their future lives, careers, incomes and roles in society. There are numerous reasons why students have preference for subjects in tertiary education, including performance in secondary education, perception of one's own abilities, social, economic and family background, career aspirations and labour market expectations among others.

The global presentation including Africa on the field of graduation for men and women in eight fields: education; health and welfare; humanities and arts; social science, business and law; science; engineering, manufacturing and construction; agriculture; and services according the World Women 2015 as shown in Figure 6.

[23] UNESCO Institute of Statistics, Facts Sheet December, 2010 No.10 - Trends in Tertiary Education: Sub-Saharan Africa

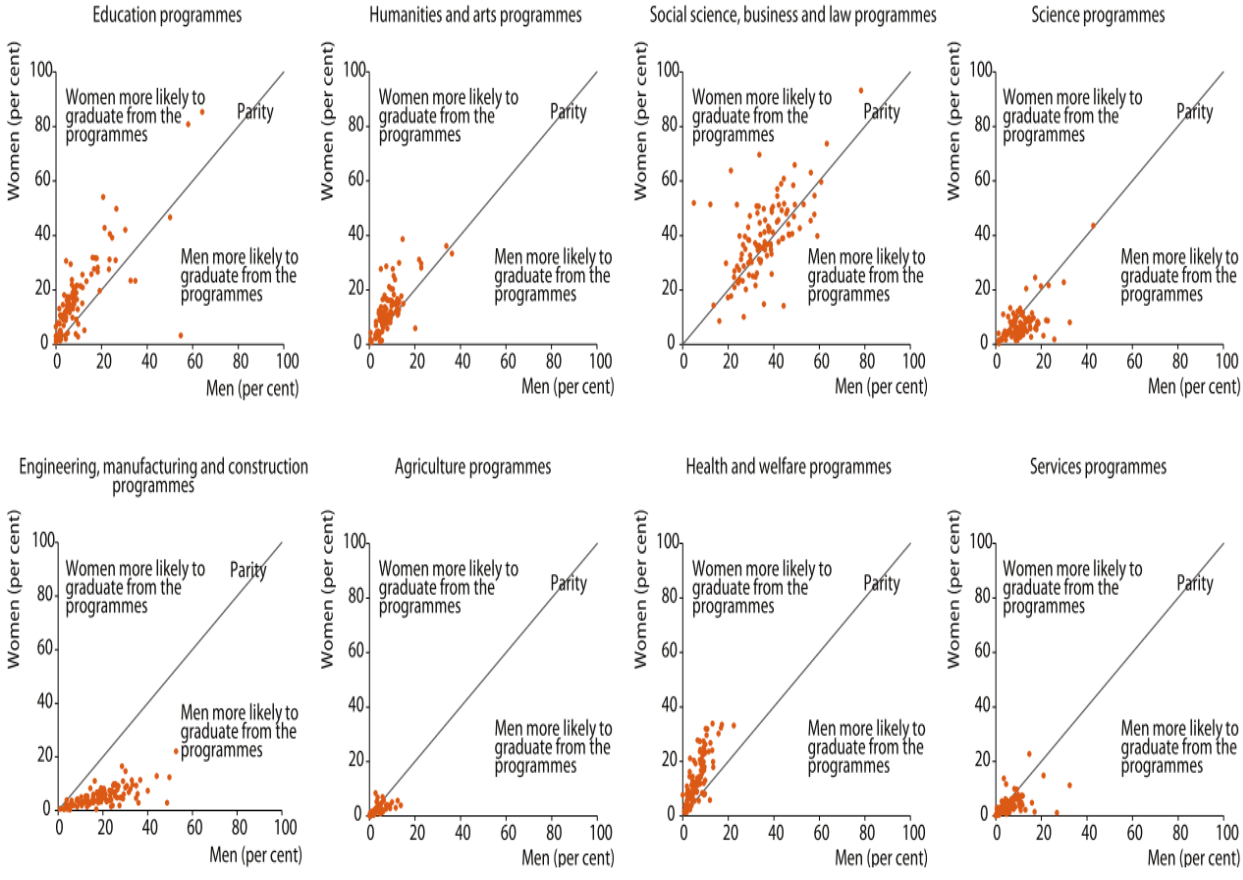


Figure 6: Global Proportion of tertiary graduates by field of study, women and men, 2005–2012. . Each point represents data of one country *(Source: The World's Women 2015: Trends and Statistics. Chapter 3 by United Nations Statistics Division)*

The graphical presentation in figure 6 shows women verses men while the parity line originates between the distribution of men and women. The graph shows that education, health and welfare, and humanities and arts are more populated with women than men that portrait that these courses are preferred by women than men.

Women experience great difficulties in some of the fields of study that are known to be men dominated. Women are less likely than men to graduate in science, engineering, manufacturing, construction, agriculture, and services. This is particularly so in the case of engineering and to a lesser extend science in many countries.

According to Máiréad and Yusuf (2002) in their work on selected AU Member States Botswana, Ghana, Malawi, Uganda and South Africa as shown in table 1. the first, left hand column is the percentage of females in the cohorts in each of six disciplinary areas, the second column shows the proportion of the whole female group enrolled in that particular discipline in each Member State. Both columns contain important data for tracing the disciplinary affiliations of the increasing female student populations.

	Botswana (1996/7)		**Ghana** (1990/1)		**Malawi** (1993/4)		**Uganda** (1995/6)		**South Africa** (1994)	
Total number of Females	2,069		1,791		527		3,745		109,952	
	% F in cohort	% of all F	% F in cohort	% of all F	% F in cohort	% of all F	% F in cohort	% of all F	% F in cohort	% of all F
Humanities and Religion	56.2	24.9*	31.0	40.4*	40.4	10.4	36.2	14.1	63.8	20.2
Social and Behavioural	55.0	21.7	26.9	12.1	21.7	22.0*	43.1	20.2*	57.7	25.7*
Business Administration	48.9	10.9	22.7	8.1	15.1µ	18.2	30.2 µ	13.8	42.7 µ	13.0
Natural Sciences	28.4µ	13.3	15.2µ	8.1	20.9µ	12.7	23.0 µ	5.6	45.1 µ	5.5
Math and Computing	25.4µ	0.8#	10.7µ	1.2	-	-	16.7 µ	1.0#	30.5 µ	4.1
Engineering	13.4µ	1.6	3.0µ	1.1	1.6µ	0.4#	13.9 µ	1.6	8.9 µ	0.4#

KEY: *# Indicates the lowest female participation;*
** Indicates the highest female participation;* µ *Indicates female participation below the higher education average*

Table 1: Female Enrolment in Selected Sub-Saharan African Countries by Fields of Study
(*Source: Máiréad D. and Yusuf S. (2002) Transformation and Equity: Women and Higher Education in Sub-Saharan Africa. Journal of International Studies in Educational Administration, Volume 30, Number 1, 2002).*

Table 1 indicates women cohort is highly represented in the humanities and religion; social and behavioral sciences; and business administration which are general arts disciplines. In Botswana, Uganda and South Africa social and behavioral Sciences are dominated by women students together with high proportions of females in the cohorts. While humanities and religion studies are

populated by females in Botswana and South Africa. It was examined that these two subjects attract high proportions of the women students in higher education. The access to science and technology based jobs by women in all of these countries looks desperately limited in the immediate future.

The table portrait by Máiréad and Yusuf (2002) which is in consonance with the global data[24] there are difficulty in attracting students, especially females to sciences and engineering related in Africa. Taking Botswana for example, just over one quarter of the cohort in Mathematics and Computing are female, but this is less than one percent of the women students and only 4% in South Africa while Uganda and Ghana stands at 1% and 1.2% respectively[25].

The percentages are invariably different for natural sciences as 13.3% in Botswana and 12.7% in Malawi respectively. There are far less women studying sciences and engineering in Africa hence access to science and technology based jobs in all of these countries looks limited in the immediate future for women. This study further portrays that very few students take sciences and engineering at tertiary level in the five Member States; in Mathematics and Computing and Engineering remain consistently unattractive to female students in Africa.

1.3 Women in Science and Technology Research

The Research and Development (R&D) in accordance with the Frascati manual refers to 'any creative systematic activity undertaken in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this knowledge to devise new

[24] The World's Women 2015: Trends and Statistics. Chapter 3 by United Nations Statistics Division (https://unstats.un.org/unsd/gender/worldswomen.html) accessed 20 March 2017

[25] Máiréad D. and Yusuf S. (2002) Transformation and Equity: Women and Higher Education in Sub-Saharan Africa. Journal of International Studies in Educational Administration, Volume 30, Number 1, 2002

applications'[26,27]. However, in this document attention is given more to Science and Technology or Science, Technology, Engineering and Mathematics (STEM).

Earlier we have seen that Africa is yet to meet the parity level at the primary education level that further declined at the secondary education level while the tertiary has the lowest of all in terms of parity. There is no doubt the enrollment rate in tertiary education have increased but not translating to anywhere appreciable level when it comes to rate of women in enrollment. This on itself is a disadvantage for women from the onset.

There is no way where the number of women in the tertiary education to be low and expecting women in research to be high in number; the reality is that number of women in science and technology is low[28]. Men continue to outnumber women, at the tertiary levels in STEM profession. There are enormous numbers of reasons in literatures for this lukewarm trend but mostly centered on economic, social and environmental factors contributed to the underrepresentation of women in science and technology.

The fact that women are not only much less represented than men in tertiary education but are also often confined to so-called 'feminine' fields, such as the social sciences, humanities, services and health-related courses, which do not boost their chances of equal job opportunities with men in the same field[29]. This further confirmed the findings of Máiréad D. and Yusuf S. (2002).

Drawing on a large and diverse body of research where schooling often remains the privilege of boys than girls in Africa. Where gender

[26] https://stats.oecd.org/glossary/detail.asp?ID=2312
[27] UNESCO Statistical Yearbook 2003, UNESCO, Paris, 68 and 65, Chap. 5.
[28] Máiréad D. and Yusuf S. (2002) Transformation and Equity: Women and Higher Education in Sub-Saharan Africa. Journal of International Studies in Educational Administration, Volume 30, Number 1, 2002.
[29] UNESCO Science Report 2010

disparities in primary education increase with the level of education, as can be seen the drop in the percentage of girls between the secondary and tertiary levels of education. Women still face considerable barriers as they transit from higher education to careers in research. Each step up the ladder of the scientific research system sees a drop in women participation until, at the highest echelons of scientific research and decision making further buttressing the earlier findings by some authors.

According to Jane Muthumbi (2015)[30], women researchers employed in R&D exceeded the global average in Central Asia (47%), Latin America and the Caribbean (44%), Central and Eastern Europe (40%), Arab States (37%) and North America and Western Europe (32%) and Sub-Saharan Africa (30%), and these figures and statistics have exceeded the global average of 28%. This explains why 70% of the African researchers are men with variations among the Member States.

Table 2 shows that Nigeria counted for the largest number of researchers in Africa in 2005 followed by South Africa, Guinea, Botswana and Democratic Republic of Congo. However, when the number of researchers is assessed per million inhabitants, Nigeria drops down the ladder below Botswana, South Africa, Senegal and Guinea.

The percentage share of women researchers across the continent remains very low; as below 10% for Ethiopia, Gambia, Guinea and Senegal. Cape Verde and Lesotho have few researchers but the percentage of women researchers are above 50% and these discrepancies were also noticed in the primary, secondary and tertiary education enrolment of the Member States. In the same table there were variations in the number of scientists and technicians per million.

[30] Policy brief on Africa's women in science by Jane Muthumbi (2015) as TDR grant scheme (*www.who.int/tdr/research/gender/Women_overview_piece.pdf*)

Country	Number of Researchers (FTE)	Women researchers (%)	Per million inhabitants (FTE)	Per million inhabitants (FTE)	Researchers by sector (FTE)			
					Business Enterprises	Government	Higher Education	Private non-profit
Benin	1 000*	-	119*	-	-	-	-	-
Botswana-2,h	1 732*	30.8	942	222	159*-	692*	859*	22*
Burkina Faso[a,h]	187	13.4	13	27	-	165[b]	1[b]	15[b]
Cameroon-2 a,h	462	19	26	-	-	462	-	-
Cape Verde-5	60	52.3	132	33	-	-	-	-
Central African Republic[a,h]	41	41.5	10	-	-	-	41	-
Congo Rep- 5,a	102	12.8[f]	34	37	-	-	-	-
Cote d'Ivoire-2,a	1 269	16.5	66	-	-	29	1 240	-
Dem.Rep of Congo-2,h	10 411	-	176	26	-	877	9 534	-
Ethiopia[a]	1 615	7.4	21	12	-	1 361	254	-
Gabon-1,a,h	150	24.7	107	30	-	150	-	-
Gambia-2,a,h	46	8.7	30	18	-	-	-	-
Guinea-7,a,h	2 117	5.8	253	92	-	1 096	1 021	-
Lesotho-3,a	20	55.7	10	11	-	11	9	-
Madagascar[a]	937	35.2	50	15	-	262	675	-
Mali-1,a	513	12.1	42	13	-	227	286	-
Mozambique -1,a,h	337	33.5	16	35	-	337	-	-
Niger-2,a	101	-	8	10	-	-	-	-
Nigeria-2,a,h	28 533	17	203	77	-	1 051	27 482	-
Senegal[a]	3 277*	9.9*	276*	-	-	418*	2 859*	-
Sychelles-2,a	13	35.7	157	640	-	8	-	5
South Africa- 1	18 574	39.7	382	130	6 111	2 768	9 491	204
Togo	216	12	34	17	-	26	190	-
Uganda[h]	891	41	29	18	71	473	321	26
Zambia -2,a	792	27.4	67	106	4	565	146	77

*national estimate; a=partial data; b=the sum of the breakdown does not add up to the total; h=for these countries, data is only available for headcounts; F=full time equivalent (FTE) instead of headcount

Table 2: Women Researchers in Sub-Saharan Africa 2007
(*Source: UNESCO Science Report 2010)*

In another study UNESCO Science Report[31] through a leaky pipeline presentation showed that a share of women in higher education and research on a global scale female bachelor's and master's graduates number stands at 53% each but observed an abruptly drop off at PhD level. Hence, male graduates (57%) overtake women. The discrepancy widens at the researcher level were women are only 28%.

	Year	Natural Sciences	Engineering &Technology	Medical Sciences	Agricultural Sciences	Social Sciences and Humanities
Angola	2011	35	9.1	51.1	22.4	26.8
Botswana	2012	27.8	7.9	43.6	18.1	37.5
Burkina Faso	2010	10.1	11.6	27.7	17.4-	35.9
Cabo Verde	2011	35	19.6	60	10.0	54.5
Egypt	2013	40.7	17.7	45.9	27.9	49.7
Ethiopia	2013	12.2	7.1	26.1	7.6	13.3
Gabon	2009	31.4	20	58.3	30.2	17
Ghana	2010	16.9	6.6	20.8	15.5	22.3
Lesotho	2009	42	16.7	–	40	75
Madagascar	2011	34.6	18.7	33.8	24.9	44.8
Malawi	2010	22.2	6.5	17.5	12.5	32.8
Mali	2006	7.2	15.1	14.9	25.9-	12.2
Mauritius	2012	36.4	19.4	41.7	45.4-	51.9
Morocco	2011	31.5	26.3	44.1	20.5	27.1
Mozambique	2010	27.8	28.9	53.1	20.4	32
Senegal	2010	16.7	13	31.7	24.4-	26.1
Togo	2012	9	7.7	8.3	3.2	14.1
Uganda	2010	17.1	23.3	30.6	19.7-	27
Zimbabwe	2012	25.3	23.3	40	25.5	25.6

Table 3: Female researchers by field of science, 2013 closes year (%)
(*Source: UNESCO Science Report towards 2030 (2015))*

[31] UNESCO Science Report Towards 2030 (2015)

From the menial representation of women in research in Africa when distributed per field of science the number further diminish. Botswana's share of women researchers in 2007 was 30.8% when distributed to field 27.8, 7.9, 43.6, 18.1, and 37.5 percentages for Natural sciences; Engineering and technology; Medical sciences; Agricultural sciences; and social sciences and humanities respectively.

The table indicates that Social sciences and humanities have the highest number of women researchers followed by Medical sciences while there is bit of closeness in percentages distribution between Natural sciences and Agricultural sciences in some instances one exceeds the other in some of the Member States. For example, Angola, Egypt, Gabon, Lesotho, Madagascar and Morocco have higher percentage of women researcher in Natural sciences than Agricultural science while reverse the case in Burkina Faso, Mali, Mauritius, Senegal and Uganda. This further reaffirmed the distribution path in proportion of tertiary graduates by field of study, women and men, 2005–2012 as presented in figure 6.

Globally, women's participation is the lowest in engineering and technology 17% while in Africa the percentage is far below this[32]. There are fears on the ability to retain the few women who embark on training in science disciplines that are hindered by many factors including discrimination and suppressed motivation. The few African women in science and engineering also face unique challenges that are likely to derail their careers at a much higher rate than their male counterparts. And the result is that all over the continent, there are still very few women scientists and engineers with even fewer in leadership positions to articulate the inclusion of women in the management of science and technology institutions.

Development of a critical mass of scientists in the region is one of the pillars to the promotion of S&T for development and it is important

[32] The World's Women 2015: Trends and Statistics. Chapter 3 by United Nations Statistics Division (https://unstats.un.org/unsd/gender/worldswomen.html) accessed 20 March 2017

that this inequity is addressed because human resource capacity building cannot be completed successfully if half of the population is faced with constraints in access to higher education in Science & Technology and Research. There is no doubt if the education sector is affected by a challenge consequently the research fields must be inevitably affected too. Studies elsewhere have shown that there are fewer numbers of women working in senior scientific positions that sound disadvantageous for female scientist in their career development[33].

There were several issues mentioned that hindered research progress in Africa and the participation of women in scientific research while the Member States have put many policies and mechanism to catch up with the rest of the world. Some of which are creation of strategic ministries and agencies that deals with science and technology research but the funding and investment remained a challenge. For example, many of the AU Member States still have a long way to reach the target of devoting 1% of GDP to research and development as endorsed by AU Heads of States and Government Decision in 2007 and Governments remains the major source of research funding and some instances foreign partners. The foreign sources contribute a sizeable chunk to Africa's R&D, in Ghana 31%, Senegal 41% and Burkina Faso 60% in research[34]. These underpinned research at all levels in the continent and a career in the research field.

The underrepresentation of women in science and research poses a challenge for development. Against this backdrop the Science Technology Innovation Strategy for Africa 2024 (Assembly/AU/Dec520 (XXIII)) has one of its pillars on building technical and professional competencies and has gender-related objectives aimed at promoting women's participation in science. It is

[33] The World's Women 2015: Trends and Statistics. Chapter 3 by United Nations Statistics Division (https://unstats.un.org/unsd/gender/worldswomen.html) accessed 20 March 2017
[34] UNESCO Science Report towards 2030 (2015)

also a key message in 'Science Agenda for Agriculture in Africa' that agricultural transformation in Africa will not happen without realizing the potentials of women and young people. The UN Economic and Social Council's Resolution 2011/17 on Science and Technology (S&T) supports the role of women and girls seeking science careers through education and training in science and technology. However, the fact remains that women's participation in the science research workforce continues to be characterized by low levels of retention and success.

1.4 A Paradigm Shift in Support for Women in Scientific Research

There are several initiatives and programmes that exist and aim at empowering women in science. The initiatives vary from global, continental, regional to national and each have their unique modes of approach in policy and implementation. However, they all have ultimate goal of women empowerment through building capacities.

L'Oréal-UNESCO for Women in Science International Awards: This programme was established in 1998, the L'Oréal-UNESCO for Women in Science is an International Awards program which, identifies and supports eminent women in science throughout the world. Every year, five Awards Laureates are recognized for their contributions to the advancement of science, in Life or Physical Sciences. The programme has encouraged, promoted and honoured women scientists all over the world. Each of the five Laureates will receive an award of €100,000.

However, the L'Oréal-UNESCO also realized that much need to be done considering the participation of women in science and made the organizers to launch of the For Women in Science Manifesto: an opinion campaign aimed at engaging the scientific community and the general public to step up the pace of change for women in science.

Merck STEM Initiative: MERCK, a leading science and technology company compelled by their belief for better healthcare and health for all, it gives back to society in a unique and different ways through its social responsibilities via several programmes and initiatives such as Merck STEM for Women and Girls Program; UNESCO Merck Africa Research Summit; Merck Universities program; Merck Cancer Access Program; Merck More than a Mother among others. However, the company's broad activities and programmes are beyond the realms of this publication hence the emphasis here is on women in STEM; more information can be found on the websites www.merckgroup.com and www.unesco-mars.com .

Merck STEM for Women and Girls Programme: This programme is aimed at empowering women and girls in STEM. It envisaged making Africa an international hub for research excellence and scientific innovation. The programme is empowering over 7, 000 girls and 60 women researchers in Africa in 2017 through many STEM initiatives including; renovation and setting up of laboratories; computer libraries in schools; appointment of the UNESCO-MARS research awardees to be ambassadors for the STEM programmes among others.

UNESCO Merck Africa Research Summit (UNESCO MARS Summit): This is an annual Summit that was conceptualized and established by Merck in partnership with UNESCO, African Union Scientific, Technical and Research Commission (AU-STRC); and scientifically supported by the University of Cambridge (UK), the University of Rome Tor Vergata (Italy) and the Institute Pasteur (France). The Summit, recalling UNESCO's priorities which are Africa and Gender, aims to build research capacity and empower young African researchers with special focus on empowering women in the fields of research and healthcare to raise the level of scientific research. Moreover, it can be considered as the fertile ground to improve North-South and South-South cooperation among STEM investigators.

In order to provide a concrete contribution in capacity building, promoting and valorizing local talents, MERCK offers special fellowships and awards to early-career investigators. Moreover, during the 2nd edition of the event, the participants witnessed unveiling of research platform "on-line research community" **(**www.merck-cap.com**)** to enable young researchers to share experience and knowledge with their peers and with senior researchers in Africa and beyond. The summit attracts large number of women scientists and researchers along with several well-recognized cluster of eminent scientists from the western hemisphere and Africa.

African Congress of Female Scientists: The Congress was held in 2008 as a collaborative effort by the African Union HRST Department, the African Society Scientific Research and Technology (ASSRT), The Human Resources, Science and Technology Cluster of ECOSOCC. The Congress emphasized on the popularization and public understanding of the importance of scientific research & technology for the development of the African continent by women.

The congress 1st and only meeting was a platform for women in STEM, Information Communication Technology (ICT), Nuclear Science, Engineering to share personal experiences on discrimination and marginalization, in the often male dominated field of science research and technology in Africa. The congress recommended that mentoring programs and special initiatives targeting women to use ICT in literacy campaign that have proven successful should be supported by government and the private sector, and that low expectations of women and minority groups by teachers in the field of scientific research and technology should be discouraged.

African Union Kwame Nkrumah Awards: The African Union Commission launched the prestigious African Union Scientific Award Program in 2008 with the support of its development partners particularly the European Commission. The awards are given to top African Scientists for their achievements and invaluable contribution

to the development of scientific community and the continent. The awards are in three levels; national, regional and continental. However, the regional was specifically marked for women scientists while the other two is open for both men and women.

The regional award distinguishes and singles out for women and the programme prizes are awarded to top African scientists in each of the following two sectors of Life and Earth Science; and Basic Science, Technology and Innovation. The objective is to recognize, award and honour outstanding excelling African women scientists and researchers for their scientific achievements, discoveries and innovations. This raises the profile of science and technology sector in the African Union Member States and Africa as a whole and thus contributing to Africa's sustainable development, poverty alleviation and integration efforts. The calls are launched in each of the five geopolitical regions of Africa, the awards envelope is $20,000 per region.

International Day of Women and Girls in Science: The United Nations realized and pointed out challenges that women and girls face in scientific career must be addressed at every level in learning and research, from administration to teaching across all scientific fields. To achieve this, there is need to engage Government and stakeholders in promoting the full participation of women and girls in science.

Hence, the United Nations General Assembly decided to proclaim the 11th February of each year, the International Day of Women and Girls in Science through resolution A/RES/70/212, on 22nd December 2015[35].

International Telecommunication Union's (ITU) Annual Girl's Information Communication Technology (ICT) Day: International Girls in ICT Day is an initiative of the ITU strongly supported by its

[35] http://www.un.org/en/ga/search/view_doc.asp?symbol=A/RES/70/212

Member States contained in ITU Plenipotentiary Resolution on the 2014[36]. International Girls in ICT Day is celebrated on the 4th Thursday in April every year. This is aimed at creating a global environment that empowers and encourages girls and young women to consider careers in the growing field of ICTs, enabling both girls and technology companies to reap the benefits of greater female participation in the ICT sector.

The ITU Member States celebrate this unique day in their own ways. Since the inception of this programme, to date over 240,000 girls and young women have taken part in more than 7,200 celebrations of International Girls in ICT Day in 160 countries worldwide including AU Member States.

UNESCO Prize for Girls' and Women's Education: This prize was set-up in 2015 for the first time to honour outstanding innovation and contribution made by individuals, institutions and organizations to advance girls' and women's education. It was created by UNESCO's Executive Board with the view of contributing to the attainment of the 2030 SDGs on education and gender equality. The award is given annually to two laureates and the prize envelope is $50,000 to each awardee towards improving their work in the field of girls' and women's education.

[36] Resolution 70 (Rev. Busan, 2014)

Part 2

Strategic Analysis

2. Strategic Analysis

In order to have a comprehensive strategic analysis to address the overall objective - Towards enhancing technical; and professional competencies to accelerate Africa's transition to an innovation led, knowledge based economy" and its purpose for increasing women's participation in science, this strategic analysis was developed through conducting focus group studies and investigation of available reference materials . The output shows that for achieving the purpose and overall objective, there is need for an increased number of sensitization /capacity building programme for female scientists and more political commitment to female participation in science. Several other activities were also drawn out which are summarized in this part.

2.1 Focused Group Study

A focus group study was conducted during the 2nd UNESCO MARS Summit, where a session was dedicated to Empowering Women and Youth in Research with an overall objective of enhancing technical and profession competencies to accelerate Africa's transition to an innovation led knowledge based economy. This objective is the second pillar of STISA-2024 that is "building critical mass of technical and professional competencies".

In that session a group of 150 participants worked closely with 10 moderators/lead discussants, to develop an inventory for a problem statement "**Women and youth participate less in Research".** Each cluster 'composed of 15 participants with the support of moderators/lead discussant' investigated and reflected on the problem statements and some other motivating questions such as: why woman are not interested in scientific research?; what are the obstacles that may hinder their participation in scientific research?

By the end of the session the reporters of each cluster presented the output of their consultation which is problem inventory and raw problem tree. The participants in this exercise were junior and mid-career and young scientists; the parity of women was more than 70%.

In continuation to this, the African Union, Scientific, Technical and Research Commission analyzed the solutions and findings using problem tree analysis and object tree analysis to identify the interventions mechanisms to be put in place for the enhancement of women participation in science.

2.2 Methodology and Analysis of the Problem

An inventory was developed by giving cards for the participant to write/list all the problems that gave rise to the causative factors as to why women participate less in Scientific Research. The inventory highlighted issues such as; lack of motivation and sensitization programme; government pay less attention to female education, female students less informed on the role they can play in their country's future by participating in science education; family commitments, responsibilities and challenges; weak recognition to female scientists and their contribution to the scientific community and their country at large; see full list of inventory in Annex (1).

The process to develop the problem tree (Annex 2) started with an open brainstorming about which of the problems were to be considered as a priority whereas the inventory identified was logically examined against the problem statement based on relations and similarities hierarchically while establishing the cause and effect relationship. Thereafter, the problem tree was established and reviewed; which is fundamental in determining the intervention to be followed, in order to maximize the participation of women in Scientific Research.

The problem tree helped in visualizing the problems and its break down into cause and effects. Thorough review of the problem tree identified four main problems needed to be confronted to achieve the ultimate goal of this study, which are; lack of mentorship and sensitization programmes; Ministries of Science and Technology are not committed to encouraging women participation in Scientific research; female students are less informed on the role they can play in the development of their community future by participating in science education; and mutual task on the part of the women.

The negative situations of the problem tree are then converted into solutions in the affirmative and the affirmative achievements are considered to be objectives.
Through the solutions that eliminate each problem, the solution inventory was developed. Hence, all the negative problems in the problem tree are converted into solutions as positive achievements so that they are desirable and achievable as shown in the objective tree (Annex 3).

Here, insignificant problems were dropped, in some instances reformulated or new additions were made. The objective tree at this stage showed many objectives that cannot be reached at once but most of them are achievable and realistic. On the other hand, it presents a summary of the future situation.

2.3 Activities and Actions

In the analysis of the objective tree, the objectives that share the same nature were clustered considering similarities of having possible future activities with the same aim of intervention. It further identifies the results out of which activities are to be drowned out.

The strategic analysis on the women participation in scientific research identified two results to address its purpose and overall

objectives which are; increased number of sensitization and capacity building programme for female scientists; and more political commitment to female participation in science. Table 4 presents the output of the strategic analysis on women participation in Scientific Research.

Objective hierarchy	**Statements**
Overall Objective	Enhancing technical and professional competencies to accelerate Africa's Transition to an innovation led, knowledge based economy.
Purpose	Women participate more in science
Result - 1	**Increased number of Sensitization /Capacity Building Programme for Female Scientists**
Activities	1.1 Awards for successful scientists 1.2 Scholarship scheme for female scientists 1.3 Popularization and advocacy programmes and strategy for female in science (Career Counseling; Peer Mentoring; Head-hunting for female scientists). 1.4 Improvement of existing research facilities and infrastructure 1.5 Creation of active research hubs & networks for female scientists 1.6 Development of professional enhancement programmes for female Scientists. 1.7 Development of research grant scheme for female scientists.
Result - 2	**More political commitment to female participation in science**

Activities	2.1 National survey on female enrollment to education and female's contribution to STI. 2.2 Development/ Review of Science Gender Mainstreaming Policy. 2.3 Women in science advocacy campaigns. 2.3.1 Enlightenment campaign for policy makers on the role of female scientist in national development; 2.3.2 Encouraging private sector to invest on women in science; 2.3.3 Development of policy briefs on the role of female scientists in national development; 2.3.4 Mass communication and publicity action plan.

Table 4: Strategic Analysis and the Objective Hierarchy on Women Participation in Scientific Research

These activities and actions are to tackle the puzzling questions and present a picture of what is to be done about girls and women in scientific fields. Also, they address the role of stakeholders i.e. Member States/Governments, families, schools, and communities as to what can create an environment of encouragement, policies, mechanism that can disrupt negative stereotypes about women's capacity in these demanding fields.

Giving the required support to the development of girls' confidence in their ability to learn science and technology will help motivate interest in these fields. The highlighted activities ensure that women and girls have full access to educational and employment opportunities in science, technology, engineering, and mathematics and towards achieving improved scientific output in Africa through female participation.

2.3.1 Result 1: Increased number of Sensitization /Capacity Building Programme for Female Scientists

Generally capacity building is a process by which individuals obtain, improve and retain skills and knowledge needed to do jobs competently. Capacity building in simple terms aims to develop or improve a process to strengthen female scientists' skills and abilities.

While sensitization is a form of learning process, with a stimulating factor, it enhances the response of whole segments of stakeholders, communities, community leaders among others.

As in table 4 and in order to address the achievement of result 1 identified under this strategic analysis, activities was crafted to be as a guideline for stakeholders and partners to further develop them to fit into the mission and objectives.

Activity 1.1 **Awards to Successful Scientists:** Awards are seen as an integral part of promoting women scientists in aspiring to achieve their dreams. There are many of such awards that are on-going in the continent and the AU Member States. However, there is need to have different categories of awards like Creativity, Science Enterprise, Invention Awards for inventions designed to solve real problems by women and should be classified to national, regional and continental.

The awards should also cover the growth spectrum of female scientists from early, mid and senior categories. The rewards for the successful awardee should assist the awardee on how they can move from the bench scale invention to market place or see how to harness the support of corporate R&D laboratories in further assisting the awardee to build their own prototypes that will make their achievements more remarkable.

Activity 1.2 **Scholarship scheme for female scientists:** Scholarship scheme is considered to be one of the support mechanisms for

encouraging students and scholars to achieve their academic ambitions. For women whether they are studying their degree for the first time or going back to school for a career change, women attending tertiary education in science, technology, engineering and mathematics in numbers that are less than men according to literature sources. Studies have shown that many women face the challenge of being in the minority in their classes in sciences. To better encourage women to enter and excel at these fields, a number of science grants and scholarships for women must be provided at the national, regional and continental levels.

Presently there are various financial aids and scholarships for women around the continent but the scholarships for women must be made available at all degree levels i.e. Undergraduate, Graduate, Master's, PhD and Postdoctoral for upgrading their education. A huge number of organizations and institutions must offer many grants to women so that they can continue with their education without any difficulty.

Activity 1.3 **Popularization and Advocacy Programmes and Strategy for Females in Science:** Popularization and advocacy programmes and strategy for female scientists is a key factor for success in the implementation or attainment of set goals for women in science. There is need to develop a popularization and advocacy programme and strategy that includes; communication plan targeting the spectrum of stakeholders, community leaders and female learners. Not only that, special attention should focus on Career counselling, Peer mentoring and Head-hunting for female scientists

Career Counselling **-** this gives the leverage for women to help themselves to know and understand themselves and the job market/demands in order to be well informed on what to study and skills needed in developing a career.

The career counselling is imperative in the sense that it is a lifelong process, meaning that throughout their lives as one may change career

within the scientific realm as situations will change, and one is expected to continuously make career and life decisions. The aim of a career counselling is to help one make a decision that one need to make now and to give one the knowledge and skills needed to make future career and life decisions.

Peer Mentoring **-** In the recent times Cross-age peer mentoring programs are an increasingly popular choice for educators and youth development professionals hoping to create positive outcomes for youth. In this regards building an effective peer mentoring programme for women in science that usually takes place between women who have experience in science and women who are new to the realm of science is imperative. An example would be an experienced science student being a peer mentor to a new student, the peer mentee in schools.

Peer mentors will be encouraged to have one-on-one sessions that meet regularly to help them get acquainted to science. They also provide research and other educational support opportunities to individuals. The peer mentor may challenge the mentee with new ideas, and encourage the mentee to move beyond the things that are most comfortable. Most peer mentors are picked for their sensibility, confidence, social skills and reliability.

Head-hunting for Female Scientists **-** There is also need to reach out to the communities to catch young women for a career in science by providing them with what attracts them most to the field. Another front can be to establish a scholarship program aimed at supporting women in secondary and tertiary education with a goal to support young interested women in science and technology careers while building a future pipeline of candidates for entry-level. There numerous approach to hunting including quiz competition, science park show, analyzing secondary student score cards, using head scouters, etc.

Activity 1.4 **Improvement of existing research facilities and infrastructure:** Infrastructural development and improvement is an integral part of the STISA 2024 and it is one of its four pillars. Knowing well that Africa requires upgrading of science laboratories and setting up of world class STI infrastructure. There is strong need to leverage on existing physical and digital infrastructure to increase its utilization. Lack of infrastructural facilities for imparting good quality education and conducting advanced research is key to building a knowledge based economy in the continent.

The science and technology institutions and other tertiary institutions working on science have made some significant impact on the development of teaching and research through their own efforts, a stage has reached in the continent where they needed strengthening of their infrastructure for cutting edge research in science. This must call for a renewed effort through diverse stakeholders, governments, private sector, international organizations among others.

It had also become necessary to extend such infrastructure support to Member States through a regional sharing of infrastructure via virtual laboratories, digital infrastructure and intra-university cooperation. This leeway must also look at the improvement and building of lower and higher secondary educational science facilities, considering that they are the bases for building science.

Whence, recognizing all these factors, there is need to make a special "Fund for Improvement of S&T Infrastructure in Universities, Higher Educational Institutions, and Secondary Schools" in the continent in the following areas; Laboratories; Basic Equipment & Scientific Toolkits; Networking & Computational Facilities; Research Infrastructure and Maintenance of equipment.

Activity 1.5 **Creation of Active Research Hubs/Networks for Female Scientists:** It is often believed that women are more attached to their community where they can play a significant role to change in

attitude and behaviour of their community. Building on this comparative advantage of attachment to community by female scientists, establishing research hubs/networks will impact positively on the community and national development.

Inter-regional and multi-disciplinary research hubs and networks will be to maximize the female contribution to the STI output. It will also facilitate the work of female scientists to address their community needs and challenges by focusing on inclusive and eco-innovations. The role of the hubs/networks may include but not limited to;

- The coordination and management of research activities
- Defining and guiding on thematic field of research
- Clearing house for scientific information and a platform for exchange of knowledge and experiences
- Linking female scientists to institutions and experts on thematic fields
- Building capacity on scientific and entrepreneurial activities

The research hubs/networks may differ from region to region depending on the strength and needs of the regions.

Activity 1.6 **Development of professional enhancement programmes for female scientists:** Professional enhancement programmes aim to provide the knowledge and skills necessary for female scientists to achieve personal and professional effectiveness. There are many-fold approaches to such programmes formally or informally that include consultation, coaching, communities of practice, lesson study, mentoring, reflective supervision and technical assistance, etc. While the modes of approach can either be group or individual. It further ensures that women have knowledge and access to general leadership and professional development training programmes including leadership skills, process skill, time management, evaluations, effectiveness, critical and lateral thinking among others.

On the other hand these programmes should focus on enhancing the capacities on retention of female scientists' re-engagement during career breaks; whatever the family reason, health, child care etc.; in such case the scientific community should not loss the hands of trained scientists. It is also to give especial attention to skills needed by female scientists to assign senior research positions.

Activity 1.7 **Development of research grant scheme for female scientists:** The need for strengthening and/or establishing a Research Grant Scheme specifically dedicated to women scientists aimed at providing opportunities to women scientists in STEM between the age group of 30-57 years; it will enable them to demonstrate their research talents and capabilities. In furtherance, the research grant scheme will assist female scientists to springboard their research from the bench side to market place.

This kind of grant could be an innovative way to support women to gain a strong foothold to spring back the scientific profession. It will also help them re-enter into the mainstream and provide a launch pad for further forays into the field of science and technology.

The scheme can be prioritized in the areas of needs of the Member States, and regions so that the women scientists will be encouraged to pursue research in frontier areas of science and engineering, on problems of societal relevance and to take up S&T-based self-employment after the programme.

2.3.2 Result 2: More political commitment to participation of females in science

Political commitment to participation of females in science is a demonstration of governments' dedication to the advancement of gender parity; it serves as the driving force to stimulate the management cycle and to develop response and interventions to the

weak participation of female in science. Accordingly, activities under result 2 were developed to ensure more political commitment and to serve as a guideline for stakeholders and partners to further develop them to fit into the missions and objectives.

Activity 2.1 **National survey on female enrollment to education and female's contribution to STI:** A robust survey system that is built on best practices that develop and deliver timely accurate and policy relevant indicators is one of the ways by which the African Union Member States are to be informed on the education and scientific output.

This surveying system needs to be developed and conducted through the National Bureau of Statistics of Member States. Each bureau should be autonomous and should develop its indicators according to the well know manuals such as Frascati manual among others. This will not stop the bureaus to develop their national indicators that may address local/ national challenges.

The Bureau is also to develop milestone bench marks and smart indicators to measure political commitment, recalling that commitment is measured indirectly by examining statements; and policies against the actions and the outcomes. Surveys output and its analyses should be presented to the public and decision makers in comparative way to long and short terms predefined goals.

Activity 2.2 **Development/ review of science gender mainstreaming policy:** Over 70% of the African Union Member States currently have gender policies, few of them have established Gender Management Systems because of stunted gender/women machineries and inadequate resources which impact negatively on gender mainstreaming interventions in the continent. Consequently less Member States give attention to the participation of women in Science and Technology.

It is practically impossible not to encourage women in the field of science and technologies to drive development. This is on the backdrop that women constitute about 51% of Africa's population[37] and STISA 2024 commitment on capacity development and technical competencies where gender equality is an integral component of this strategy. In other words, women should be assisted more than ever before in science and technology to enable them increase their participation.

A science gender mainstreaming policy should be developed on national and continental level to provide a mandate for the operationalization of decisions and commitments of AU and its organs on gender parity in Education and Science and Technology, a policy that harnesses effectively the potential of female scientists for Africa's socio-economic development that is accompanied by a comprehensive action plan to guide the implementation.

Activity 2.3 **Women in science advocacy campaigns:** A comprehensive advocacy campaign for woman in science will be a driving force to ensure public policies are influenced by gender mainstreaming through the development of public pressure groups and raising awareness of policy makers and parliamentarians and others. The campaign should aim to introduce a paradigm shift on societal perception for woman in science and cultural change process that to result in supportive actions and legislation that to assist female scientists and students to overcome their challenges to capitalize on their strength to benefit Africa's socio-economic development agenda.

Such campaign should be built on several pillars that encompasses but not limited to:

Enlightenment campaign for policy makers on the role of female scientists in national development **-** Here the policy makers are singled out from the wider section of the segment hence its strategy should be concise and straight forward. Convincing policy makers in

[37] http://en.worldstat.info/Africa

the continent to join and fully develop or enact policies on women in science and support the implementation of such policies. This targets Government Departments, Ministries of Women affairs, Science and Technology; the office of the Prime Minister or the President; Parliamentarians and other relevant institutions in addition to key development partners and community/traditional leaders. Such, a combination of many different advocacy approaches has worked in countries around the world. Each Member State should consider which approach are most likely to influence policy makers and advocate for the role of female in science advancement in the continent.

Encouraging Private Sector to Invest on Women in Science - The contribution of the private sector to the GDP in Africa is enormous and it is important that the sector must contribute and support women in science. Knowing fully well that women and girls have limited access to education, health services, and struggle to gain economic opportunities in men dominated continent. The Safe School initiative of Nigeria[38] is an excellent example of commitment from the private sector. However, there is need to have a similar initiative that will attract investment for women in science or that will highlight opportunities for public-private sector collaboration to come up with modalities on how to invest. This needs a development of robust resource mobilization strategy and investment plan for in women in science with the support of some Heads of States decisions. The objects must include but not limited:

- To scale business-driven private sector solutions to women in science; and
- To highlight opportunities for public-private sector collaboration in education and science and Technology.

[38] Press Release, The office of the UN envoy for Global Education (http://educationenvoy.org/press-release-safe-schools-initiative-launched-at-world-economic-forum/) accessed 16 April, 2017

Development of policy briefs on the role of female scientists in national development - Policy briefs are succinct and straight to point and are handy to be read by parliamentarians, policy makers, general public and others. Policy briefs should showcase the roles played by women within the scientific community and their contribution to national and continental development. This will provide an insight into their careers and how they achieved it. The aim is to break down stereotypes and perceptions that roles in science and engineering are unattainable and mainly reserved for men.

Mass communication and publicity action plan - The media gender stereotyping found in portrayals of women in general and in particular, women in science have played a significant negative impact on the participation of young women and girls in science. A well designed mass communication and publicity action plan; an action plan that persuades or affects the behaviour, attitude, opinion and emotion of the stakeholders, including policy makers, community leaders and populace at large will be the driving force for gender equality and women empowerment.

The action plan to focus on the challenges of women in science as well as their roles in science, economy, humanitarian outreach, health, and other global challenges should be addressed and acknowledged. Nevertheless, it must try to answer some of the most fundamental questions such as:

- How media can present professional women scientists in a style that will portray them as role models to motivate women and girls into science?
- How can media expand the public perceptions of women scientists?
- How media and celebrities can popularize science in a society?
- How can media and celebrities inspire girls into scientific fields?

- What role the Celebrities may play in recognizing the achievements of Women Scientists and encouraging girls into fields related to science?

On the other hand the plan needs to acknowledge the fact that there is a need to develop the capacity of Journalists and Bloggers; this is a fundamental factor for success in the fight for women in science. Recalling that advocacy on science itself was tamed due the difficult nature of the subject and there are not many trained journalists in the continent to handle it. The building of the capacities of advocators must be an integral part of this plan.

2.4 Reflections on some of the Existing Initiatives:

In this section, the authors reflected on the existing initiatives presented under the paradigm shift in support for women in scientific research, where the authors touted out for the implementing agencies, partners and stakeholders which may result in magnifying its impact and visibility.

L'Oréal-UNESCO for Women in Science International Awards: This prestigious award has an envelope of 100,000 euros per awardee; the awarding committee or the prize steering committee may consider how the enveloped fund can be utilized by the awardees. This can be done by designating part of the envelope. As UNESCO ambassadors for science, they can tour their region/ country to advocate for women participation in Science. This action will have a direct impact on presenting a role model for young girls and women in science not only that it would also contribute positively to societal perception and cultural change process among others.

African Congress of Female Scientists: For unseen reasons, the congress of female scientists was held once and has never convened since 2008. The financial aspect could be one among others to be

easily identified. In this regards, the AUC needs to work with partners to hold the congress on regular bases, to be conducted every 3 to 5 years to ensure that the voice of women scientists is well amplified and received. Other ways to strengthen the Congress is by considering it as an Advisory Board for the African Scientific, Research and Innovation Council (ASRIC).

African Union Kwame Nkrumah Awards: The awardees must be confirmed with the titles of AU Science Ambassadors in their respective regions and to travel within the region and their country to advocate for the women in science. In addition, they need to be invited and recognized for scientific functions that may take place in their respective regions and nations.

Unlike the envelope for L'Oréal-UNESCO for Women in Science International Awards the allocation here for each awardee is 20,000 US dollars. The AUC is to work with partners to increase the allocation by considering the needed travel arrangement and other incidental costs. Such action may have a huge impact on the young girls and early career female scientists. This will surely be a changing factor on Africa's perception on women in science and will pave ways for a dynamic cultural change.

International Day of Women and Girls in Science**:** Member States of the Union need to recognize and celebrate the International Day of Women and Girls in Science in style and to design a well-crafted action plan on such celebration. The date must be marked with the full attention of Minsters in charge of Women affairs, Education, and Science and Technology and parliamentarians committees on the respective sectors. The celebration should be in all the national educational institutions while the media (traditional and social) should be at the vanguard of the events.

International Telecommunication Union's (ITU) Annual Girl's Information Communication Technology (ICT) Day: Member States of the Union need to recognize and celebrate the annual girls ICT day and develop relevant actions. Actions and activities that highlight the fact we live in the era of digitalization and atomization, there will be no robust future without women participation in crafting our current day and future. The pioneer/inventor women in the field of ICT need to be recognized and admired for their contribution. It would be worthwhile, if the Department of Infrastructure and Energy of the AUC to consider the publicity of this day and to develop guide line on how Member States can celebrate and recognize the girls ICT day.

Other initiatives that may advance the course of Women in Science:

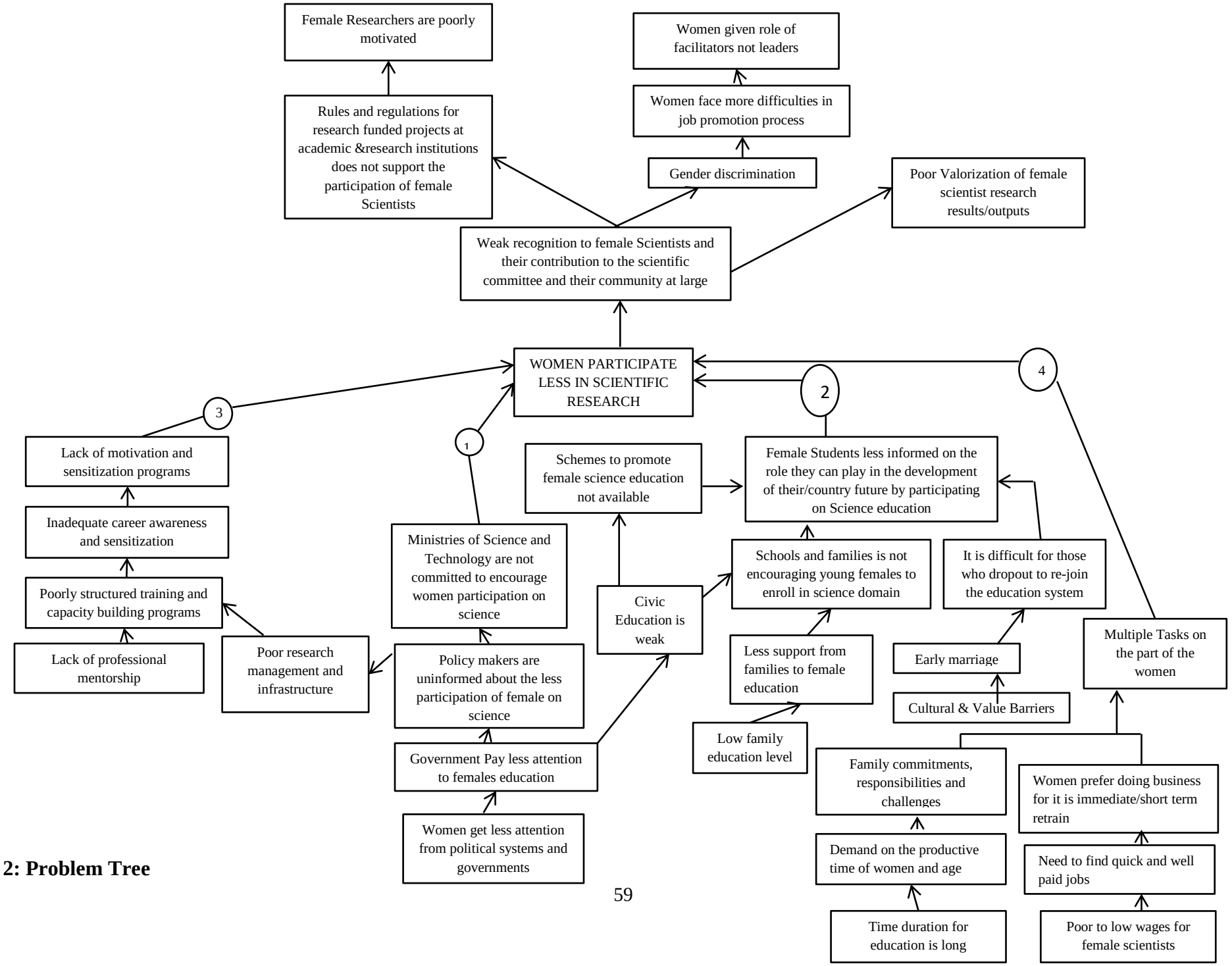
There are many ongoing initiatives in the continent that support the course of education and the scientific research but these initiatives may be modified or improved with special consideration for enhance women participation in science such as the African Union Research Grant[39] and Mwalimu Nyerere African Union Scholarship programmes; both programmes are run by the Department of Human Resources Science and Technology.

[39] The African Union Research Grant (AURG) was initiated in 2011 to support Pan African research and development through grants and direct funding. The programme provides the needed opportunity to use Science and Technology (S&T) as a tool for sustainable development, building and strengthening Africa's S&T capacities.

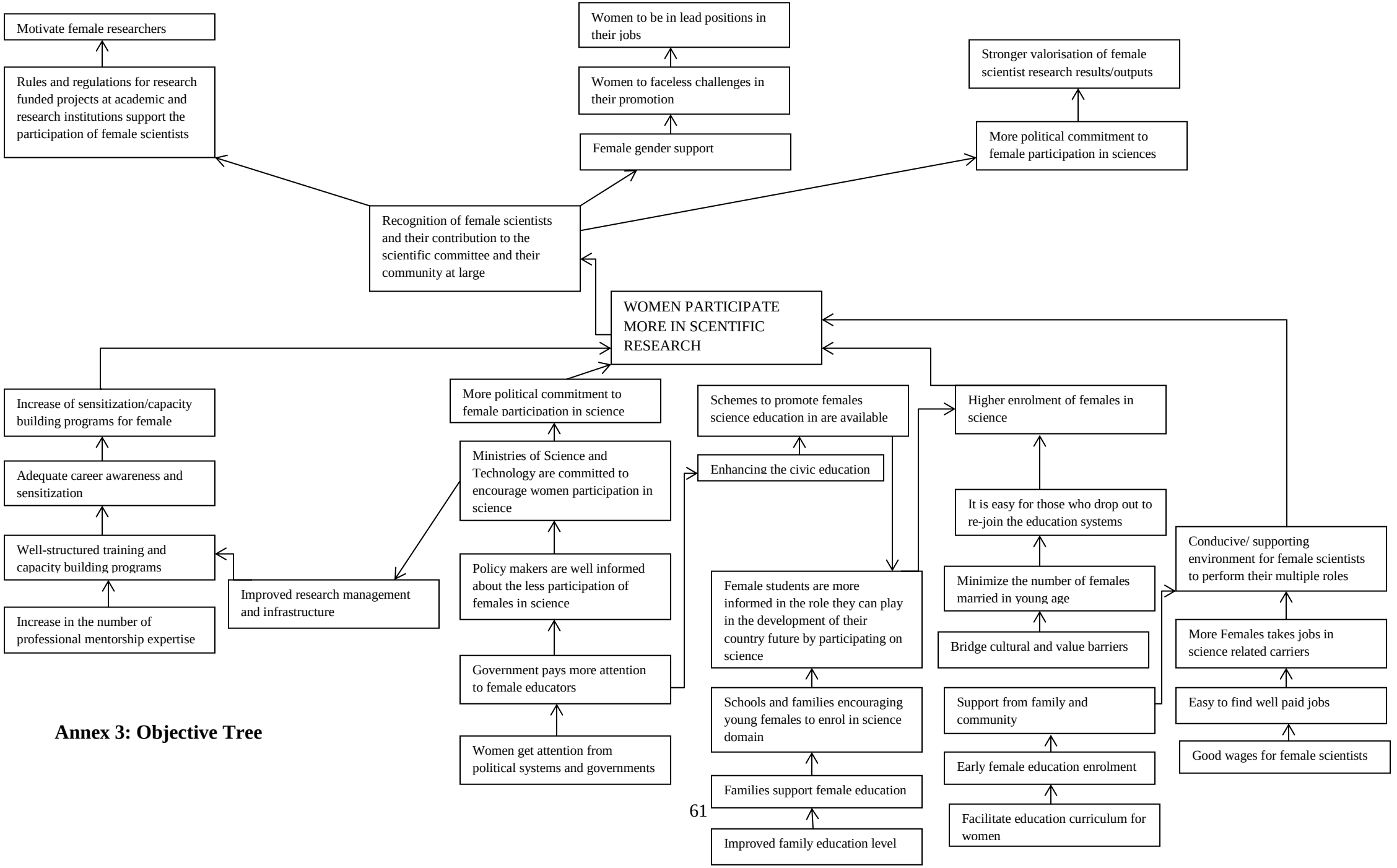
Annex 1: Problem Inventory

Less support from families to females education
Less support from families to females education
Government Pay less attention to females education
Women get less attention from political systems and government
Inadequate career awareness and sensitization
Role Models are not promoted
Women prefer doing business for it is immediate/short term retrain
Cultural & Value Barriers
Low family education level
Civic Education is weak
Ministries of Science and Technology are not committed to encourage women participation on science
Need to find quick and well paid jobs
Misplaced Societal values
Poorly structured trainings and capacity building programmes
Poor valorization of female scientist research results/outputs
Poor research management and infrastructure
Poor research and clinical works balancing system
Early Marriage
Female Researchers are poorly motivated
Less Professional mentorship expertise
Rules and regulations for research funded projects at academic &research institutions does not support the participation of female Scientists
Weak recognition to female Scientists and their contribution to the Scientific committee and their community at large

Lack of motivation and sensitization programmes
Gender discrimination
Schemes to promote female science education not available
Multiple tasks on the part of the women (kids commitments, family commitments)
Female Students less informed on the role they can play in the development of their/country future by participating on Science education
Family commitments, responsibilities and challenges
Demand on the productive time of women and age
Women given role of facilitators not leaders
Women face more difficulties in job promotion process
Schools and families is not encouraging young females to enroll in science domain
Time duration for education is long
Female mentors are few
Early marriage
Less consideration/recognition for Female scientists role models
Cultural barriers
Policy makers are uninformed about the less participation of female on science
It is difficult for those dropout to re-join the education system
Poor to low wages for female scientists
Multiple Tasks on the part of the women



Annex 2: Problem Tree



Annex 3: Objective Tree

This book is structured into two parts. The first part is a review of the GER of Male and Female cutting across Primary, Lower Secondary, Upper Secondary and Tertiary Institutions; from gender disparity to gender equality bringing about a paradigm shift in support for women in science. The second part is a strategic analysis conducted on a focus group that identifies the root cause and effects of less participation of women in scientific research which also portrays the methodology and analysis of the problem, with an overall objective of enhancing technical and professional competencies to accelerate Africa's transition to innovation led knowledge based economy. This overall objective is the second pillar of STISA-2024 for building a critical mass of technical and professional competencies. The analysis shows that there is need to carry out key activities that will spearhead a paradigm shift in women participation in scientific research.

The authors in this book have identified intervention mechanisms to be put in place for the enhancement of women participation in science.

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