Investing in Women as Drivers of Growth: A Gender-based Assessment of the Science, Technology and Innovation Ecosystem in Uganda

Final Report

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Table of Contents

Acronyms and Abbreviations

AA	Affirmative Action
ABPR	Annual Budget Performance Report
ACE	Africa (Higher Education) Centres of Excellence
AfDB	African Development Bank
AFRISA	Africa Institute for Strategic Animal Resource Services and Development
AGDI	Africa Gender and Development Index
AI	Artificial Intelligence
ASTI	Agricultural Science and Technology Indicators
AU	African Union
A-Level	Advanced Level
BTVET	Business, Technical and Vocational Education and Training
CA	Constituent Assembly
CAO	Chief Administrative Officer
CEDAT	College of Engineering, Design, Art and Technology (of Makerere University)
CM	Cabinet Minister
CRTT	Centre for Research in Transportation Technologies (of CEDAT)
CSO	Civil Society Organisation
CURAD	Consortium for Enhancing University Responsiveness to Agricultural Development Limited
CV	Curriculum Vitae
DE	Domain of Empowerment
DFCU	Development Finance Company of Uganda
DTA	Designated Technical Agency
EAC	East African Community
EASTECO	East African Science and Technology Commission
EASSy	East African Submarine Cable System
EGI	Electronic Government Infrastructure
ESSP	Education and Sports Sector Strategic Plan
FAWE	Forum for African Women Educationists
FAWoVC	Forum for Women Vice Chancellors in Africa
FTE	Full Time Equivalent
FY	Financial Year
GDP	Gross Domestic Product
GEI	Gender Equality Index
GERD	Gross Expenditure on Research and Development
GE&KS	Gender Equality in the Knowledge Society (Framework)
GGI	Gender Gap Index
GII	Gender Inequality Index
GPI	Global Parity Index
GWG	Gender Working Group
HEST	Higher Education, Science and Technology
ICT	Information Communication Technology
ICT4A	ICT for Agriculture
IDRC	International Development Research Centre
IFPRI	International Food Policy Research Institute
IoT	Internet of Things
IsDB	Islamic Development Bank
ITP	Industrial Technology Park
IWISE	Initiative on Women in Science and Engineering
KM	Knowledge Management
LEGCO	Legislative Council
LSOM	Legislators, Senior Officials and Managers
MAAIF	Ministry of Agriculture, Animal Industry and Fisheries
MaRCCI	Makerere Regional Centre for Crop Improvement
MDAs	Ministries, Departments and Agencies

MFPED	Ministry of Finance, Planning and Economic Development
MoES	Ministry of Education and Sports
MoGLSD	Ministry of Gender, Labour and Social Development
MoH	Ministry of Health
MoICT	Ministry of Information, Communication and Technology
MoLG	Ministry of Local Government
MoSTI	Ministry of Science, Technology and Innovation
MoTTI	Ministry of Tourism, Trade and Industry
MP	Member of Parliament
MSI	Millennium Science Initiative
MSME	Micro, Small, and Medium Enterprises
MTEF	Medium Term Expenditure Framework
MUBS	Makerere University Business School
MUST	Mbarara University of Science and Technology
M-SEF	Mind-set, Skills, Exposure and Follow-up
NARO	National Agricultural Research Organisation
NARS	National Agricultural Research System
NBI	National (Data Transmission) Backbone Infrastructure
NCC	National Consultative Council
NCHE	National Council for Higher Education
NDP	National Development Plan
NEPAD	New Economic Partnership for Africa's Development
NGO	Non-Governmental Organisation
NITA-U	National Information Technology Authority of Uganda
NRC	National Research Council/National Resistance Council
NTC	National Teachers College
OECD	Organisation for Economic Cooperation and Development
O-Level	Ordinary Level
PLE	Primary Leaving Examinations
PhD	Doctor of Philosophy
PIBID	Presidential Initiative on Banana Industrial Development
PIRT	Presidential Investors Round Table
PIST	Presidential Initiative on Science and Technology
PTC	Primary Teachers College
PTW	Professionals and Technical Workers
RENU	Research and Education Network of Uganda
RUFORUM	Regional Universities Forum for Capacity Building in Agriculture
RSCA	Regional Service Centre for Africa (of UNDP),
R&D	Research and Development
R&E	Research and Education
SACCO	Savings and Credit Cooperative Organisation
SDGs	Sustainable Development Goals
SIGI	Social Institution and Gender Index
SMEs	Small and Medium Enterprises
STEM	Science, Technology, Engineering and Mathematics
STI	Science, Technology and Innovation
STISA	Science, Technology and Innovation Strategy for Africa
SWEP	Strengthening Women Entrepreneurs Program
S&T	Science and Technology
TBI	Technology Business Incubator
TBIIC	Technology, Business and Innovations Incubation Centre (of Busitema University)
TEA	Total Entrepreneurial Activity
TEAMS	The East African Marine System (submarine fibre optic cable system)
TEXDA	Textile Development Agency
TEXFAD	Textile, Fashion and Design
TVET	Technical and Vocational Education and Training
UA	Unit of Account

UACE	Uganda Advanced Certificate of Education
UBOS	Uganda Bureau of Statistics
UCC	Uganda Communications Commission
UCE	Uganda Certificate of Education
UGX	Uganda Shillings
UIA	Uganda Investment Authority
UICT	Uganda Institute of Information and Communications Technology
UIRI	Uganda Industrial Research Institute
UMU	Uganda Martyrs University
UNHS	Uganda National Household Survey
UN	United Nations
UNCST	Uganda National Council for Science and Technology
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Programme
UNECA	United Nations Economic Commission for Africa
UNESCO	United Nations Education, Scientific and Cultural Organisation
UNOSCC	United Nations Office for South-South Cooperation
UPE	Universal Primary Education
UPPET	Universal Post Primary Education and Training
URA	Uganda Revenue Authority
URSB	Uganda Registration Services Bureau
USD/US$	United States Dollar
USE	Universal Secondary Education
USSIA	Uganda Small Scale Industries Association
UTAMU	Uganda Technology and Management University
UWONET	Uganda Women's Network
UWOPA	Uganda Women Parliamentary Association
WEAI	Women Empowerment in Agriculture Index
WEF	World Economic Forum
WISAT	Women in Global Science and Technology
4IR	Fourth Industrial Revolution

Busitema University Programmes

AMI	Bachelor of Agricultural Mechanization and Irrigation Engineering
APE	Bachelor of Science in Agro-Processing Engineering
APM	Bachelor of Animal Production Management
BAB	Bachelor of Agribusiness
BBA	Bachelor of Business Administration
BBW	Bachelor of Business Administration (Weekend)
BCT	Bachelor of Science in Computer Engineering
BEP	Bachelor of Education Primary
BNA	Bachelor of Science in Anaesthesia
BNS	Bachelor of Science in Nursing
BPM	Bachelor of Procurement & Supply Chain Management
BSA	Bachelor of Science in Agriculture
BTI	Bachelor of Information Technology
BTT	Bachelor of Tourism and Travel Management
CGA	Certificate in General Agriculture
DAG	Diploma in Agricultural Engineering
DAP	Diploma in Animal Production and Management
DBA	Diploma in Business Administration
DCE	Diploma in Computer Engineering
DCP	Diploma in Crop Production and Management
DEE	Diploma in Electronics and Electrical Engineering
DEP	Diploma in Education Primary
DGE	Diploma in Ginning and Industrial Engineering

DLB	Diploma in Science Laboratory Technology (Biology)
DLC	Diploma in Science Laboratory Technology (Chemistry)
DRI	Diploma in Records and Information Management
DTT	Diploma in Tourism and Travel Management
EDM	Master of Educational Leadership and Management
EDU	Faculty of Science Education
ELS	Bachelor of Education Languages (English and Literature in English)
ENG	Faculty of Engineering
ENM	Bachelor of Entrepreneurship Development and Management
FAG	Faculty of Agriculture & Animal Sciences
FHS	Faculty of Health Sciences
FMS	Faculty of Business & Management Sciences
FNR	Faculty of Natural Resources & Environment
FWR	Bachelor of Science in Fisheries and Water Resources Management
MBA	Master of Business Administration
MCC	Master of Science in Climate Change and Disaster Management
MCF	Master of Computer Forensics
MEB	Bachelor of Science in Mining Engineering
MED	Bachelor of Medicine and Bachelor of Surgery
MID	Master of Science in Irrigation and Drainage Engineering
MIM	Master of Science in Industrial Mathematics
MMM	Master of Medicine, Internal Medicine
MPH	Master of Public Health
NRE	Bachelor of Science in Natural Resources Economics
PCF	Postgraduate Diploma in Computer Forensics
PHB	Master of Science in Physics
SCE	Bachelor of Science Education
SCS	Bachelor of Science in Computer Science
SPE	Bachelor of Science Education (Physical Education)
TEX	Bachelor of Science in Polymer, Textile and Industrial Engineering
WAR	Bachelor of Science in Water Resources Engineering

EXECUTIVE SUMMARY

Introduction

Science, technology and innovation (STI) can play a crucial role in meeting internationally agreed development goals. However, they cannot effectively facilitate equitable and sustainable development unless the aims, concerns, situations and abilities of women as well as men are considered when formulating STI policies and executing STI initiatives.

The *"Gender-based Assessment of the Science, Technology and Innovation Ecosystem in Uganda"* was commissioned by the Forum for Women Vice Chancellors in Africa (FAWoVC) with support from the Regional Universities Forum for Capacity Building in Agriculture (RUFORUM) and funded by a grant from the Islamic Development Bank (IsDB). The aim of the study was to make an informed analysis of the status of STI in Uganda, upon which gender-smart solutions and capacity development would be premised. The study was designed to collect data, develop analysis of factors that affect participation, and document trends, challenges and opportunities for women and girls participation in science, technology, engineering and mathematics (STEM) education and STI careers.

The Gender Equality in the Knowledge Society (GE&KS) framework developed by the Women in Global Science and Technology (WISAT) Organisation was adopted to assess readiness for and participation of girls and women in the world defined by knowledge along the 8-Step STI skills staircase for basic education and professional formation and practice.

Three areas are identified as entry points for applying a gender lens within the STI ecosystem:

- **Science for women**: developing science and technology which support women's development and livelihood activities;
- **Women in science**: promoting gender equality in science, technology and engineering education, careers and leadership; and,
- Encouraging and supporting the role of **women in innovation systems** at national and grassroots levels.

Uganda's STI Ecosystem

The STI ecosystem is comprised of research management and research implementation institutions (mainly public sector), training institutions which produce the human resources for research and professional practice, support institutions which plan and manage STI activities as well as the financing and dissemination of STI outputs; and, industry and professional practice that develop and utilise/apply science-derived knowledge and technologies for innovation.

The STI skills pipeline involves education and training (at school, higher education and the workplace) and professional practice. The requirement to succeed in each of the phases is riddled with numerous bottlenecks – especially for girls and women - which need attention. The *theoretical training of STI professionals starts from childhood, with adequate exposure to the concepts, thinking and theory that build STEM/STI problem-solving capabilities.* Access to education still exhibits *substantial spatial variation and rising inequality at regional level. This means that many with aptitude are often denied the opportunity to enter the STEM/STI space*. The higher education system comprises 9 public and 41 private universities and over 160 other tertiary institutions. There are about 8,700 academics and 1,900 researchers employed in the system.

Investment in Research and Education

Uganda's gross expenditure on research and development (GERD), as a ratio of gross domestic product, averaged 0.31 percent between 2002 and 2014, with a minimum of 0.17 percent in 2014 and a maximum of 0.48 percent in 2010. Ministry of Education and of Finance statistics indicate that education sector expenditures as a proportion of national budget grew from 12% in 1991 to 21% between 1997 and 2000. Thereafter, the share steadily declined to 18% between 2001 and 2006 to the current 10% in FY 2019/20. Investment in tertiary/university education declined from 11% in 1997 to 8% in 2002 and averaged about 11% of public education expenditure between 2003 and 2012 when it shot up reaching 20% in 2016 and then sharply declined to 13% in 2019.

Enabling Policy Environment for Women Participation

Uganda created a *Ministry responsible for gender* in 1987, the *National Women's Council* in 1993, and the *Equal Opportunities Commission in* 2007. A significant number of laws have been enacted, and policies and programs implemented that sought directly or indirectly to improve women's (social, educational, and health) conditions, economic autonomy, civic participation, and empowerment. Gender equality is upheld in local frameworks. The *National Gender Policy (2007)* promotes gender mainstreaming in all government ministries and local governments, mandating numbers of women in leadership positions. The *Gender in Education Sector Policy (2009)*, the *National Strategy for Girls' Education (2000)* and institutional gender policies seek to eliminate all forms of gender disparities in education, social services and the workplace. A number of women activist, advocacy and support groups are active in the country, including those focused on women in science, technology and innovation.

National Gender Parity

Global gender parity rankings indicated that Uganda had reduced its gender equality gap from 70% in 1996 to 48% in 2017. Parity in education attainment was at 90%. In the professional and technical workspace, women representation increased from 22% in 2006 to an average of 35% since 2014. A 2011 UNDP study showed that women constituted 33% of all staff in the public service and 22% of senior management positions. Only 9 women out of 65 appear on the honour roll of Fellows of the Uganda National Academy of Sciences.

Women in STEM Education

Women's capacity to participate in science, technology and innovation is grossly under-developed and under-utilized. Not only do they have less access to information and technology, they are also poorly represented in educational, entrepreneurship and employment opportunities. The impact of affirmative action in education policy has visibly narrowed gender gaps in education, but this has not yet translated into women's equal participation in employment. Nonetheless, hundreds of women are an inspiration in STI practice. Ugandan women are debuting and making a mark in science, as innovators, directors/owners of entrepreneurial activities and businesses, stewards of STI sub-systems, researchers and practitioners who form part of the backbone of the national STI ecosystem. Compared to their male counterparts, they are still few largely because of "gender leakages" along the education pipeline, the employment chain, and the innovation landscape.

The gender gap in primary education had been closed and gender parity achieved by 2000. However, massive leakages occur along the education pipeline, especially for girls. Only 42% of the boys and 35% of the girls who leave secondary school each year qualified to go on to higher education are able to find places at the limited number of institutions. Girls constituted only 44% of enrolments at secondary level, 25% in post O-Level institutions and 35% in tertiary level institutions in 2000. The

proportion of girls steadily increased to 46% in secondary, 41% in post O-Level and 44% in tertiary institutions between 2012 and 2016.

Government, through the 2007 science preference policy, directed that science students would receive 75% of the Government scholarships to public universities and tertiary institutions. Public universities have made special provision to encourage women in science through internal quota policies. Makerere University Council in August 2019 approved an affirmative action policy ring-fencing 40% of vacancies in all STEM disciplines for women. Busitema University reserves 27 – 30% of admissions for female students. The NCHE reported the proportion of students enrolled in Arts and Humanities increased from 65% in 2010 to 74% in 2011 as against 35% and 26% in Science and Technology. The 2015 UNESCO Science Report indicated very low representation of females in all science fields with 17% in natural sciences, 23% in engineering and technology, 31% in medical sciences, 20% in agricultural sciences and 27% in social sciences. The 2016 WISAT assessment of gender and STI in Uganda reported an overall ratio of 39% females, with a considerable variation between institutions.

Science for Women

The national STI research system has generally adopted processes and approaches which benefit women. These research processes involve consulting and working with women in the choice, development and application of technology. A range of support activities and programs encourage girls to study STEM subjects and female professionals to pursue and remain in STI career fields. A good number of networks and agencies provide advocacy and support for girls and women in STEM study and STI professional practice. *Applying a gender lens by integrating gender concerns and taking steps to understand gender patterns of use and access have been critical for promoting STI for women.*

Women in STI Professional Practice

UNESCO, NEPAD and UNCST statistics indicate that the head count of researchers in Uganda was 1,942 in 2014. Female researchers constituted 24% of researcher full time equivalents (FTE), down from 40% in 2008. The total number of agricultural researchers was reported to be 559 FTE in 2016 with the share of female agricultural researchers rising from 20% in 2008 to 30% in 2016. The 2009 household and demographic survey indicated that only *13.8% of working women were in paid employment, compared to 27.9% of working men. Given this dynamic, it is likely that more women would move from self-employment into paid jobs if these were available to them.*

A study to trace and establish the career trajectory of a cohort of engineers who graduated between 2008 and 2012 indicated that 34% of female engineers were in professions that were not related to engineering, far fewer women were registered, and only 15% of females were nationally mobile. UBOS statistics indicated that majority of women-owned enterprises were concentrated in the trade sector (44%); education, health and social work (49%); and accommodation and food services (65%), indicative of the strong influence of the predominant patriarchal culture in the Ugandan society where enterprises involving technical skills are traditionally 'male' dominated sectors.

Busitema University Case Study

Busitema University, established in 2007, has a strong focus on STI and the training of hands-on graduates, research and outreach activities to improve on innovation, and commercialization of innovations through public-private sector interface and knowledge transfer. Despite a strong commitment to gender parity in the administration, staffing and student enrolment, this is far from being attained. For example, the current University Council - the supreme policy formulation organ of

the University - has only 5 (25%) female members out of 20. Only one (14%) of the Heads of the seven academic units is female.

The university admission policy also has a gender parity dimension. Female students generally have lower cut off points on admission, but remain under-represented for most courses. The university has a quota allocation of a minimum of 27 - 30% for female students. Female student enrolment increased at a rate of 21%, higher than for males at 13% between 2014 and 2018. However the overall male to female student ratio, although meeting the quota requirement, remained at 68 – 70% for males and 30 – 32% for females. There were gender differences in enrolment in the different courses, with a much lower proportion of females enrolling for engineering and science & education. The proportion of females enrolling for postgraduate study was also lower with noticeable differences between courses.

Females constituted only 23.8% of the academic staff in 2018, with engineering (18%), health sciences (21%) and agriculture (24%) having a lower proportion of female staff than natural resources and environment (36%) and science & education (31%). Males dominate the higher ranks. There is a deliberate push to recruit and mentor young females into academic careers as is indicated by the higher proportion (58%) of female Teaching Assistants. The female ratio for the administrative and support cadre was 35% and 27% respectively.

The university gender policy puts emphasis on gender research, budgeting, quality control and university outreach initiatives that pool knowledge, skills, experiences and resources from the larger society to support gender mainstreaming and university development. The university has three gender-focused initiatives that form best practices: (i) a minimum quota allocation of 27 – 30% has been set for female students admitted in all undergraduate courses and this has been maintained over the years across all faculties; (i) admission into the university is merit-based but with a gender lens, offering females a lower cut-off point than males; and (iii) the university budgets funds for conducting gender sensitive tailor-made career guidance in secondary schools and teaching practice in rural-poor-science-performing schools.

Conclusions and Recommendations

Uganda recognises women's legal status and rights as cornerstones of inclusive growth and gender equality. National and local government structures support gender-focused governance, knowledge management and capacity building for gender equality. Capacity development for *women in science* is best promoted by building their knowledge through policies and actions promoting equal access to STEM education and training, and equal opportunity in the management and implementation of research. Broad science education preference policies do not seem to have helped girls and women much. The initiators of these policies have to understand and appreciate the need for affirmative action if women are to benefit more. The specific gender-focused conclusions and recommendations are as follows:

a) Several science education system-related factors, including effective policies to increase access to quality STEM education; teaching strategies and learning environments; assessment procedures and monitoring tools; and ICT-based technologies or approaches to reach more girls, build STEM literacy and skills, and address gender divides; gender roles and expectations on girls' participation, progression and learning achievement; family, peers and teachers, gender stereotypes in the media and the broader society, and educational resources - influence girls' aspirations, confidence and self-efficacy in STEM study and STI practice.

b) It is now universally accepted that countries and systems must more effectively pull girls into, and retain their interest in STEM studies and engagement in STI, including through mentors,

role models, and extracurricular activities if genuine equitable development is to be attained. Empowerment, leadership and confidence as common drivers have to be imparted through existing and potential partnerships (e.g. cross-sectoral, public-private, parent-schools, counsellors-students, industry-governments) to help advance gender-responsive STEM education and career advancement of women in STI. Cooperation is a win-win for girls and women.

c) The gender dimension must be incorporated in all national STI and other development/sector policies - especially linking the STI policies to policies on food and agriculture, water, energy, infrastructure and industry. Policy implementation has to be routinely tracked and assessed to ensure that policies benefit both men and women equally. Staff training in gender analysis in order to produce gender-sensitive policies, programming and impact evaluation, including development of skills in collecting gender-disaggregated information and analysis of data sets, and monitoring of policies and programmes, must be supported.

d) Developing and maintaining functional partnerships and collaboration among international and national research institutions and agencies, universities, nongovernmental organizations/civil society, government agencies and the private sector is critical to integrating gender perspectives and the inputs of women producers, scientists and innovators into STI for development.

e) The attrition rate is higher for girls than boys along the education pipeline. The progressively widening gender gap with higher levels of education and along urban-rural divides must be checked, through interventions that deepen the provision of incentives and opportunities to girls in the areas of health, livelihood and social support systems, to enable them stay in school and access life-long learning.

f) Gender gaps are more pronounced in the sciences than in the arts and humanities, and even widening in some fields. National support systems should be focused on gender-responsive innovations in technology that benefit everyone and mitigate new and emerging technologies widening old gaps and creating new ones.

g) The science preference policy in education and all other STI complimentary policies should integrate a gender lens, especially in their implementation, in order to: (i) encourage and support girls and women to realize their full potential; (ii) promote consultation with women concerning their technology needs and choices, and work with them to gain the knowledge, skills and resources to manage technology for their own purposes; and (iii) support the ability of women to participate actively in innovation systems and in key sectors.

h) Strengthening research in science and industrial leadership in innovation, including investment in key technologies, access to capital and support for SMEs is important in the application of STI to address societal challenges. Policy choices determine who benefits. Women's participation in decision-making at all levels, including through temporary special measures, and support policies and mechanisms that create an enabling environment for women's organizations and network has to be promoted.

i) Support for and scaling up of successful models and approaches through appropriate financial and policy measures, focusing on multi-stakeholder partnerships, and encouraging private sector and livelihood development to ensure the sustainability of initiatives is essential.

j) Uganda law and policy should continue to always ensure women's equal access to resources, education, extension and financial services, land and markets as part of overall support for

their STI- and gender-related activities. The focus ought to be on three key questions around innovation, growth, and inequality: How can government and industry use existing technologies to deliver services more effectively and equitably to citizens? What are the best gender-sensitive mechanisms for creating and spreading new technologies to tackle shared problems? And, how can policymakers ensure that advances in technology (artificial intelligence, automation, and communications) bring shared benefits and not greater gender inequality?

k) Digital technologies and innovations are increasingly not only becoming an important avenue for training and knowledge acquisition, but also a means for women and girls to (i) overcome the barriers that they face across a variety of contexts, and (ii) achieve their goals and ambitions. There is need for a profound change in teaching methods and the curricula, and of more interconnected and multidisciplinary ways of learning science and technology as a means of promoting more creative and engaging ways to attract women to a career in science and technology.

l) A suite of well-funded support programmes for girls and women in STEM are needed – in the form of high school STEM awareness, mentoring programmes and scholarships for young women, particularly from less advantaged backgrounds. More cooperation is needed between the universities, the private sector and the state in developing a whole program that not only increases access for women to go into those fields, but supports them along their career path. Increasing the capacity of women and girls at the local level through appropriate information and education (formal and informal), training and technical support systems is essential.

m) Research and innovation institutions are key “transmission mechanisms” that are largely responsible for linking and disseminating the “global stock of knowledge” and skills among individuals, communities and enterprises. Women are underrepresented in tertiary STI education, research and industry. Representation, especially at strategic, decision-making levels is critical, both because it is important to have a diversity of viewpoints in the manner in which policy and programmes are designed and implemented at the national and local levels, and because participation builds leadership skills and visibility that helps members advance their careers. When women are prevented from reaching their full potential, the entire field suffers. Uganda needs 100% of the available brainpower to make the biggest impact and move STI forward as quickly as possible.

n) Talent management (attraction, recruitment, retention, development, and deployment) within the workspace should not continue to be “gender-blind” in the sense that it does not take into consideration gender roles and responsibilities of women and men, hence often unintentionally disadvantaging women. Working women STI professionals need additional support mechanisms focused on childcare, job and work time flexibility, funding, and career development initiatives. The imbalance in numbers of women needs to be corrected through genuine affirmative recruitment policies, women friendly working environments, and flexible work schedules that guarantee equal opportunity for retention and progression.

Science and technology must support women’s development and livelihood activities, through solutions that achieve the overall objectives of interventions while closing relevant gender gaps in the process. Women can no longer be bypassed in STI policies and decisions, as this will not reflect their specific needs and concerns. It is imperative to: (i) support education, training and employment of women as scientists and professionals; (ii) ensure women’s equal access to opportunities, resources, education, and services to support their STI- and gender-related activities; (iii) target technologies and other forms of support for developing income-generating activities to take into account the different

needs of men and women; and, (iv) support the packaging of information and knowledge in a variety of formats to make it more accessible to women.

FAWoVC – Agenda for Action

FAWoVC is high profile advocacy group whose members share a common social interest and try to advance those interests through various avenues and mechanisms. Serving the women of the university and the wider community by advocating for women's equity in education and work is a principal objective of FAWoVC. This involves supporting learning, discovery and engagement, and enabling women to achieve their highest potential in an environment of diversity, respect and freedom of expression. FAWoVC initiatives should impact the nation's STI workforce in the following ways: (a) benefit under-represented female STEM students by increasing enrolment and retention through quality programmes; (b) demonstrate the importance of multiple, integrated programmes to succeed in science fields; (c) prepare female students for careers in STI by valuing diversity; and (d) enhance communication between female students, faculty, and staff.

Being at the helm of their institutions, the members can be very influential not only in changing policies in their institutions but also convincing people who either hold power or who may hold power to support the policy positions the group wants to be supported. As a university-based group, it can also be effective in providing information and education on complex issues that ideally will help government make informed decisions on further improving gender equality in STEM study and the advancement of STI. To advance some of the aforementioned general recommendations, FAWoVC could run the following programmes and activities: *mentoring programmes for girls in STEM studies and early career women professionals; mentoring societies of female STEM professionals; influencing the hiring of female faculty and staff;* and *advocacy for girls'/women-friendly study and work environment.*

CHAPTER I: INTRODUCTION

Aspiration 6 of the African Union's Agenda 2063: "An Africa where development is people driven, relying upon the potential offered by people, especially its women and youth and caring for children," and the principles enshrined in Article 4 (l) of the AU's Constitutive Act: "promotion of gender equality" as well key continental and global commitments. The United Nations Commission on the Status of Women adopted agreed conclusions on *"access and participation of women and girls in education, training and science and technology, including for the promotion of women's equal access to full employment and decent work"* in March 2011. These conclusions highlighted, amongst others, the need for the sharing of good practice examples and lessons learned in mainstreaming gender perspectives in STI policies and programmes, with a view to replicating and scaling up successes.

Gender equality can enhance economic growth and improve other development outcomes in three ways: (i) increasing women's access to and control over resources can generate broad productivity gains, (ii) improving women's and girls' status improves many other development outcomes (health, nutrition, etc.), and (iii) crucially, women's economic gains benefit not only themselves but also the next generation, magnifying the development impact. Gender equity is achieved when the distribution of opportunities, resources, and choices is the same for males and females, and when different behaviours, aspirations of women and men are equally valued and favoured, so that they have equal power to shape their own lives and contribute to their families, communities, and country. Promoting gender equality is a smart development policy.

This study focused on presenting selected highlights and results to facilitate an increased understanding and shared learning on Uganda´s gains in gender equality in general, and girls/women participation in STEM study and STI employment in particular. The report brings together a significant amount of data and information about gender in key areas in the knowledge society (science, technology and innovation), much of it widely dispersed in institutional databases and reports, official government results and statistics, as well as published research and grey literature, scholarly books, journals, monographs, official reports of international (mainly UN agencies) organizations, and numerous periodicals. Given the different sources of information consulted, the methods used for obtaining, analysing, and interpreting the data, and the dates information was obtained and published, contradictions among the different sets of data for the same indicator can exist and are to be expected. The sources of all the data used in the report are indicated in the notes on the appropriate tables or as a footnote.

1.1 The Forum for Women Vice Chancellors in Africa

The Forum for Women Vice Chancellors in Africa (FAWoVC) is an innovative umbrella group of female university leaders established in 2016 to be an influential voice within the higher education space in Africa championing gender equality and women's empowerment as a way of helping women surmount the prevailing societal and cultural barriers to women leadership in Africa.

Specific objectives that informed the founding of the Forum include: understanding leadership and management of universities in Africa; mentoring of female senior staff members in Universities and Research Institutions; exploring impact of Women Networks in supporting women leaders in Higher Education and sharing of experiences and benchmarking with peers from other parts of the World. The Forum pursues an agenda that spearheads gender responsive training in higher education institutions to increase the enrolment, participation and performance of female students, as well as stimulating interest and galvanizing women to take up careers and leadership positions in the academia and general workplace.

1.2 Defining Gender, Science, Technology and Innovation[1]

While science, technology and innovation (STI) are inextricably connected, on an individual level they are profoundly different concepts with sometimes overlapping but often very different ecosystems and drivers. In a knowledge economy, ***Research and Development (R&D)*** comprises basic research (aimed at creating new knowledge with no specific application in view), applied research (new knowledge towards a specific practical aim) and experimental development (to develop new products or processes).

Science can be defined as the systematic study of the physical or material world (natural science) and of society (social science) that generates, or creates, knowledge from which data and information is drawn. ***Technology*** can be defined as the application of scientific knowledge to develop techniques to produce a product and/or deliver a service or as the application of scientific knowledge for practical ends. ***Innovation*** is defined as the process of deriving the benefits from a new or significantly improved product (good or service), or process (production or delivery method), or *marketing (p*roduct design, packaging, placement, promotion, pricing) or a new organizational method (such as in business practices, workplace organization or external relations). "Innovation" in STI entrepreneurship refers specifically to the creation of new and potentially disruptive ideas, products, or services - distinct from outcomes typically cited as part of the business case. A key point to differentiate innovation from improvement is that innovation derives significantly (as opposed to incrementally) more impact (economic, social and environmental) from existing products, processes and services or from a combination of proven and new science and technology to develop new products, processes or services.

Gender refers to the social attributes and opportunities associated with being male and female and the relationships between women and men and girls and boys, as well as the relations between women and those between men. These attributes, opportunities and relationships are socially constructed and are learned through socialization processes. They are context/time-specific and changeable. Gender determines what is expected, allowed and valued in a women or a man in a given context. In most societies there are differences and inequalities between women and men in responsibilities assigned, activities undertaken, access to and control over resources, as well as decision-making opportunities.

1.3 Global Context of Gender in Science, Technology and Innovation

Science and gender equality are both vital for the achievement of the internationally agreed sustainable development goals (SDGs) and Africa's Agenda 2063. Globally, over 50% of the population is female, yet widespread gender inequality exists, especially in the science, technology, engineering and mathematics (STEM) fields of study and participation in the STI ecosystem. Today, only about 29% of researchers are women and only 3% of Scientific Nobel Prizes have been awarded to women. While men and women are equally represented in scientific courses at the age of 16-19, the representation of women in scientific disciplines reduces when responsibility is increased. Many factors contribute to the attitudes towards the achievement of young men in STEM subjects, including encouragement from parents, interactions with mathematics and science teachers, curriculum content, hands-on laboratory experiences, early high school achievement in the subjects, and resources available at home. Results from several nationally representative longitudinal studies[2], indicate few differences in

[1] *The six major fields of science and technology suggested in the 1978 UNESCO "Recommendation Concerning the International Standardisation of Statistics on Science and Technology" are: Natural Sciences, Engineering and Technology, Medical Sciences, Agricultural Sciences, Social Sciences, and Humanities.*

[2] *See: Women in STEM fields, https://en.wikipedia.org/wiki/Women_in_STEM_fields#mw-head*

girls' and boys' attitudes towards science in the early secondary school years. However, students' aspirations to pursue careers in STEM influence both the courses they choose to take in those areas and the level of effort they put forth in these courses.

1.3.1 STEM skills and the new generation of digital natives

Technology has fundamentally altered how people live, work, and relate to one another - through an increasingly interconnected world where ideas, knowledge and data flow more freely than ever before, potentially fuelling collaborative and open approaches to innovation. Through access to digital platforms for research, development, marketing, sales and distribution, while providing real-time information on impacts on society and the environment, STEM knowledge and skills form the basis of the fastest-growing job categories. In recent times, those who have gained the most from the transformative stage of STI have been people able to afford and access the digital world and skills. The effects of the digital transformation manifest in job destruction and creation in different sectors, the emergence of new forms of work, and a reshaping trade landscape, in particular for services.

Recent studies[3] show that machines and algorithms in the workplace will create 133 million new roles, but cause 75 million jobs to be displaced by 2022 resulting in 58 million net new jobs, particularly in data analysts and scientists; artificial intelligence and machine learning specialists; software and applications developers and analysts; and data visualization specialists. These studies predicted a net employment impact of more than 5.1 million jobs lost between 2015 and 2020 due to robotics and automation alone; and that almost 65% of children entering primary school today will have jobs that do not yet exist. There had been predictions even, that by 2015, about 90% of formal employment across all sectors would require ICT skills.

Digital and fabrication technologies have already changed how technology interacts with the science world and have spurred a movement towards citizen science where scientific research is conducted, in whole or in part, by amateur or non-professional scientists. The ICT sector has thus emerged as a key driver of innovation, especially among the youth. Digital innovation and new business models are driving transformation, including of jobs and trade. Data-driven innovation, new business models, and digital applications are changing the workings of science, governments, cities, and sectors like health and agriculture. This kind of revolution, though not without its challenges, has serious implications for the process and conduct of science education, for women in science and the effective use of science to support women's development and livelihood activities. The conflicts and trade-offs between technological advancement for economic growth and social inequality is real. This is more of a fundamental reason why STI must now be embraced in an integrated approach to minimise or entirely avoid new gender divides emerging and old gaps widening.

1.3.2 Global responses to widening old gender gaps and emerging new divides

Gender was for a long time the missing link in national programmes and international development agendas, with different consequences and impacts on the lives of both men and women. Serious obstacles are not only preventing girls and women from accessing science education and pursuing careers in STI, but also technological change is benefiting men more than women, largely because policies and programmes do not explicitly recognize the gender specific nature of development. The global *Gender Parity Index (GPI)*[4] stood at 68% parity, leaving a gender gap of 32% in 2018. At the

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[3]*See:* ***WEF (2018)****: The Future of Jobs Report 2018. (http://www3.weforum.org/docs/WEF_Future_of_Jobs_2018.pdf)*

[4]***WEF (2018)****: The Global Gender Gap Report, 2018. World Economic Forum, Insight Report http://reports.weforum.org/global-gender-gap-report-2018/. The Global Gender Gap Index examines the gap between men and women in four fundamental categories (sub-indexes) and 14 different indicators that compose them. The sub-indexes are Economic Participation and Opportunity, Educational Attainment, Health and Survival and Political Empowerment. The highest possible score is 1 (equality) and the lowest possible score is 0 (inequality). There are three basic concepts underlying the Global Gender Gap Index, forming the basis of how indicators were chosen, how the data is treated and*

current rate of change, it will take 108 years to close this overall gender gap and 202 years to bring about parity in the workplace. For the four components of the index, the gender gap narrowed by 96% for health and survival; 95% for education attainment; 59% for economic participation and opportunity; and, 22% for political empowerment.

The challenges affecting women participation, the importance of the link between gender and STI, and the integral nature of women's contributions to development have increasingly become more prominent in global and national agendas since the mid-1990s and early 2000s[5]. Subsequent to the 1995 Beijing World Conference on Women and the 2002 Johannesburg World Summit on Sustainable Development, the global community has made a lot of effort in inspiring and engaging women and girls in science. The UN began celebrating the International Women's Day (March 08) in 1975, which over the decades has morphed from recognizing the achievements of women to becoming a rallying point to build support for women's rights and participation, especially in the political and economic arenas. At the 81st plenary meeting in December 2015, the UN also proclaimed February 11 each year as the *International Day of Women and Girls in Science* in light of the global need to achieve full and equal access to and participation in science for women and girls, and further to achieve gender equality and the empowerment.

The importance of science, technology and innovation in achieving development was emphasized in the 2030 Agenda for Sustainable Development, which positions STI at the heart of development as drivers and facilitators. Statistics on STI are fundamental to understanding the processes by which development has an impact on societies and their economies. Two key indicators related to research and development are now among the core indicators for monitoring target 5 of SDG# 9, which calls on countries to *"enhance scientific research, upgrade the technological capabilities of industrial sectors, including encouraging innovation and substantially increasing the number of research and development workers per 1 million people and public and private research and development spending"*.

The various UN agencies, especially UN Women and UNESCO, work with partners around the world to close the gender gap in STEM and digital technologies. Interventions include providing women empowerment principles that offer guidance on empowering women in the workplace, marketplace and community; and tackling inequalities early within the education system by stimulating girls' interest in STEM subjects, combating stereotypes in school curriculum, and increasing access to female mentors. They also provide fellowships, networking and mentoring opportunities for women researchers, and support the inclusion of gender equality in national STI policies, strategies, plans and legislation by focusing on the collection of sex-disaggregated data. The L'Oréal - UNESCO For Women in Science program has recognized outstanding female scientists since 1998. The program has valued the achievements of more than three thousand women in the field of science, put them at centre stage, supported and promoted them in the scientific community and beyond. The Fondation L'Oréal conducted additional actions such as raising awareness on scientific careers for girls in order to generate vocations.

Through such and many other initiatives, the global community has demonstrated determination and commitment to encourage a new generation of women and girl scientists, to tackle the major challenges of our time. Yet women and girls continue to be excluded from participating fully in science. The gender gap in STEM fields of study and STI careers has to be closed and gender equality actively promoted. By harnessing the creativity and innovation of all women and girls in science, and properly

the scale used. First, the Index focuses on measuring gaps rather than levels. Second, it captures gaps in outcome variables rather than gaps in input variables. Third, it ranks countries according to gender equality rather than women's empowerment.

[5] ***GWG (Gender Working Group) (1995)**: Taking action - Conclusions and recommendations of the Gender Working Group of the United Nations Commission on Science and Technology for Development. In: Missing Links: Gender Equity in Science and Technology for Development. Ottawa, International Development Research Centre (IDRC).*

investing in inclusive STEM education, research and development and STI ecosystems, the world has an unprecedented opportunity to leverage the potential of the fourth industrial revolution to benefit society.

1.4 Closing the Gender Gap – Science for Women and Women in Science

Shaping the future of education, gender and work[6] points to three key interconnected features that affect how talent is developed and deployed in the world: (i) technology and globalization are significantly shifting business models in all sectors, increasing the pace of change in job destruction and job creation, including new forms of work, as well as skills churn within existing jobs; (ii) education and training systems, having remained largely static and under-invested in for decades, are largely inadequate for these new needs; and, (iii) outdated but prevailing cultural norms and institutional inertia create roadblocks particularly when it comes to gender. Despite rising levels of education, women continue to be underrepresented and undervalued in both STEM education and STI paid workforce, especially in high potential sectors and high status jobs.

Science, technology and innovation (STI) can play a crucial role in meeting internationally agreed development goals. However, they cannot effectively facilitate equitable and sustainable development unless the aims, concerns, situations and abilities of women as well as men are considered when formulating STI policies. In other words, a "gender lens" needs to be applied to STI policy-making - emphasising the necessity of integrating a gender perspective into STI policies to effectively address socio-economic development challenges. Three areas are identified[7] as entry points for applying a gender lens:

- Science for women: developing science and technology which support women's development and livelihood activities;
- Women in science: promoting gender equality in science, technology and engineering education, careers and leadership; and,
- Encouraging and supporting the role of women in innovation systems at national and grassroots levels.

Women tend to be bypassed in STI policies and decisions, which often do not reflect their specific needs and concerns. Because of their key role in an economy and society, women are powerful agents of change. It is therefore critical that their interests and concerns be reflected in efforts at harnessing STI for development by applying a gender lens. The participation of women in science can increase their contribution to society, because, among other things, they could influence the agenda for science and technology (S&T) research and development (R&D). However, at present a gender imbalance is observed in S&T education, which favours boys/men in three out of four countries worldwide that report on intake ratios. In order to increase the role of women in innovation, it is necessary to ensure greater access of women to education, capital and markets to improve their livelihoods. Women need to be supported in entrepreneurial development.

1.4.1 Gender disparity in STEM study

There is no shortage of literature to reflect the unfortunate reality of gender disparity and inequality. Literature indicates that in the early education formative years, girls are just as interested in STEM as boys but appear to lose interest in these subjects as they reach adolescence. While more girls are

[6] ***WEF (2017):*** *Realizing Human Potential in the Fourth Industrial Revolution - An Agenda for Leaders to Shape the Future of Education, Gender and Work. (http://www3.weforum.org/docs/WEF_EGW_Whitepaper.pdf)*

[7] ***UNCTAD (2011)****: Applying a Gender Lens to Science, Technology and Innovation. United Nations Conference on Trade and Development Current Studies on Science, Technology and Development, No. 5*

attending school than before, they are significantly under-represented in STEM subjects in many settings. Female representation progressively becomes lower than male in all aspects of the education value chain and career 'pipeline' from interest to majoring in STEM fields in post-secondary education to STI professional careers.

Several studies identify various barriers and challenges for girls in STEM education. These include: inappropriate school environments for girls, safety concerns, teaching pedagogy that favours boys, and differential access to technical and vocational education. Also cited is lack of female STEM role models; pop-culture portrayals and societal attitudes; female discomfort in male-dominated classes; lack of encouragement and support for girls in STEM fields; inflexible and unfriendly academic systems, and careers that deter women.

Another commonly mentioned explanation for the low numbers of girls in STEM fields of study is the self-perception of and confidence in their capabilities. Some girls (and their parents/guardians) tend to believe that success in math and science is a question of natural abilities and that girls do not have the same capability as boys to excel in these fields. Underrepresentation of women in STEM is partially rooted in such long-standing gender stereotypes and cultural biases which have created false expectations and misconceptions. In some societies, there is even sexism where social constructions dictate what is regarded as appropriate work (and therefore course of study) for women.

All these constitute issues of social and gender identity, an educational 'pipeline' that starts early in life and forms a gender-biased sequence of study, perceived barriers [by women and girls] for women in science compared to other fields, and inequitable resources and opportunities offered to women compared to men in both education and employment in science fields. Many of these problems can be addressed by applying a gender lens in all aspects of STI for development, promoting gender-relevant teaching methods and materials, and providing funds and other non-monetary incentives to promote girls and women in STEM education.

1.4.2 Gender inequality in the STI career path

There are a number of potential reasons for observed inequitable participation of women in the STI career pipeline. These include: (i) domestic and career responsibilities - conflicts between career and family, inflexible working hours; (ii) the length of preparation required; (iii) gender bias - the perception of women in these fields as unfeminine and/or lack of confidence that they can handle the work; and, (iv) lack of social encouragement to pursue careers in these fields.

Automation is also having a disproportionate impact on roles traditionally performed by women, wiping out many of the jobs that were traditionally viewed as feminine. At the same time, women are underrepresented in growing areas of employment that require STEM skills and knowledge. Another potential reason is that the infrastructure needed to help women enter or re-enter the workforce – such as childcare and eldercare – is under-developed and unpaid work remains primarily the responsibility of women.

Recent national assessments[8] indicated that numbers of women in the STI fields are alarmingly low (and severely under-represented in some of the disciplines) and are actually on the decline in many countries. Reports[9] show that women in the tech industry constitute only 30% of professionals in the

[8] *See: http://wisat.org/national-assessments/. These assessments (conducted between 2012 and 2019 in Brazil, India, Indonesia, the Republic of Korea, South Africa, United States, the European Union, Argentina, Mexico, Kenya, Ethiopia, Rwanda, Uganda, Senegal, Nepal and Panama) are a cross-national comparison of the status of women in national knowledge economies, including STI, undertaken as a collaborative initiative of Women in Global Science and Technology (WISAT), the Organization for Women in Science for the Developing World (OWSD), the Elsevier Foundation, and Gender in Science, Innovation, Technology and Engineering (GenderInSITE).*

[9] *See: UNOSCC (2019): Creating a level playing field for women in technology in Africa, https://www.unsouthsouth.org/2019/02/01/creating-a-level-playing-field-for-women-in-technology-in-africa/, United Nations Office for*

sector in Sub-Saharan Africa, slightly higher than the 28% worldwide. These statistics throw into light the huge gap between women and men in exploring careers in STI ecosystem. Similar patterns were observed in global surveys[10] comparing experiences of men and women *physicists* and scientists in the fields of *mathematical, computing, and natural sciences.* A global four-year initiative on women in science and engineering (IWISE) initiated in 2014[11] also revealed systematic underrepresentation of women in STEM. Promotion, recruitment, and retention of women to senior roles lacked parity, as were policies to support women in science. Women were well represented amongst undergraduate, graduate, and post-graduate students (constituting over 50% of each population), but among faculty, as seniority increased, representation of women decreased (averaging 42% of assistant professors, 34.2% of associate professors, and 23.4% of full professors). Women made up less than 10% of tenured faculty recruits in nearly one-third of institutions. This data suggested that rather than recruiting women into STEM, the bigger issue appears to be retention and promotion of women into positions that allow them more influence, resources, and in turn, high-impact research.

The IWISE data also showed that there were no significant or systematic changes in institutional practices supportive of women in STEM over time. Policies and programs to support gender equity were emerging, but limited. Women representation on strategic, decision-making committees was critical, both because it is important to have a diversity of viewpoints within these groups, and because participation in committees builds leadership skills and visibility that helps members advance their careers. When women are prevented from reaching their full potential, the entire field suffers. While the gender gap in STEM study and STI careers is well chronicled globally, new evidence is also pointing to a glaring gender gap developing even in the new and emerging areas of expertise[12]. Broadly, women do not have equal access to the career-advancing resources and opportunities enjoyed by their male colleagues.

South-South Cooperation, Addis Ababa, Ethiopia ; and UNDP (2019): http://www.africa.undp.org/content/rba/en/home/presscenter/pressreleases/2019/creating-level-playing-field-for-women-in-technology-in-africa.html, UNDP Regional Service Centre for Africa (RSCA), Addis Ababa, Ethiopia.

[10]See: https://www.aip.org/sites/default/files/statistics/international/globalsurvey2010.pdf; and https://gender-gap-in-science.org/project/

[11] Report by the University of Michigan analysing the New York Stem Cell Foundation (NYSCF) Research Institute institutional Report Card for Gender Equality to evaluate the representation of women in STEM (https://www.eurekalert.org/pub_releases/2019-09/nysc-ger082919.php and https://www.cell.com/cell-stem-cell/pdfExtended/S1934-5909(19)30345-5)

[12] For example, as reported in the 2018 global gender gap report, women represented only 22% of the artificial intelligence professional workforce. This gap was three times larger than in other industry talent pools. Women were more likely to be employed in junior roles as data analysts, researchers, information managers and teachers, unlike their male counterparts who were more likely to be positioned in more lucrative and senior positions senior roles or signal expertise in high-profile emerging skills – as software engineers, heads of engineering, heads of IT and chief executives.

CHAPTER II: STUDY OBJECTIVES

2.1 Objectives of the Study

The gender-based assessment of STI ecosystem study was conducted in selected countries of RUFORUM member universities, as a component of a wider 2-year project on *"Strengthening Capacity of the Forum for Women Vice Chancellors in Africa to Promote Gender Inclusive Participation in Science, Technology and Innovation"*. The aim of the Uganda case study was to make an informed analysis of the status of STI in the country, upon which gender-smart solutions and capacity development will be premised. The study was designed to collect data on and develop analysis of factors that affect the participation of women and girls in STI. It focused on documenting the trends, challenges and opportunities for women and girls participation in STEM education and STI careers. Findings from the study will form a critical reflection on national indicators of gender equality and women's empowerment, knowledge in decision making and in STI, women and lifelong learning, and the influence of enabling policy environment on specifically identified aspects of promoting gender equality in the national STI ecosystem.

2.2 Scope of the Study

The Terms of Reference for the study (Annex 1) spell out the following activities:

a) Reviewing and documenting with a gender lens the current status of the STI ecosystem in Uganda, drawing from lessons (if any), from initiatives to improve STI at country level;

b) Developing a methodology and tools for undertaking the gender based STI ecosystem assessment;

c) Analysing the wider STI eco-system, but with special emphasis on gender and the higher education sector;

d) Consulting with key STI and higher education sector stakeholders at national level, including the national commissions, relevant Ministries of STI and Gender, research agencies, university staff and other key stakeholders to identify their perceptions about gender-based STI ecosystem;

e) Reviewing literature on STI, gender and higher education in Uganda including, national STI and Gender policies and practices and others that enhance gender participation in STI;

f) Identifying and describing best practices in existence at higher education institutions, the methods and tools that have been successfully applied, and how such practices could be adopted and/or scaled up in other African universities;

g) Recommending detailed options for strengthening gender focused STI in Uganda; and,

h) Sharing results of the gender assessment in the form of a report and presentations to the FAWoVC and selected stakeholders, a publishable Country Report, and a synthesis report on the status of gender based STI in Uganda.

2.3 Methodology

The detailed methodology for the study is described in Annex 2. The assignment was undertaken using a quick analysis expert judgement approach, using content knowledge to quickly sift and synthesize existing data and quickly fill critical gaps with expert observation and targeted interviews. The review thus was guided by the following among others:

a) The identification of activities and initiatives (including legislation, regulations, policies and practices) that were instituted in order to progress towards achievement of the national STI and gender equality objectives and results;

b) An extensive online search and review of literature on STI in Uganda, including national level policies and practices, investments and other factors that enhance or impede the study of STEM and application of STI especially by girls and women;

c) Discussions with selected stakeholders to leverage collective knowledge, engagement and understanding of the various issues relating to STI and gender in Uganda; and,

d) Synthesis and analysis of available data, and insights from targeted interviews, published reports and grey literature.

CHAPTER III: TOOLS FOR GENDER-BASED STI ECOSYSTEM ASSESSMENT

Gender parity assessment tools can play an essential role within larger organizational gender equality and mainstreaming processes. Deeply understanding the impetus for any organizational gender-equality effectiveness effort is critical, and the more that is known about an organization's needs, ultimate goals, and intentions for gender parity, the easier it becomes to find tools that can meet the assessment need. A number of tools exist, with numerous variations between them.

3.1 Global Gender Inequality Indices

To measure the extent of the magnitude and scope of gender-based disparities at country level, many gender-related indices[13] have been created—among them the *Global Gender Gap Index (GGI)* from the World Economic Forum (WEF), the *Africa Gender and Development Index (AGDI)* from the United Nations Economic Commission for Africa (UNECA), and the *Gender Inequality Index (GII)* from the United Nations Development Programme (UNDP). Most of these indices measure gender-differentiated outcomes in the key domains of: (i) *human endowments*, notably health and education; (ii) *economic opportunity*, as measured by participation in economic activities and access to and control of key productive assets; and, (iii) *voice and agency*, as expressed in freedom from violence, the ability to have voice and influence governance and political processes, and the ability to exercise control on key decisions of personal nature.

The Organisation for Economic Cooperation and Development (OECD) of the European Union uses the *Social Institution and Gender Index (SIGI)* that focuses on the factors underlying gender inequality, measuring social institutions (which are mirrored by societal practices and legal norms) that discriminate against women. The *Gender Equality Index (GEI)* of the African Development Bank (AfDB) combines both gender-differentiated outcomes and social institutions that explain gender gap in countries, addressing the institutional dimension, in addition to the social and economic dimensions, as a factor in the gender gap.

3.2 Gender Equality in the Knowledge Society Frameworks

A number of methodologies for capturing and reporting gender disaggregated data on various STI aspects also exist. The Women Empowerment in Agriculture Index (WEAI)[14] developed by the International Food Policy Research Institute (IFPRI) measures empowerment, agency, and inclusion of women in the agriculture sector. The UNESCO Frascati Manual and OECD Oslo Manual provide international standards and guidelines for collecting and interpreting gender-disaggregated research and development statistics and innovation data respectively.

The most comprehensive methodology focused on gender and STI is the *Gender Equality in the Knowledge Society (GE&KS) framework* (Figure 1) developed for the national assessments on gender and STI undertaken by the Women in Global Science and Technology (WISAT) Organisation. The overriding objective in the context of the GE&KS is to provide country-level data (quantitative and qualitative) to assess the readiness for and participation of girls and women in the global world defined by knowledge. Such readiness goes much further than education or any other single factor to include gender indicators about: health status, social and economic status, level of opportunities available,

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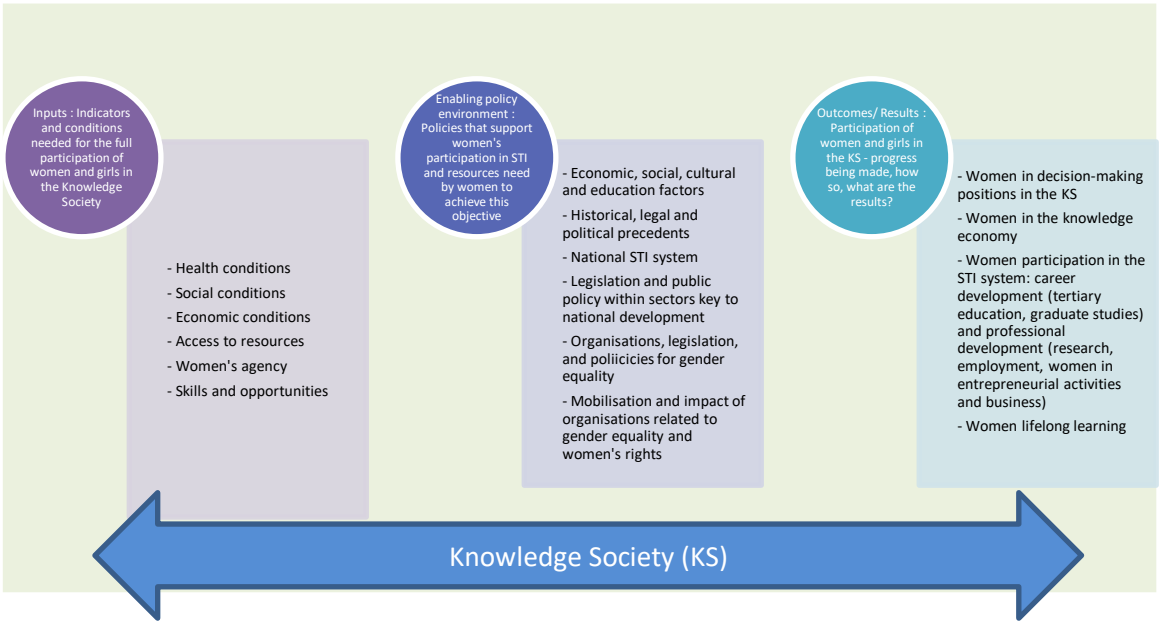
[13] *See: World Economic Forum (2018): https://www.weforum.org/reports/the-global-gender-gap-report-2018 (GGI); United Nations Economic Commission for Africa (2011): https://www.uneca.org/sites/default/files/PublicationFiles/agdi_2011_eng_fin.pdf (AGDI); United Nations Development Programme - http://hdr.undp.org/en/content/gender-inequality-index-gii (GII); Organisation for Economic Cooperation and Development - https://www.genderindex.org/ (SIGI); African Development Bank Group- https://www.afdb.org/fileadmin/uploads/afdb/Documents/Generic-Documents/Gender_Equality_Index_Methodological_Note.pdf (GEI); and World Bank (2011): World Development Report 2012 – Gender Equality and Development (https://siteresources.worldbank.org/INTWDR2012/Resources/7778105-1299699968583/7786210-1315936222006/Complete-Report.pdf).*

[14] *See: http://www.ifpri.org/publication/womens-empowerment-agriculture-index (WAEI)*

level of political participation, access to resources (inputs), all of these accompanied by an enabling policy environment in line with SDG# 5.

Figure 1: Gender Equality - Knowledge Society (GE&KS) indicator framework



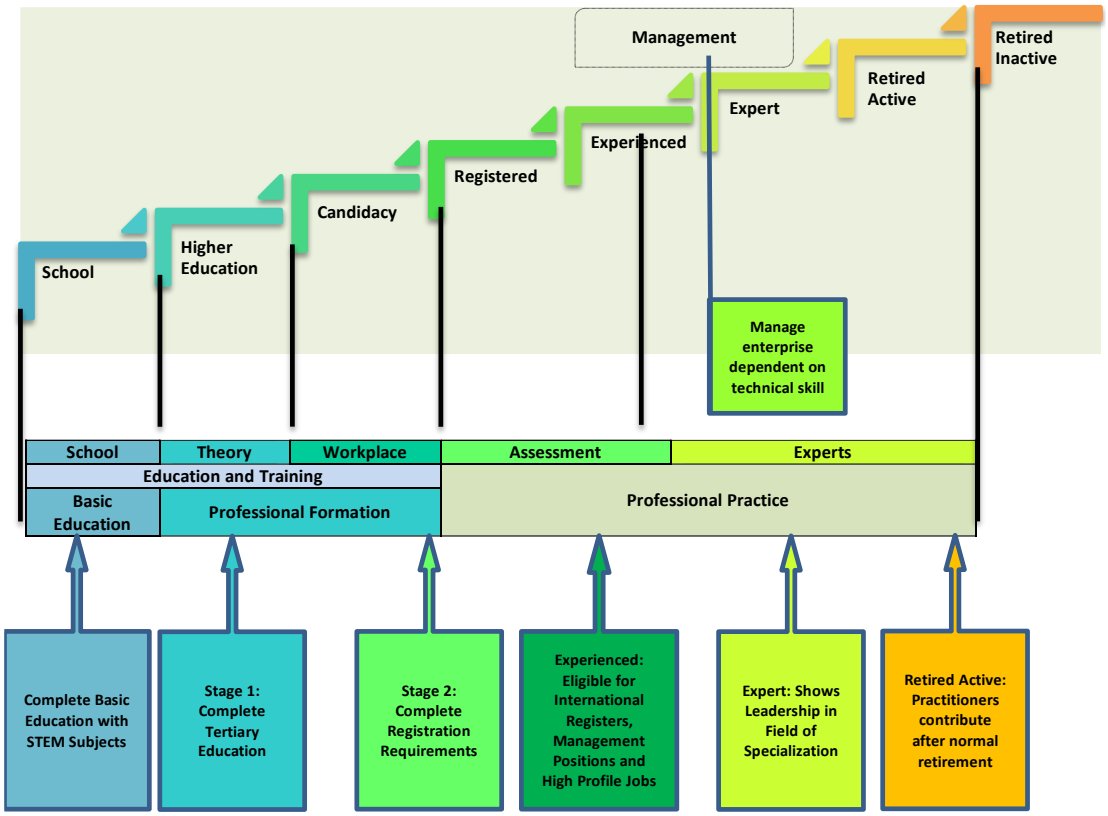
The GE&KS framework brings together gender-sensitive data on key areas in the knowledge society to assess the barriers and opportunities for women in a world dominated by knowledge economy and society and how these factors and the combinations thereof can either constrain or impel girls and women in participating and benefitting from STI. The test of readiness (results/outcomes) is in the ability of women and men to participate in the knowledge society as measured by such outcomes as: access to STEM education, access to and use of technology, decision making in knowledge society sectors, participation in STI systems and access to lifelong learning (an essential part of knowledge society for women's lives at all levels that may provide them with entry to the world of STI at any point in these lives) among others.

The framework does not offer simple causal relations to guide specific interventions in the gender and technology fields. Its approach broadens the context of understanding the relationship between gender and technology, anchoring this process with the socio-economic variables modulated by social institutions. It also helps to come up with good data needed to provide more useful information on opportunities and challenges, as well as laying a foundation for better and informed decision making. This framework makes a gender analysis of indicators in STI, ICT and the knowledge society relating to the social, economic and political aspects of development which determines the ability of both women and men to equally contribute to the knowledge society.

3.3 The 8-Step STI Skills Staircase

The development and application of STI skills comprises three steps of education and training (basic STEM education at school and professional formation through theoretical grounding and practical training in tertiary education and workplace) and four steps of professional practice and development before inactive retirement (Figure 2).

Figure 2: The 8-Step STI Skills Staircase



The requirements to succeed along the protracted development pathway from school to operating independently as a professional, each with numerous bottlenecks – especially for girls and women, are as follows:

- **Schooling:** Demonstrate an aptitude for STEM as required by each programme in tertiary education.
- **Theory:** Complete an accredited professional degree or diploma through a university, polytechnic, or college.
- **Workplace:** Complete a workplace training phase in a community of expert practice under supervision and mentorship. This may require following a prescribed range of activities or follow best practice guidelines, complete logbooks or reports as required by the professional body, and develop a portfolio of evidence; being exposed to an adequate range of increasingly complex activities and taking increasing responsibility, until able to perform as an independent professional; and, submitting logbooks, portfolios of evidence and reports as required, either during the course of development or when ready for assessment for the purpose of registration.
- **Assessment:** Be assessed through an examination or peer review or both to determine whether the required level of competence has been achieved.
- **Registration:** Be awarded a designation commensurate with the person's education, training and experience.
- **Professional practice:** Work in a professional environment which values STI professionals, offers them opportunities to develop as experts or to grow into management and leadership roles and affords them the opportunity to make technical and strategic decisions. Experienced professionals must: adhere to the Code of Conduct prescribed by the relevant

Statutory Council and work within the practice area for which their education, training and experience has rendered them competent; and continue to develop and keep up to date by actively engaging in continuing professional development and life-long learning.

- **Institutional commitment:** Work in an environment where appropriate staff, systems, processes, support and necessary service providers are in place or may be appointed.
- **Investment:** Work in an environment where investment in planning, development, operations and maintenance of infrastructure, products, systems and/or processes takes place.

CHAPTER IV: THE UGANDA STI ECOSYSTEM: COUNTRY STUDY FINDINGS

4.1 Organisation and Structure for Developing and Harnessing STI Professionals

The National innovation system is made up of different actors *(research institutes, universities, technology transfer agencies, chambers of commerce and industry, financing institutions, investors, government departments, individual firms as well as company networks and industry clusters of producers, product aggregators, voluntary professional associations, and regulatory agencies)* and their interactions. The aim of a national STI system is to produce knowledge and information, and ensure its spread and diffusion in order to be used for economic development. The system supports the various actors in their innovation (knowledge and technology generation) and business development needs for competitiveness and rapid technological change.

The strength of a national STI system relies on:

- *Infrastructure* - the facilities, organisations, agencies, institutions, regulatory frameworks (including rules, norms and standards), resources (including human, financial, material) and related services used by the scientific community;
- *Structural capital* - the sectoral and disciplinary composition comprised of organisational culture, intellectual property and processes; and,
- *Relational capital* - the interactions across and within components of the STI system characterised by formal and informal relationships, networks, partnerships, alliances, reputation, brand image, stakeholder engagement, licensing agreements and joint ventures.

A strong innovation system can therefore be seen as one with systematic linkages between different sources of knowledge production (universities, public and private research institutions, and other intermediary organizations like professional and vocational training institutions and knowledge brokers) and industry (large companies, mature SMEs and new technology-based firms/startups), facilitated and driven by a strong demand from consumers and producers, enabling framework conditions (financial, taxation, incentives, propensity to innovation and entrepreneurship, mobility), and infrastructure (banking, venture capital, IPR and information, innovation and business support, standards and norms). The inter- and intra-play of infrastructure, structural and relational capital, guided by specific attributes, leads to excellence that is characterised by new knowledge (formal and informal), marketable technologies, new businesses, and solutions to societal challenges. They also largely determine the gender parity in participation and benefit.

4.1.1 Education sub-system

Basic education in Uganda consists of pre-primary education, primary education and lower secondary education during which the study of STEM subjects is mandatory. The education sector statistics indicate that Government owned 64% of primary schools, 38% of secondary schools and 48% of all post-primary institutions in 2015. Pre-primary education features two or three year olds through five year olds and is outside the scope of compulsory education. The entry age to primary education is six years old. Primary education lasts for seven years from P1 to P7. Primary education is divided into three phases: lower primary (P1 through P3), transition year (P4) and upper primary (P5 and P7). On completing P7, pupils sit the primary leaving examinations (PLE). After the introduction of Universal Primary Education (UPE) in 1996, primary education for seven years became free in 1997 and compulsory in 2008.

Secondary education, which lasts for six years from S1 to S6, gradually became free through the implementation of the Universal Secondary Education (USE) initiative and Universal Post Primary Education and Training (UPPET) programmes since 2007. Secondary education consists of two cycles.

When pupils complete the first cycle (S1 through S4 in lower secondary education), they sit the Uganda Certificate of Education (UCE). On passing this exam, they obtain an O-level qualification. Depending on the examination results, pupils with O-level qualifications can advance to higher secondary education (S5 and S6), non-university institutions (business/technical school, vocational training school or other) or a primary teachers' college (PTC). At the end of S6, pupils sit the Uganda Advanced Certificate of Education (UACE) and obtain A-level qualifications on passing these examinations. Pupils obtaining A-level qualifications can advance to university, technical college or a national teachers' college (NTC), depending on the examination results.

The ***vocational education system*** is three-tiered so one can join a vocational training institution on completion of primary school, after O-level and at tertiary level. Primary school leavers can enrol for three-year full-time courses, leading to the award of a Uganda Junior Technical Certificate. Students who have completed O-level can also obtain a craft certificate (Part I and II) from technical institutes on completion of three-year full-time courses. The business, technical and vocational education and training (BTVET) institutions comprise of Community Polytechnics, Farm Schools, Technical Schools, Technical Institutes, Vocational Training Institutes, Technical Colleges, Uganda Colleges of Commerce, Health Training Institutions and other Specialised Training Institutions that include Agriculture, Forestry, Fisheries, Wildlife, Meteorology, Survey, Cooperatives, Oil & Gas, and ICT.

The duration of ***tertiary education*** ranges from two to five years depending on the course enrolled for. By 2005, the higher education sub-sector had 152 institutions, 51 of these were public and 101 private. There were 28 universities (5 public, 13 chartered and licensed, 10 unlicensed) and 124 other tertiary institutions. Institutions of higher learning grew to 187 in 2011: the number of registered universities increased to 34 and 2 "Other Degree Awarding Institutions". By 2016, there were a total of 211 tertiary education institutions (i.e. 116 public; 95 private). The university level, had 50 institutions (i.e. 9 public and 41 private universities), while "other tertiary institutions" were 161 (i.e. 112 public and 49 private).

Public universities are mainly science and technology-oriented. Teaching is the main focus of most universities, although research capacity is growing. The spatial location of public universities in the various regions of the country, and an emphasis on STEM education, is likely in the long term have a positive influence on the local innovative activities of surrounding firms and communities. At the same time, entrepreneurial activities are gaining prominence within university systems. These show an increasing recognition of the value of university-industry-government links.

Most students prefer university programmes, as are their parents and policy makers. The result is lack of middle level technicians and workers. For example, in 2011 only 1.05% programmes in Health Sciences and 0.86% in engineering were for diploma level. A total of 2,099 programmes were offered; of which 1,105 were in universities, 664 in teacher training and 114 in management. The academic staff numbers and infrastructure growth have not kept pace with student enrolment growth. For example, while students grew by 14.2% in 2010/11, staff grew by only 10.6%. In 2010, there were 7,871 academics and by 2011, the number was 8,702. Only 11% of academic staff had PhDs although the number increased in absolute terms from 858 in 2010 to 914 in 2011. Masters increased from 2,967 (38%) to 3,657 (42%) while Bachelors represented 34%. The overall academic staff/student ratio was 23. The ratios for specific categories of institutions were far below the standards set by the National Council for Higher Education (NCHE).

4.1.2 Research sub-system

The Uganda research system was originally comprised of government line ministries with Research Secretariats or Departments with fulltime research personnel. In 1970 the National Research Council (NRC) was established as the research coordinating and funding arm of government. The research system underwent several reforms as part of the structural adjustment and economic recovery

processes that occurred in the late 1980s and early 1990s. Currently, research is liberalised although it is still largely undertaken by public research institutes and universities. There are a few private enterprises and international research organisations. The institutions conduct basic research; carry out research to improve organizational, program or project performance; and, engage in applied research and commercial product development. The research institutions may be categorised into:

a) Institutions mandated to formulate and implement research policy and national level coordination;

b) Regulatory institutions including those for standards and intellectual property management;

c) Research institutions which carry out research;

d) Training institutions which produce the human resources for research, as well as carrying out research especially as a component of graduate training programs; and,

e) Research support institutions which plan and manage research activities as well as the financing and dissemination of research results.

4.1.3 Professional practice and paid employment

It is often assumed that self-regulation mechanisms in a market economy ensure the necessary supply to the labour market, but there is evidence of this not being the case in Uganda. Graduates and/or experienced STI professionals are reported to be in short supply for some professions, and vacancies exist in many public sector structures and private sector. At the same time, reports indicate that STEM/STI graduates are unable to find employment, leading to the growing phenomenon of the 'unemployed graduate'. About 400,000 youths are released into the job market after graduating every year, yet the job market is only able to provide employment to about 90,000 resulting in a youth unemployment rate of 22.5%. Ugandan universities alone graduate over 40,000 youth every year, yet the market can provide only 8,000 jobs annually.

According to results from the 2009/10 Uganda National Household Survey (UNHS), 75.9% of Ugandans were self-employed, including 86.2% of working women and 72.1% of working men. The self-employment rate was high among youth of 18-30 years of age: 61.5% among young women and 52.5% among young men. The average labour force participation rate was very high – 92.2% for men and 91% for women, indicating a paucity of paid employment opportunities. *Only 13.8% of working women were in paid employment, compared to 27.9% of working men. Given this dynamic, it is likely that more women would move from self-employment into paid jobs if these were available to them.*

While official unemployment rates are low, various forms of underemployment and labour market exclusion are widespread. A large proportion of the workforce is primarily employed in near-subsistence agricultural and in informal, low-productivity household enterprises where jobs are precarious and low-paying. The vast majority of the workforce is self-employed, with wage and salaried workers accounting for only 21.2% of the total labour force. Uganda's labour force grew at a compound rate of 3.8% between 2007 and 2017 resulting in 606,000 new jobseekers; yet only 147,000 formal jobs were created in 2016[15]. Unemployed graduates are an exasperated group of young people. A large percentage of these youth have had very frustrating experiences trying to enter the workplace, and often don't get meaningful work even when appointed.

One critical cause of youth unemployment is attitude, with most youth shunning work particularly practical-blue-collar tasks. There is a tendency to crave for white collar jobs which are unfortunately,

[15] ***ANDE (2018):*** *Uganda Entrepreneurial Ecosystem Initiative. Aspen Network of Development Entrepreneurs (ANDE), Centre for Development Initiatives, Enterprise Uganda, Koltai and Company, Kampala, October 2018, (http://enterprise.co.ug/wp-content/uploads/2019/05/UEEI_Report_November_2018_Final.pdf)*

not available in large numbers today. There are many reasons that appear in literature explaining why graduates are unable to find work, the most important of which are:

- *Oversupply:* The supply greatly exceeds the demand for graduates for some disciplines.
- *Limited projects:* Organisations cannot afford to take on graduates unless they have enough work, which has become a problem in tough economic times.
- *Quality:* The quality of graduates leaves a lot to be desired and organisations select only the best to employ and train.
- *Not career ready:* Potential employers expect that graduates should be career ready like the medical profession or teachers, and wish to employ only experienced professionals, but do not consider the years of internship covered in the qualifications of the other professions. (It should be noted, however, that the cost of internships for the medical and education professions are borne by the state in teaching hospitals, etc.)
- *Competitive bidding:* Employers cannot afford to train graduates - because government has delegated training to the private sector, while at the same time expecting the sector to compete for work at rock-bottom prices.
- *International service providers:* Most large projects have been awarded to international consultants and contactors who appoint expatriate staff, even in positions that could be occupied by local staff, let alone train graduates.
- *No junior posts:* There are few junior posts in the public sector, or legislation prescribes that only registered professionals may be appointed. This precludes recent graduates from joining the public sector.
- *Moratorium on employment:* There have been long-standing moratoriums on employing new staff in the public sector.
- *Inappropriate qualifications:* Graduates from some institutions find that their qualifications are being questioned.

The current workforce is not static, but rather reduces over time as people exit the workforce for various reasons (qualified not entering service, leaving industry, emigration or returning home, retirement, mortality), and others enter (qualified entering, immigration, returning retirees and expatriates, others returning to industry). Merit (qualifications and experience) is still a cardinal principle in recruitment. For example, between 2015 and 2016 the New Vision newspaper advertised 8,358 jobs. 41% required possession of an undergraduate degree, 19% Masters/postgraduate, 17% Diploma, 12% Certificate and 1% a PhD degree. 51% wanted candidates with work or job oriented skills, 15% demanded experience in a specific field, and 26% wanted those who had additional professional qualifications. However, the requirement for experience if fast waning especially with jobs based on new technology. The smaller pool from which to select, and the generally observed lower performance of women, inevitably disadvantages them when such gender-blind policies are followed to the rule.

There is a growing demand for talent in the IT job sector: from established entities, whether public or private, who need a steady flow of IT specialists in a range of roles; a thriving start-ups community, a large proportion of which is based on new technology; and international freelancing work. A recent study[16] indicated that 48% of all IT-related job postings were for mid-level IT administration roles in networking, hardware and software maintenance, from diverse industries ranging from government, NGOs, finance, entertainment, energy, airlines, and the education sector. Data-related job postings,

[16] ***Mercy Corps (2019)****: Competing in a Digital Age – The Development of IT Skills and Jobs in Kenya and Uganda, A report by the Moringa School/Youth Impact Labs, Mercy Corps. April, 2019.*

largely from the NGO and research sector, accounted for 21%, mainly for data and business intelligence roles including data managers, officers, administrators and analysts – rarely for data scientists; 13% were for developers for government, health, logistics, and finance industry. Only 28% of the job postings were looking for senior-level applicants.

4.1.4 Entrepreneurship and competitiveness in the innovation sub-system

In a bid to accelerate growth and make it more inclusive, Uganda has made industrial development an integral part of the government's overall development and specific sector policies, strategies, and pieces of legislation. Among these are the National Industrialization Policy 2008; the National Science, Technology and Innovation (STI) Policy 2009; the National Development Plans; the Agricultural Sector Development Strategy and Plan; and several others. A large share of the active labour force is still engaged in entrepreneurship mainly in the service sector. The national strategy for entrepreneurship development rests on the premise that no single factor alone moves entrepreneurship forward. Rather, entrepreneurs thrive when multiple sectors and actors consciously work together to develop a supportive environment for entrepreneurship. Only through such comprehensive, holistic approaches can true progress toward a healthy entrepreneurship ecosystem be achieved.

Although Uganda appears to have numerous policies relating to research and innovation, its challenge is to get a policy mix that is synergistic and creates an environment conducive to learning and interaction among actors in the public sector, private businesses, and civil society. Nonetheless, the emphasis on science and technology in today's government policies and strategies calls for more action from national organizations such as the Uganda National Council for Science and Technology as well as from local and regional innovation networks. The institutional, structural, and human capacity elements of the innovation ecosystem have been emphasized in Uganda's Vision 2040. The challenge going forward will be to match the policy commitments to STEM promotion with financial resource allocations and to encourage the various actors to interact and learn from each other to spur innovation.

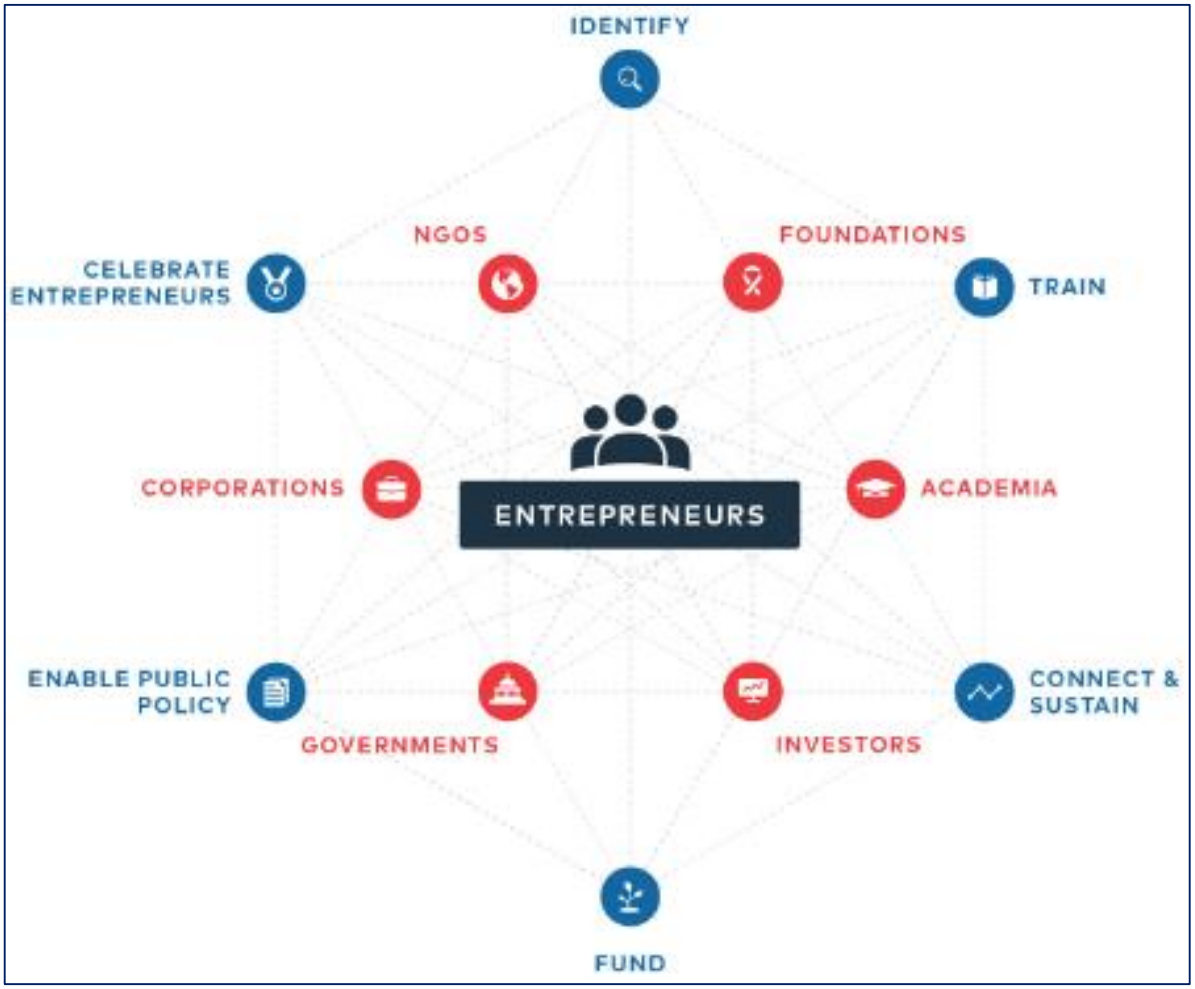
A number of recent initiatives by various STI ecosystem actors *(foundations, academia, investors, governments, corporations, and NGOs)* business, have relied on the Koltai Six + Six Entrepreneurship Ecosystem Model[17] (Figure 3) to *identify, train, connect & sustain, fund, enable/regulate, and celebrate* entrepreneurs. In the model,

- ***IDENTIFY*** represents all activities towards discovering new entrepreneurs or new business ideas. It includes but is not limited to business plan competitions, pitch events, and innovations labs.
- ***TRAIN*** refers to standardized academic education and applied training interventions that share the broad objective of providing individuals with the entrepreneurial mindsets and skills to support participation and performance in entrepreneurial activities.
- ***CONNECT & SUSTAIN*** refers to all the networks that allow information to flow among entrepreneurs as well as between entrepreneurs and other actors (e.g. government, business support service providers, funders, partners, etc.). Both physical and virtual spaces and channels facilitate these connections. *Sustain* refers to non-financial support that helps entrepreneurs grow their businesses, including tailored training, mentorship, and business support services. This support is commonly delivered through incubators or accelerators.

[17] *Koltai, S. and Muspratt, M. (2016): Peace through entrepreneurship. Washington D.C.: Brookings Institution Press. https://www.amazon.com/Peace-Through-Entrepreneurship-Investing-Development-ebook/dp/B01EEQ9CHM/ref=sr_1_1?ie=UTF8&qid=1548256765&sr=8-1&keywords=Peace+through+Entrepreneurship%3A+Investing+in+a+Startup+Culture+for+Security+and+Development*

- ***FUND*** refers to all types of financing (debt, equity, grant, etc.) aimed at starting or growing a small and growing business (SGB), and encompasses access to capital for all stages of a venture (early, growth, and onwards).
- ***ENABLE*** refers to the legal, fiscal, and regulatory environment that influences the ability of an entrepreneur to operate and succeed. It also encompasses the policy influences surrounding an entrepreneur's decision to formalize (i.e. legally register) a business.
- ***CELEBRATE*** refers to activities that increase the visibility of entrepreneurial successes and reinforce the positive role they play in society

Figure 3: Koltai six + six entrepreneurship ecosystem model



Uganda promotes the private sector as the engine for economic growth and development, but the private sector must be competitive domestically and internationally. Efforts to develop the private sector became more vigorous since the 1980s. The establishment of the *Uganda Investment Authority (https://www.ugandainvest.go.ug/)* in 1991 to create a favourable investment climate, the *Private Sector Foundation (https://www.psfuganda.org/)* in 1995 for capacity and policy advocacy, the *Enterprise Uganda Foundation (https://enterprise.co.ug/)* for promoting entrepreneurship and business growth, , and the *Uganda Export Promotion Board (http://www.ugandaexports.go.ug/en/)* in 1996 (replacing the Export Promotion Council first established in 1969) to facilitate exports of Ugandan goods and services are some of the best known. Collectively, these entities have established a solid institutional foundation for developing Uganda's private sector. To this end, the policy focus has shifted to enhancing firm competitiveness.

The Private Sector Competitiveness Project[18] sought to increase the number of formal enterprises, the number of people employed and the number of skilled employees by: (i) providing priority infrastructure and related facilities to support the growth of the industrial and business sector, particularly through enhancing the availability of serviced industrial land in a modern, well-planned Industrial Park; (ii) improving enterprise creation and growth, particularly in Micro, Small, and Medium Enterprises (MSMEs), by changing enterprise behaviour toward investment in skills, including investment in skills for women, raising productivity and improving the quality, standards, and reliability of MSME producers participating in export value chains; and, addressing critical issues in the business environment.

The annual Presidential Investors Round Table (PIRT) held since 2014 has become an influential forum in which industry can advocate for reforms in policy and service delivery that promote their business interests. Many government MDAs have deployed information and communication technologies in dispensation of administration and service delivery functions, making it increasingly easier for stakeholders to comply with their obligations or access services. Reforms to the *Uganda Registration Services Bureau (https://ursb.go.ug/)* have improved IP administration and management as well as business registration services, as with digitalisation of tax administration and revenue collection in the *Uganda Revenue Authority (https://www.ura.go.ug/)*.

Many STI graduates seek to implement their ideas through establishing their own companies but few have had even basic guidance about starting and running a business; many developers have great ideas but struggle to enact them. As a first step to address employment challenges for youth and women, the MFPED allocated UGX 44.5 billion towards creating jobs in FY 2011/12 to: (i) establish a *Youth Entrepreneurship Venture Capital Fund* together with *Development Finance Company of Uganda (DFCU) Bank* to support youth starting or expanding their business enterprises with loans of UGX 100,000 to UGX 5 million or 20% of injected equity for youth group investments; (ii) undertake a *Youth Entrepreneurial Training Programme* through *Enterprise Uganda* to instil business management skills among the youth, to enable them join the job market or create their own enterprises; and, (iii) undertake Business Development Skills clinics in collaboration with the private sector, Enterprise Uganda and *Uganda Small Scale Industries Association (https://www.ussia.or.ug/)*, with special focus on imparting technical skills to youth, using non-formal vocational training programmes. Dedicated work spaces would also be established in markets starting in Kampala, in which youth and other small scale manufacturers under the *Job Stimulus* programme would undertake manufacturing and other processing activity.

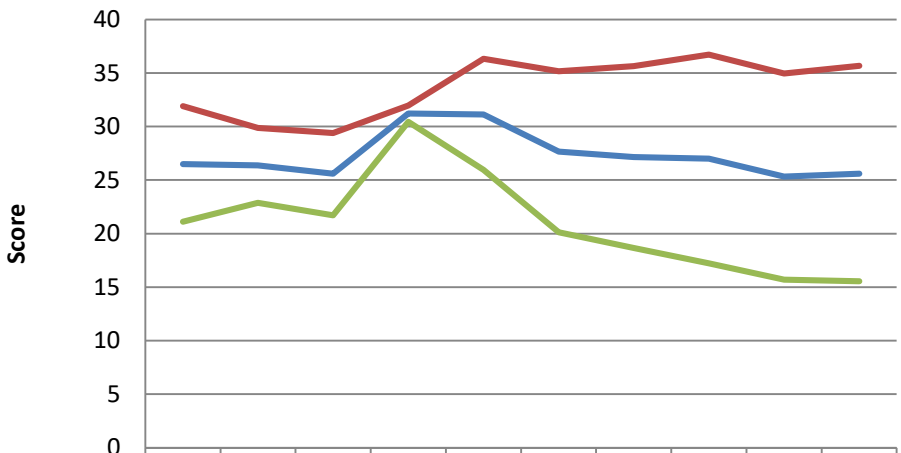
Even though Uganda is seemingly bustling with innovations, scientific assessments through the Global Innovations Index (GII)[19] show that the country's innovation grades have been declining since 2013 (Figure 4), despite the country being severally classified as an 'innovation achiever and pillar outperformer' - implying that Uganda's GII score relative to its GDP was significantly higher than that of other economies at the same level of development in the low income bracket. The GII published by Cornell University (US), *Institut Européen d'Administration des Affaires* (INSEAD)-France and the UN's World Intellectual Property Organisation (WIPO), has become one of the leading references for measuring how countries are performing on innovations. The index provides insight into multi-dimensional aspects of innovation-driven growth; effectively measuring how innovative and conducive for innovations countries are. The GII is generated from two sub-indices - the **Innovation Input Sub-Index** and **the Innovation Output Sub-Index** - each built around key pillars. Each of the pillars is divided into sub-pillars and each sub-pillar is composed of individual indicators. The Input sub index is developed from five inputs of the national economy that enable innovative activities. These

[18] *See: World Bank (2004): Project Appraisal Document, Second Private Sector Competitiveness Project, Uganda. http://documents.worldbank.org/curated/en/264431468779365334/pdf/296390UG.pdf*

[19] ***Cornell University, INSEAD, and WIPO (2009 - 2019):*** *The Global Innovation Index Reports. Cornell University (US), Institut Européen d'Administration des Affaires (INSEAD)-France and the UN's World Intellectual Property Organisation (WIPO) (https://www.wipo.int/global_innovation_index/en/).*

are: Institutions (for research and its governance), human capital and research, infrastructure, market sophistication, and business sophistication. The output sub-index is developed from: Knowledge and technology outputs and creative outputs.

Figure 4: Uganda - Innovation Index Scores, 2009-2019



	2009-10	2011	2012	2013	2014	2015	2016	2017	2018	2019
GII	26.5	26.37	25.6	31.21	31.14	27.65	27.14	27	25.32	25.6
Input	31.9	29.86	29.4	31.97	36.32	35.17	35.63	36.71	34.96	35.66
Output	21.1	22.87	21.7	30.45	25.96	20.13	18.65	17.23	15.69	15.55

Women find it much harder to navigate the business terrain, amidst their challenging journey that includes limited access to capital and other productive assets, lack of business and technical knowledge and social pressures. Targeted support and affirmative action is required. Enterprise Uganda with support from the Government of Norway, through the Strengthening Women Entrepreneurs Program (SWEP) project (2013 – 2016), offered practical training and business advisory services based on the M-SEF Model (Mind-set; Skills; Exposure and Follow-up) in order to facilitate business growth amongst women in Northern Uganda. The project reached 5,133 women belonging to 67 groups. These women were equipped with entrepreneurship and business management skills that formed a foundation for building sustainable businesses. As a result, incomes of the women increased by about 80%; savings increased by 84.5% and women's groups were linked to market off-takers, agro-input dealers and financial institutions. The groups also witnessed an increased positive attitude towards the women's role in family and business. Local leadership relations improved and several women farmers adopted environmentally friendly farming practices.

4.2 Investment in Science Education and Research

Uganda's long-term Vision 2040 and the second National Development Plan (NDP) II, while emphasising transformation and industrialisation, stress the importance of 'inclusive growth' to create sustainable development. The key poverty alleviating sectors targeted for domestic public spending include health, education, water, environment and agriculture. These sectors together took up 26.5% of the country's 2017/18 approved budget allocations: agriculture (3.8%), health (8.4%), education (11.4%) and water (2.9%). This level of public spending is not being sufficiently redistributive in nature nor leading to inclusive growth, because the country's revenue expenditure is not sufficiently targeting the poorest. For the past 5+ years Uganda's budget and resource allocation has been skewed towards infrastructure spending in the works, transport and energy sectors, compromising the efforts for inclusiveness.

The science, innovation and entrepreneurship ecosystems have overlapping value chains and are affected differently by financing mechanisms, business support structures, policy instruments, markets, human capital, infrastructure (digital spaces and skills, energy, mobility, product transformation, etc.), research and development (R&D – e.g. patents) and STI culture. There are four mutually enforcing pillars that are prerequisite conditions to the success of any national STI ecosystem: (i) building and upgrading STI infrastructures; (ii) enhancing professional and technical competencies; (iii) promoting entrepreneurship and innovation; and, (iv) providing an enabling environment for STI development. Significant investment in human capital and STI infrastructure, in particular, is needed for Uganda to transform into a knowledge economy. Enhancing science education is considered to be a strategic investment for a country that is aiming to create a critical mass of scientists and engineers to spur growth and development.

4.2.1 Education sector budgets

The quality of science education is determined by institutional mechanisms, the quality and number of science teachers, the status of the science research and teaching infrastructure, and the relevance of the curriculum to the needs of the country. The level of enrolment and performance of science students at different levels are also a reflection of the quality of science education. The Education and Sports Sector Strategic Plan (ESSP), 2017–2020 committed to continue implementing the policy of having a government primary school in each of 7,243 parishes; secondary school in each of 1,293 sub-counties; and a technical institute in each district (now 135 in number). Government would also increase the staff establishment of public universities from an average of 35% to at least 55%; establish an institutional framework for coordinating skills development through establishment of a TVET Council; and enhance capacity of universities to teach science and technology through rehabilitation and expansion of STI learning facilities in the nine public universities.

A synthesis of information in the Medium Term Expenditure Frameworks (MTEFs), the Ministry of Education and Sports (MoES) Annual Budget Performance Reports (ABPR) and other resources[20] reveals that although absolute amounts allocated have been increasing (Table 1), the share of education expenditure in the national budget and GDP has been sharply declining since the late 1990's. Education sector expenditures grew from 11.5% in 1991 (1.5% of GDP) to 21% of national budget between 1997 and 2000. Thereafter, the share steadily declined to 18% between 2001 and 2006 (about 5.2% of GDP) to the current 10% (Figure 5). Budgetary allocations to the BTVET sector have steadily increased from a low 0.6% in 1997 to 4.7% in 2009 and 11% in 2017 before dropping back to 9.1% in 2019. Investment in tertiary/university education declined from 10.6% in 1997 to 8.4% in 2002 and averaged about 11% of public education expenditure between 2003 and 2012 when it shot up reaching 19.6% in 2016 and then sharply declined to 13% in 2019.

Table 1: Education sector budgets, FY 1997/98 – FY 2019/20

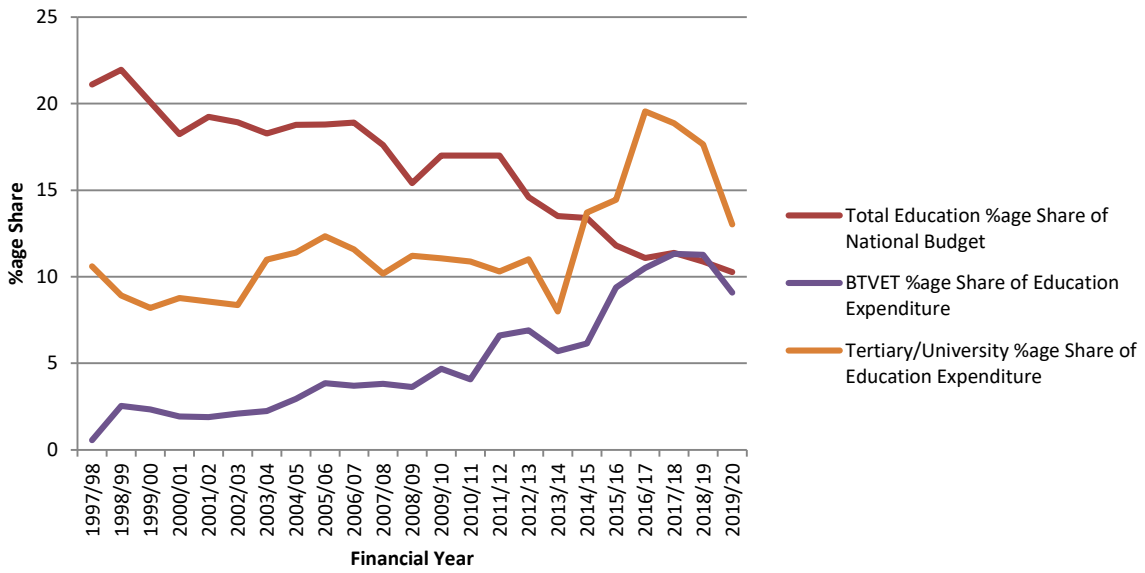
Financial Year	Total Education		BTVET		Tertiary/University	
	Allocation (UGX.bn)	%age Share of National Budget	Actual Expenditure (UGX.bn)	%age Share of Education Expenditure	Actual Expenditure (UGX.bn)	%age Share of Education Expenditure
1997/98	311.88	21.11	1.72	0.55	33.06	10.60
1998/99	388.36	21.95	9.82	2.53	34.64	8.92
1999/00	401.32	20.09	9.36	2.33	32.87	8.19
2000/01	451.31	18.24	8.67	1.92	39.60	8.77

[20] *See:* ***Nakanyike Musisi and Florence Mayega (2010)****: Higher Education Financing in Uganda. In Higher education financing in East and Southern Africa, Chapter 10, pp 195 – 221, edited by Pundy Pillay, Centre for Higher Education Transformation (CHET), South Africa.*

Financial Year	Total Education		BTVET		Tertiary/University	
	Allocation (UGX.bn)	%age Share of National Budget	Actual Expenditure (UGX.bn)	%age Share of Education Expenditure	Actual Expenditure (UGX.bn)	%age Share of Education Expenditure
2001/02	567.92	19.23	10.76	1.89	48.63	8.56
2002/03	564.25	18.92	11.85	2.10	47.14	8.35
2003/04	574.66	18.27	12.88	2.24	63.14	10.99
2004/05	585.50	18.77	17.18	2.93	66.67	11.39
2005/06	578.82	18.80	22.23	3.84	71.37	12.33
2006/07	576.31	18.90	21.33	3.70	66.69	11.57
2007/08	779.63	17.60	29.68	3.81	79.34	10.18
2008/09	770.60	15.40	28.02	3.64	86.36	11.21
2009/10	902.30	17.00	42.32	4.69	99.85	11.07
2010/11	1,093.66	17.00	44.47	4.07	119.04	10.88
2011/12	1,610.42	17.00	106.29	6.60	165.87	10.30
2012/13	1,687.63	14.60	116.45	6.90	185.64	11.00
2013/14	1,868.06	13.50	106.48	5.70	149.45	8.00
2014/15	1,761.59	13.40	108.25	6.15	241.46	13.71
2015/16	2,029.08	11.80	190.16	9.37	293.29	14.45
2016/17	2,454.61	11.08	258.09	10.51	479.96	19.55
2017/18	2,474.49	11.37	279.98	11.31	466.72	18.86
2018/19	2,419.19	10.87	272.55	11.27	426.89	17.65
2019/20	3,280.00	10.26	297.97	9.08	426.89	13.01

Source: MoES Education and Sports Sector Strategic Plans, MFPED Medium Term Expenditure Frameworks and MoES Annual Budget Performance Reports

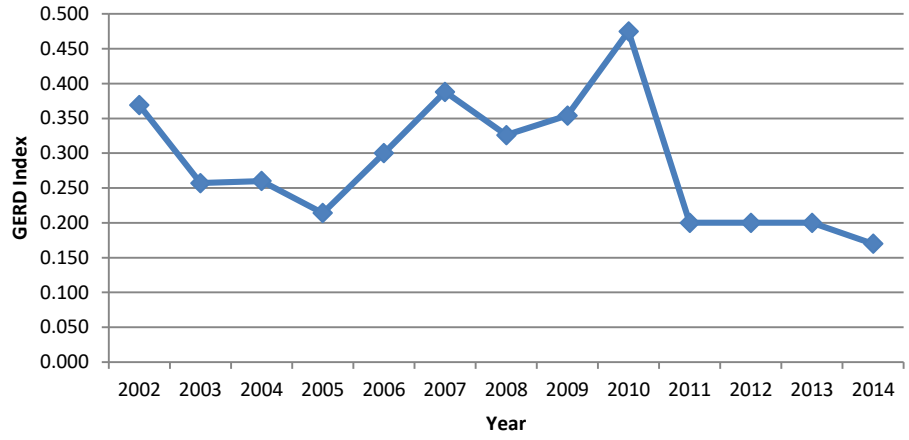
Figure 5: Budget share for education sector, 1997 - 2019



4.2.2 National gross expenditure on research and development

UNESCO statistics[21] indicate that there has been a considerable gain in interest in STI since 2009 in most countries in East and Central Africa, many basing their long-term planning documents and NDPs on harnessing STI to development. Cameroon, Rwanda and Uganda were singled out as increasingly looking for investors rather than donors and devising schemes to support local STI based businesses, especially in the dynamic IT sector where technology incubators are increasingly becoming successful in helping start-ups capture markets. UNESCO and UNCST statistics indicate that Uganda's GERD (gross expenditure on research and development as a % of GDP) averaged 0.31 percent between 2002 and 2014, with a minimum of 0.17 percent in 2014 and a maximum of 0.48 percent in 2010 (Figure 6) when Uganda was ranked 68th in the world, spending about US$ 0.28 billion on R&D[22].

Figure 6: Uganda's Gross Expenditure on R&D (% of GDP), 2002 - 2014



The R&D intensity (GERD/GDP) was 0.6 per cent in 2009 which was still below the Africa continentally agreed target of investing 1% of national GDP to science and technology. Most of the research expenditure came from external donors and government and largely funded programmes in public research and higher education institutions (Table 2). The UNCST 2011 STI Status Report indicated government expenditures on science and technology of UGX 359.8 billion in 2007, UGX 367 billion in 2008 and UGX 479 billion in 2009 or a GERD of 1.1% in 2007, 1.9% in 2008 and 2.3% in 2009. More broadly, Government R&D expenditure increased from UGX 61.1 billion in 2008 (0.31%) to UGX 79.7 billion (0.39%) in 2009. The 2012 Global Innovation Index put Uganda at position 117 with a score of 25.6. Uganda's capacity to innovate was this low because the precipitants of innovation (e.g. stock of scientists, engineers, and S&T institutions) were far below international average due to inadequate research infrastructure, low quality of research institutions and the high levels of brain drain.

Table 2: Uganda's Gross Expenditure on R&D, 2008 - 2014

Indicator	2008	2009	2010	2014
GERD (UGX billion)	79.94	123.89	194.77	118.07
GERD as % of GDP	0.326	0.354	0.475	0.170
GERD by Sector (%)				
Business enterprise	4.30	8.23	34.77	4.34
Government	76.38	64.35	38.58	47.09

[21] See: ***UNESCO (2015)***: *UNESCO Science Report. (https://en.unesco.org/sites/default/files/usr15_focus_sub-saharan_africa.pdf)*
[22] see https://www.indexmundi.com/facts/uganda/indicator/GB.XPD.RSDV.GD.ZS

Indicator	2008	2009	2010	2014
Higher education	-	17.56	25.41	45.99
Private	19.29	9.85	1.25	2.58
Source of Funds				
Business enterprise	4.34	8.23	13.67	3.41
Government	52.34	48.07	21.94	38.89
Higher education	-	17.56	1.04	2.32
Private non-profit	0.08	0.08	6.05	3.32
External donors	43.24	26.06	57.30	52.40
GERD by Field of Science (%)				
Natural Sciences	0.08	0.32	8.99	9.09
Engineering and Technology	9.84	10.56	12.19	20.70
Medical Sciences	19.78	9.36	18.14	12.98
Agricultural Sciences	53.57	50.59	16.75	27.71
Social Sciences	16.73	29.17	29.81	27.33
Humanities	-	-	14.12	2.19
Source: UNESCO Statistics, UNCST (2011) STI Status Report				

Inadequate and undiversified funding regimes remain a major challenge to the development of more vibrant research and innovation infrastructure. In the absence of private-sector funding and competitive grants, public universities and research institutes in Uganda predominantly depend on dwindling public subsidies as well as unpredictable international donor support. This narrow funding base suggests that research and innovation systems face severe financial deficits and lack the capacity to formulate and drive their own domestic research agendas. National policymakers and university leadership need to be encouraged to work in closer partnership and to prioritize the strategic importance of research and innovation in national economic growth and competitiveness by investing more significantly in strengthening research capacity, infrastructure, and research opportunities in universities.

4.2.3 Investment programmes to boost STI capacity

Government initiated a number of investment programmes to boost STI capacity and sustain the momentum created These addressed several challenges - such as few science programs, a particularly low number of science and technology graduate students and researchers, limited national funding for science and technology research, and lack of systems to improve conditions for research.

a) ***Millennium Science Initiative:*** The USD 33.35 million *Millennium Science Initiative (MSI)*, 2007-2013[23] provided competitive grants for: top-end research involving both senior researchers and graduate students; the creation of undergraduate programmes in basic science and engineering; and, support for co-operation with the private sector, which consisted in-company internships for students and grants for technology platforms through which firms and researchers could collaborate on solving problems of direct interest to industry. A series of school visits by top scientists and researchers were conducted to change negative perceptions that deterred students, especially girls, from pursuing careers in science.

[23] ***IEG (2016)****: Uganda Millennium Science Initiative (IDA Credit No. 4170) Project Performance Assessment Report, Independent Evaluation Group, World Bank, April 2016.*

b) ***Presidential Initiatives:*** The initiatives were started purposely to enhance the development of science and research through better funding and organisation. The initiatives work through various research stations and universities/tertiary institutions across the country.

- The *Presidential Initiative on Science and Technology (PIST)* created a Presidential Innovations Fund in July 2010 endowed with UGX 25 billion (USD 8.5 million) over five years to support innovation related projects at Makerere university's College of Engineering, Design, Art and Technology (CEDAT). One of the major breakthroughs that resulted from the Presidential Support to Scientists is the 'Kiira EV' electric car produced by engineering students and faculty researchers at CEDAT through the Centre for Research in Transportation Technologies (CRTT), and the development of value-added products by the Colleges of Agriculture and Veterinary Medicine. The Presidential Support to Scientists amounted to US$4 million in the period between 2006 and 2014.

- The *Presidential Initiative on Banana Industrial Development (PIBID)*, that was conceived and led by a Ugandan woman scientist, is modelled around a rural Technology Business Incubator (TBI) and an Industrial Technology Park (ITP) concept to establish state-of-the-art banana processing enterprises. Prototypes have been developed, some patented but scaling up many of them into commercial products remains challenging.

c) ***Innovation Hubs and Cluster initiatives:*** Business incubation and technology accelerator programmes are being promoted by several institutions (public, private and in partnerships) to help young innovators and business start-ups grow into viable enterprises, to stimulate innovations and provide space for ideas to flourish:

- The Ministry of Science, Technology and Innovation (MoSTI) is to construct incubation centres and science industrial parks to support research and innovations in all districts and municipalities across the country.

- Makerere University runs the Food Technology and Business Incubation Centre, Makerere University Innovation and Incubation Centre *(http://miichub.com/)*, the National Software Incubation Centre, the Africa Institute for Strategic Animal Resource Services and Development (AFRISA). It also hosts the *Consortium for Enhancing University Responsiveness to Agricultural Development Limited (https://curadincubator.org/)* incubation hub launched as a public–private partnership in 2014 which targets young innovators in the agribusiness sector with the goal of generating new enterprises and employment, especially in the coffee and fruits value chains.

- The Makerere University Business School (MUBS) Entrepreneurship Incubator and Innovation Centre *(https://epc.mubs.ac.ug/)* is an outreach unit intended to promote an entrepreneurial culture among individuals and institutions in the country. Afri Banana Products *(https://afribananaproducts.wordpress.com/about-us/)* is an incubation and diversification of banana products for agribusiness incubator consortium hosted by Kyambogo University.

- The Ministry of Trade, Industry and Cooperatives has been implementing a program "One village One Product" based on virtual incubation practices since 2010 across the country. Micro and small enterprises or groups/cooperatives are trained in basic business management skills, value addition and marketing techniques. Some groups are also provided with production and technical equipment as seed funding.

- Uganda Investment Authority (UIA), a semi-autonomous government agency responsible for promoting and facilitating private sector investment in Uganda and offering support to SMEs intends to develop an SMEs business incubation Centre at Kampala Business

Industrial Park to foster and encourage a spirit of entrepreneurship and enterprise development generally, particularly among the youth and women.

- A number of other government institutions such as universities (Uganda Management Institute, Mbarara, Kyambogo, Bishop Stuart, Gulu, Busitema), research institutions (UIRI, NARO) and privately operated companies and quasi-government agencies (Presidential Initiative on Banana Industrial Development -PIBID, Textile Development Agency – TEXDA, TEXFAD Vocational Business Incubator, FinAfrica Uganda Ltd that have or are in the process of establishing technology, business and innovation incubation centres to nurture innovative science and technology based ideas into viable commercialized new technologies and offer some form of business incubation services.
- A number of "Cluster Initiatives" under savings and credit cooperative organisations (SACCOs) have been established over the country with membership levels ranging from 30 to 300 members representing various sectors of the economy including agriculture, food processing, manufacturing, service sector, and ICT. Many have received funding and equipment through the Presidential wealth creation initiatives.

d) ***Centres of Excellence:*** The principal objective of Centres of Excellence is to promote specialization in areas that address specific development challenges, to strengthen the capacities of the selected institutions deliver high quality training and research, and to meet the demand for skills required for national development. These are aimed at developing initiatives addressing one or more fields of education training and promoting innovation, exchange of experience and know-how between universities and other types of organisations, including those in the private sector.

- Uganda is host to one of five centres of excellence in biomedical sciences established in 2014 as the first phase of 19 centres in five East African Community (EAC) countries.
- Government secured a loan of Units of Account (UA) 74.44 million (USD 98 million) from the African Development Bank (AfDB) to Support the *Higher Education, Science and Technology (HEST)* project (see *https://www.afdb.org/en/projects-and-operations/p-ug-iad-001)* involving seven public universities and two degree-awarding tertiary institutions The project objective was to improve equitable access, quality and relevance of skills training and research leading to job creation and self-employment through business creation.
- The *Eastern and Southern Africa Higher Education Centres of Excellence (ACE II)* project[24], funded by the World Bank, established four ACEs in agriculture (Centre for Crop Improvement at Makerere - MaRCCI and Centre for Agro-Ecology and Livelihood Systems at Uganda Martyrs University – UMU), industry (Centre for Materials, Product Development and Nanotechnology at Makerere) and Health (Centre for Pharm-Biotechnology and Traditional Medicine at MUST). Each centre was funded to the tune of USD 6 million.

e) ***Research and Innovation Fund:*** Government provided US$0.2 million in FY 2003/04 as the National Innovation Fund. On 23rd August 2019 Makerere University announced receipt of special funding of UGX 30 billion (USD 8.1 million) from government under the Research and Innovation Fund (RIF) to support competitive grants for high impact translatable research and scalable innovations that address key gaps required to drive Uganda's development agenda

[24] *see http://documents.worldbank.org/curated/en/105551478248187571/pdf/109745-BRI-ACEII-finalOct-PUBLIC.pdf*

across different sectors. Government has committed to providing this funding for at least three financial years starting FY 2019/20.

4.2.4 Investment in ICT and e-solutions

Uganda has an Innovation friendly Policy Framework, which has actively supported growth in the ICT sector. These include: the National Science Technology and Innovation Policy (2009), ICT Policy (2014), Rural Communications Development Policy and eGovernment Strategy (2011). E-Infrastructure is rapidly improving with a national backbone of over 5,000 km of fibre optic cable, National Data Transmission Backbone Infrastructure (NBI) and Electronic Government Infrastructure (EGI) being finalised and links to three submarine cables (TEAMS, SEACOM and EASSy). ICT Initiatives are primarily focused on eInfrastructure, eGovernment, Technology-enhanced Learning, eHealth, eCommerce and ICT for Rural Development and Entrepreneurship.

The ICT sector has been one of the fastest growing in Uganda's economy. Uganda's ICT development index has grown steadily to 2.19 in 2017, up from 1.53 in 2010. Uganda had attained 100% GSM coverage and a cellular penetration of over 95% by 2016. The National IT Survey carried out by the National Information Technology Authority of Uganda (NITA-U) in 2018 found that 24.9 million people use mobile phones, while 18.8 million access internet. In relation to Communications, according to Uganda Communications Commission (UCC) as at June 2018 the number of fixed line subscribers (252,165) and Mobile subscribers (21,648 million) with a teledensity of 56.1%. The mobile internet subscriptions dropped to 9,855.034 million while the fixed internet subscriptions grew to 173,600 by the end of June 2018. The estimated Internet users dropped slightly to 18,502,166 by end of December 2018 from the19.1 million as estimated in September 2018. Official reports from the UCC indicate that the number of internet users increased from 2.48 million in 2008 to 14.36 million in 2018, reflecting an annual growth of 8.3% over the ten year period.The Internet penetration stood at 47.4% in 2018[25].

The increase in internet usage has been further fueled by the country's youth bulge - Uganda has the world's youngest population, with over 78% below 30 years. Mobile technology is helping strengthen skills, improve data collection, and reach women and girls with services and information they need. Gender and generational gaps exist for the active use of and influence on the technological space and gender enabling e-solutions[26]. It is important to pursue the endorsement and implementation of technological and E-solutions and platforms in a manner that advances gender equality and women's empowerment. The divide in terms of comprehension, understanding, and comfort with technology, between *"digital natives"* who are growing up exposed to the continuous flow of digital information and for whom computers and the Internet are natural components of their lives and *"digital immigrants"* struggling to learn and adopt new technology, has dire consequences for the future of education and application of science and knowledge for Uganda's development.

To keep in step with the fourth industrial revolution (4IR), Uganda is building an ecosystem of traditional training institutions to address IT skills gaps: Makerere University hosts an AI and Data Science Lab, the Microsoft Innovation Centre Uganda, Centre for Innovations and Professional Skills Development, and Global Business Labs; and, the Uganda Technology and Management University (UTAMU) has the Centre for Innovations and Business Incubation. Together with other universities (Uganda Christian University, ISBAT University and the Uganda Institute of ICT) Makerere university

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[25] *See 2010-2018 IST- Africa Consortium (2018): D2.3 Report on Bilateral & Multilateral Cooperation, v1 31 December 2018 (http://www.ist-africa.org/home/files/IST-Africa_D2.3_BilateralCooperation_v1_311218.pdf) and 2012-2018 IST-Africa Consortium (2018): D2.1 Report on ICT Initiatives, Research and Innovation Priorities v2, December 2018 (http://www.ist-africa.org/home/files/IST-Africa_D2.1_ICTInitiatives_ResearchInnovationPriorities_v2_Dec18.pdf)*

[26] ***ITU (International Telecommunication Union) (2016)**: ICT Facts and Figures 2016. www.itu.int/en/ITUD/Statistics/Pages/facts/default.aspx and **ITU (2017)**: Measuring the Information Society Report, International Telecommunication Union.*

offers undergraduate, postgraduate, and diploma programs producing over 5,000 IT-related university graduates with many more learning similar skills through degrees such as electrical engineering.

A consistent complaint by graduates and employers is that the curricula offered by most universities do not match the requirements of the market, variously described as too "outdated", "modular", "shallow" and "basic". Ultimately, technology and the associated skills demanded by the market evolve too quickly for a long-term university curriculum (the Makerere curriculum changes every 5 years; a 1-year review is held after every 4 years) to remain entirely relevant. Many students also lack soft skills, meaning they lacked critical skills like problem solving, critical thinking and teamwork, all of which are vital to ensure they are competitive in the IT industry and overall job market. The *Uganda Institute of Information and Communications Technology (http://www.uict.ac.ug/)* is establishing a modern incubation hub and specializes in offering middle-level skills-based and practical-oriented ICT training at certificate and diploma levels as an alternative to the theoretically-grounded degrees offered by universities and other tertiary institutions.

A number of non-traditional institutions (innovation hubs, complementary programmes and online platforms) have sprung up to bridge IT skills gaps and to target STI innovators (developers, programmers, engineers, and technical writers) who build websites, create applications and perform other online creation functions for their fellow innovators and for use by adopters to perform tasks more efficiently. The Research and Education Network of Uganda *(https://www.renu.ac.ug/)* is a cooperatively owned and community-driven Research & Education (R&E) services provider, helping to facilitate research and education networking among its member institutions (universities, research and tertiary education), as well as interconnecting them with other research and education networks and to the commercial Internet worldwide, thereby overcoming the traditionally high costs of information and knowledge sharing and exchange.

Uganda now has up to 20 hubs and co-working spaces which act as accelerators and incubators for IT start-ups. A recent study[27] identified a total of 183 ICT for Agriculture (ICT4A) innovations that were at various stages of development: idealization or conceptualisation (54.3%), prototype (27.1%), and 9.3% each for validation and commercialisation stages. The innovations were largely developed using mobile and web technologies especially android platform for mobile, java, PHP and MySQL for web applications. Content development is uncoordinated and unregulated. Generally, there were a few high-end technology innovations using platforms like artificial intelligence and advanced mobile technologies like drones and RFIDs. Yet these technologies provide excellent opportunities to address critical challenges on the services such as pest and disease detection and surveillance, climate smart animal and crop management, real-time information gathering and automated decision making among others. However, the agriculture and many other sectors have not realized enough innovations to be used on the market since majority of the innovations were at the prototype stage.

Various actors including MDAs, research institutions and CSOs develop and distribute content to users without having the content validated and certified. Most of the innovations are not driven by scientific research but rather by intuition and passion of students in higher institutions of learning and fresh graduates, often resulting into duplicated efforts and slow transition into commercial viable products. Most of the innovations at the commercialization stage had either been personally supported or received donor support.

- NITA-U established a *Business Process Outsourcing – IT Enabled Services (ITES-BPO)* incubation centre at the Uganda Bureau of Statistics (UBOS) House in 2013. The facility can accommodate 250 agents and is run by three private companies.

[27] *Mirembe, P. Drake and Jude Lubega (2019): State of information communications technology (ICT) for agricultural innovations in Uganda. Report prepared for the Rural Communications Development Fund (RCDF), Uganda Communication Commission (UCC), Kampala, Uganda. May 2019.*

- *Hive Colab Innovation Hub (http://hivecolab.org/)* was launched in 2010 by *AfriLabs (https://www.afrilabs.com/),* a network organization of 158 innovation centres across 45 African countries, to serve as a community-owned collaborative space to facilitate interaction among technology entrepreneurs, web and mobile app developers, designers, investors, venture capitalists, and donors. Hive Colab incubates companies and start-ups critical to Uganda's technology ecosystem. It focuses on technology verticals that are considered cornerstones to the country's emerging digital economies: financial technologies *(fin tech)*, medical technologies *(med tech)*, educational technologies *(ed tech)*, agricultural technologies *(ag tech)*, and technology for governance *(tech4gov)*.
- Outbox *(https://teheca.com/outbox-incubation-hub/)* is another incubation hub in Uganda that helps new and upcoming entrepreneurs interested in using technology to build high growth companies with workspace, mentorship, and training programs. Through its partnerships, it helps them raise money for their ventures and access markets. It also works with students, developers, researchers and organizations to build inclusive communities that entrepreneurs can tap into for talent and collaboration.
- Other outstanding technology incubators and accelerators include *Innovation Village, Venture Labs East Africa, Pulse Lab Kampala, Grameen Foundation, AppLab,* and *Designhub* which is a co-working space, and a number of other outstanding institutional and individual innovators[28] who have developed ICT innovations that have attracted national and international attention and recognition. Several complementary programmes (short courses) and online IT courses are offered by groups like *Andela, AP Tech, New Horizons, Artfield School* (animations) and international training and certifications providers.

4.3 Enabling Policy Environment for Women Participation

4.3.1 Women leadership, agency, voice and visibility

Women in Uganda began to organize to exercise their political power in the 1960's with the formation of the *Uganda Women's Union* and the *Uganda Council of Women.* The NRM government on assuming power in 1986 immediately pledged to eliminate discrimination against women in official policy and practice and stimulated women's participation all spheres of national development. The promulgation and institution of "quota" laws and policies contributed to a leap in female participation in political institutions, increased girl child enrolment in school, and the gradual transformation of the legislative agenda, as a large number of laws pertaining directly or indirectly to gender equality began to be presented and promulgated. Intense negotiations and debates in which female politicians and activists took part led to the creation of a *Ministry responsible for gender (1987)*, the *National Women's Council (1993)*, and the *Equal Opportunities Commission (2007)*, among others.

Diverse academic, research, and women's organizations have taken actions to promote the design and implementation of public policies geared toward resolving gender inequalities in various fields. It is important to mention that there is a growing number of studies being undertaken by diverse circles (study centres, networks and groups of female/gender studies scientists, girl-child focused agencies and institutions, gender activists, female politicians, policy makers and government functionaries, development agencies, etc.) to supply evidence of the gender inequalities and to increase awareness of the negative consequences of these patterns, for both women and men, as well as for development in general. A number of women activist, advocacy and support groups are active in the country,

[28] *Outstanding innovators who have developed ICT4Agric innovations that have attracted national and international attention and recognition include: ERIGNU project, Kudo, Fits Uganda, Ensubiko, Jaguza, M-Voucher, Greenleaf, Ticprome among others. The innovation and incubation hub operators included organizations that run innovation and incubation programmes. Some of the key organizations surveyed are; Mbarara University of Science and Technology (CAMTech), Uganda Technology and Management University (CIBI), Gulu University Department of Computer Science, Outbox, HiveColab, Design Hub, Makerere Innovation Centre, CURAD, AI Lab Makerere University, TechBuzz and Innovation Village.*

notable among which are: the *Uganda Women Parliamentary Association (http://uwopa.or.ug/)*; *Action for Development (http://new.acfode.org/)* formed in 1985 by women civil servants and professionals; the *Uganda Association of Women Lawyers* more popularly known as FIDA; and, *Uganda Women's Network (https://www.uwonet.or.ug/)*. The agendas and work of these actors on behalf of women's rights and equality or parity has been incessant.

4.3.2 Effective laws, policies and institutions

A significant number of laws have been enacted, and policies and programs implemented that sought directly or indirectly to improve women's (social, educational, and health) conditions, economic autonomy, civic participation, and empowerment. Gender equality is upheld in local frameworks such as the *1995 Constitution, Vision 2040, NDP II, National Women's Council Act (1993),* the *Equal Opportunities Commission Act (2007),* the *National Youth Policy (2001)* and the *2016 NRM Manifesto.* The *National Gender Policy (2007)* promotes gender mainstreaming in all government MDAs and local governments, mandating numbers of women in leadership positions. The *Gender in Education Sector Policy (2009)*, the *National Strategy for Girls' Education (2000)*, the *Social Development Sector Strategic Investment Plan*, and institutional gender policies seek to eliminate all forms of gender disparities in education, social services and the work place.

STI specific legislation dates back to 1970 when the *National Research Council (NRC)* was established by a Cabinet decision to oversee and provide advice on national research policy. It also acted as the research funding arm of the government. The NRC was replaced by the *Uganda National Council for Science and Technology (UNCST)* established by Act of Parliament in 1990. For quite a long period of time, policy discussions centred on institution building - identifying a need for a standalone ministry for science and technology. Eventually, science and technology were added to the Ministry of Education and Sports, creating a new Ministry of Education, Sports, Science and Technology and later the *Ministry of Information, Communication and Technology (MoICT)* created in 2006 and Ministry of *Science, Technology and Innovation (MoSTI)* in 2016. The UNCST provides overall national coordination of activities with MoSTI providing political and policy leadership on all issues relating to the implementation of STI. Other Ministries with a direct bearing on the management and operation of the STI ecosystem include Agriculture, Animal Industry and Fisheries (MAAIF); Education and Sports (MoES), Finance, Planning and Economic Development (MoFPED), Gender, Labour and Social Development (MoGLSD), Tourism, Trade and Industry (MoTTI), and Health (MoH).

The NDP II and the Vision 2040 accorded STI sector status. Subsequently, a 5-year *National STI Plan* was formulated in 2012 to facilitate implementation of the *National Science, Technology and Innovation Policy* adopted in 2009. The overarching goal of the national STI policy is to *'strengthen national capability to generate, transfer and apply scientific knowledge, skills and technologies that ensure sustainable utilization of natural resources for the realization of Uganda's development objectives'*. The 9th policy statement is to: *"support basic, applied and development research for enriching the STI knowledge base and product development for enhancing indigenous knowledge and adaptation of imported technology*". The STI plan prioritises research and development activities as critical determinants of Uganda's technological and socioeconomic progress. It seeks to increase Uganda's Gross Expenditure on Research and Development (GERD) from 0.5% of GDP to the African Union (AU) recommended 1%, in addition to increases in the number, qualifications and productivity of research personnel[29].

Uganda also fully subscribes to the Science, Technology and Innovation Strategy for Africa (STISA), which the African Heads of State adopted in 2014 to accelerate Africa's transition to an innovation-

[29] *See: **UNCST (2011)**: Policy Options for Sustainable Funding of Uganda's Science, Technology and Innovation System; UNCST (2012), Science, Technology and Innovation Statistical Abstract; UNCST (2013), National Research and Development Survey and National Innovation Survey 2012 Reports;*

led, knowledge-based economy by improving STI readiness in terms of infrastructure, professional and technical competence, and entrepreneurial capacity. By virtue of membership of the East African Community (EAC), the Uganda STI system become a constituent member of the *East African Science and Technology Commission (EASTECO)* established in 2007 (became operational in 2015): to enhance cooperation in the development of regional science and technology policies; to encourage joint mobilization, use, management and development of resources, both material and human, for the development of science and technology in the EAC region; to promote scientific and technological innovation within Partner states; and to provide support mechanisms to facilitate the harnessing and application of STI at a regional level and at scale. The *East African Regional Science, Technology and Innovation Policy* will ensure that universities are enhanced to be centres for excellence for investments in education, technical competencies and training, particularly in science technology and education.

The combination of science, technology and innovation in one strategy creates a complexity in the mix of technical competences and requirements, and the measurement structure due to the differences in the metrics used in each of the sectors. The institutional architecture for STI implementation is thus complex. While the decision-making processes at the MoSTI/UNCST level appears straight forward, the fact that STI spans several sectors involving many policy organs at the level sector ministries brings in coordination complications. The implementing structure is even more complex with a multiplicity of actors. A number of sector institutions and agencies have been established by law to provide technical lead for the priority areas, with their own established mechanisms of developing research proposals, conducting scientific peer review and implementing research projects, and/or regulating and guiding professional practice. These include:

a) ***Science Education:*** The education sector legal framework is derived from the Constitution and reinforced by several acts and regulations[30].The Government White Paper on Education of 1992, adopted following recommendations of the Education Policy Review Commission Report of 1989, was the basis for all education policy since 1992. Strategies to achieve the aims of engendered education are contained in subsequent policy documents including the Uganda Vision 2040, the National Development Plans, the Education Sector Strategic Plans, and the annual Ministerial Policy Statements. Quality assurance and integrity of science education at primary, secondary and BTVET levels is maintained through the various examining bodies and inspectorate services of the MoES. The *National Council for Higher Education (NCHE)* established under the *Universities and Other Tertiary Institutions Act, 2001* accredits higher education programmes and sets the minimum standards and regulations for higher degrees programmes. The Presidential promise of higher salaries for graduate science teachers (monthly salary of UGX 1.9 million against UGX 600,000 arts teachers during FY 2018/19 was vetoed by parliament, arguing that this would only create disparity in the payment of teachers with the same qualifications.

b) ***Agriculture and Environment:*** National Agricultural Advisory Services Act, 2001; Animal Breeding Act, 2001; National Agricultural Research Act, 2005; Uganda National Meteorological Authority Act, 2012; National Environment Management Authority Act (1995); National Forestry and Tree Planting Act, 2003; Uganda Wildlife Act, 2019; Policies and laws contributing to agriculture and sustainable environment and natural resources management include: the National Environment Management Policy (1994); the National Policy for the Conservation and Management of Wetlands (1995); Uganda Wildlife Policy (1999); the National Water

[30] *Local Government Act, 1997 as amended; Education (Pre-Primary, Primary and Post-Primary) Act, 2008; Industrial Training Act Cap 130; Business, Technical, Vocational Education and Training (BTVET) Act, 2001; Universities and other Tertiary Institutions Act, 2001; Uganda National Examinations Board (UNEB) Act, 1983; National Curriculum Development Centre (NCDC) Act, 2000; Education Service Act, 2002; Uganda Nurses and Midwives Act, 1996; Uganda Nurses and Midwifery Examination Board (UNMEB) Regulations 2009; Uganda Business and Technical Examinations Board (UBTEB) Regulations 2009; Uganda Allied Health Examinations Board(UAHEB) Regulations 2009; Uganda National Commission for United Nations Educational, Scientific, Cultural Organization (UNATCOM-UNESCO) Act, 2014; and, Higher Education Students' Financing Board (HESFB) Act (2014).*

Policy (1999); Uganda Forestry Policy (2001); Agricultural Education Policy (2004); National Land Use Policy (2010); Disaster Preparedness and Management Policy (2011); National Agricultural Research Policy (2005); National Fisheries Policy (2003); Uganda Food and Nutrition Policy (2003) and the Urban Policy (2011).

a) ***Engineering, ICT, Industry, Commerce and Trade:*** Uganda National Bureau of Standards Act, 1989; Uganda Export Promotion Board Statute No. 2 of 1996, which repealed the Uganda Export Promotion Council Act No. 7 of 1983; Uganda Industrial Research Institute Act, 2003; Uganda Communications Act, 2013; National Information Technology Authority Act, 2009; Trade Secrets Protection Act, 2009; Uganda Tourism Act, 2008; Atomic Energy Act, 2008; National Oil and Gas Policy, 2008; Energy Policy, 2002; Renewable Energy Policy, 2007; Patents (Amendment) Act, 2002; Copyright and Neighbouring Rights Act, 2006; Trademarks Act, 2010; Plant Variety Protection Bill, 2014; Industrial Property Law, 2014.

b) ***Medical Sciences:*** Uganda National Health Research Organisation Act, 2011.

4.3.3 Commitment, compliance and reporting on gender equality

A recent study[31] documenting existing gender equality local and international laws and policies and analysis of the state of their implementation, and an earlier assessment of gender equality and STI[32] conclude that while Uganda had strong gender-sensitive policies and legislative measures, problems remained in implementing existing laws and policies. There is evidence of progress in women's representation in decision-making, but the benefits of these policies are yet to be seen in other socio-economic indicators. Nonetheless, most of the existing gender policies and laws, although issue specific, collectively compel all government ministries, departments and agencies (MDA's) to have policies, strategies and programmes for addressing gender and equality issues.

The 17 SDGs, including SDG# 5 on gender equality and women's empowerment were localised and aligned into the second National Development Plan (NDP II). Gender and equity budgeting was domesticated and is a mandate of not only the Ministry of Gender, Labour and Social Development but also Ministry of Finance, Planning and Economic Development, Ministry of Local Government and the Equal Opportunities Commission to ensure gender equity in public finance management. The Equal Opportunities Commission assessment report for FY 2018/19[33] indicated a 98.6% commitment to inclusion and 75% compliance of strategic objectives with gender and equity requirements amongst government MDAs. Often, many key indicators of STI sector performance do not provide gender-disaggregated statistics[34].

4.4 Mechanisms to Promote Advancement and Participation of Women

Several gender-sensitive/biased/neutral dimensions still affect women participation: health, social, economic, access to resources, agency or political space, targeted initiatives for skills' acquisition and increasing opportunities. Evidence suggests that the solution to barriers and problems of women participation does not depend exclusively on the extent of regulations, but rather requires profound transformation within institutional cultures and social, economic and cultural constructs that are historically based in male patterns. These directly or indirectly impede the full participation of girls in

[31] ***Ssali, S.N (2019)****: A matrix and analysis of GENDER EQUALITY laws and policies in Uganda. Report published by School of Women and Gender Studies, Makerere University, in partnership with University Forum on Governance under the Gender Equality Project, April 2019.*

[32] ***WISAT/WOUGNET (2015)****: Gender Equality in Knowledge Society - Uganda National Assessment, Final report, November 2015.*

[33] ***EOC (2018)****: Promoting gender and equity budgeting for sustainable inclusive growth and development: Assessment report on compliance of ministerial policy statements with gender and equity requirements for Financial Year 2018/2019. Equal Opportunities Commission, April, 2018.*

[34] *See* ***UNCST (2017)****: National Innovation Survey, 2011 – 2014. Uganda National Council for Science and Technology, Ministry of Science, Technology and Innovation, December 2016.*

STEM education and the development of women's STI careers by presenting them with limited options for negotiating work and family life and by devaluing or "making invisible" their achievements and contributions. Nonetheless, government and other players have positively responded to these demands, addressing them through concrete regulatory frameworks and gender-responsive initiatives as briefly discussed above and the sections that follow.

4.4.1 National gender parity

Development good practice now demands that the selection and design of development interventions is evidence-based and takes into consideration elements that are the most relevant to the domains of empowerment, using a market systems and gender-responsive approaches. Uganda has made progress in several areas towards promoting gender equality. Table 3 shows the global gender gap rankings for Uganda for the period 2006 to 2018. Uganda has reduced its gender equality gap from 70% in 1996 to 59% in 2001 and 48% in 2017[35]. Rankings by the WEF global gender gap index[36] indicate that overall and for economic participation and opportunity, Uganda has on average narrowed its gender gap by about 70% (Figure 7) and yet to cover the remaining 30% (Figure 8). Performance has even been more pronounced in education attainment (over 90%) and in health and survival (98%). Parity in political empowerment averages around 30%, close to the constitutional affirmative action requirement of one third representation.

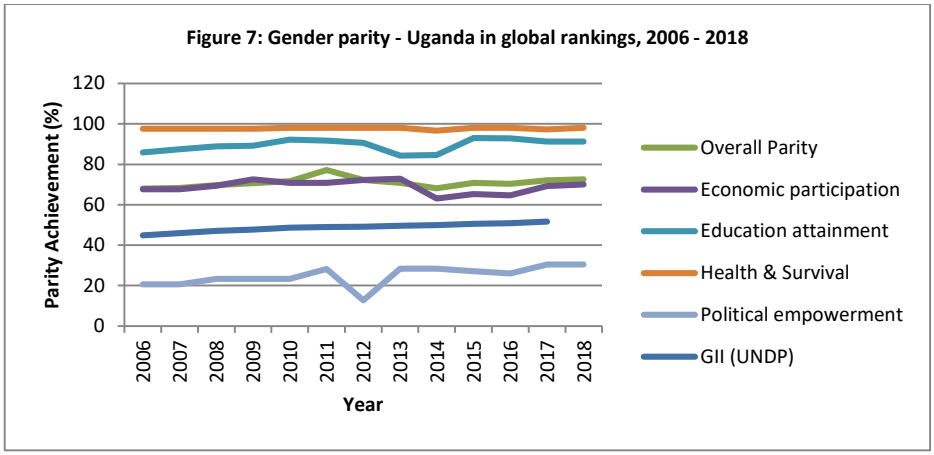
Table 3: Uganda Gender parity achievement scores and global ranking, 2006 – 2018

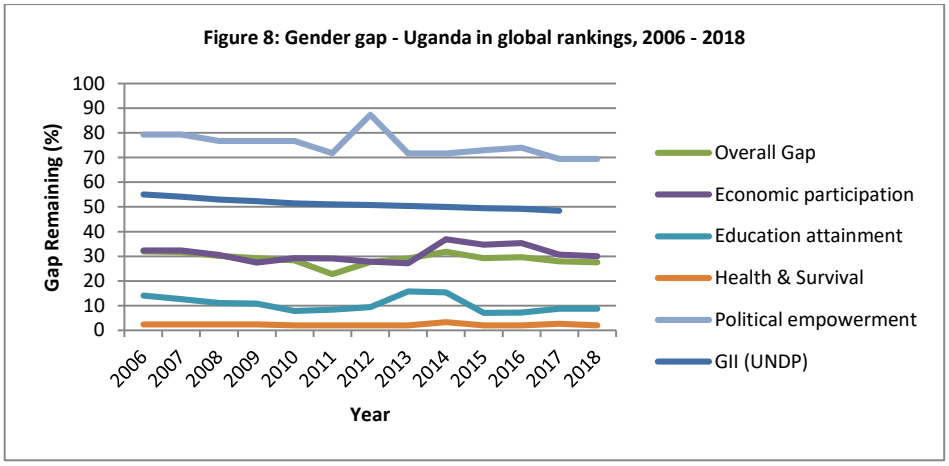
Domain	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
No. of Countries	115	128	130	134	134	135	135	136	142	145	144	144	149
Rank	47	50	43	40	33	29	28	46	88	58	61	45	43
Overall Parity	**68.0**	**68.3**	**69.8**	**70.7**	**71.7**	**77.2**	**72.3**	**70.9**	**68.2**	**70.8**	**70.4**	**72.1**	**72.5**
Economic participation	*67.7*	*67.7*	*69.4*	*72.6*	*70.8*	*70.9*	*72.2*	*72.9*	*63.1*	*65.3*	*64.7*	*69.3*	*70.0*
Education attainment	*85.9*	*85.9*	*88.9*	*89.2*	*92.2*	*91.7*	*90.6*	*84.3*	*84.6*	*93.0*	*92.8*	*91.3*	*91.3*
Health & Survival	*97.6*	*97.6*	*97.6*	*97.6*	*98.0*	*98.0*	*98.0*	*98.0*	*96.7*	*98.0*	*98.0*	*97.3*	*98.0*
Political empowerment	*20.7*	*20.7*	*28.3*	*23.3*	*23.3*	*28.2*	*12.7*	*28.4*	*28.4*	*27.1*	*26.0*	*30.5*	*30.5*
Gender Inequality Index (UNDP)	**55.1**	**54.1**	**53.0**	**52.3**	**51.4**	**51.0**	**50.8**	**50.4**	**50.0**	**49.5**	**49.2**	**48.4**	**55.1**

Source: WEF Global Gender Gap and UNDP Human Development Reports.

[35] *UNDP Gender Inequality Index (GII) as reported in the Human Development Reports, http://www.ungei.org/infobycountry/uganda.html and http://hdr.undp.org/en/content/gender-inequality-index-gii. GII measures gender inequalities in three important aspects of human development—reproductive health, measured by maternal mortality ratio and adolescent birth rates; empowerment, measured by proportion of parliamentary seats occupied by females and proportion of adult females and males aged 25 years and older with at least some secondary education; and economic status, expressed as labour market participation and measured by labour force participation rate of female and male populations aged 15 years and older.*

[36] *See the Global Gender Gap Reports published by the World Economic Forum for years 2006 to 2018.*





The Women Empowerment in Agriculture Index (WEAI)[37] is another tool that measures the degree to which women are empowered in their households and communities and the degree of inequality between women and men (who are married or in some other form of partnership) within the same household. The WEAI recognises five domains of Empowerment (5DE): decision-making power over agricultural production; ownership, access to and decision-making power over productive resources including credit; decision-making over use of income and expenditures; participation in the community; and workload and satisfaction with available leisure time. A woman is defined as empowered in 5DE if she has adequate achievements in four of the five domains or is empowered in some combination of the weighted indicators that reflect 80 percent total adequacy.

A Uganda pilot study[38] covering five spatially dispersed rural districts found the WEAI, calculated as the weighted average of the 5DE sub-index value of 0.777 and the gender parity index (GPI) sub-index value of 0.898 to be 0.789. The 5DE showed that 37.3% of women were empowered, while 62.7% of the women though not yet fully empowered, on average, had achieved empowerment in 64.4% of the 5DE dimensions. The GPI showed that 54.4% of women had gender parity with the primary male in their household. Of the 45.6% of women who were less empowered, the empowerment gap between them and the male in their household was 22.4%. Wealth was clearly associated with empowerment as was education level which also has a significant positive influence: 35% of women with less than a

[37] ***USAID Feed the Future/LEO (2016)****: Intervention Guide for the Women's Empowerment in Agriculture Index (WEAI) Practitioners' Guide to Selecting and Designing WEAI Interventions. Leveraging Economic Opportunities (LEO) Report # 10 (http://www.acdivoca.org/wp-content/uploads/2016/08/WEAI-Intervention_Guide_Final-8.2016.pdf).*

[38] ***IFPRI (2012)****: Women Empowerment in Agriculture Index, USAID/IFPRI/OPHI, https://www.ophi.org.uk/wp-content/uploads/2012_WEAI_Brochure.pdf*

primary-school education were empowered while 45% of those who had completed primary school were empowered. Women who were empowered also reported significantly greater decision-making and autonomy.

4.4.2 Women in leadership and decision-making positions

Available statistics illustrate a trend of increasing female participation in the educational, political, social, cultural, and economic arenas. In some of these arenas, women have progressively occupied decision-making positions, a phenomenon motivated by the modernization of Uganda's society, an increase in the level of female education, the democratization of politics, the public's explicit rejection of discrimination, the struggle for women's rights, and the implementation of legislation and policies specifically geared toward equality. Gender gaps, however, have certainly not been overcome in all areas, and inequalities persist in women's access to and retention in decision-making positions. It is important to note, nonetheless, that degrees of gender equality have disparate expressions across different socio-economic sectors, including in STI, and cultural frameworks.

The government decreed in 1989 that one woman would represent each administrative district in the national legislature. The number of districts, hence District Representative Members of Parliament, has increased form 39 in 1989 to 135. The Local Government Act of 1997 provides for a minimum of one third representation of women on all Local Council (leadership) structures. Statistics from MoGLSD and the Parliament of Uganda indicate that through these constitutionally guaranteed affirmative action measures, women in parliament increased from 3% in the 4th parliament (1980–1985) to 43% in the 9th Parliament (2011–2016) before dropping to 35% in the current 10th parliament (Table 4; Figures 9 and 10). In 1989 there were two women serving as ministers and three serving as deputy ministers in cabinet. The number of women in cabinet was at 23% in 2015 and 39% in 2019 comprising 18 women (50%) and 18 men as Ministers and 32 men and 14 (30%) women as Ministers of State. Women Local Council leaders, increased from 6% in the early 1990s to 44% in 2003.

Table 4: Women representation in the Parliament of Uganda, 1962 – 2019

Assembly	Period	Total Legislators	Women Legislators		
			District	All	%age
Legislative Council 1 (LEGCO1)	1958 - 1961	10		1	10.0
Legislative Council 2 (LEGCO2)	1961 - 1962	91		1	1.1
1 (National Assembly - NA)	1962 – 1966	82	-	-	-
2 Parliament (2P)	1967 – 1971	82	-	-	-
3(National Consultative Council - NCC)	1979 – 1980	30	-	2	6.7
		120	-	2	1.7
4Parliament (4P)	1980 – 1985	126	-	4	3.0
5 (National Resistance Council - NRC)	1986 – 1989	38	-	-	-
	1989 – 1991	270	39	50	18.5
	1991 – 1994	283	39	50	17.7
Constituent Assembly (CA)	1994 – 1996	286	39	51	17.8
6Parliament (6P)	1996 – 2001	276	56	75	27.2
7Parliament (7P)	2001 – 2006	304	79	100	32.9
8Parliament (8P)	2006 – 2011	319	112	131	41.1
9Parliament (9P)	2011 – 2016	326	112	139	42.6
10Parliament (10P)	2016 – 2017	375	116	143	38.1
	2017 – 2018	426	122	149	35.0

Assembly	Period	Total Legislators	Women Legislators		
			District	All	%age
	2019 – 2021	459	135	162	35.3

Source: Parliament of Uganda (https://www.parliament.go.ug/page/history-parliament); Wikipedia (https://en.wikipedia.org/wiki/Elections_in_Uganda) and African Elections Database (http://africanelections.tripod.com/ug.html)

Figure 9: Number of representatives in parliament by gender, 1958 - 2019

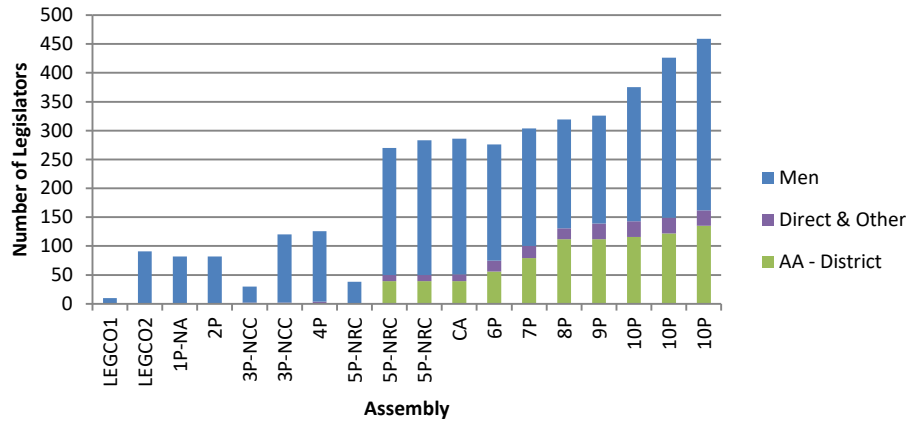
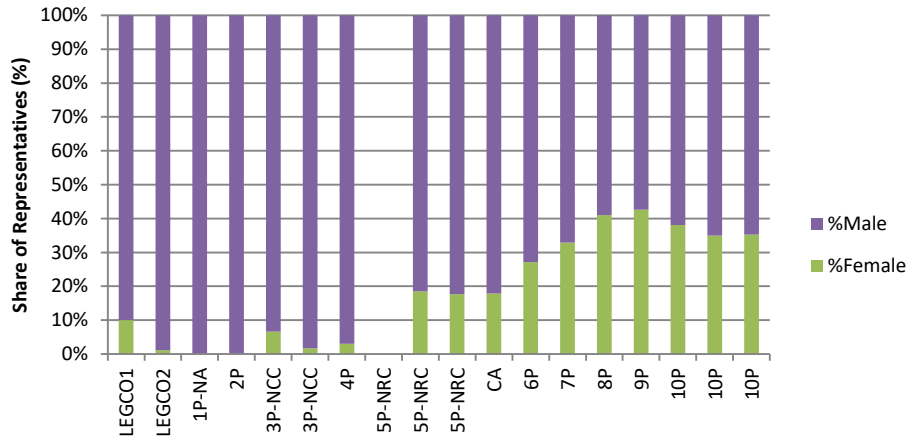


Figure 10: Representation in parliament by gender, 1958 - 2019



As reported in the WEF global gender parity reports, the gender parity gap in many areas of opportunity and political empowerment narrowed between 2006 and 2009 and stagnated thereafter up to 2013 (Table 5; Figure 11). Women representation in the legislature, senior official and managerial positions rose from 8% in 2006 to 25% between 2009 and 2013 and then dropped to 17% up to 2017 before picking up again to 24% in 2018.

A study examining gender equality in public administration in Uganda focusing on equal participation of women as staff, including at decision-making levels[39] indicated that in 2011, women constituted

[39] ***UNDP (2012)**: Gender Equality and Women Empowerment in Public Administration – Uganda Case Study, UNDP initiative on Gender Equality in Public Administration (GEPA)*

only 33% of all staff in the public service, with the majority at the lowest levels. Women made up only 22% of senior management Public Service positions and 16% of middle management positions (Table 6). Ministry of Local Government (MoLG) data for 2011 and 2012 also showed that women constituted only 8% of the Chief Administrative Officers (CAOs) and 13 percent of the Deputy CAOs, a proportion that was far below the national average in the entire Public Service. At municipality town clerk level, the percentage of women decreased from 34% to 9%, thereby lowering overall proportion of women in local government positions from 15% in 2011 to 9% in 2012. The top positions in local governments, as in central government and in education, were dominated by men.

Uganda's Public, Health and Education Services have both occupational segregation, where particular sectors or types of work such as nursing, secretarial and clerical jobs, and pre-primary and primary education are female-dominated, as well as hierarchical segregation, where men dominate the top positions and women the lower ones. As such, Uganda's public administration is structured along gender lines, where men dominate certain jobs and sectors and women are concentrated in sectors that require lesser skills and are care-related. Uganda's public administration has yet to achieve the recommended minimum critical mass of 30% women in decision making in the public administration as recommended in a number of international instruments and the situation is even worse at subnational level. As summarized by the 2011 Ministry of Public Service Gender Mainstreaming Guidelines, the main gender issues in the public administration are related to: Recruitment, Selection and promotions, Training and development, Postings and transfers, Gender-inclusive language, Working environment, Workplace harassment (respectful workplace), and, Terms and conditions of service.

Table 5: Gender parity global rankings - opportunities and political empowerment, 2006 - 2018

Position	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
LSOM ♀	8.0	9.0	9.0	25.0	25.0	25.0	25.0	25.0	12.5	17.0	17.0	17.0	23.5
LSOM ♂	92.0	91.0	91.0	75.0	75.0	75.0	75.0	75.0	87.5	83.0	83.0	83.0	76.5
PTW ♀	21.5	22.5	24.5	27.0	27.0	27.0	27.0	27.0	35.5	34.0	34.0	34.0	35.0
PTW ♂	78.5	77.5	75.5	73.0	73.0	73.0	73.0	73.0	64.5	66.0	66.0	66.0	65.0
MPs ♀	22.5	22.5	20.5	22.0	23.0	27.0	27.0	27.0	27.0	27.0	25.0	26.0	26.0
MPs ♂	77.5	77.5	79.5	78.0	77.0	73.0	73.0	73.0	73.0	73.0	75.0	74.0	74.0
CMs ♀	20.0	20.0	20.0	19.5	23.5	23.5	23.5	23.5	23.5	21.0	21.0	29.0	29.0
CMs ♂	80.0	80.0	80.0	80.5	76.5	76.5	76.5	76.5	76.5	79.0	79.0	71.0	71.0

Source: WEF Global Gender Gap Reports.

Notes: LSOM = Legislators, Senior Officials and Managers; PTW = Professionals and Technical Workers; MPs = Members of Parliament; CMs = Cabinet Ministers.

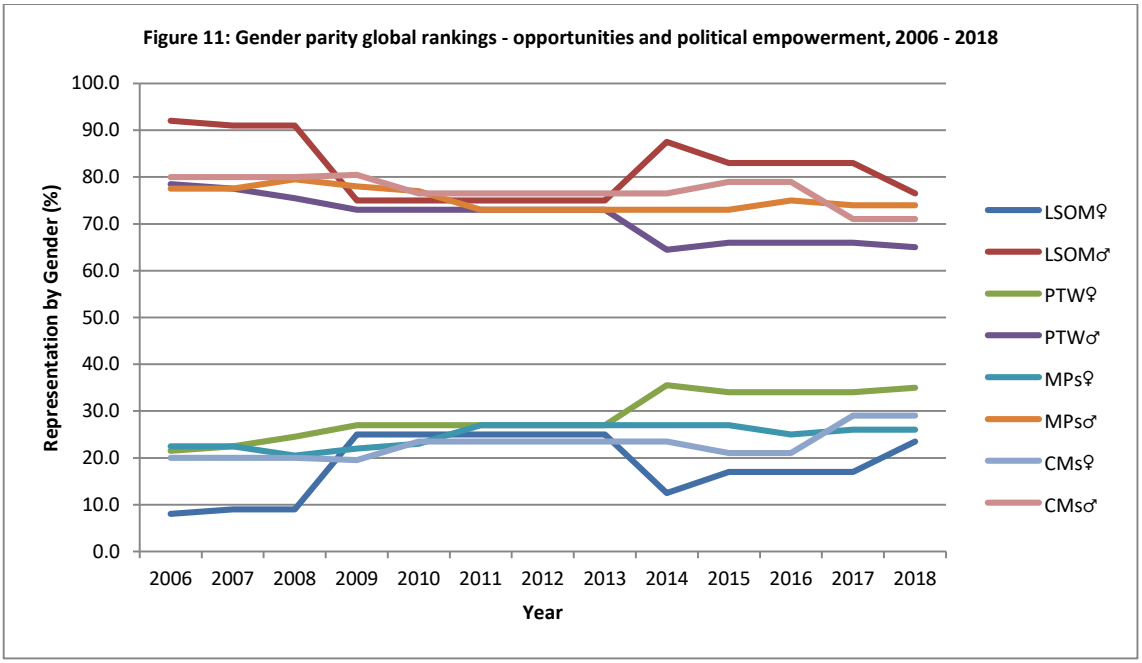


Table 6: Size of Public Service, Local Govt. Administration & Education Service by Gender, 2010/11

Position	Total Staff	%age Women
Public Service	**271,854**	**33**
Senior Management (U1)	808	22
Middle Management (U2-U3)	4,180	16
Graduate and Diploma Entry Level (U4-U5)	59,973	28
Lower Level (U6-U8)	206,893	35
Local Government Administration	**159**	**15**
Chief Administration Officers	71	8
Deputy CAOs	56	13
Municipal Town Clerks	32	34
Education – Teachers, Lecturers & Instructors	**226,724**	**42**
University (full-time)	1,738	23
Tertiary level (excluding university)	6,769	29
Secondary (only government)	25,970	25
Primary (government)	126,448	40
Primary (private)	45,955	44
Pre-Primary	19,844	83

Source: UNDP (2012): Gender Equality and Women Empowerment in Public Administration – Uganda Case Study, UNDP initiative on Gender Equality in Public Administration (GEPA)

4.4.3 Women access to resources, services and opportunities

Uganda is a country rich in culture and traditions. Daily life for its inhabitants varies drastically according to socioeconomic level, gender, ethnicity and racial perceptions, regional characteristics, rural-versus-urban differences, and other social and cultural factors. There are basically seven major societal institutions that include: family, community, religion, academia, business, media, and government. Freedom occurs when all seven of these societal institutions are on an equal plane with no one form being more important or having more power or influence than another. When one gains predominance, some form or level of tyranny always emerges. Ugandan society is largely a typical example of patriarchy, were male superiority is accepted as part of the natural order of things and

women are relatively powerless in the public sphere and, to a lesser extent, in the private sphere. Health, social and economic conditions, access to resources, women's agency, skills and opportunities are critical inputs - indicators and conditions - needed for the full participation of women and girls in the knowledge society.

There is evidence that men tend to make decisions that affect the entire family, and that personal decisions are more important to women than any other decisions they make. Unfortunately, in those decisions related to women's economic independence, such as whether they can work or study and what they do with the money they earn, rates of partner interference are significantly high. Despite their large numbers, girls and women have traditionally had access to much fewer resources than their male counterparts. Many women, especially in rural areas, still observe the traditions of their culture of origin and often pass them on to the next generations. Ongoing changes are redefining substantial differences between the traditional woman´s portrayal and the contemporary one - women are reaching higher levels of education, increasing their level of incorporation to the labour market and assuming greater economic responsibility for their families. Although there has been much progress, much still remains the same and in many occasions autonomy comes not from a personal choice, but rather from an economic or social necessity.

One of the most significant consequences when girls do not have adequate social protection is that many have their dreams destroyed - dropping out of school and unable to complete their education, thus reducing their chances of finding employment in the future. Due to stereotyping, work related to domestic activities –such as caring for children, managing the family economy, home up-keep and other activities– is regarded as a "woman's duty", implying that they are confined by an identity and social role. Working women often face the wrath of "the double working day", having to combine their activities at the work place with a significant burden of domestic chores.

Education is the key to all areas of successful human endeavour. The *Promotion of Girls Education* scheme aims at improving girls' retention and performance at school. The scheme provides funds for construction of latrines, classrooms, houses of senior women teachers; girls play grounds, enabling school children to access water and sportswear. The *Girls' Education Movement in Africa* was also launched in Uganda in August 2001 to promote gender parity in education through enabling girls to realise and concretize their rights to participate in identifying best practices that enhance their participation in education, and issues that affect their education, and life skills hence forth. The *Child Friendly School* programme is another intervention aimed at promoting girls' education in a friendly school and home environment. *Girls and Focusing Resources for Effective School Health* focuses on provision of safe water and sanitation to schools, provision of washrooms for girls, urinals for boys, and latrines with priority for girls and special emphasis on separation from boys' facilities.

4.5 Results in terms of Women's Participation

Greater equality drives big gains in health, education, employment, and improved livelihoods - for individuals, their families, and their communities. However women and girls still face legal, economic, and political constraints that prevent them from participating fully and equally in society. Nonetheless, hundreds of women scientists provide inspiration to young females opting for STEM education and careers (see Annex 3 and for sampled examples). Ugandan women are debuting and making a mark in science innovation[40] as innovators, directors/owners of entrepreneurial activities and businesses, stewards of STI sub-systems, researchers and practitioners who form part of the backbone of the national STI ecosystem. However, compared to their male counterparts, they are still few largely because of "gender leakages" along the education pipeline, the career staircase, and the innovation

[40]*See for example: https://www.softpower.ug/ursb-awards-ugandas-leading-female-innovators-iconic-figures/; https://en.wikipedia.org/wiki/Category:Ugandan_women_scientists*

landscape (i.e. the proportion of females and males reaching each stage of higher education, further research and inventors).

4.5.1 Science for women: STI approaches with a gender lens

Women's and men's contributions to economic and development activity vary. They have varying access to resources, development of capabilities and opportunities, and different socially constructed roles and accepted responsibilities. Women's activities in food production, community management, natural resources management, education of children and family care place them at the centre of development. STI can play several roles in supporting women's development and livelihood activities. Technology may not be the answer to closing gender inequality, but it is a powerful enabler. The national STI system needs prudent ways to enable the private sector, technology industry, and governments work together to innovate smartly and responsibly.

Agriculture: Since the adoption of a new agricultural research policy in the early 2000s, most institutions in the national agricultural research system (NARS), especially the institutes of the National Agricultural Research Organisation (NARO) and the universities, adopted research processes and approaches which benefit women. These processes involve consulting and working with women in the choice, development and application of technology. The adoption of participatory and community engagement approaches provided insights into access, opportunities, priorities and choices among women and men in a range of social groupings. Applying a gender lens by integrating gender concerns and taking steps to understand gender patterns of use and access have been critical for promoting STI for women in agriculture. A number of gender-biased/focused STI initiatives for validating, protecting and improving local knowledge, innovations and skills around food production, energy, water, nutrition, transport and natural resource management exist and various technologies have been developed and disseminated - particularly those focused on easing the workload and improving the health of women, dealing with gender differentiated needs and problems, or presenting unique opportunities to women.

a) Science and technology has been used to reduce women's workload, for example by providing improved energy sources that shorten or eliminate the long distances they often have to walk to collect fuelwood.

b) S&T has been harnessed to increase the value of women's productive activities by improving quality and efficiency. Tools and equipment appropriate for women's tasks, such as planting, weeding and grinding, ferrying heavy loads, do exist. Despite these developments, it is often reported that few women use them because many are unaware of the full range of available tools, tend to lack the cash to purchase such tools and equipment, or gender-related customs and practices inhibit their development and adoption. For example, technologies for animal traction are seen as a men's domain and it is an abomination in some cultures for a woman to be seen riding a bicycle. Improved hoes, motorised weeders, planters, and grinding mills increase productivity and reduce energy costs; improved farming techniques, such as conservation agriculture and drip irrigation reduce the time spent on labour-intensive tasks such as weeding; and food processing technologies, such as cassava graters and oil-seed presses, increase women's incomes with less time and energy expended.

c) Targeted research and extension services have enabled women to access and use productivity enhancing technologies – improved seeds and livestock, agricultural inputs and finance, water and transport for domestic use and production (rain water harvesting techniques, intermediate transport devices). ICT, digital and mobile technology are making it easier for women to access information, to connect to market outlets and to access credit through mobile banking thus transforming women's activities into business ventures.

Healthcare and environment: Technologies that enable improved access to sanitation, waste management, and clean and potable water; and the development and deployment of modern, clean, affordable and sustainable (green and renewable) energy (domestic biogas, solar home systems) and clean and efficient household cooking solutions and home designs (cook stoves that use a wider variety of biomass for fuel, chimneys/hoods and adequate ventilation in kitchens) has contributed to improved health, time savings through the reduced drudgery associated with fuel collection, and environmental benefits. Women are also the primary decision makers for their family's care. AI and automation of routine tasks can eliminate a lot of bureaucratic procedures, which could lower hospital costs. Widespread use of online platforms can relay and request information privately, promoting women's autonomy over health care decisions and results. Menstrual cycle tracking apps could, for example, help girls reduce missing class and work.

4.5.2 Science for women: ICTs and modern technologies in support of women's livelihoods

ICTs provide a convenient avenue for women and men to access information and knowledge that helps build sustainable livelihoods, improve health and well-being. The NDP II notes that despite the remarkable achievements demonstrated by exponential growth of the ICT sector in Uganda, a number of challenges have emerged that have hindered further growth of the sector leading to the poor national ranking on the global ICT development index. These include: the high cost of internet bandwidth; vandalism and damage to infrastructure; poor quality of service; inadequate skilled human resource; limited local digital content; low uptake of e-services; and lack of commercial orientation for exploitation of the various ICT innovations. In addition, the increase in the benefits of ICT have not been matched with equal access to ICT platforms that are customized to the information needs of females to link them to local and international opportunities.

- ***ICTs for agriculture:*** In the ICT4A study cited earlier, it was reported that most innovations were graduates who had recently completed their bachelor degree, giving interpretation that most of the current innovations start as projects within the institutions of learning. Majority of these innovators were self-employed and quite a few in either formal employment or not employed at all. Majority of users (nearly 85%) of these innovations were smallholder farmers. Women constitute a majority of the population engaged in agriculture, and should be a deliberate target.
- ***ICTs for entrepreneurship:*** Women entrepreneurs of micro and small businesses face four specific barriers that ICTs can potentially help overcome: (i) they encounter greater difficulty accessing formal finance; (ii) have less time to spend on their businesses due to the burden of family responsibilities; (iii) generally have less access to skills and training, and, (iv) they often have less physical mobility, which is a constraint in accessing opportunities, markets and networks. Few initiatives and policy interventions have so far taken full advantage of ICTs to support women entrepreneurs. Involving women in the production and dissemination of technologies and related services, not only increases their self-confidence and greater respect but can also enable them launch into profitable business ventures.
- ***ICTs for financial services:*** Women value convenience, security, privacy, and reliability when it comes to their finances. Mobile money offers these benefits, but the gender gap in mobile phone usage and lack of trust in formal institutions prevent women from opening and using digital financial services. Gender responsive innovations in digital identity can address the privacy and accessibility issue. Finance apps should be designed with women's preferences in mind. For example, women are more likely to use leaner interfaces that are more intuitive and take up less space. They might also prefer an app that focuses on savings and money transfers (women's two most used financial products).
- ***ICTs for social services:*** Women are disproportionately in need of social services, most of which are cash-based, therefore subject to leakage and corruption. Digital payments via

mobile apps may substantially improve their security and efficacy, perhaps through stronger validation mechanisms like fingerprint or face recognition. Including easy to use and adequate customer support within the app may help to address distrust during technical glitches - and this support experience must be designed with illiterate women and digital migrants in mind.

- ***ICTs for education:*** Girls are more likely than boys to be excluded from school, which prevents them from fully participating in the labour force. While many education initiatives focus on getting girls to school, apps can be used to bring technical and business education to women already working. Access to finance and job market knowledge alone is insufficient in promoting women's labour force participation - this requires cultivating certain financial behaviours and skill building.
- ***ICTs for mentoring and networks:*** It is common knowledge that of mentorship hinders labour prospects, a common reason for women leaving professional careers. Mentoring is extremely beneficial: for gaining professional and business skills and confidence; having more networks and markets to tap into, thus quantifiably impacting on personal professional growth and financial stability. Mobile and anonymous mentorship especially may provide an element of trust and security and connection to people, peers and markets. Mobile phones, computers and the Internet can facilitate access to markets, clients and suppliers, improve market research, and increase profits and efficiency, as well as access to sources of finance through, for instance, mobile banking. This is particularly important for those groups, especially women micro entrepreneurs, who would not otherwise have easy access to market, information and finance. Many women are using platforms like Whatsapp to obtain micro-level knowledge. These technologies could be more harnessed to diversify the supply chain: connecting women with larger multinational institutions with stronger procurement power and employment opportunities.
- ***ICTs and asset ownership:*** Women face barriers in legally owning their assets, which lessens their credibility as a trusted business. Digital identity could help create certifications of credibility, and further distinguish business with greater female ownership as *"woman-owned business"* with verified durable assets. This certification in turn could help business enterprises diversify their supply chain by easily identifying women entrepreneurs. These digital certifications need to be smart and reliable measure whether a business is truly "woman-owned."

4.5.3 Women in science: STI-focused gender networks and advocacy groups

Women's participation in STI has gradually become a priority national issue and actions to encourage girls to continue the study of STEM throughout their schooling and into university and working life initiated. The range of support activities include: gender-biased policies and support frameworks; enhancing knowledge and understanding of STEM concepts by girls; forming networks with like-minded peers; meeting and networking with women in STEM careers; providing career information, including opportunities for internships and scholarships to support female university students to continue their studies and pursue STI career pathways; mentorship, technical support and policy advocacy services; challenges and training programmes; conferences, mentoring opportunities, and programs that encourage female professionals to remain in the STI fields, etc. A good number of networks and agencies provide advocacy and support for girls and women in STEM study and STI professional practice[41]. These institutions and networks immensely contributed to uplifting the quality of life of women, in the professional, formal and informal sectors.

[41] *Some examples include: Women of Uganda Network (https://wougnet.org/); Women in Technology Uganda (http://witug.org/); sheSTEM Network; Forum for African Women Educationists (https://www.faweuganda.org/); the ResilientAfrica Network (https://www.ranlab.org/); Private Sector Foundation Uganda (https://www.psfuganda.org/); Andela (https://andela.com/); Zimba*

The Forum for African Women Educationists (FAWE), for example, received a grant of USD 10.48 million from the Mastercard Foundation to implement an eight-year (2016 – 2023) *Higher Education Access Program* that seeks to enable 300 young women and men from economically disadvantaged regions of Uganda access to education and leadership development, including transition to higher education or to secure employment in sectors that contribute to the development of their communities and the country. The Program focuses on providing bursaries to academically bright and gifted students; 60% of the students will undertake degree courses while 40% will be in diploma courses. The program is designed with focus on sciences, covering courses in agriculture, medical and health, whereas education related courses will focus on sciences and language. The Program is being implemented in partnership with 5 higher education institutions; Mbarara University of Science and Technology, Gulu University and Busitema University, Jinja School of Nursing and Midwifery, and Medical Laboratory Training School. Upon graduation, the students are encouraged to return to their communities to work and improve the lives of others by filling a critical human resources gap and contribute to economic development.

4.5.4 Women in science: gender equality trends in basic science and mathematics education

Literacy discrepancies and educational inequity are a serious factor in the propagation of gender inequality. The foundation for interest in STEM subjects is laid early in the education pipeline. Although female school attendance at all levels of society in Uganda is lower than that of men, equitable access to education has considerably increased, in a context of strong population growth of 3.3% per year. The introduction of UPE in 1997 led to a significant increase in the enrolment figures in the primary sub-sector, especially for girls (Table 7; Figure 12). The total pupil enrolment increased from 2.7 million pupils in 1995 to 5.3 million in 1997. Between 2000 and 2016, enrolment at primary level rose from 6.6 million to 8.7 million pupils[42]. The proportion of school age children (6-12 years) enrolling in primary school rose from 79% in 2000 to 83% in 2003 before plummeting to 68% in 2011. This shot up again in 2012 to over 90% but has been declining since then. By the year 2000, the gender gap in primary education had been closed and gender parity achieved. The gender parity index in primary education between 2000 and 2008 was actually greater than one, implying more girls enrolled than boys. Between 1997 when UPE started and 2015, there was a 169% increase in enrolment with boys registering a 150% increase and girls a 192% phenomenal increase.

Table 7: Student enrolment by level of education, 2000 – 2017

Year	Primary				Secondary		Post O-Level (BTVET & Other)		All Tertiary		University	
	School age population (boys)	School age population (girls)	Boys	Girls	Boys	Girls	Male	Female	Male	Female	Male	Female
2000	4,159,416	4,191,719	3,396,000	3,163,000	290,176	228,755	10,558	3,519	35,389	19,055	-	-
2001	4,296,134	4,330,570	3,528,000	3,373,000	301,814	237,972	10,736	3,579	41,740	22,476	-	-
2002	4,439,922	4,478,932	3,721,000	3,633,000	359,494	296,457	15,499	4,815	49,179	30,678	33,762	23,382
2003	4,589,286	4,627,905	3,873,000	3,761,000	374,659	308,950	18,271	8,042	53,932	34,990	39,374	25,285

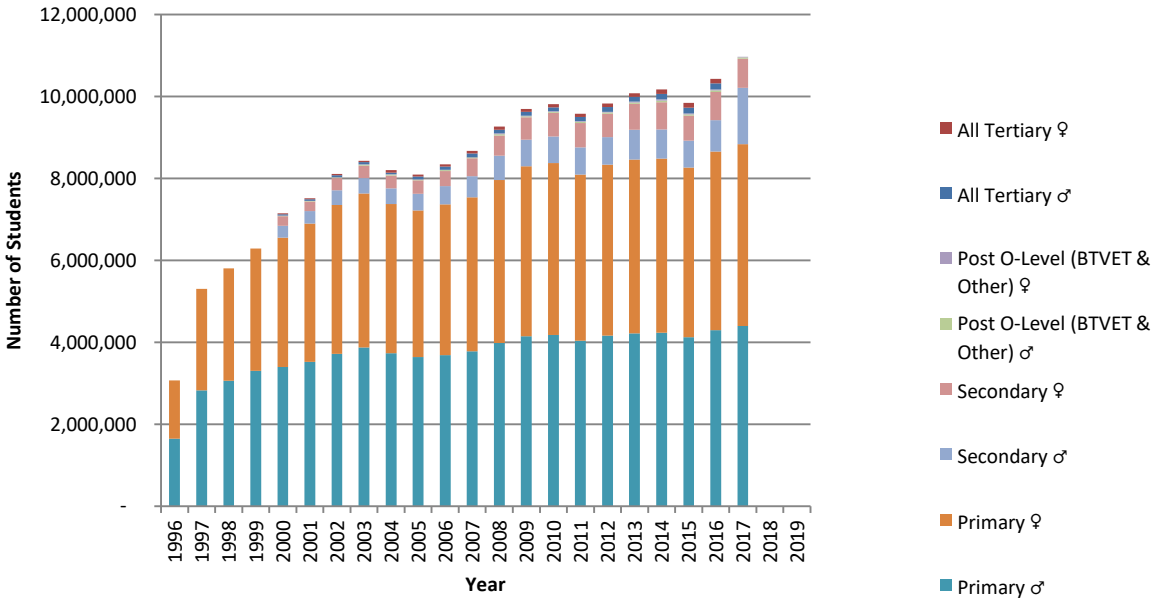
Women (https://www.zimbawomen.org/); Pollicy Uganda (http://pollicy.org/); Uganda Women Entrepreneurs Association (www.uweal.co.ug); Uganda (now East African) Women Entrepreneurs Exchange Network; Association of Uganda Professional Women in Agriculture and Environment (http://aupwae.net/); Association of Women Engineers, Technicians and Scientists in Uganda (WETSU); African Women in Agricultural Research and Development (https://awardfellowships.org/); Association of Women in Industry and Agricultural Development; Women Farmers Association of Uganda; Uganda Women's Finance Trust (now Finance Trust Bank) (https://www.financetrust.co.ug/); Council for Economic Empowerment of Women (CEEWA)-Uganda Chapter (https://www.ceewa.org/); Uganda Women's Trust (https://www.empowerwomen.org/en/community/organizations/uganda-women-trust).

[42] ***MoES (2017)**: Education and Sports Sector Strategic Plan, 2017/18 – 2019/20, Ministry of Education and Sports, September 2017; ODI (2010): Sector Budget Support in Practice – A Case Study of the Education Sector in Uganda, February 2010; JICA (2012): Uganda Basic Education Sector Assessment Report, August 2012; MoES (various years): Education and Sports Sector Annual Performance Reports..*

Year	Primary				Secondary		Post O-Level (BTVET & Other)		All Tertiary		University	
	School age population (boys)	School age population (girls)	Boys	Girls	Boys	Girls	Male	Female	Male	Female	Male	Female
2004	4,742,702	4,778,784	3,733,000	3,644,000	383,652	313,855	17,860	7,654	40,400	63,574	36,250	35,046
2005	4,898,142	4,930,163	3,642,500	3,581,300	400,758	327,635	18,754	6,844	69,558	50,587	33,127	44,807
2006	5,057,307	5,084,596	3,692,200	3,677,060	443,716	370,371	19,648	6,214	79469	57,721	52,507	40,098
2007	5,228,523	5,248,075	3,779,338	3,758,633	517,254	437,074	23,102	6,339	88,228	66,854	55,028	41,793
2008	5,409,752	5,418,984	3,987,160	3,976,819	589,358	499,386	28,709	18,589	92,820	71,755	56,318	42,658
2009	5,597,846	5,594,959	4,150,037	4,147,743	648,014	546,440	27,300	11,628	95,441	74,035	67,369	42,442
2010	5,789,067	5,773,082	4,179,248	4,195,400	654,971	570,721	27,562	11,688	98,062	76,313	78,420	42,226
2011	5,988,173	5,958,057	4,039,734	4,058,443	662,003	596,081	28,601	14,577	100,831	78,738	93,808	42,733
2012	4,576,491	4,484,416	4,168,939	4,168,130	669,334	578,103	26,906	19,083	111,831	86,235	78,817	61,270
2013	4,730,712	4,635,534	4,219,523	4,240,197	727,212	635,527	35,415	23,383	113,688	87,572	79,709	60,398
2014	4,900,720	4,802,121	4,235,669	4,249,336	709,140	665,406	40,014	29,305	39,092	109,957	100,525	79,835
2015	5,374,462	5,266,332	4,122,663	4,141,654	657,163	608,845	33,212	24,020	143,212	114,643	103,280	82,035
2016	5,597,911	5,485,285	4,294,473	4,361,451	765,406	691,871	37,107	26,178	144,314	114,552	104,432	81,980
2017	5,812,150	5,695,214	4,396,000	4,445,000	1,371,000	716,000	29,102	16,051	-	-	-	-

Source: MoES – Education and Sports Sector Strategic Plans and Annual Performance Reports; UBOS Statistical Reports; NCHE Reports; Consultant's calculations based on UN World population prospects report (http://worldpopulationreview.com/countries/uganda-population/).

Figure 12: Student enrolment by level of education, 1996 - 2017

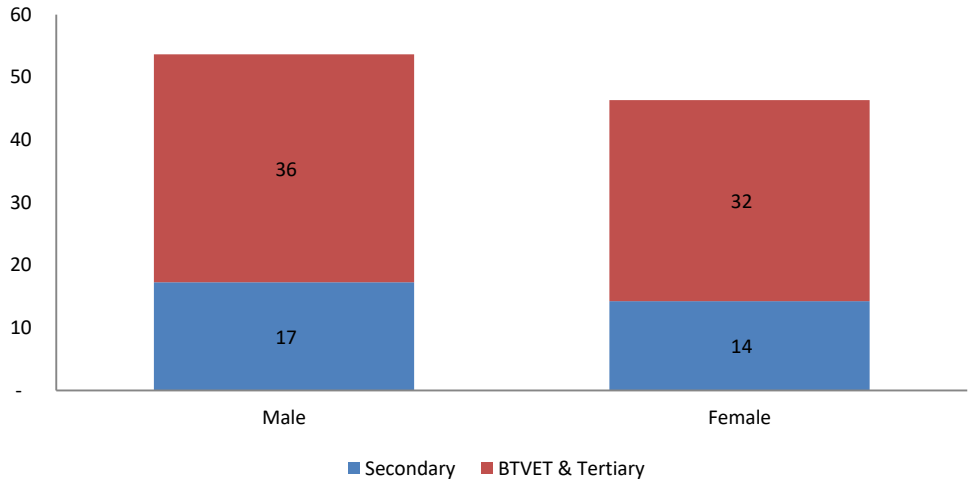


However, there is substantial spatial variation and rising inequality at regional level. This can be attributed to levels of poverty, variation in adequacy of infrastructure, social pressures, and early maternity. Literacy rates for young females still lag behind that of young boys by five percent, and nearly half of all girls in Uganda are married before the age of 18. A significant force in preventing attendance at adult literacy classes, and even higher education, is husbands stopping their wives from attending. These barriers continue throughout a woman's life, as one cited challenge to adult females' participation in literacy education. Studies have shown that marriage and pregnancy rates, prior to the age of 18, is decreased by roughly 7% when girls receive an extra year of education.

UPE has aimed to bring equality of education to all the children of the country, specifically to those in rural, impoverished areas. It has had controversial results, but overall the UPE program has successfully allowed for higher enrolment, specifically among young girls. However, there is no clarity over whether there are true gender discrimination factors affecting whether the children go to school; it is noted that girls' enrolment is dependent upon their age and their mother's level of schooling. Boys, on the other hand, are not affected by their father or mother's education level. Even though the increased number of pupils was perceived as a good thing, classes were overcrowded (between 70 and 150 pupils) and there is over-age studying in almost all schools. The UPE required pupil-teacher ratio of 1:40 was overwhelmed. The large number of pupils worsens the learning environment and it becomes harder for the teacher to be heard and teach. The issue of many classes having the inappropriate age of pupils was driven by late enrolment or grade repetition, which in turn was caused by the poor quality of education.

Massive leakages occur along the education pipeline, especially for girls[43]. Education census data from 2004, for example, indicated that for every ten students enrolled in primary schools, only one was enrolled at a secondary institution. Although survival and transition rates[44] for both boys and girls in primary school were reported to be almost the same, the rates decreased between 2011 and 2015. Survival rates declined from 32% (boys) and 31% (girls) to 30% for both boys and girls in 2015 while transition rates declined from 67% (boys) and 64% (girls) in 2011 to 53% (boys) and 52% (girls) in 2015. Between 2000 and 2016, a total of 66.8 million boys and 66.1 million girls attended primary school, giving an average of 9.5 million for both boys and girls in each of the 7 years of primary school education. Only 16% of the boys and 14% of the girls completing primary school got to attend secondary school (Figure 13).

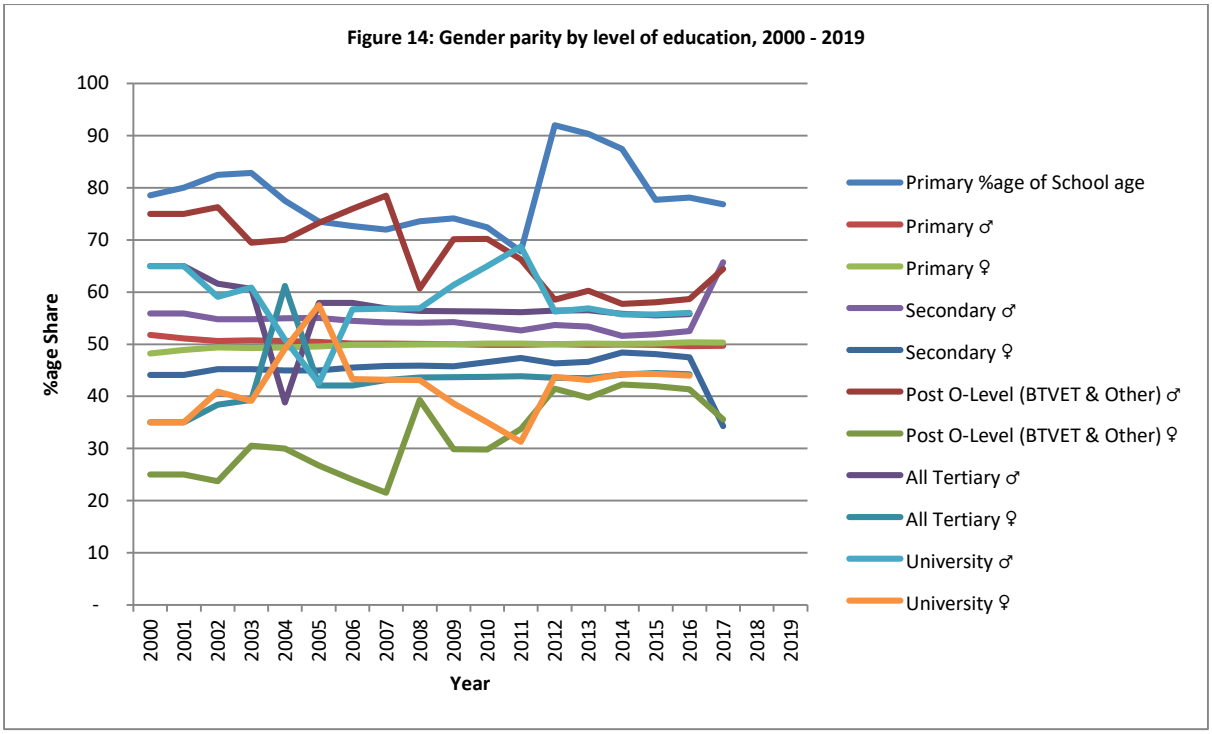
Figure 13: Overall transition rates to secondary and tertiary level education, 2000 - 2019



The gender gap has continued to narrow. Girls constituted only 44% of enrolments at secondary level, 25% in post O-level institutions and 35% in tertiary level institutions in 2000. The proportion of girls steadily increased to 46% in secondary, 41% in post O-level and 44% in tertiary institutions between 2012 and 2016 (Figure 14).

[43] ***MoES (2017)**: Education and Sports Sector Strategic Plan, 2017/18 – 2019/20, Ministry of Education and Sports, September 2017.*

[44] *Survival rate is the number of pupils that make it to the top class at each level in proportion to those that joined at the entry level in each cohort of admissions. Transition rate is the number of students that join the next level in the education pipeline in proportion to the candidates that sat the qualifying exams the previous year.*



In 2016, the enrolment rate for boys in secondary school was 4 percent higher than for girls with 29 and 25 percent respectively and the Gender Parity Index (GPI) was 86 percent. In the same year, completion rates for Senior 4 for boys stood at 40 percent, compared to 36 percent for girls. The disparity widened at the transition point to Senior 5 with 34 percent of boys and only 24 percent of girls transitioning. Learning outcomes tend to be lower for girls in certain subjects. For instance, in 2016 only 33 percent of girls in Senior 2 were proficient in mathematics in comparison with 49 percent of boys. A low quality teaching force, often lacking the necessary skills, has led to poor learning outcomes. For example, although 90 percent of secondary school teachers had the required formal qualifications, results of a learning assessment administered to secondary teachers indicated that they did not have the content knowledge and other studies have shown they do not have sufficient pedagogical skills to teach. The learning assessment found that only 66 percent of teachers were proficient in English, 70 percent in mathematics and 17 percent in biology[45].

The National Strategy for Girls' Education identified barriers and obstacles (such as location, menstruation, home responsibilities and overall attitudes within the school domain) to bringing equality in the education system for both women and girls, and particularly secondary education. The introduction of Universal Secondary Education (USE) in 2007 led to a rise of approximately 49% in girls' enrolment rates in public secondary schools. The policy was most beneficial to girls of poor households who otherwise would not have had the opportunity to attend due to fees and the general belief that boys' secondary education yields more benefits than a girls' education. However, the overall performance since the USE has decreased in the schools, as teachers are working in worse conditions and students are not as motivated, especially as their parents now see education as completely in the realm of the government whereas the policy meant to involve a plethora of actors to support children's education.

[45] *World Bank (2018): Uganda Secondary Education Expansion Project (P166570). Project Information Document (http://documents.worldbank.org/curated/en/521301533884327735/pdf/Concept-Project-Information-Document-Integrated-Safeguards-Data-Sheet-Uganda-Secondary-Education-Expansion-Project-P166570.pdf)*

4.5.5 Women in science: gender equality trends in tertiary education

In 1991, the Government of Uganda instituted a policy where girls entering university were given an extra 1.5 points to address the persistent gap in enrolment of women in higher institutions. This measure resulted in a surge in women's enrolment so that, in some university courses, women were in the majority. The higher education sub-sector has continued to expand in terms of student enrolments and the number of institutions. These increases, however, have occurred in the face of declining or stagnant unit cost funding for education facilities, infrastructure and academic staff. Although 60,000 to 70,000 students leave secondary school each year qualified to go on to higher education, only some 42% of the boys and 35% of the girls are able to find places at the limited number of institutions. The majority of students go to universities, both public and private. As depicted in Figure 13 above, the gender gap tends to widen as the level of education rises.

Women enrolment at university level increased from 23% in 1989 to 35% between 1999 and 2001; 41% in 2002 and 57% in 2005; thereafter decreasing to 31% in 2011 before rising again to an average of 44% between 2012 and 2016.. A revision of the 1.5 points policy has a provision to the effect that any disadvantaged gender should have a minimum enrolment. The NCHE[46] statistics indicate that total enrolments in the tertiary sector continued to grow since the 1980's. Most of this growth continued to be in Universities and affiliated colleges in the 1990's and 2000's. University level enrolment grew from 57,144 students in 2002 to 186,412 in 2016. Gross enrolment ratio, the students enrolled in higher education institutions, regardless of age, as a percentage of the population of the relevant age range expected to be in higher education institutions, grew from 5.4% in 2010 to 6.2% in 2011. This growth was still inadequate compared to the world average of 17.4%.

The immensely wide gender gap in BTVET education that existed up to 2006 (averaging 75% for male and 25% for female) was narrowed down to 56% for boys and 44% for girls thereafter. Student enrolment in BTVET institutions steadily increased from a very low 14,000 students in 2000 to 47,298 in 2008 and 63,285 in 2017 (Table 7). The Uganda Business, Technical and Vocational Education and Training (BTVET) Strategic Plan 2011 –2020 gives *female BTVET graduates preferential access to BTVET Instructors training* and targets 35% of female enrolment in industrial training programmes.

4.5.6 Women in science: gender equality trends in STEM study disciplines

Affirmative action exists for STEM education, and is important for two reasons. First, the measures help over the long term to ensure a cohort of qualified women for STI and other fields (and having good employment prospects could similarly stimulate enrolment in STEM study). Second, such a measure could be considered in the Public Service, although it would need to be backed up by extra measures, such as reforming the recruitment process and fast-tracking women in promotions and training, in order to attract and equip talented women as well as sensitizing employers to benefits of employing women.

The Uganda Science Education Policy (2005) made the study of Physics and Chemistry compulsory for O-Level secondary school students in addition to Biology, English and Mathematics. Enrolments in sciences at the upper secondary school level are only about 20% of the total enrolments. The science preference policy also required first year students at university to take some science subjects. Government also decreed that science students would receive 75% of the Government scholarships to public universities and tertiary institutions. Increased female enrolment in STEM is one of the objectives of the *Higher Education Students' Loan Scheme* introduced in 2013.

[46] ***NCHE (2013)***: *The state of higher education and training in Uganda 2011: A Report on higher education delivery and institutions, National Council for Higher Education, Kampala, Uganda.*

The NCHE introduced a bridging and conversion programme in July 2019 as part of university education to enable students who did not offer STEM subjects at A-Level take science courses and obtain certification after 1 year of study. Busitema University has a 27–30% quota for female students at each intake. Makerere University Council in August 2019 approved an affirmative action policy ring-fencing 40% of vacancies in all STEM disciplines for women; and runs various female scholarship initiatives for students from disadvantaged socio-economic backgrounds admitted specifically to science-based programmes. Mbarara University of Science and Technology (MUST), with support from Google runs a "STEM for Girls" project that organises workshops to build the capacity of secondary school science and mathematics teachers in order to put them in a better position to prepare and encourage girls' involvement in STEM; and also visits schools to talk to girls about the available STEM career paths, show them profiles of females working in STEM, encourage them to believe that they can make it in STEM, and connect them to mentors. It also organises STEM Camps where female mentors help girls see themselves in STEM roles they had never imagined before. The African Rural University *(www.aru.ac.ug)* is a women only university for rural transformation that focuses on teaching sustainable agriculture exclusively to women.

MoES and NCHE reports indicate that there were significant improvements in female access to higher education, computer access and use, as well as enrolment in science and technology. However, the S&T enrolments were largely in computer-related areas rather than in basic, mathematical or other technical sciences. Overall university enrolment increased on average by 14% between 2000 and 2006, while the average annual growth rate for STEM enrolments was higher at 22%. Despite this rate of growth, total student enrolment in science and technology at both private and public universities continued to lag, reported at less than 27% in 2006. NCHE further reports that enrolment into Science and Technology disciplines declined to 26% in 2011 from 35% in 2010[47]. The minimum recommended registration in science and technology in order for a country to economically take off and participate in the global knowledge based economy is 40%[48]. At the non-university level, only 6% out of 198,061 students were enrolled in science and technology – mainly for computer science and related courses.

Evidence reveals that the compulsory sciences aspect of the education policy resulted in increased student enrolment in STEM studies. The science preference policy, however, has been blamed for partially shattering girls' hopes for higher education, as noted from the widened gender gap in enrolments between 2007 and 2012. Before the policy, about 37% of government merit scholarships to university were awarded to women. The admission lists of government sponsored students to public institutions of higher learning showed further declines in female students admitted on merit – 29% in 2007 rising to 42% in 2008 and steadily declining again to 28% in 2012[49]. The gender parity gap has since been narrowed, with males constituting 56% and females 44% in 2017 (Table 7).

Despite the number of female students pursuing sciences at tertiary level increasing, it did not match the increments in the non-science disciplines. The 2017 and 2018 global gender gap reports revealed major differences in gender equality in major fields of STEM studies. Males dominated in agricultural, engineering and natural sciences (the hard and/or highly menial/practical sciences) while there was gender parity in the medical/health sciences and a narrower gap in ICT. Females continued to dominate in all non-science fields of study, more so in the services sector (Figure 15).

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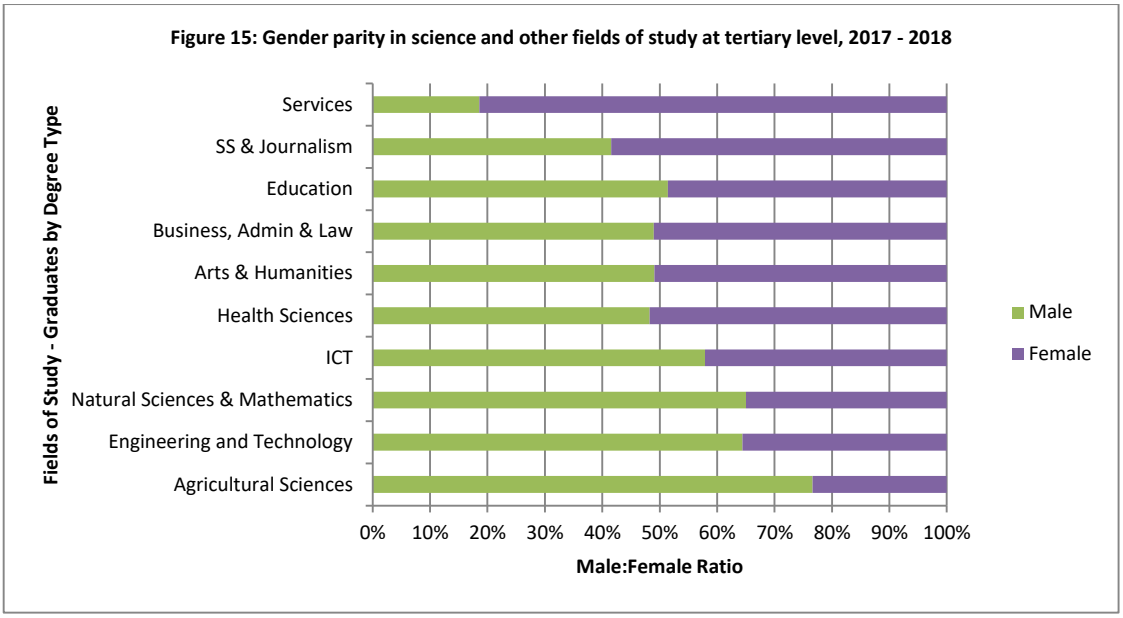
[47] In this context, the Uganda National Council for Higher Education defines science as referring to physical, natural, health, mathematical, engineering, computer, agricultural, architectural, forestry, and fisheries sciences. It does not include social or metaphysical sciences.

*[48] **UBOS (2017)**: Education – A Means for Population Transformation, Uganda Bureau of Statistics, November 2017.*

*[49] See **Lydia Namatende-Sakwa and Chia Longman (2013)**: Government Policy on Science Education in Uganda: A Glass-Ceiling for Women's Access to Higher Education. (https://biblio.ugent.be/publication/2890724/file/2911818.pdf)*



NCHE also reported that whereas female enrolments in the humanities rose by 109% during 2008-2010, this was only 18% in the medical sciences for the same period. Enrolment for female students in higher education institutions in 2005 stood at 41% rising to 44% by 2010. The only category of institutions where there were more females than males were Meteorology (62%), Management & Social Development (57%), Hotel and Tourism (54%) and Commerce/Business (51%). Males continued to dominate Survey and Land Management (90%), Aviation (86%), Theological Colleges (83%) and Agricultural Colleges (72%).

The 2015 UNESCO Science Report indicated very low representation of females in all science fields with 17.1% in natural sciences, 23.3% in engineering and technology, 30.6% in medical sciences, 19.7% in agricultural sciences, and 27% in social sciences. The WISAT 2016 assessment of gender and STI in Uganda reported an overall ratio of 39% female participation, with a considerable variation between institutions.

4.5.7 Women in the STI workforce and professional practice

The impact of affirmative action in education policy has visibly narrowed gender gaps in education, but this has not yet translated into women's equal participation in employment. Various factors are suggested, including women's lack of self-esteem, societal factors and underlying gender stereotypes that limit women's potential in the job market. Affirmative action policy that has been implemented in politics and education sectors has not been extended into the broader employment sector so that after graduation, women have to face the competitive world of work where male privilege is still largely the norm. Even in fields where there are qualified women and their numbers have been rising, such as social work and law, this is not yet reflected in women's participation, especially in the Public Service.

Besides, even if official statistics can be difficult to access, a cursory observation shows that, even in feminized sectors such as education, the pyramid that places women at the bottom of the ladder persists. Therefore, although affirmative action boosts the number of women to attain education, the only place where their seats are guaranteed is in politics. In the world of work, they have to compete on an equal basis with men and compete for the available jobs where, as evidenced from the structure of the public service and many organisations, women still dominate stereotyped jobs of personal assistants, receptionists or tea persons.

Technology was for long indisputably considered a man's arena and a simple statistics show men are likely to gain 1 job for every 3 lost to technology. Majority of the women in the STEM courses were more likely to drop it for a rather deemed "feminine" degrees for myriads of reasons from community influence to cultural believe that made science a boy's club. However, as Ugandan society became more gender equal year on year, women started to stand up and be counted. More than ever before, girls are studying and excelling in STEM disciplines. And the women thriving in STEM industry are continually mentoring, inspiring and motivating young girls willing to take the careers, which is a good start. However, the representation of women working as professionals in the STI ecosystem has not matched the dramatic increase in girls' educational achievements in these subjects. Women face considerable barriers as they move up the education ladder to research and professional careers. The share of women science career professionals and researchers differs from one field to another.

The Uganda Bureau of Statistics (UBOS) indicated that of the 1.1 million persons who were employed as business owners in 2007, about 56% (as compared to 61% in 2002) were male, who also dominated almost all the industry sectors. Females dominated the sector of accommodation and food Services as well as education, health and social work. The UNESCO, NEPAD[50] and UNCST statistics indicate that the number of researchers in Uganda doubled from 1,768 in 2007 and 1,387 in 2008 to 2,823 in 2010 and 1,942 in 2014 (Table 8).

[50] See ***NEPAD (2014):*** *African Innovation Outlook II. African Science, Technology and Innovation Indicators Initiative, NEPAD Science, Technology & Innovation Hub, NEPAD Planning and Coordinating Agency, Pretoria, South Africa*

Table 8: Researchers in Uganda, 2008 - 2014

Indicator	2008	2009	2010	2014
Number of Researchers (Head Count)	1,387	1,703	2,823	1,942
Researchers per 1 million inhabitants (Head Count)	43.80	51.97	83.42	50.01
Women Researcher (% of FTE)	39.6	40.4	24.3	29.8
Researcher employment by Sector (%)- Head Count				
Business enterprise	-	5.87	14.31	5.61
Government	-	47.45	50.69	29.51
Higher education	-	37.05	31.17	56.59
Private	-	9.63	3.83	8.29
Researchers by Field of Science (%)				
Natural Sciences	-	7.34	17.43	10.92
Engineering and Technology	-	1.64	12.15	12.05
Medical Sciences	-	39.52	10.06	18.43
Agricultural Sciences	-	13.09	11.52	17.10
Social Sciences	-	38.40	37.38	28.73
Humanities	-	-	11.45	12.77
Source: UNESCO Statistics				

Female researchers constituted 24.3% of a total head count and 26.3% of full-time equivalent (FTE) in 2012[51] and 29.8% of FTE in 2014 down from 40% in 2008/09. The total number of agricultural researchers was reported to be 559 FTE in 2016[52] with the share of female agricultural researchers rising from 20% in 2008 to 30% in 2016. The Uganda National Academy of Sciences lists 65 Fellows on their website. Only nine of these (13.9%) are female. As reported in the WEF global gender parity reports (see Table 5; Figure 11) women representation in the professional and technical workspace in Uganda, increased from 22% in 2006 to between 34 and 36% since 2014.

Among seven RUFORUM member universities[53], which accounted for a combined 83% of the teaching staff employed at Uganda's 15 agriculture-related higher education agencies, teaching capacity ranged from 15 to more than 150 staff, with varying ratios (10 – 47%) of female teaching staff. In general, female researchers and academics were younger and less qualified compared with their male counterparts. About 30% of the students enrolled in agriculture-related programs were female, but shares differed by institution and degree. In general, the share of female graduating students was lower than the share in female students enrolled.

A study[54] to trace and establish the career trajectory of a cohort of engineers who graduated between 2008 and 2012 indicated that whereas 72% of engineering graduates described their current occupation as being 'closely related' to their undergraduate training, 34% of female engineers were

[51] See ***UNCST (2013)***: *National Survey of Research and Development 2012 Report. Uganda National Council for Science and Technology, Ministry of Science, Technology and Innovation, April 2013.*

[52] ***ASTI/IFPRI (2018)***: *Uganda Agricultural R&D Indicators Factsheet Update, https://www.asti.cgiar.org/sites/default/files/pdf/Uganda-Factsheet-2018.pdf , November 2018.*

[53] ***ASTI/RUFORUM (2018)***: *Assessment of RUFORUM member universities in Uganda, https://www.ruforum.org/MCF/sites/default/files/documents/Uganda-RUFORUM-Universities-Assessment.pdf, October 2018.*

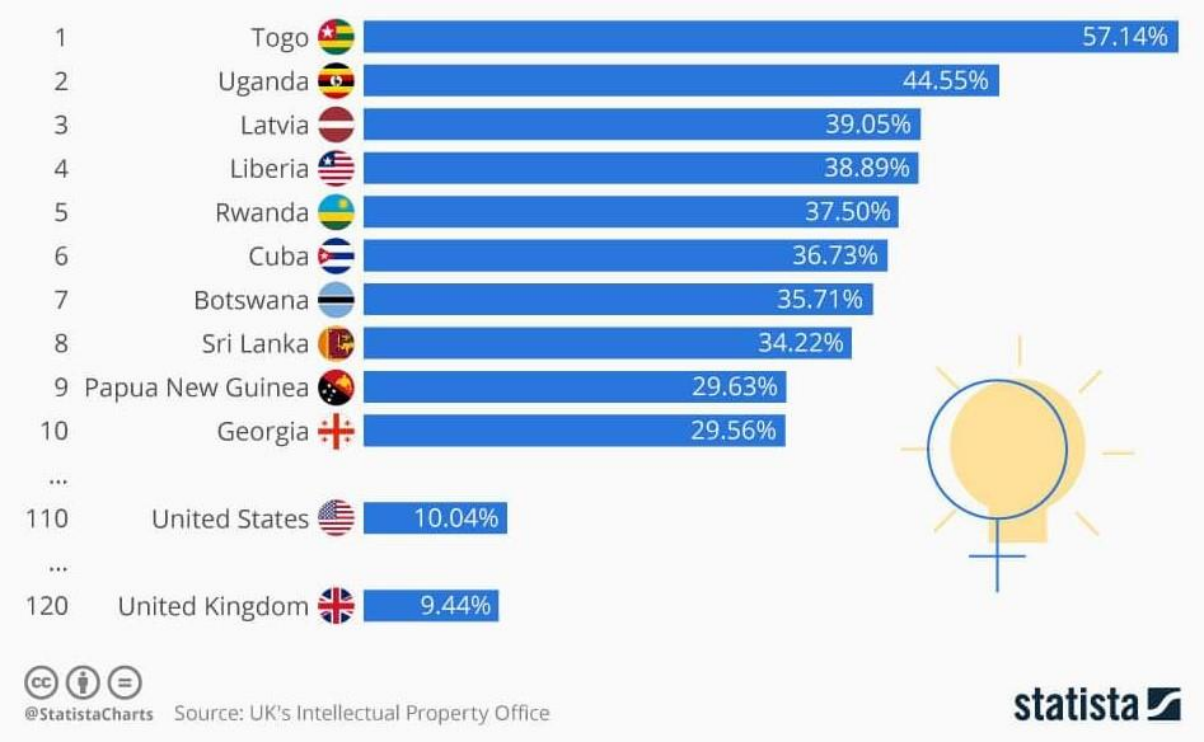
[54] ***UNCST (2016)***: *Tracer study of engineering graduates in Uganda. Uganda National Council for Science and Technology, Ministry of Science, Technology and Innovation, December 2016; UNESCO Statistics (http://uis.unesco.org/en/country/ug?theme=science-technology-and-innovation}*

in professions that were not related to engineering. In addition, whereas the number of male engineers in 'unrelated' professions reduced by 11%, the number of female engineers in such professions increased by 400% between 2008 and 2012. The increase in number of engineers in 'closely-related' professions was 46% for female and 123% for male graduates respectively. Proportionately, far fewer women engineers were registered, and only 14.8% of female engineers were nationally mobile.

4.5.8 Women in the innovation system: entrepreneurship and job creation

A recent analysis of patent statistics by the Intellectual Property Office of the United Kingdom[55], found that an increasing proportion of patent inventors worldwide are female. Between 1998 and 2017, the proportion of female inventors worldwide almost doubled from 6.8% to 12.7%. Further, the proportion of patent applications that named a female amongst their inventors rose from 12% to 21% over the same period, and the proportion of applications with at least as many female inventors as males rose from 3% to 8%. Some countries boasted a far higher female share, particularly in Africa. The study found that Uganda had the second highest proportion of female involvement at 44.55 percent behind Togo's 57.14 percent (Figure 16).

Figure 16: Countries with the most female inventors: Proportion of female inventors in patent applications, 1998-2017.



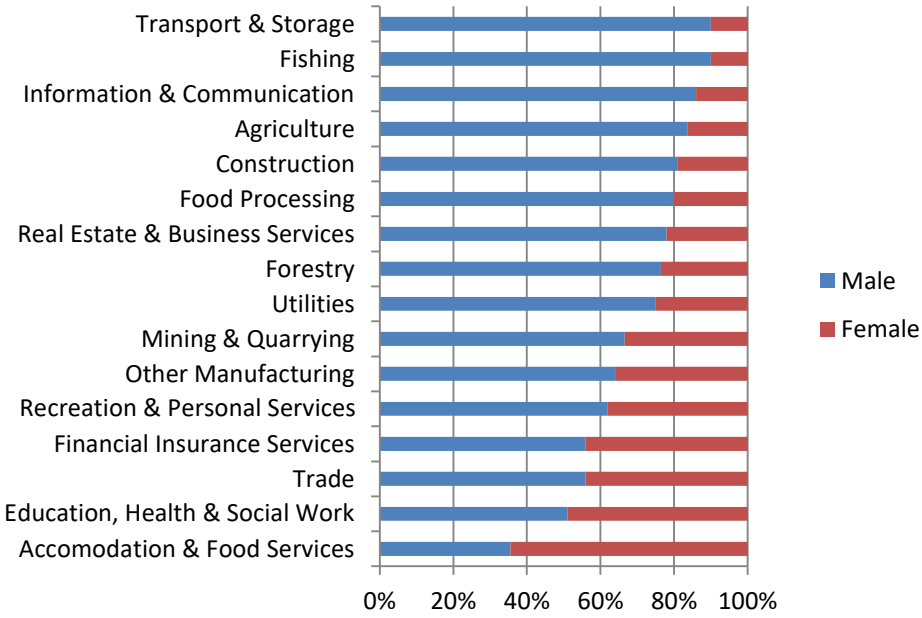
The ease of starting businesses based on new home-grown technologies remains challenging, especially for women. Between 2002 and 2011, the number of women-owned businesses grew by 236%, outpacing male-owned businesses that grew by 153%[56]. However, even though women owned

[55] ***IPO (2019)**: Gender profiles in worldwide patenting: an analysis of female inventorship (2019 edition). Intellectual Property Office of the United Kingdom (https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/834013/gender-profiles-in-worldwide-patenting-2019.pdf) and https://delano.lu/d/detail/news/countries-most-female-inventors/208038; or https://www.weforum.org/agenda/2019/10/countries-highest-numbers-female-inventors/*

[56] ***UBOS (2002)**: Report on the Uganda Business Register, 2002, Uganda Bureau of Statistics; **UBOS (2011)**: Report on the Census of Business Establishments (COBE), 2010/11, Uganda Bureau of Statistics, December 2011; **Mugabi, Enock (2014)**: Women's entrepreneurship development in Uganda: insights and recommendations / Enock Mugabi; International Labour Office – Geneva: ILO, 2014. Available at: https://www.ilo.org/wcmsp5/groups/public/---ed_emp/---emp_ent/---ifp_seed/documents/publication/wcms_360427.pdf.*

44% of the business establishments in 2010/11 up from 39% in 2002, they were mainly engaged in self-employment. The majority of women-owned enterprises were concentrated in very few sectors (Figure 17), namely the trade (44%) sector; education, health and social work (49%); and accommodation and food services (65%), indicative of the strong influence of the predominant patriarchal culture in the Ugandan society where enterprises involving technical skills are traditionally 'male' dominated sectors.

Figure 17: Ownership of businesses by gender, 2010/11



The other point to note is that, although female workers were heavily involved in agricultural production (70-80%), only 0.4% of female-owned businesses (with fixed premises) were in the agriculture sector and women owned only 16.3% of all agricultural businesses. Women were mainly engaged in sectors traditionally perceived to be 'female'. Women entrepreneurs, like other entrepreneurs, were more likely to start businesses related to their knowledge, experience and skill base (see Box 1). If social roles, educational choices and labour market experiences are gendered, then the types of businesses started by men and women will reflect this differentiation. As well, women are more likely to start enterprises with low capital costs and barriers to entry because of their lower capacity to source external financing.

Results from an African #StartUpsurvey conducted in 2014 put Uganda on top of all the countries surveyed with 36.1% of female established businesses. Similarly Uganda was ranked the top performing country in Africa in terms of women entrepreneurship, with 34.8% of businesses owned by women in 2016[57], with 90.5% of women borrowing and saving money to start a business, which was significantly higher than the 52.4% average of other low-to-lower-middle-income countries. Women entrepreneurial activity rate was 100% and labour force participation rate was 93.9%. Ugandan females also generally displayed a lower but consistently rising rate of early-stage entrepreneurial activity than males whose rate was somewhat variable from 2003 until 2012, when the total entrepreneurial activity (TEA) rates reached parity[58]. However, Ugandan women were less likely than men to own an established business: 29% of adult women were established business

[57] *MasterCard report released in 2016 (https://face2faceafrica.com/article/women-entrepreneurs-uganda). The MasterCard Index is based on three main factors: women's advancement outcomes, access to knowledge and financial services, and supporting entrepreneurial factors. MasterCard examined 54 countries around the globe, including Botswana, Ethiopia, South Africa, and Uganda.*

[58] ***Kelley, D.J. et al (2012)**: Global Entrepreneurship Monitor (GEM) 2012 Women's Report, Centre for Entrepreneurial Leadership, Wellesley, MA: Babson College.*

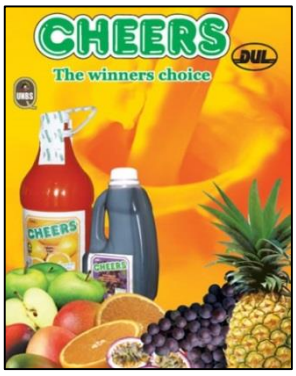
owners, compared to 34% of adult men. The rates of early-stage entrepreneurial activity were the same among adult women as adult men at 25%, but women tended, more so than men, to be motivated to start a business out of necessity (because they have no other option for work) than opportunity (seeking independence or to improve, not just maintain, their income).

The growth in TEA rates among adult women may be a factor of their lesser opportunities to secure employment. If they want to earn a livelihood or contribute to the family income, then entrepreneurial activity may be one of the only options available to them. Only 37% of women with new businesses had any employees, compared to 48% of men. For established business owners, only 38% of the women had employees versus 55% of the men. Six critical conditions are necessary for women to thrive in business: (i) gender-sensitive legal and regulatory system that advances women's economic empowerment; (ii) effective policy leadership and coordination for the promotion of women entrepreneurship development; (iii) access to gender-sensitive financial services; (iv) access to gender-sensitive business development support (BDS) services; (v) access to markets and technology; and, (vi) representation of women entrepreneurs and participation in policy dialogue. Increasing the role of women in innovation requires greater access to education, capital and markets to improve livelihood.

Promoting innovation for women requires supporting women in entrepreneurial development not only in micro and small scale enterprises but also large scale enterprises. This includes providing: advice and training; access to markets and financing; technology support in production and quality processes; representing women at senior management levels; and knowledge of business and intellectual property rights management. Very few dedicated supports are currently available to help women with growth potential to migrate to employer-businesses. One policy objective should be to identify, support and enable self-employed women with growth potential to achieve scale in their enterprise activity so they can create more employment opportunities. More effort is required to encourage women to enter into sectors with growth potential, through education, promotion of positive role models, financing, and a private sector and business climate that are open to women.

Box 1: Ugandan Women in STI Entrepreneurship.

Business acumen among Ugandan women knows no boundaries, be it in age or education levels. Both young and old, educated and non-educated can be found. ***Julian Omalla Adyeri*** has a certificate in food science and was taught by her mother to process fruits. Adyeri is the proprietor of Delight Uganda (manufacturers of the "Cheers" brand of fruit drinks), chairperson of Bunyoro Grain Farmers Association, and Till and Feed the Nation, which comprises more than 100 women members. She is into large scale crop production, owns a food processing company called Global Food Securities, where she packs flour and maize porridge for both the local market and export. She operates two poultry farms accommodating 40,000 layers and 20,000 broilers. She also makes feeds under the Mummy Choice brand. In 2008, Adyeri was among the six women in Africa to be honoured for their entrepreneurship skills by the World Bank. Delight has patterned with government and producer groups to construct fruit processing factories across the country. ***Jessica Nanyunja*** holds a PhD in Biosciences Engineering (Food Quality). She is proprietor of Harmony Nutri Foods, a growing fruit juice processing business. ***Winnie Nakato Sempa*** graduated from Makerere with a Bachelor's degree in ICT. Failing to get a job, she enrolled for a course in a technical institute on water engineering. She started a company, Winnex Technical Services that drills boreholes, constructs shallow wells, and designs and sets up small scale irrigation systems. ***Judy Rugasira Kyanda*** owns Knight Frank, one of the most prestigious Real Estate companies, an industry dominated by men. Women innovators have come up with products enhancing women health *(Ecosmart - ecopads, Aloesh Organic - herbal and food supplements)*, environmental protection and waste recycling *(Oribags, EcoStove)*, medical science and innovative research *(AfriGal Tech, Naiga Basaza organic pesticides, Ngaju Makobore's Electronically Controlled Gravity Feed Infusion Set, M-SCAN)*, food processing and value addition – *(Prudence Ukkonika – K Roma wines and juice),* and many others. Josephine Okot is the founder, managing director and chief executive officer of Victoria Seeds Limited, an agribusiness enterprise based in Uganda that processes, packages and markets agricultural seeds to farmers in the countries of the African Great Lakes. She attended Makerere University Business School (MUBS) and received postgraduate executive training from Harvard Business School and from Stanford Graduate School of Business. Okot founded Victoria Seeds Limited in 2004, with the primary objective of providing quality seeds to smallholder farmers, first domestically and then regionally. Okot's company received a financial guarantee from a USAID-funded project, which allowed her to secure start-up funding. Victoria Seeds Limited is affiliated with 900 rural farmers, the majority of whom are women. The company markets nearly 100 varieties of seeds, through over 400 affiliated agro-dealer outlets. As of August 2011, the company annual sales exceeded US$2.5 million with about 140 employees. As of 2013, Victoria Seeds Limited maintained three seed-processing facilities (a) the original facility in Gulu established in 2004 (b) the second facility located in Masindi commissioned in 2011 and (c) the new company headquarters and newest facility located in Kampala Industrial and Business Park, in Namanve commissioned in 2012. In recognition of her efforts, persistence, resilience ad mentorship, Okot has received national and international awards including the Yara Prize in 2007, the Oslo Business for Peace Award for promoting ethical and socially responsible business practices in 2009, and the Uganda Responsible Investment Award for Best Seed Company 2013.



4.6 Busitema University: A detailed Case Study

4.6.1 Introduction

Busitema University is a public University established by Statutory Instrument No.22, 2007 enacted by Parliament on 10th May, 2007. The University is a multi- campus model with seven campuses namely; Arapai, Busitema, Kaliro, Mbale, Nagongera, Pallisa & Namasagali. The main campus is located at Busitema, formerly the National College of Agricultural Mechanization, which is along Jinja-Tororo highway. Nagongera Campus is located along Tororo-Busolwe access road; Namasagali Campus is based in Kamuli District at the former Namasagali University; Arapai Campus at the former Arapai National Agricultural College, Soroti, on Moroto road; Pallisa Campus is based in Pallisa Town Council; and, Kaliro Campus at Kaliro National Teachers' College. Mbale Campus is based at Mbale Regional Referral Hospital.

The university has a strong focus on STI (Table 9) and the training of hands-on graduates, research and outreach activities to improve on innovation, and commercialization of innovations through public-private sector interface and knowledge transfer. A university Technology, Business and Innovations Incubation Centre (TBIIC) and demonstration farm to nurture innovative agro-technology based ideas into viable commercialized new technologies, with the aim of increasing production and productivity in agriculture and promoting industrialization, are some of the infrastructure projects being undertaken by the university to enhance its presence in the STI ecosystem in Uganda. The University also plans to establish a Postgraduate School, model villages and demonstration centres in order to effectively collaborate with the private sector in research and development. Investment in infrastructure and use of ICTs is a top priority.

Table 9: Busitema 2019/2020 programmes and fees per semester

Codes	Programmes	Duration (years)		Tuition (UGX '000)	
		Min	Max	Ugandans	Non-Ugandans
Bachelor Degree Programmes					
MED	Bachelor of Medicine and Bachelor of Surgery	5	8	1,300	1,950
BNA	Bachelor of Science in Anaesthesia	3	5	1,300	1,950
BNS	Bachelor of Science in Nursing	4	6	1,300	1,950
AMI	Bachelor of Agricultural Mechanization and Irrigation Engineering	4	6	1,250	1,875
BCT	Bachelor of Science in Computer Engineering	4	6	1,250	1,875
SCS	Bachelor of Science in Computer Science	3	5	1,300	1,950
BTI	Bachelor of Information Technology	3	5	1,300	1,950
SCE	Bachelor of Science Education	3	5	700	1,050
SPE	Bachelor of Science Education (Physical Education)	3	5	700	1,050
BEP	Bachelor of Education Primary	3	5	235 (Per Session)	352.5 (Per Session)
ELS	Bachelor of Education Languages (English and Literature in English)	3	5	700	1,050
MEB	Bachelor of Science in Mining Engineering	4	6	1,250	1,875
TEX	Bachelor of Science in Polymer, Textile and Industrial Engineering	4	6	1,100	1,650
WAR	Bachelor of Science in Water Resources Engineering	4	6	1,250	1,875
APE	Bachelor of Science in Agro-Processing Engineering	4	6	1,100	1,675

Codes	Programmes	Duration (years)		Tuition (UGX '000)	
		Min	Max	Ugandans	Non-Ugandans
NRE	Bachelor of Science in Natural Resources Economics	3	5	800	1,200
FWR	Bachelor of Science in Fisheries and Water Resources Management	3	5	800	1,200
BBA	Bachelor of Business Administration	3	5	700	1,050
BBW	Bachelor of Business Administration (Weekend)	3	5	700	1,050
BAB	Bachelor of Agribusiness	3	5	800	1,200
APM	Bachelor of Animal Production Management	3	5	1,100	1,650
BSA	Bachelor of Science in Agriculture	4	6	1,100	1,650
BPM	Bachelor of Procurement & Supply Chain Management	3	5	700	1,050
BTT	Bachelor of Tourism and Travel Management	3	5	700	1,050
ENM	Bachelor of Entrepreneurship Development and Management	3	5	700	1,050
Diploma and Certificate Programmes					
DEP	Diploma in Education Primary	3	5	180(Per Session)	270 (Per Session)
DGE	Diploma in Ginning and Industrial Engineering	2	3	500	750
DAG	Diploma in Agricultural Engineering	2	3	500	750
DCE	Diploma in Computer Engineering	2	3	600	900
DAP	Diploma in Animal Production and Management	2	3	400	600
DCP	Diploma in Crop Production and Management	2	3	400	600
DBA	Diploma in Business Administration	2	3	400	600
DEE	Diploma in Electronics and Electrical Engineering	2	3	900	1,350
DRI	Diploma in Records and Information Management	2	3	400	600
DTT	Diploma in Tourism and Travel Management	2	3	400	600
DLB	Diploma in Science Laboratory Technology (Biology)				
DLC	Diploma in Science Laboratory Technology (Chemistry)				
CGA	Certificate in General Agriculture	2	3	360	540
Master Degree Programmes					
MMM	Master of Medicine (Internal Medicine)	3	5	2,000	3,000
MPC	Master of Medicine (Paediatrics and Child Health)				
MPH	Master of Public Health	2	3	3,000	5,400
MBA	Master of Business Administration	2	3	1,100	1,650
EDM	Master of Educational Leadership and Management	2	3	1,500	2,250
MIM	Master of Science in Industrial Mathematics	2	3	1,800	2,700
PHB	Master of Science in Physics	2	3	2,000	3,000
MCC	Master of Science in Climate Change & Disaster Management	2	3	1,800	2,700
MID	Master of Science in Irrigation and Drainage Engineering	2	3	1,895	2,842.5
MCF	Master of Computer Forensics	2	3	1,800	2,700
PCF	Postgraduate Diploma in Computer Forensics	1	2	1,800	2,700

Source: BU (2018): 2018/19 Notes for New Students. Busitema University, Office of the Academic Registrar (http://www.busitema.ac.ug/wp-content/uploads/2018/07/Busitema-BOOK__Joining-Instructions.pdf)

4.6.2 Gender mainstreaming

The university gender policy puts emphasis on gender research, budgeting, quality control and university outreach initiatives that pool knowledge, skills, experiences and resources from the larger society to support gender mainstreaming and university development. Busitema received a six-year gender mainstreaming fund of US$ 2.5m USAID in 2012 to address student, staff, curriculum and institutional development. The university budgets for building capacity of staff in gender concepts and analytical skills to enable them engender teaching, learning and community engagement. Despite a strong commitment to gender parity in the administration, staffing and student enrolment, this is far from being attained. For example, the current University Council - the supreme policy formulation organ of the University - has only 5 (25%) female members out of 20. Only one (14.3%) of the Heads of the seven academic units (6 Faculties[59] and the Directorate of Graduate Studies, Research and Innovation) is female. However, the university had the opportunity of having the first female Vice Chancellor of the 9 public universities in Uganda. The university budgets funds for conducting gender sensitive tailor-made career guidance in secondary schools and teaching practice in rural-poor-science-performing schools in Eastern Uganda.

The university admission policy also has a gender parity dimension. Apart from the quota allocation, female students also generally have lower cut off points on admission for most courses (Table 10). In a few cases, they were either at par or higher than males: Nursing in 2018/19; Education in 2017/18; Natural Resource Economics in all three academic years 2016 – 2018; Fisheries and Water Resources Management and Animal Production in 2017/18 (Figure 18). A plausible explanation is that the engineering courses require a mandatory Mathematics and Physics as the essential subjects where girls tend to perform poorly. In the courses where they come on top, the range of essential subjects expand to two best done of Mathematics, Physics, Biology, Chemistry and/or Economics and one best done of Entrepreneurship, Mathematics, Agriculture, Foods & Nutrition, Chemistry, Physics, Biology, Geography. Academic year 2017/18 was rather unique as females came in at higher cut-off points in most of the courses (Figure 19), indicating a generally higher performance by girls in the A-level examinations the previous year.

Table 10: Cut-off points for Busitema University programmes (government sponsorship)

Codes	Programmes	2016/17		2017/18		2018/19	
		F	M	F	M	F	M
MED	Bachelor of Medicine and Bachelor of Surgery	42.5	44.5	43.2	43.8	43.1	45.8
BNA	Bachelor of Science in Anaesthesia	-	-	-	-	41.3	43.7
BNS	Bachelor of Science in Nursing	41.8	46.1	41.6	41.9	43.0	42.4
AMI	Bachelor of Agricultural Mechanization and Irrigation Engineering	41.0	42.5	34.7	37.1	40.1	44.1
BCT	Bachelor of Science in Computer Engineering	44.7	45.0	40.7	42.8	40.0	44.5
SCS	Bachelor of Science in Computer Science	-	-	-	-	34.8	40.2
SCE	Bachelor of Science Education	37.9	39.3	38.5	37.2	37.4	48.9
MEB	Bachelor of Science in Mining Engineering	37.9	41.2	39.0	39.3	40.8	41.5

[59] *Faculties of Health Sciences (FHS), Agriculture & Animal Sciences (FAG), Natural Resources & Environmental Sciences (FNR), Science and Education (EDU), Engineering (ENG), Business & Management Sciences (FMS).*

Codes	Programmes	2016/17		2017/18		2018/19	
		F	M	F	M	F	M
TEX	Bachelor of Science in Polymer, Textile and Industrial Engineering	41.5	42.1	38.3	38.3	40.8	42.1
WAR	Bachelor of Science in Water Resources Engineering	41.7	47.2	41.0	43.6	44.0	47.5
APE	Bachelor of Science in Agro-Processing Engineering	39.7	41.7	37.5	39.0	41.1	42.2
NRE	Bachelor of Science in Natural Resources Economics	43.9	41.5	44.6	41.1	45.6	44.6
FWR	Bachelor of Science in Fisheries and Water Resources Management	-	-	37.1	35.4	40.0	40.3
APM	Bachelor of Animal Production Management	35.9	37.9	37.7	37.5	37.4	38.2
BSA	Bachelor of Science in Agriculture	-	-	-	-	38.5	38.5
DGE	Diploma in Ginning and Industrial Engineering	28.7	32.4	28.9	28.0	29.8	29.8
DAG	Diploma in Agricultural Engineering	29.7	31.3	24.5	33.2	32.1	36.7
All Courses	All Courses	39.0	41.0	40.6	38.4	39.4	41.8

Source: MoES (https://news.mak.ac.ug/sites/default/files/downloads/MoES-Public-Universities-Joint-Admissions-Info-2019-2020-Busitema.pdf)

Figure 18: Average admission cut-off points, 2016 - 2018

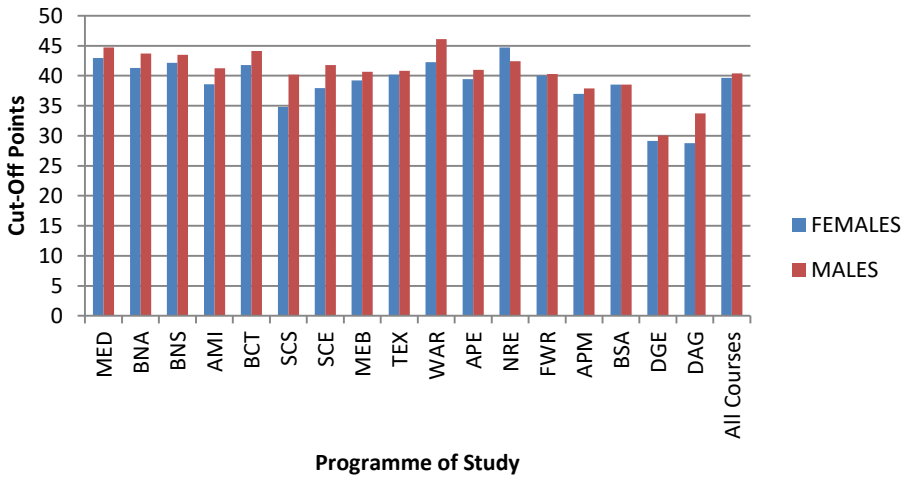
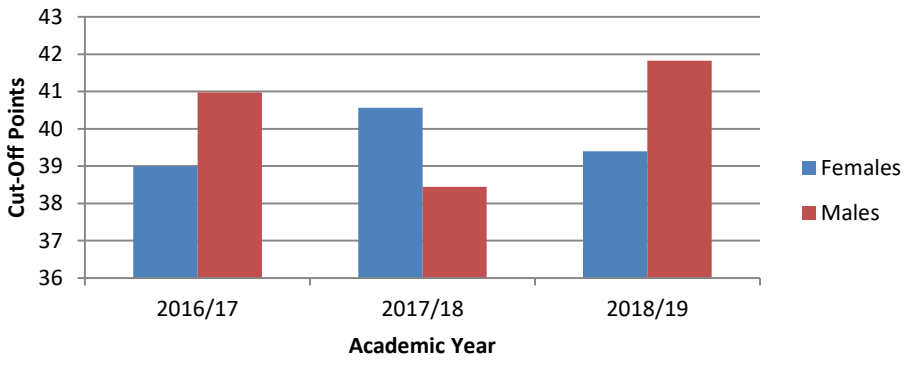


Figure 19: Average cut-off points for all courses, 2016 - 2018



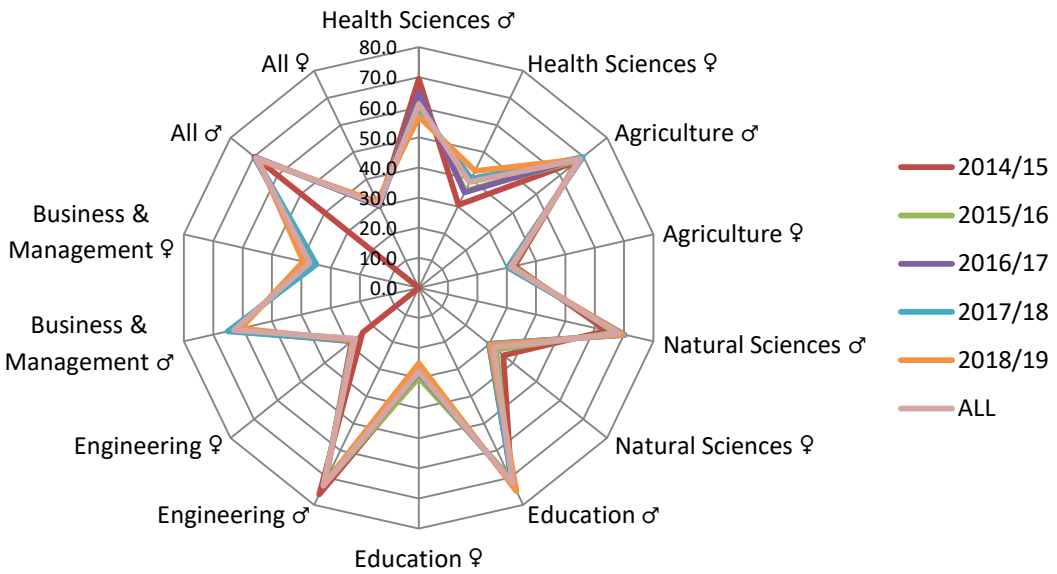
4.6.3 Inequalities in student enrolment and graduation

Busitema University, which specialises in engineering courses, has a quota allocation of 27 - 30% for female students. The overall undergraduate student enrolment was slightly above 3,100 between 2014 and 2016, and then increased by 10% in 2017 to 3,467 and 4.3% in 2018 to 3,615 (Table 11). The female student enrolment increased at a higher rate (20.8%) than males (13.1%) between 2014 and 2018. However the overall male to female student ratio remained at 68 – 70 % for males and 30 – 32% for females (Figure 20).

Table 11: Undergraduate student enrolment by faculty and gender, 2014 - 2018

Year	FHS		FAG		FNR		EDU		ENG		FMS		Total University	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F
2014/15	75	33	1,271	616	66	37	216	89	555	174	-	-	**2,183**	**949**
2015/16	124	69	1,205	565	61	30	268	114	553	206	19	11	**2,230**	**995**
2016/17	188	102	1,033	452	66	28	358	141	516	206	39	22	**2,200**	**951**
2017/18	258	174	1,000	436	32	75	466	181	515	201	84	45	**2,398**	**1,069**
2018/19	269	204	1,152	526	80	35	389	130	186	479	100	65	**2,469**	**1,146**
Total	**914**	**582**	**5,661**	**2,595**	**348**	**162**	**1,697**	**655**	**2,618**	**973**	**242**	**143**	**11,480**	**5,110**
%age	**61.1**	**38.9**	**68.6**	**31.4**	**68.2**	**31.8**	**72.2**	**27.8**	**72.9**	**27.1**	**62.9**	**37.1**	**69.2**	**30.8**

Figure 20: Undergraduate students enrolment by faculty and gender, 2014 - 2018



There were gender differences in enrolment in the different courses, with a much lower proportion of females enrolling for engineering (27.1%) and science & education (27.8%) courses than for health sciences (38.9%), agriculture (31.4%), natural resources management (31.8%) and business (37.1%). The proportion of females enrolling for postgraduate study was also lower (25.2%) with noticeable differences between courses (Table 12 and Figure 21). For example, more females enrolled for medicine (33.3%) and business administration (40.7%) than for irrigation and drainage engineering (7.1%), industrial mathematics (11.1%) and computer forensics (7.7%). The proportion of females graduating also gets lower as the level of qualification increases, averaging 38.4% for certificate, 28.8% for diploma and 22.4% for the degree (Table 13).

Table 12: Admissions for post graduate programmes, 2014 - 2018

Course	2014/15		2015/16		2016/17		2017/18		2018/19		TOTAL			
	F	M	F	M	F	M	F	M	F	M	F	M	%F	%M
Climate Change	3	6	5	9	4	10	3	21	9	25	**24**	**71**	**25.3**	**74.7**
Irrigation	-	4	-	-	-	5	1	10	1	7	**2**	**26**	**7.1**	**92.9**
Public Health	-	-	5	5	3	10	9	22	5	15	**22**	**52**	**29.7**	**70.3**
Education	-	-	1	5	3	7	3	7	2	9	**9**	**28**	**24.3**	**75.7**
Mathematics	-	-	-	-	-	3	-	-	1	5	**1**	**8**	**11.1**	**88.9**
Computer	-	-	-	-	1	3	-	-	-	9	**1**	**12**	**7.7**	**92.3**
Physics	-	-	-	-	-	-	1	4	-	-	**1**	**4**	**20.0**	**80.0**
Business	-	-	-	-	-	-	2	10	9	6	**11**	**16**	**40.7**	**59.3**
Medicine	-	-	-	-	1	1	-	-	-	1	**1**	**2**	**33.3**	**66.7**
Paediatrics	-	-	-	-	-	-	-	-	3	4	**3**	**4**	**42.9**	**57.1**
Total	3	10	11	19	12	39	19	74	30	81	**75**	**223**	**25.2**	**74.8**
%age	**23.1**	**76.9**	**36.7**	**63.3**	**23.5**	**76.5**	**20.4**	**79.6**	**27.0**	**73.0**	**25.2**	**74.8**		

Figure 21: Student enrolment in graduate programmes by course and gender

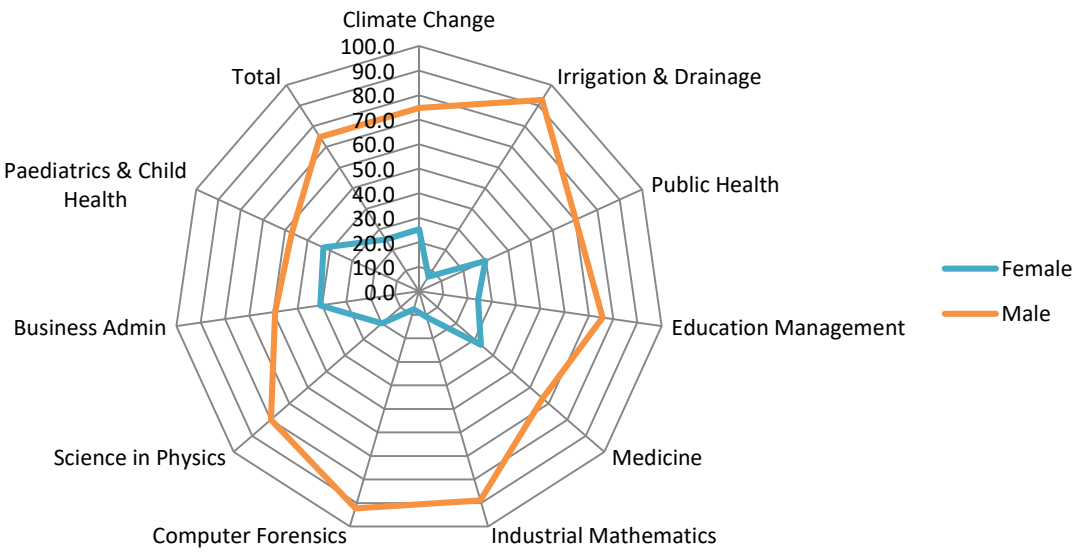


Table 13: Graduands by level of qualification and gender, 2010 - 2017

	2010		2011		2012		2013		2014		2015		2016		2017		Total	
	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M
Number of graduands																		
Certificate	-	-	-	-	-	-	41	89	167	277	182	258	130	172	74	156	594	952
Diploma	-	-2		5	9	23	82	213	137	391	110	299	127	352	132	194	597	1,479
Bachelors	9	34	21	124	20	136	53	190	50	190	75	224	67	189	72	181	367	1,268
Total	9	36	21	129	29	159	176	492	354	858	367	781	324	713	278	531	1,558	3,699
Proportion of graduands (%)																		
Certificate	-	-	-	-	-	-	32	68	38	62	41	59	43	57	32	68	38	62
Diploma	-	100	-	100	28	72	28	72	26	74	27	73	27	73	40	60	29	71
Bachelors	21	79	14	86	13	87	22	78	21	79	25	75	26	74	28	72	22	78

4.6.4 Inequalities in staff establishment

As of 30th June 2018, staffing level was at 48.2% with 160 teaching staff in post against 332 approved posts, which still below the education sector strategic plan target of at least 55%. Females constituted only 23.8% of the academic staff (Table 14), with engineering (17.9%), health sciences (20.8%) and agriculture (23.5%) having a lower proportion of female staff than natural resources and environment (36.4%) and science & education (31.3%). There was no female member of staff in the Faculty of Business and Management Sciences. Males also dominate the higher ranks, but there appears to be a deliberate push to recruit and mentor young females into academic careers as is indicated by the higher proportion (57.9%) of female Teaching Assistants (Table 15). The female ratio for the administrative and support cadre was 34 -35% and 24 – 27% respectively (Table 16).

Table 14: Academic staff numbers by faculty and gender, 2016/17 – 2018/19

Faculty	2016/17 & 2017/18			2018/19		
	M	F	%F	M	F	%F
Health Sciences	16	6	27.3	19	5	20.8
Agriculture & Animal Sciences	15	4	21.1	13	4	23.5
Natural Resources & Environment	8	3	27.3	7	4	36.4
Science and Education	35	17	32.7	33	15	31.3
Engineering	37	11	22.9	46	10	17.9
Business & Management Sciences	5	0	0	4	0	0
TOTAL	**116**	**41**	**26.1**	**122**	**38**	**23.8**

Table 15: Academic staff by rank and gender, 2016/17 – 2018/19

Title	Approved Posts	2016/17 & 2017/18			2018/19		
		M	F	%F	M	F	%F
Professor	41	2	1	33.3	2	0	0
Associate Professor	40	3	0	0	2	0	0
Senior Lecturer	70	12	1	7.7	14	1	6.7
Lecturer	102	68	26	27.7	73	23	24.0
Assistant Lecturer	51	22	4	15.4	23	3	11.5
Teaching Assistant	28	9	9	50.0	8	11	57.9
TOTAL	**332**	**116**	**41**	**26.1**	**122**	**38**	**23.8**

Table 16: Administrative and support by gender, 2016/17 – 2018/19

Title	2016/17			2017/18			2018/19		
	M	F	%F	M	F	%F	M	F	%F
Top Management							5	2	28.6
Administration Staff	44	23	34.3	44	23	34.3	35	19	35.2
Chief Technicians							7	0	0
Library Staff							13	9	40.9
Support Staff	201	64	24.1	137	64	31.8	135	49	26.6
TOTAL	**245**	**87**	**26.2**	**181**	**87**	**32.5**	**195**	**70**	**26.4**

CHAPTER V: EMERGING ISSUES, CHALLENGES AND OPPORTUNITIES

5.1 Paradigm Shifts, Policy Coherence and Management of STEM Education and STI Practice

Uganda recognises the centrality of STI and gender equality in the national development process and has created an enabling policy environment to harness social and economic growth dividends arising from gender-sensitive STI activities. Revitalizing the manufacturing, agriculture and agro-processing sectors in Uganda offers enormous possibilities for industrialisation and employment generation. In this regard, the most important ingredient for success is the availability of a highly skilled domestic technical workforce. It is therefore important for Uganda to consolidate policies and strategies which promote STEM study at all levels to facilitate the development of higher order skills necessary for modernising or revamping local manufacturing industries.

Acknowledging the importance of STI and gender parity and the formulation of policies and strategies are not enough to unleash the full potential of girls' and women's participation in the knowledge economy for sustainable socio-economic development. Inadequate and undiversified funding regimes remain a major challenge to the development of more vibrant STI infrastructure, and in the absence of private-sector funding and competitive grants, public universities and research institutes predominantly depend on dwindling public subventions as well as unpredictable international donor support. This narrow funding base leads to severe financial deficits and limits the capacity of the national STI institutions and individual researchers/innovators to formulate and drive domesticated research and innovation agendas.

STEM education and training requires an economic policy environment that promotes the creation and growth of enterprises and stimulation of the economy to create opportunities for the STEM graduates. Uganda's US$30+ billion economy is made up of the agriculture, industry and services sector with services (including ICT) making the highest GDP contribution of 42%, compared to 41% and 17% from the industry (largely manufacturing) and agriculture sectors respectively – sectors that are most amenable to science and technology application. When businesses in these sectors grow or expand, demands for new or additional technical skills emerge, new training opportunities arise, and additional jobs are created. Furthermore, skills training systems are greatly enhanced by a strong management and leadership capacity to drive the entire system. The policy framework and governance arrangements for the management of the higher education, research and innovation systems clearly demonstrate an unmistakeable emphasis on developing more effective institutional arrangements and policies to promote STI governance and gender equity and nurture a knowledge economy.

Uganda's national development policy frameworks and program initiatives demonstrate a clear focus on the interconnectedness between STI and development planning. However, the level of coherence within and among the existing policies, programs, and institutions still remains relatively weak. The key and probably most persistent weakness is the lack of adequate incentives for full implementation of both national and institutional policies and programmes, and to stimulate and encourage

collaboration and knowledge exchange between research and industry/business (innovation) subsystems. STI ecosystem managers with multiple professional, pedagogical, leadership and people skills are needed within the STEM delivery chain and STI skills application staircase. This must have multiple implementation structures, including the provision of equal opportunities and, where appropriate, gender-focused incentives to enhance the participation of girls and women.

Increasing investments in the STI sector and building a strong engendered strategy implementation capacity are important, but a paradigm shift in perceptions about (and the provision of) STEM education and STI practice is required. The need for systematic and coherent approaches to integrating STI policy and programming that have a gender lens into national economic and development strategy cannot be overemphasised. *This embedding process should accord particular emphasis on the coherent translation and cascading of national development goals and STI policies into clear action plans and intervention programs that are directly connected to promoting economic growth and improving people's real livelihoods. Policymakers require greater awareness and capacity building to ensure that national STI policies and programs capture the national development priorities and are internally and externally consistent in order to promote policy complementarily, coherence, and effectiveness.*

Mainstreaming of gender and STI at the national development policy level, and the growing emphasis on the instrumentality of universities in promoting economic competitiveness and sustainable development, is increasingly leading higher education institutions to strongly integrate into the emerging knowledge-based development paradigm and discourse. Ugandan universities are refocussing their vision, resources, capacity, and leadership to embrace STI as a guiding principle for their strategic planning and delivery of academic programmes. *Internationalisation, particularly through transnational and transdisciplinary partnerships and networks among universities, has broadened opportunities and represents one of the most effective options for strengthening STEM education and research capacity and governance arrangements*.

5.2 Ensuring Flexibility, Relevance, Quality and Employability of STEM Training

Training for high-quality skill in STI requires qualified instructors; appropriate training facilities, equipment and tools; adequate supply of training materials; practice by the learners; and participation of industry practitioners in training delivery. National policymakers, HESTI and TVET leadership, R&D institutions and the private sector need *platforms for interaction and working in closer partnership to prioritize the strategic importance of a pluralistic STI ecosystem in national economic growth and competitiveness by investing more significantly in strengthening STI capacity, infrastructure, and opportunities.*

Assuring the employability of trainees begins with *effective guidance and counselling of potential learners in the choice of training programmes in relation to their aptitude, academic background, career ambitions, as well as current or future job openings. Gender stereotypes must be avoided in all this*. The notion of employability presupposes that the skills needs of the labour market should drive training provision. There is therefore need for dynamic labour market information systems which track current and future skills needs in the economy. There are many challenges facing the education sector, including: high enrolments, poor throughput, excessive numbers graduating, and a proliferation of education institutions of varying calibre. To address the poor quality of graduates and high dropout rates due to inadequate staffing and poor facilities and support, the bottlenecks that require attention include the following:

- ***Infrastructure:*** Facilities, laboratories and teaching space are limited and have not been expanded to cope with the increased enrolments in recent years. Most lecture venues were built for smaller classes and enlarging them is not always an option, as venues become audio-

visually compromised. Many universities have antiquated equipment, as well as not having enough sets of equipment for the large numbers enrolled; shortage of computers and up-to-date software; and library facilities that cannot cater for the number of students enrolled and have not been modernised to include access to online research materials and books.

- ***Staffing numbers:*** Academic staffing is the core of what it takes to make a meaningful impact to ensure the success of students. Staffing shortages, high vacancy rates, unsatisfactory staff-student ratios and staff attrition are evident across the system and severely compromise the ability to supply the necessary support to individual students. The existing lecture venues and laboratories are not designed to accommodate large classes, necessitating the splitting of classes into groups which increases the teaching load, in addition to lecturing staff being expected to undertake research and supervise post-graduate students without a decrease in their lecturing load. The heavy load and the lack of competitive packages lead to lecturing staff leaving or not wanting to enter the higher education sector. University policies should embrace and support the use of external specialists or retired professionals to supplement the teaching staff and act as mentors.

- ***Staff qualifications and skills:*** The qualification levels of lecturing staff are not always appropriate for the qualifications being offered and there is insufficient funding to support them to continue with post-graduate studies. To fill posts, recent graduates are employed, many of whom see these jobs as a temporary measure until they find something more suitable. Without post-graduate knowledge, work experience or lecturer training, they can contribute very little to the development of their students. A good number of academics lack practical experience and cannot adequately contextualise the theory. Traditionally, lecturers were selected based on expertise in their field, and there was no requirement for them to have formal teaching qualifications and soft skills. With the increasing load, the changing student profile and generational learning differences, they are not well equipped to engage today's students in new and contemporary ways. Professional registration and keeping up with the latest technology are important, but few institutions cover annual professional registration fees or membership of voluntary associations.

- ***Supporting staff:*** There are not enough dedicated laboratory technicians to ensure that equipment is adequately set up, calibrated, operated and maintained, and to assist with practical sessions to achieve optimum results. Many universities do not have enough administrative staff to remove the burden of routine paperwork and reporting from overstretched academics.

- ***Curricula:*** Re-curriculation and modernisation of many courses and associated material should be considered. At many institutions, course content does not consider rural or local challenges and solutions. Little time is spent on solving problems and developing new and creative ways for value addition. Content should be presented to, and debated with, industry, governments and educational specialists to ensure that it is fit for purpose, and sufficiently challenges students to meet the requirements of the job market. To ensure that graduates can cope with the ever-changing environment, skills in critical thinking, problem-solving, creativity, teamwork and managing people should be developed.

- ***Teaching and learning***: Teaching methods ought to be adapted for the 21st century student and should include problem-based learning, blended learning and the use of clickers and the like to ensure engagement. The use of the 'flipped classroom' is one such innovation - where students watch lectures online and attend classes to discuss topics and undertake associated activities. Traditional teaching methods, that encourage cram work to pass exams, produce graduates with limited critical thinking, complex reasoning and writing - skills that are so

critical for STEM/STI students and professionals to develop. They attribute much of this to colleges not adapting to today's life and learning styles.

- The ***learning environment*** is also important. Millennial learners tend to absorb more information and develop problem-solving techniques through dialogue. Open spaces for engagement and group work is important but is not always available. In the early years of study where classes are very large, lecturers cannot identify and support all the students who are struggling for various reasons: poor foundation in mathematics and science; writing difficulties due to poor English grammar; lack of career and course guidance at school, resulting in students not being suited to the qualification chosen; challenges with living conditions due to inadequate funding; adjustment to university life, particularly for those transitioning from rural areas; and, lack of family and community support.

- ***Practical training:*** Industrial /Field attachments allow students to understand the context in which they are learning. However, finding willing employers and monitoring progress is expensive and funding is no longer adequate to cover these activities. Without completing time in the workplace, students graduate with little or no practical experience. A consistent and prominent demand from employers is for candidates who have applied their studies in a practical manner and are thus able to contribute without the need for extensive additional training.

- ***Funding***: Making funding available for tertiary education is an ongoing challenge and there are never enough funds to cover all the shortcomings. Governments need to prioritise investment in STEM departments, and industry needs to be encouraged to supplement salaries or contribute to investment funds. Where industries require specialist knowledge and research to be carried out, they should be encouraged to fund professorial chairs and research students. Although industry and funders are often happy to make funds available, funds are frequently diverted into other budgets. It is important that mechanisms are put in place to ensure that funding given to universities for specific initiatives are ring-fenced so that they are used for the chosen purpose.

- ***Too Many Graduates?*** There is a persistent complaint about a shortage of STEM skills, despite the opening of many more universities and the offering of many more STEM qualifications. It would appear that it is not a case of unavailable (scarce) skills, but rather the presence of qualified people who do not have appropriate experience thus creating a skills gap. This is being caught up in the web of - *'Too few, too many, No experience – can't get a job, No job – can't get experience'*. There are 'too few experienced' STI professionals and far 'too many inexperienced' graduates. The number graduating has increased substantially since the 2000s and exceeds the number that can be absorbed, giving rise to the phenomenon of the unemployed graduate. The continued supply-side approach to education and training has to change and become more reflective of demand.

5.3 The Gender Question in STEM Education and STI Workforce

Uganda recognises women's legal status and rights as cornerstones of inclusive growth and gender equality. National and local government structures have supported gender-focused governance, legal and regulatory regimes; secure property ownership for women; reduction in gender-based violence; and a private sector and business climate that are open to women. Economically empowering women has involved increasing women's access to and control over financial resources and services, leveraging infrastructure for gender equality, advocating for affirmative action in favour of women and women-owned businesses, increasing the productivity of women and facilitating their inclusion in the market, and providing women with skills training in science and technology.

There has been a strong push for knowledge management and capacity building for gender equality, including improving national, sectoral and institutional gender results reporting, building the capacity of the public service to promote gender equality in operations, supporting education and research institutions in building their capacity to promote and mainstream gender equality in policies and programmes, and producing better gender-disaggregated data and gender statistics.

The national gender-sensitive investments and interventions in STI have focussed on:

a) Establishing supporting institutional structures needed for effective and sustainable STI policy implementation, and approaches that facilitate the application of a gender lens, ensuring that both women and men benefit;

b) Establishing and maintaining effective partnerships and consultation with stakeholders in the study and application of science, and in the development and deployment of technologies, to ensure benefits to both women and men;

c) Identification of strategies needed to choose, implement and develop successful models for attaining and maintaining gender parity, and their eventual replication across sectors and institutions;

d) Capacity development by providing tools, knowledge, skills, networking and connections, funding, and recognition.

The STI and gender spectrum in Uganda is a mix of both vertical (sectoral) and horizontal (general) policies and governance structures, with different aspects of the STI ecosystem run by separate government MDAs. Often there is poor coordination, little formal collaboration and inadequate funding within and across sectors. To be effective, there is need to:

a) Strengthen governance of STI and gender through the mandated structures that have clearly defined responsibilities to ensure strategic implementation and appropriate political backing. In particular, there is noticeable variability across sectors and MDAs in the extent to which the adopted policies and compliance measures have been implemented. Clear implementation guides and results matrices should be provided, sectors and areas lagging behind identified and strategies to accelerate the implementation process based on detailed implementation plans for each priority area and strategic action devised;

b) Conduct regular foresight exercises to inform STI and gender action plans aligned to global, continental, regional and national agenda and integrated across all the science-dependent sectors. This should draw on the support of international and regional partners in ascertaining the necessary expertise to craft these plans;

c) Institutionalise regular reporting on STI and gender indicators and monitoring of STI and gender policy across all MDAs and sectors, including institutionalizing reporting on social (gender) and environmental impacts of STI operations and investments by both the public and private sectors. This will involve improving the monitoring of impacts of policies and programmes on women and men in STI sectors and the systematic collection and use of gender-disaggregated data to ensure that STI benefits both men and women equally;

d) Reinforce the gender dimension in the national STI policy and link it to policies in other sectors, especially those with a high potential for poverty reduction and human development (food and agriculture, water, energy, infrastructure, industry, ICT, education);

e) Foster a cooperative and interlinked approach among all relevant MDAs including, for instance, ministries of agriculture, energy, trade, industry, health, education, transport, ICT and STI, and the national agencies for STI and gender equality;

f) Further reinforce the practice of gender-responsive budgeting and audits of policies and programmes in all government departments and ensure compliance to gender parity and equality; and,

g) Increase the capacity of personnel involved in implementing national development strategies and STI programmes to identify and address the challenges and constraints facing girls and women. This could be achieved through training programmes and the development and dissemination of methodologies and tools.

5.4 Funding for STEM Education and STI Research and Application

Rapid developments in STI do not only pose challenges but also create immense opportunities that will continue to confront future STI capacity building. Steps being taken to advance engendered STEM study and STI practice, as indicated in various national plans, and STI and gender policies are encouraging. However, tangible results and progress can only be obtained if there is a solid foundation for STI development through high-quality institutions and infrastructure.

Furthermore, the quest for building a knowledge economy cannot be met while inadequate funding is being provided to STI capacity building. Many of the STI institutions are underdeveloped and fail to effectively generate and deploy knowledge and technological innovations for socioeconomic development. Most research institutions and universities are inadequately staffed with skills and expertise, and lack adequate financial resources, infrastructural capabilities and equipment. A strong commitment to funding and incentivizing investment in STI is desirable and possible through:

a) Allocating the agreed percentages of national resources to (i) education with targeted allocation for higher and vocational education for women, (ii) engendered research and development, (iii) venture funds for women-led/initiated start-ups, and (iv) increasing the quality of physical infrastructure (e.g. science laboratories, innovation hubs, science parks, maker spaces, Internet infrastructure, etc.) and aiming for internationally accredited standards for STI research and STEM education;

b) Leveraging educational technologies such as distance and e-learning that make it more convenient for women to access STEM education; science and technology curriculum that expose students to problem-solving skills, critical thinking and innovation, so as to create the appropriate critical mass of high-quality STI professionals (especially in the fast growing digital space); and,

c) Establishing innovation hubs (incubators and technology accelerators) in universities and other institutions of higher education and learning to nurture a stronger science-innovation mindset, and providing high-quality support services to women entrepreneurs (e.g. business planning, financial management, risk management, legal advice, market access, etc.) and

5.5 Developing Capacities for Applying a Gender Lens in STI for Development

Capacity development is the process by which individuals, organizations, institutions and societies develop abilities (individually and collectively) to perform functions, solve problems and set and achieve objectives. Capacity development requires institutional support mechanisms that enhance the capabilities of women and men, and encourage the development of technologies that increase their exercise of choice and voice.

Developing capacity to promote *science for women* requires improving the rate at which technology is acquired and used through partnering research, advisory service providers, and technology entrepreneurs with institutions and promoting participatory approaches to understand how science

can be applied to meet women's specific needs. Significant steps have been taken by universities and research institutions in this direction, but efforts are limited by inadequate funding.

Access to the knowledge stock can facilitate capacity development of *women in innovation* at the individual, community and enterprise level. Institutions of higher learning, research institutions and employers (public and private) should create spaces that promote women's participation in solving local livelihood problems. Targeted support to women, such as establishing "women science and technology parks" to support, incubate and accelerate S&T-based entrepreneurship of women could enhance their participation in innovation as users and creators of new knowledge and technologies.

Capacity development for *women in science* is best promoted by building their knowledge through policies and actions promoting equal access to STEM education and training, and equal opportunity in the management and implementation of research. Broad science education preference policies do not seem to have helped girls and women much. The initiators of these policies have to understand and appreciate the need for affirmative action if women are to benefit more. Furthermore, in higher education, research and innovation institutions (which are key "transmission mechanisms" largely responsible for linking and disseminating the "global stock of knowledge" and skills among individuals, communities and enterprises), women are underrepresented (Section 4.5). This lack of a gender balance in STI has implications for how policy and programmes are designed and implemented at the national and local levels.

5.6 Technological Choices and Uses for Women's Development and Livelihood Activities

Future outlooks into the innovation landscape[60] point to five areas of innovation within technology poised for explosive growth trends and likely to disrupt the job market, especially in the fields of medicine, travel, education, agriculture, and retail trade. These areas include: the Internet of Things, Big Data, Artificial Intelligence, Digital Health, and Gamification. Effective participation in the global knowledge economy will necessitate countries to have a wide array of human capital that possesses the knowledge, skills, and motivation to quickly insert itself and contribute to innovation in all industries by deepening their engagement in the more "traditional" sciences and promoting the strategic adoption of these emerging sciences.

In order for Ugandan women to fully benefit from STI, they must be able to access resources and knowledge, while the development and application of technologies should support women's needs and activities. Technology dissemination ought to use channels that do not discriminate women or overlook their needs. Community and gender-driven approaches to technology development can help women to benefit through reduced unproductive time and increased outputs.

The national research, extension and advisory services focus on improving the rate of technology adoption. Increasing the number of women advisory and technical services providers, and skilling them to provide advice on various enterprise and technology alternatives, and to better adjust to the needs of those who run small-scale diversified businesses can greatly improve adoption rates, especially by women.

There is evidence that a significant portion of the processes being used by research institutions in various sectors apply a gender lens by integrating gender concerns and taking steps to understand gender patterns of technology use and access as critical for promoting STI for women. It is also important to integrate a gender-differentiated analysis of trends and priorities relating to resources, opportunities and responsibilities in access to, use of, and leadership within STI-enabled initiatives to increase effectiveness, sustainability and social cohesion in the application of technology. When

[60] ***UBI Global (2019)****: The 2019 Innovation Landscape – Sectors and Start-ups set to disrupt the Market.*

participatory approaches are gender-sensitive, women are likely to feel more enfranchised and may have fewer difficulties in accessing and using resources and improved technologies than they did prior to implementing an initiative that does not involve them.

Partnerships in STI implementation are an effective means to diffuse innovations and knowledge. Partnerships between research and technology transfer institutions and women's organizations have been an important entry point for women's inputs and decision-making in technology development and innovation activities. Ugandan universities and R&D institutions have adopted a variety of community engagement and outreach approaches to build capabilities of students, scientists and communities in the development and adaptation of technologies and digital solutions to improve and address development problems and challenges. More women need to enter the system as scientists, technologists and development advisory services providers, and more scientists and professionals need to understand how their skills and work can benefit women. Many researchers and professionals are working with women to provide and refine STI solutions in farming, health, livelihoods and other productive activities. This is a welcome development and should be encouraged and intensified.

5.7 Capacity Development for STEM Education and Training

Education and training systems are the first steps to equipping people with the knowledge and skills to improve their lives and participate in national STI systems. As indicated in the national statistics presented and discussed in Chapter 4, there are clear gender disparities in different educational contexts, both formal and informal, but more especially at the higher levels of the education pipeline. Such disparities affect the potential for national development. Empirical evidence shows that when women are educated, nutrition and child mortality rates improve and the number of children per family declines, while a lower education level of men is associated with higher levels of irresponsible behaviour, adherence to stereotype social-cultural constructs, and violence against women and children.

Capacity development of individuals and institutions through the acquisition and application of knowledge is both a challenge and an opportunity, and a prerequisite for the application of STI solutions to development. It requires individuals who are educated in STEM, and are able to analyse and develop innovative responses to problems. The Uganda education system is often criticised as not being effective in creating employment for graduates. That it focusses too much on cognitive education - over emphasising the transfer of information rather than creating skills and capabilities to learners and trainees. That the current system is highly biased toward academic and formal education where speaking good English is more acclaimed than having a skill that can enable secure gainful employment.

The theoretical training of STI professionals is not limited to tertiary education, but starts from childhood, with adequate exposure to the concepts, thinking and theory that build STEM/STI problem-solving capabilities. From early childhood all the way up to post-doctoral studies, the phases to develop STI experts are theoretical training phases. The importance of each phase in the full STEM education life cycle must be considered when developing national policies. The critical elements, on which the STI professions must play a role, are schooling and tertiary education.

5.7.1 Schooling

There are several areas of concern in the schooling system with regard to the development of STEM/STI practitioners. Access to education is still a major barrier. Even with UPE and USE, *there is substantial spatial variation and rising inequality at regional level. This means that many with aptitude will never have the opportunity to enter the STEM/STI space*. Coupled with this, the teaching capacity

and inadequacy of infrastructure and resources present further challenges which impact on developing the potential of those in the system.

The quality of teaching and access to high school education presents a problem. The numbers achieving the required pass marks are inadequate to meet the need of the technical, scientific, actuarial and other professions requiring high-performance school-leavers who have excelled in science and mathematics. In the attempt to extend education to the entire population (UPE & USE), the complexity of science subjects has been reduced to accommodate large classes and make teaching easier for underqualified teachers. Furthermore, the move to the outcomes-based approaches to education has, due to the size of classes, meant that process, rather than principles, have been taught. This has had a detrimental effect on STEM education. The rationale for opening many more universities to '*better skill and create employment opportunities'*, could easily backfire as STEM/STI *students with an inadequate foundation in mathematics and science have little hope of succeeding. More emphasis has to be placed on improving teaching mathematics and science subjects at school level*.

Bridging or foundation courses have been introduced to assist those entering higher education to 'catch up' on poor school teaching. However, if there has been no grasp of the basic principles early on, understanding subsequent concepts is difficult. As a result, those arriving at university with poor school results require years to catch up, rather than being able to do so in the short period offered as part of bridging. Additionally, the temptation is always to provide more books and teachers, but without adequately qualified teachers, the concepts and principles so vital for STEM students cannot be developed. Teacher development is therefore one of the important elements for developing STEM/STI skills for the future.

Learners with an aptitude for STEM from rural schools need to be helped to stream into stronger schools to develop their potential from an early stage, but the emotional and social difficulties faced by such learners as they transition from a weak school to a high-performance and highly competitive environment must be addressed as they can be very challenging. However, the sheer numbers requiring access and better resourced schools will require years of intervention. In the face of inadequacy of teaching capacity and material, technology (online learning material) should be harnessed; and group work encouraged, allowing those who have grasped concepts to assist those who are struggling.

The need for more *career guidance to attract high-calibre candidates into the STEM/STI fields* has been variously demonstrated. A range of methods need to be considered, including presentations at schools, taking stands at career shows, including appropriate STI examples in mathematics and science textbooks, creating career portals and providing detailed online material. Young professionals should be encouraged to act as the role models by delivering presentations and making themselves available to counsel potential entrants into STEM studies. Large numbers are entering school, but the proportion of girls keeps reducing along the pipeline. A suite of support programmes for girls/women in STEM, including high school STEM awareness should be developed and funded.

5.7.2 Tertiary education for a knowledge-based society

In the face of high unemployment levels, there has been a radical paradigm shift in government policy and in the programmes being offered by most higher education and tertiary institutions to put more emphasis on psycho-motor education and training which focus on imparting highly competitive skills to learners and trainees. *The national education system should aim to ensure that all those graduating from the system, at whatever completion level, are able to secure employment in all circumstances, through a skill-mix development educational process where both knowledge and skills form the core for learning and training*.

The proportion of women in tertiary level education has been increasing, but men continue to make up the majority of those studying STEM subjects. Most universities have taken active steps to understand the reasons for the low enrolment rates of women in their science programmes and are trying to redress this imbalance. Costs, lack of confidence in their ability to "handle" the courses, and the burden of family commitments deter women from opting for science and technology-related subjects. Previously, because of high competition for the few available places especially at university level and the perennial poor performance in science subjects, many teachers (and parents) steered girls and women away from STEM studies at secondary and tertiary levels, or failed to present STEM courses in a manner that would appeal to young women.

Greater effort and more affirmative action and incentives are required to encourage girls and women to study science-related subjects. *Open access policies and waiver of certain prerequisites for science courses could encourage women to join. The changes in the curriculum that place STEM in a wider, real-world context; pedagogical approaches which stress skills development and reflective practice; the teaching of STI ideas and concepts in a broader historical and social context; encouraging peer networking and support among girl/women students; and, engaging in outreach and career guidance programmes with secondary schools that have been initiated by many universities should be continued and deepened.*

5.7.3 Use of ICTs to increase access and participation by girls and women in STEM education

Digital technology is increasingly not only becoming an important avenue for training and knowledge acquisition, but also a means for women and girls to overcome educational barriers. Computer- and Internet-mediated learning has been shown to be a useful educational strategy for women in the formal education system. Globally, there are clear gender differences in online educational activities with more women than men enrolling in e-learning.

Online courses are a comfortable learning medium for female students who may particularly appreciate the privacy of virtual courses, experiencing less pressure concerning their inputs and less fear of appearing to be "ignorant" in front of male colleagues. The cost of online courses also tends to be more affordable than that of face-to-face courses which have related expenses such as travel and boarding – circumstances which are more challenging to females than to males.

Anonymity and social distance provided by the Internet, and the flexibility of access and study hours could potentially inspire and encourage women to feel more confident about enrolling and participate in online STEM courses. Borderless learning can benefit women particularly in regions that have limited know-how in STI, in conflict areas, and in areas where women are marginalized or excluded from traditional learning systems. However, inadequate ICT facilities, costs and reliability of internet access, limited operating hours of facilities, inadequate user skills of both teachers and students remain critical barriers to the effective implementation of e-learning programmes.

5.8 Capacity Development and Talent Management for Women in STI Careers

5.8.1 Gender-blind employment policies, strategies and conditions

Talent management typically consists of four pillars of intervention: attraction, retention, development and deployment. Recruitment, promotion and retention of women to senior roles still lacks parity, as is the specificity of policies in supporting women in STI careers. At most, these are gender-blind, as enumerated below:

- ***Absence of explicit policy and targets for women's participation:*** Affirmative action policy may be provided for but often the non-existence of targets or compulsory quotas for women's minimum participation still leaves men to advantage.

- ***Need to focus on gender balance within service administration as well as service delivery:*** While significant work on gender equality has been going on, evidence shows that the focus has largely been on service delivery. The idea has been to address the aspects of the beneficial impact of government programmes to the end-users. Limited effort has been paid to the machinery, namely, administration structures and systems that deliver the services.

- ***Women find it difficult to balance career and domestic responsibilities:*** This means that women are disadvantaged because of their care responsibilities and 'double burden' in the absence of flexible working arrangements and similar mechanisms. There are no facilities for child day-care and opportunities for flexible work schedules are limited. An underlying lack of awareness of the different implications of policies on women and men and assumptions of men being the bread-winners also means that women are inadvertently disadvantaged compared to men. Studies show that traditional gender relations in the domestic sphere have been more resilient than in the public domain. It is therefore important that attention be paid to changing the gender division of labour and to sharing domestic responsibilities in the home in order to address gender equality issues in the workplace. This will require a programme of life skills for women in paid employment, so that they can negotiate the difficult terrain both in the domestic and the job arena.

- ***Sexual/workplace harassment is a concern:*** Policies that prohibit sexual harassment exist. Public institutions have dismissed male staff on account of sexually harassing students and/or female staff members. However, despite the policies and dismissals, sexual harassment still persists and particularly rampant against young female staff and interns, including sexual harassment during recruitment and in exchange for marks/passing exams in education institutions. It is not uncommon to hear something like *"There are incidences of sexual harassment on the side of ladies when they come to ask for jobs or passing exams. They are frustrated by the male officers/lecturers hoping that the ladies would yield to their hidden demands. In many cases the male officers/lecturers directly ask for sex as a condition to pass the interview or getting higher marks."* The positive aspect of this worrying issue is that it has been captured and action can therefore be taken such as sensitization of relevant officials on the provisions of sexual harassment and complaints mechanisms.

Affirmative action is required if gender imbalances in employment in the STI job market are to be corrected. After all, if it can be done for leadership positions, why can't it be done for technical jobs? Why do we have affirmative action policies for education, if we are not going to apply the same proportionate measure for employment? The imbalance in numbers of women needs to be corrected through genuine affirmative recruitment policies, women friendly working environments, and flexible work schedules that guarantee equal opportunity for retention and progression.

Support mechanisms to female scientists could include: provision of childcare (on-site or contract-guaranteed positions at nearby day-cares, extended hours, or paid childcare), flexibility (videoconferencing for pregnant scientists, lactation rooms, family-friendly meeting times, technology to enable research from home, or extended eligibility periods for leadership positions for those who have taken parental leave), funding (a ''mother's bonus'' to be used for personal or research purposes, or extra travel allowances to pay for children and/or sitters to attend meetings), and career development initiatives (additional research or technical support to enable early career female scientists to meet professional milestones, mentoring and networking programs, or mandated unconscious bias training for those serving on promotional committees).

5.8.2 Recruitment and retention

While recruitment and retention strategies across different occupational groups and industries have many common features, such as competitive pay, good working environment, and progressive human resource policies that offer opportunities for advancement, they need to be context-specific and evidence-based and not gender-blind to be more effective.

Despite the prevalence of equal opportunities policies and legislation, some issues still remain unresolved (such as social construction of gender in stereotypical male roles assumed by females, isolation and sexual harassment, and generational differences relative to the perception of women in STEM/STI). Others are ignored or not perceived as problems (such as recruitment and promotion practices for part-time, hourly paid, pregnant women and older staff). Generally, although the country is investing in educating young people with a view to expanding the STEM skills base, it is not developing mid-career practitioners or valuing, using and retaining those with experience. Transparent procedures for recruitment, staff development opportunities and promotion operate in some institutions but less equitable practices exist, especially in establishments recruiting staff from a narrow and elite range of career routes and backgrounds.

Recruitment, appointment, promotion and allowances based on merit and gender-neutral criteria do not necessarily favour women. There is a need to review and update public sector and institutional regulations with respect to recruitment, retention and promotion of women in Uganda's employment sector with a view of introducing gender parity provisions, supported by sensitization about the provisions and key issues so as to dispel myths and misunderstandings.

5.8.3 Terms and conditions of service, rights and privileges

There are several aspects and elements that contribute to successful and efficient career progression. Career progression not just simply finding better jobs but staying in current jobs and roles, while receiving greater responsibility, satisfaction and success (whatever each individual defines 'success' to be). Career progression is not simply about finding a new and 'better' job, but also about receiving a pay rise, being given additional responsibilities, moving sideways in the employing organisation and can even be the process of leaving the employer and starting own ventures.

Remuneration between women and men is based on equal pay for equal work value, as dictated by the Employment Act (2006). However, there is anecdotal evidence that, in some cases, employed women did not always want to put in extra effort to build the performance competencies necessary for promotion because *"they are married to men who earn better; and since the husbands provide everything, they do not need to stress in the name of promotion, especially where the additional pay rise is negligible".* This kind of attitude points to a number of potential problems. Firstly, this applies only to women supported by their husbands and not to single or widowed women. Secondly, the de facto existence of a gender pay gap in favour of men should be explored - allowances, such as travel and housing allowances, can inadvertently lead to unequal financial benefits if their basis is the assumption that the male is the breadwinner, and that all families have such a male breadwinner.

To stem high voluntary female staff turnover rates and improve retention, employers have to: ***(****i) put special focus on specific high-performing valued employees in addition to generic institutional plans and strategies; (ii) perfect their hiring practices and use appropriate engendered selection processes (e.g. presenting applicants with realistic job previews, invoking certain organisational activities such as induction and orientation programmes, analysing data related to recruitment sources; (iii) focus on organisational commitment to gender parity and engagement; (iv) conduct continuous analysis on turnover and include the results in the general talent management processes and in departmental and specific HR planning processes; (v) motivate female employees by more than money (job enrichment practices, career growth, challenging assignments, feedback from peers, and better leadership, among*

others); and, (vi) provide opportunities for improving the efficiency of women's career progression at a faster rate through: networking; mentoring, coaching, upskilling, training and development.

5.8.4 Continuing professional development

Developing tomorrow's STI specialists, experts and leaders requires more than university education and graduate training. The science leaders and practitioners of tomorrow must be visionary strategists, able to conceptualise and implement unique solutions to address client and global needs, and must inspire others to be part of the vision and solution. This requires the development of not only graduates but young professionals and those in their mid-careers to grow into leadership roles. The quality and quantity of the learning opportunities afforded by experience at work are the primary factor affecting the quantity and quality of learning by STI professionals. The reality is that the major part of a professional's training is in the workplace, working on real projects under the guidance of experienced supervisors who act as coaches, ensuring skills transfer.

STI workforce skills can be continually upgraded within the context of lifelong learning, where employees are able to sharpen or develop their skills in tandem with changes in technology at the workplace. Also, lifelong learning opportunities allow learners who have had limited access to training in the past to have a second chance to build on their skills and competences, or have their previously acquired skills certified through the mechanism of recognition of prior learning. *A national qualifications framework is the tool that helps to promote training flexibility and coherence, lifelong learning and recognition of prior learning within the STEM/STI system - standardizing, formalizing and certifying skills qualifications across the entire spectrum of formal and informal training. Whereas this is theoretically ideal, the gender-blindness of such broad applications often disadvantage girls and women, who face barriers that limit their access to many opportunities as opposed to their male counterparts.*

In a structured environment, a mentor would also be assigned to the training phase to monitor progress and ensure that in the long term the graduate has gained a range of experience of increasing complexity, and has been given the opportunity to take increasing responsibility and make decisions under guidance. The reality, however, is that there are simply not enough of the experienced age group with adequate time to devote to the development of young people, if traditional workplace skills transfer methods are the only methods used. Techniques such as Action Learning - *group learning on actual projects where the subjects learn with and from each other by mutual support, advice and criticism during they apply their knowledge on real problems* - should come in handy.

As employment is no longer for life, developing versatile professionals is important. Continuing professional development is a life-long learning process, and together with vocational educational strategies is important to women and men who need access to additional skills and training outside the formal education system. Women in general tend to hold jobs and face more barriers in accessing post-school technical and skills training which would facilitate technical and cognitive employment in higher skill and higher paid job placements. Special support mechanisms are often needed for women and girls in all stages of skills education and training, especially for encouraging girls to opt for STEM study and STI careers.

As young graduates progress in their STI careers, they may elect to become technical specialists, or follow the management route, or a combination of both. Technical leaders need to be innovators and experts in their field. As they advance, they will increasingly be given the responsibility of supervising others and checking their work, and later motivating and leading teams, departments or organisations. Once individuals have gained experience and have developed expertise in a specific area, society relies on them to lead, drive change and embrace innovation. Management and leadership require a new generation of decisive, effective and solutions-oriented leaders with leadership skills to manage change and transformation.

Various strategies can be implemented to support ongoing and lifelong training, such as promoting formal (postgraduate) and informal education, ongoing workplace upgrading, and targeted skills training programmes for women and girls. These take the form of *resources for mentoring; high profile role models; toolkits and funds to government, universities and organizations to run "Girls in STEM" programmes which showcase careers in STI for girls; apprenticeships, workplace training, and retraining when they re-enter work. Overcoming barriers, such as difficulties in balancing work and family responsibilities, discrimination and harassment, should be incorporated into training and programmes aimed at benefiting women*.

CHAPTER VI: CONCLUSIONS AND RECOMMENDATIONS

6.1 General Conclusions

The core issue in STI for development is to design, implement, monitor and adjust STI while ensuring that men and women benefit equally. This approach would require a better understanding of the varying impacts of STI policies and strategies, while also taking into account women's opportunities, interests and concerns. Applying a gender lens to STI[61] would involve recognition of the following:

a) The varying levels of access by women and men to resources and opportunities, including, inter alia, to education, training, land, financing and labour. This in turn affects the relative ability of women and men to: (i) make choices about their lives, rights and livelihoods, (ii) benefit from STI in development policies and programmes; and (iii) use science and technology to innovate;

b) The different gender-based roles and responsibilities of women and men, taking into account typical responsibilities of many women globally – productive, reproductive and community management;

c) Women's technology needs at the grassroots level; and,

d) The contributions that women can make to the design and development of STI at all levels.

Female parity in the STI ecosystem is tied to multiple factors, with the most influential being higher economic status; larger roles in government and politics; access to economic, productive and technological resources; and, a supportive policy environment. While enabling policy is very important, its implementation, monitoring and evaluation are even more important. References to gender equality and overall gender policy are insufficient without inclusion of gender specifics in policies directly related to STI.

Policies should be formulated that support women's empowerment and gender equality in relation to STI. These should: (i) ensure that science and technology supports women's development and livelihood activities in ways that bring equal benefits to both women and men; (ii) promote women's contributions and leadership in STI equally with those of men; and, (iii) encourage and support the participation of women in innovation systems, from the national level to the grassroots level.

While education is a *sine qua non* of knowledge society, women need a full enabling environment to participate in it. Access to education is not a solution in and of itself and neither is economic status. Women also need health improvements particularly in pre-and post-natal care and in their rates of infectious disease as well as freedom from gender-based violence to be able to acquire the education and skills to participate in the knowledge society. Social institutions and social attitudes about the abilities and the roles of girls and women need to adapt to changing realities that correspond to

[61] ***UNCTAD (2011)****: Applying a Gender Lens to Science, Technology and Innovation. United Nations Conference on Trade and Development Current Studies on Science, Technology and Development, No. 5*

national interests of full human resource utilization. Customary and religious law as well as outdated gender stereotypes all constrain gender equality in the knowledge society.

Women need voice and agency[62] in leadership positions throughout society. Equal pay for equal work is an essential element. Without sharing with men and without societal assistance to lessen women's multiple roles, women alone cannot bear the full responsibilities of domestic work, child and family care and still hope to become knowledge workers. All the elements of gender equality need to be in place for girls and women to reap the full benefits of the knowledge society, and their benefits in turn will greatly increase the economic growth and social welfare of their countries.

6.2 Recommendations

Uganda has made significant progress with respect to building STI capabilities in both the public and private sector. Policy formulation and institutional and capacity development around STI have been addressed concurrently. A policy mix that promotes innovation and creativity in education, scientific research and industry now exists, although implementation is often weak and disjointed. The rapid growth of universities is an opportunity to harness young talent by supporting creative work, research, and innovation. While science and technology provide opportunities, government must ensure those opportunities enhance welfare for both men and women. It must also supply the catalysing environment to push through science and technological breakthroughs to innovative products, services and businesses. All this needs to be done with a gender lens to avoid widening old gender gaps and creating new ones.

6.2.1 Managing the barriers and opportunities for women participation

The problem of STEM education and STI practice is twofold. On the one hand, there is the capacity of the system, human and material, to produce knowledgeable and capable graduates, upon which the development of a technologically competent labour force depends. On the other hand, employing such a labour force requires innovations in medicine, telecommunications and information systems, agriculture, engineering, technical services and manufacturing to fuel job creation and national development. Policies, systems and practices in both of these areas must be in place in order to meet the challenges of attaining and maintaining social and economic progress. This apart, all effort is required to ***prevent the occurrence of negative motivation to female students to choose careers in science or express genuine interest in science by - adopting gender-sensitive educational policies and using gender-targeted approaches to improve females' access to STEM education*; and *changing the negative gender image and stereotypes in STI practice.***

Given the depth of the talent gender gaps, there is a clear need for proactive measures to prevent a deepening of the gap in industries where emerging talent skills are in increasing demand. These include traditionally male-dominated industries such as manufacturing, hardware and networking, and software and IT services, as well as traditionally feminine sectors such as healthcare and education. Industries must proactively hardwire gender parity in the future of work through effective training, reskilling and upskilling interventions and tangible job transition pathways, which will be key to narrowing these emerging gender gaps and reversing the current trends.

A number of other factors have also been cited as playing a key role in empowering girls to become interested in pursuing studies in STEM and careers in STI (e.g. curiosity; intelligence; opportunity; terrific, encouraging, challenging and supportive parents and teachers; and mentorship), without which, girls are more likely to succumb to the various barriers and challenges. Debunking the myths

[62] *Agency is the capacity to make decisions about one's own life and act on them to achieve a desired outcome, free of violence, retribution, or fear (World Bank, 2014: Voice and Agency – Empowering Women and Girls for Shared Prosperity) .*

that girls do not like the sciences and other and gender stereotypes, along with investments in teacher trainings, gender-responsive technology and innovation can help reverse the current trends.

6.2.2 Investing in STEM education of the girl child

Effective and sustainable STI programmes that benefit women as well as men require capacity-development, institution building and multi-stakeholder partnerships to: *(a) support women's technological choices and uses to encourage their empowerment and development activities (science for women); (b) promote the participation of women and girls in STEM education and training, and in the STI workspace (women in science); and, (c) promote women's participation in innovation systems and recognise women's innovations.* Applying a gender lens to STI is critical in efforts to support sustainable human development. Investing in STEM and girl education is investing in national socio-economic development. STI holds the key to technological progress, rapid industrialisation, wealth creation and poverty reduction.

Uganda should therefore allocate adequate resources for modernising teaching and learning facilities in STEM education, as well as the training and continuous professional development of STEM teachers and STI practitioners, giving particular attention to gender parity. Policies should incentivize industry to support skills development – by providing experiential learning internships to learners, or training equipment support to HESTI and TVET institutions. Government should also actively encourage the domestic production of goods and services, along with value-addition to primary commodities. STI plays its role as a catalyst for socio-economic development more effectively when local manufacturing enterprises become more vibrant.

6.2.3 Integrating gender perspectives in all aspects of STEM study and STI practice

The national education system needs a profound change in teaching methods and the curricula, and of more interconnected and multidisciplinary ways of learning science and technology as a means of promoting more creative and engaging ways to attract women to a career in science and technology. *Uganda clearly needs more mentoring, scholarship and internship programmes that not only increase access for women to go into STEM fields of study, but also support them along their STI career path.* This requires the integration of a gender perspective throughout the policy-making processes and in the planning and programming for the education and STI sectors. Such a perspective necessitates an understanding of the respective impacts of policies on men and women, their access to resources and opportunities, as well as recognition of their abilities and innovative capacities, and on their needs for capacity-building to design and implement solutions.

Achieving gender equality and parity in the national STI ecosystem will require that women are consulted and engaged in the choice, development, and application of technologies; and ensuring that women have access to sufficient resources in order to benefit from STEM study and STI innovations; supporting women to become scientists and technologists; and recognizing and supporting the local knowledge and innovative practices of women. The design and implementation of STI policies and the development of solutions and strategies has to be evidence-based, utilising assessments of problems and challenges that take into account gender equality.

Programmes and support structures to implement gender-sensitive STI policy, credit and financing, scaling up of programmes, expert support, and building capacities to support institutions (through partnerships, consultation and training with and for women) are necessary to ensuring access for women to STEM education and STI skills through both formal and informal means, thereby supporting and increasing their sustainable livelihoods. These must be underpinned by implementing ongoing monitoring and impact assessments, including through the collection and analysis of gender-disaggregated data on benefits and results.

It is imperative therefore that the national STI policy and all other complimentary policies be reviewed to enhance the integration of a gender lens, especially in their implementation, in order to: (i) encourage and support women and other groups that have been traditionally excluded from STI to realize their full potential; (ii) promote consultation with women concerning their technology needs and choices, and work with them to gain the knowledge, skills and resources to manage technology for their own purposes; and (iii) support the ability of women to participate actively in innovation systems and in key sectors.

6.2.4 Using digital and emerging technologies to reduce gender inequalities

Digital technology is increasingly not only becoming an important avenue for training and knowledge acquisition, but also a means for women and girls to overcome educational barriers. Computer and Internet mediated learning has been shown to be a useful educational strategy for women in the formal education system. Globally, there are clear gender differences in online educational activities with more women than men enrolling in e-learning. The introduction of ICT and e-learning methodologies into education provision can contribute to quality improvement, technological innovation and increased outreach and access to learning opportunities.

Online courses are a comfortable learning medium for female students who may particularly appreciate the privacy of virtual courses, experiencing less pressure concerning their inputs and less fear of appearing to be "ignorant" in front of male colleagues. The cost of online courses also tends to be more affordable than that of face-to-face courses which have related expenses such as travel and boarding – circumstances which are more challenging to females than to males. Anonymity and social distance provided by the Internet, and the flexibility of access and study hours could potentially inspire and encourage women to feel more confident about enrolling and participate in online STEM courses. Borderless learning can benefit women particularly in regions that have limited know-how in STI, in conflict areas, and in areas where women are marginalized or excluded from traditional learning systems. However, inadequate ICT facilities, costs and reliability of internet access, limited operating hours of facilities, inadequate user skills of both teachers and students remain critical barriers to the effective implementation of e-learning programmes.

Emerging technologies and other new cross-cutting fields of knowledge emerging along the borders of traditional disciplines, are pushing the demand for a workforce with skills and attitudes that enable them to adapt constantly and quickly, unfortunately often widening old gender gaps and creating new ones. Recent global developments point to the future of development requiring the transformation of society through promoting a culture of excellence with gender equality, and the valorisation of STI talent, more than ever before. National support systems should be focused on gender-responsive innovations in technology that benefit everyone and mitigate new and emerging technologies widening old gaps and creating new ones.

6.2.5 Enhancing women's participation in innovation systems

The prerequisites for women's participation in innovation systems include equal access to education, capital and markets. Men and women can only have equal potential to achieve the same standard of living if they have an equal distribution of opportunities and outcomes throughout their lives, including, for instance, equal employment opportunities, earnings and returns to labour. Gender equality in an economic sense requires equal access to resources (e.g. credit, market opportunities and training), but also equal engagement in all aspects of economic activity, such as decision-making and choices over how assets and profits are used.

Increasing skills and tools in support of small and micro enterprises is an important capacity development activity for women. And increased capacity leads to empowerment, which enables more choices, gives decision-making power and autonomy, and encourages the acceptance of new social

and gender roles. There are a number of different ways that are often put forward to help female innovators succeed in progressing with their business ideas. As off-farm income and wage-earning opportunities contribute more and more towards household incomes, supporting women's access to technologies to improve their livelihoods will become increasingly important.

Encouraging women to participate in innovation not only requires providing them with access to technologies and involving them in the development of appropriate technologies; it also necessitates the development and provision of institutions and infrastructure, including credit, to support women's enterprises, along with advice and support services for business and technology development. Having a mentor can make a difference in overcoming the challenges faced by women along the way to successful innovation, as is advice on how to access funding and government (or other institutional) support, or access programmes that support developing new skills, and opportunities for networking.

Recognizing women's capacity as innovators is particularly important because women will most likely be adversely impacted by the shift to more technologically advanced labour markets as traditionally female-dominated roles (such as administrative roles) are automated while male-dominated ones (such as engineering) become more prominent. Recognising the dynamic women, who develop and lead great innovations, acts as an incentive to encourage young girls and women STI innovators and entrepreneurs. While companies tend to think of products or services as gender-neutral, in practice they're often not. But designing with and for women can open up new markets and make existing markets more profitable. The banking sector is a great example: credit, savings, and insurance products can all benefit from gendered capacity and design.

Technology does not function in isolation when introduced; it affects and is affected by social, economic, political and environmental factors. STI initiatives that investigate, assess, monitor and address implications for environmental sustainability, human development and gender equality are more likely to produce equitable and sustainable results. *Innovating with a gender lens requires: gendered social and economic analysis and assessment of problems/issues; capacity-building of both interveners and beneficiaries; recognizing and building on the innovations and capacities of women; multi-stakeholder partnerships for development and replication of initiatives; and, ongoing monitoring and analysis of results and benefits.*

These approaches have proved successful in producing a range of benefits for both women and men, including: economic benefits in the form of improved livelihoods and increased income generation in the community; environmental benefits and effects; improved health; gender empowerment and improvements in gender relations; and, sustainability, with the basic ingredients in place for innovations to continue independently of the original intervention.

6.2.6 Gender-smart solutions in STI for women

Science and technology must support women's development and livelihood activities, through solutions that achieve the overall objectives of an intervention while closing relevant gender gaps in the process. Women can no longer be bypassed in STI policies and decisions, as this will not reflect their specific needs and concerns. To avoid marginalisation, women have to be consulted in the design, development and implementation of STI programmes and strategies to ensure gender equality. Providing support for and scaling-up successful and/or promising models, approaches, technologies and innovations that promote gender equality in STEM/STI through appropriate financial and policy measures, focusing on multi-stakeholder partnerships, and encouraging private sector and livelihood development ensures sustainability of initiatives.

To ensure that science works for women and girls, their capacity as well as that of field experts working with them has to be built through appropriate, especially the use of ICTs, mechanisms and processes that provide information, education, training, technical and business support. Successful

methodologies for participatory R&D initiatives should be assessed, refined and disseminated, working with both women and men. Additionally, partnerships and collaboration between international research institutions and agencies, national STI research institutions, universities, NGOs, government agencies and the private sector for the purpose of integrating gender perspectives and the inputs of women into STI for development have to be established and nurtured.

The national research system should help to develop clear, evidence-based arguments for gender mainstreaming in STI, and identify and disseminate expertise/case studies tailored for policy- and decision-makers. Supporting training of staff in gender analysis to enable gender-sensitive policies, programming and impact evaluation (including skills in collecting gender-disaggregated information, analysis of data sets, and monitoring) and adopting appropriate measures to identify and address the negative impacts of the current global crises (food and energy, climate change and financial and economic) on women have to be embedded processes in STI development.

The education, training and employment of women as scientists and professionals in STI sectors, and ensuring women's equal access to opportunities, resources, and services to support their STI and gender-related activities requires more support. Technologies and other forms of support for developing income-generating activities have to be targeted to take into account the different needs of men and women. And not the least, the packaging of information and knowledge in a variety of ICT formats (including mobile phones), to make it more accessible to women in marginalized and rural communities, to those with low levels of literacy and to those who rely on public media such as radio, television and newspapers, is paramount.

Broad science education preference policies do not seem to have helped girls and women much. The initiators of these policies have to understand and appreciate the need for affirmative action if women are to benefit more. The specific gender-focused conclusions and recommendations from the study are as follows:

a) Several science education system-related factors, including effective policies to increase access to quality STEM education; teaching strategies and learning environments; assessment procedures and monitoring tools; and ICT-based technologies or approaches to reach more girls, build STEM literacy and skills, and address gender divides; gender roles and expectations on girls' participation, progression and learning achievement; family, peers and teachers, gender stereotypes in the media and the broader society, and educational resources - influence girls' aspirations, confidence and self-efficacy in STEM study and STI practice.

b) It is now universally accepted that countries and systems must more effectively pull girls into, and retain their interest in STEM studies and engagement in STI, including through mentors, role models, and extracurricular activities if genuine equitable development is to be attained. Empowerment, leadership and confidence as common drivers have to be imparted through existing and potential partnerships (e.g. cross-sectoral, public-private, parent-schools, counsellors-students, industry-governments) to help advance gender-responsive STEM education and career advancement of women in STI. Cooperation is a win-win for girls and women.

c) The gender dimension must be incorporated in all national STI and other development/sector policies - especially linking the STI policies to policies on food and agriculture, water, energy, infrastructure and industry. Policy implementation has to be routinely tracked and assessed to ensure that policies benefit both men and women equally. Staff training in gender analysis in order to produce gender-sensitive policies, programming and impact evaluation, including development of skills in collecting gender-disaggregated information and analysis of data sets, and monitoring of policies and programmes, must be supported.

d) Developing and maintaining functional partnerships and collaboration among international and national research institutions and agencies, universities, nongovernmental organizations/civil society, government agencies and the private sector is critical to integrating gender perspectives and the inputs of women producers, scientists and innovators into STI for development.

e) The attrition rate is higher for girls than boys along the education pipeline. The progressively widening gender gap with higher levels of education and along urban-rural divides must be checked, through interventions that deepen the provision of incentives and opportunities to girls in the areas of health, livelihood and social support systems, to enable them stay in school and access life-long learning.

f) Gender gaps are more pronounced in the sciences than in the arts and humanities, and even widening in some fields. National support systems should be focused on gender-responsive innovations in technology that benefit everyone and mitigate new and emerging technologies widening old gaps and creating new ones.

g) The science preference policy in education and all other STI complimentary policies should integrate a gender lens, especially in their implementation, in order to: (i) encourage and support girls and women to realize their full potential; (ii) promote consultation with women concerning their technology needs and choices, and work with them to gain the knowledge, skills and resources to manage technology for their own purposes; and (iii) support the ability of women to participate actively in innovation systems and in key sectors.

h) Strengthening research in science and industrial leadership in innovation, including investment in key technologies, access to capital and support for SMEs is important in the application of STI to address societal challenges. Policy choices determine who benefits. Women's participation in decision-making at all levels, including through temporary special measures, and support policies and mechanisms that create an enabling environment for women's organizations and network has to be promoted.

i) Support for and scaling up of successful models and approaches through appropriate financial and policy measures, focusing on multi-stakeholder partnerships, and encouraging private sector and livelihood development to ensure the sustainability of initiatives is essential.

j) Uganda law and policy should continue to always ensure women's equal access to resources, education, extension and financial services, land and markets as part of overall support for their STI- and gender-related activities. The focus ought to be on three key questions around innovation, growth, and inequality: How can government and industry use existing technologies to deliver services more effectively and equitably to citizens? What are the best gender-sensitive mechanisms for creating and spreading new technologies to tackle shared problems? And, how can policymakers ensure that advances in technology (artificial intelligence, automation, and communications) bring shared benefits and not greater gender inequality?

k) Digital technologies and innovations are increasingly not only becoming an important avenue for training and knowledge acquisition, but also a means for women and girls to (i) overcome the barriers that they face across a variety of contexts, and (ii) achieve their goals and ambitions. There is need for a profound change in teaching methods and the curricula, and of more interconnected and multidisciplinary ways of learning science and technology as a means of promoting more creative and engaging ways to attract women to a career in science and technology.

l) A suite of well-funded support programmes for girls and women in STEM are needed – in the form of high school STEM awareness, mentoring programmes and scholarships for young women, particularly from less advantaged backgrounds. More cooperation is needed between the universities, the private sector and the state in developing a whole program that not only increases access for women to go into those fields, but supports them along their career path. Increasing the capacity of women and girls at the local level through appropriate information and education (formal and informal), training and technical support systems is essential.

m) Research and innovation institutions are key "transmission mechanisms" that are largely responsible for linking and disseminating the "global stock of knowledge" and skills among individuals, communities and enterprises. Women are underrepresented in tertiary STI education, research and industry. Representation, especially at strategic, decision-making levels is critical, both because it is important to have a diversity of viewpoints in the manner in which policy and programmes are designed and implemented at the national and local levels, and because participation builds leadership skills and visibility that helps members advance their careers. When women are prevented from reaching their full potential, the entire field suffers. Uganda needs 100% of the available brainpower to make the biggest impact and move STI forward as quickly as possible.

n) Talent management (attraction, recruitment, retention, development, and deployment) within the workspace should not continue to be "gender-blind" in the sense that it does not take into consideration gender roles and responsibilities of women and men, hence often unintentionally disadvantaging women. Working women STI professionals need additional support mechanisms focused on childcare, job and work time flexibility, funding, and career development initiatives. The imbalance in numbers of women needs to be corrected through genuine affirmative recruitment policies, women friendly working environments, and flexible work schedules that guarantee equal opportunity for retention and progression.

Science and technology must support women's development and livelihood activities, through solutions that achieve the overall objectives of interventions while closing relevant gender gaps in the process. Women can no longer be bypassed in STI policies and decisions, as this will not reflect their specific needs and concerns. It is imperative to: (i) support education, training and employment of women as scientists and professionals; (ii) ensure women's equal access to opportunities, resources, education, and services to support their STI- and gender-related activities; (iii) target technologies and other forms of support for developing income-generating activities to take into account the different needs of men and women; and, (iv) support the packaging of information and knowledge in a variety of formats to make it more accessible to women.

6.3 FAWoVC Agenda for Action

FAWoVC is a high profile advocacy group whose members share a common social interest and try to advance those interests through various avenues and mechanisms. Serving the women of the university and the wider community by advocating for women's equity in education and work is a principal objective of FAWoVC. This involves supporting learning, discovery and engagement, and enabling women to achieve their highest potential in an environment of diversity, respect and freedom of expression. FAWoVC initiatives should impact the nation's STI workforce in the following ways: (i) benefit under-represented female STEM students by increasing enrolment and retention through quality programmes; (ii) demonstrate the importance of multiple, integrated programmes to succeed in science fields; (iii) prepare female students for careers in STI by valuing diversity; and (iv) enhance communication between female students, faculty, and staff.

Being at the helm of their institutions, the members can be very influential not only in changing policies in their institutions but also convincing people who either hold power or who may hold power to support the policy positions the group wants to be supported. As role models, members ought to continually mentor, inspire and motivate young girls willing to take STEM/STI careers. As a university-based group, it can also be effective in providing information and education on complex issues that ideally will help government make informed decisions on further improving gender equality in STEM study and the advancement of STI. To advance some of the aforementioned general recommendations, FAWoVC could run the following programmes and activities:

6.3.1 Mentoring programmes for girls in STEM studies and early career women professionals

The association has opportunity and capacity to link women STEM students with mentors, academic support, and a peer community, especially during their first year of study. The primary goal would be to ensure that female students in a STEM course receive the necessary peer support and encouragement to have a successful career at the University and beyond, and to achieve balance between their academic work and their participation in the broader university community. Support groups would be a key element of this programme to provide regular opportunities for women STEM students to come together, share experiences and support each other in their first and subsequent years of study, and provide opportunities for female students in the sciences to serve as mentors to high school girls thinking about studying STEM at the university. It is also important to develop special mentoring programmes for women professionals and managers and to continue to learn from best practices.

6.3.2 Mentoring societies of female STEM professionals:

Members could promote the establishment of campus chapters of discipline-based educational and professional service organizations dedicated to making known the need for women scientists and encouraging young women to consider STEM education and STI careers. FAWoVC could advise and offer support to these organisations as they: (i) inform young women, their parents, counsellors, and the public in general of the qualifications and achievements of women scientists and the opportunities open to them; (ii) assist women scientists in readying themselves for a return to active work after temporary breaks; (iii) collect and provide information on women in their science discipline of interest; and (iv) encourage, recognise and reward women scientists to attain high levels of educational and professional achievement.

6.3.3 Influencing the hiring of female faculty and staff

Through the leadership of FAWoVC members, the member universities should be able to make strong commitments to not only mainstream gender policies but also use assertive affirmative actions to increase the number of female faculty members in STEM units. Adding female faculty and staff provides additional networking opportunities for female students and demonstrates that females can be very successful in science. It is important to give special attention to staffing and diversity to ensure that both women and men have equal access to available positions, including senior appointments.

6.3.4 Advocacy for girls and women-friendly study and work environment

Building gender responsive institutions requires providing a work environment that attracts and retains the best female and male professionals, adopting innovative solutions that respond to the special needs and circumstances of women and men. FAWoVC should be more vocal in pushing for the: (i) promotion of family-friendly policies such as job sharing to help women returning to work after maternity leave and both men and women who have responsibility for caring for children or elderly/ disabled relatives; (ii) provision of assistance for travel, study and field/practical work for breastfeeding mothers; (iii) revision of the paternity and maternity leave arrangements to ensure that they are in line with global best practice; (iv) creation of a gender-sensitive environment by making available such amenities as nursing rooms at lecture places and adequate parents' rooms in

hostels/halls of residence for students; (v) reviewing rules on family members working for institutions/universities, to develop a family-friendly policy that benefits both men and women; (vi) commitment to work-life balance and putting in place measures to promote it; and (vii) promotion telecommuting (work/study from home, making use of internet, e-mail and the telephone) to support students/staff who have to be away from the study/duty station.

ANNEXES

Annex 1: Terms of Reference

Background

Forum for African Women Vice Chancellors (FAWoVC) has received support from the Islamic Development Bank to develop initiatives that will increase participation of women in Science, Technology and Innovation in Africa. FAWoVC is an umbrella group of female university leaders in Africa that was created in 2016 to spearhead gender responsive training in higher education institutions and to increase the enrolment of female students in STEM, as well as galvanize women to take up leadership positions. The FAWoVC establishment recognized that mainstreaming gender within higher education is of paramount importance for enhancing the performance of higher education institutions, and enabling them fulfil their mandates to train the next generation of talent to drive the continent forward. Women, STEM and education are key tenets of the Sustainable Development Goals, and the African Agenda 2063.

Despite a higher proportion of women in sub-Saharan Africa (SSA), women are underrepresented in key areas of STI. The under-representation of women in STI could be attributed to, among other reasons, policy, institutional and individual factors. For example, many countries have gender sensitive STI policies that aim at promoting the participation of women in science at all levels, but these are rarely implemented.

In Uganda, a wide gender gap in science exists in academic and research institutions. The UNESCO (2015) Science Report indicates very low representation of females in all science fields with 17.1% (natural sciences), 23.3% (engineering and technology), 30.6% (medical), 19.7% (agricultural sciences) and 27% (social sciences). For example, at Makerere University, the country's largest and premier university, only 28% of academic and research positions are occupied by women. The situation in the other 46 universities is similar. In Mozambique, apart from medical sciences where women make up 53% of scientists, women similarly lag behind in the rest of the fields. For both Uganda and Mozambique (focus countries for this proposed intervention) the numbers of female students at higher education level have remained low compared to the male counterparts.

The trend is different in Sudan, the third focus country of this proposal. Female students form the majority (55%) of enrolment at undergraduate level in higher education institutions and in some cases even reaching 70-80%. However, the majority of these female graduates are unemployed, and representation in research and development is low. Recent studies show that the participation of women in the labour force is much below that of men, i.e., 25.5% vs. 60.2%, making it a challenge towards achievement of equitable and sustainable development. According to Sudanese Women in Science Organization, there are few women scientists involved in leadership. Efforts to ensure greater inclusion of women in the management of science and technology in Sudan are much needed.

Justification:

Participation of women in Science, Technology and Innovation (STI) has remained low globally despite initiatives geared towards supporting greater engagement of women especially in research for development. Recent data from the World Health Organisation confirms that fewer women are employed in the STI sector globally. With a strong women-focused leadership, this challenge can be effectively tackled.

However, for any initiatives to make meaningful impact it is important to establish a baseline to act as the benchmark against which the impact of the intervention will be assessed. The country level gender based STI ecosystem assessments will act as this benchmark.

Rationale and Assignment Objectives:

The overall objective of the assignment is to conduct gender-based assessment of STI ecosystem in three countries Mozambique, Sudan and Uganda.

The aim is to gain a scientifically based understanding of the status of STI in the three countries upon which capacity development will be premised. A map of key actors in the STI eco-system assessment will be developed. This will include interactions, policies, and partnerships, ideal and actual roles. The assessment will link the HEI to the national STI ecosystem and develop strategies to increase participation of women in STI. Scientific journal articles will be generated from this activity detailing a gender-based capacity gaps, challenges, opportunities and future prospects for each country. These three countries will serve as pilots upon which the rest of the Continent can learn.

Each country will have an independent consultant to undertake the country-based assessment.

A. Roles/ activities of the Consultant

The role of the consultant will be to undertake the following:

1. Review and document with a gender lens the current status of the STI ecosystem in the selected country, drawing from lessons (if any), from initiatives to improve STI at country level;
2. Develop a methodology and tools for undertaking the gender based STI ecosystem assessment;
3. Analyse the wider STI eco-system but with special emphasis on gender and the higher education sector;
4. Consult with key STI and higher education sector stakeholders at national level, including the national commissions, relevant Ministries of STI and Gender, research agencies, university staff and other key stakeholders to identify their perceptions about gender based STI ecosystem;
5. Review literature on STI, gender and higher education in the country including, national STI and gender policies and practices and others that enhance gender participation in STI
6. Identify and describe best practices that may be in existence at higher education institutions and how such practices could be adopted and/or scaled up in other African universities. Describe the methods and tools that have been successfully applied; Specific reference should be made to Busitema University (Uganda), Eduardo Mondlane University (Mozambique), and University of Kordofan (Sudan).
7. Make own arrangements for logistics including accommodation, local transport, stationery, computer services and any other as detailed in the contract;
8. Ensure confidentiality / proprietary issues;
9. Recommend detailed options for the strengthening gender focused STI in the selected country;
10. Share results of the gender assessment in the form of draft report with the Forum for African Women Vice Chancellors (FAWoVC) and incorporate feedback into the final report;
11. Produce a final report and develop a publishable report on the status of STI in the selected country
12. Work with partner country teams to produce a synthesized status of gender based STI in Mozambique, Sudan and Uganda

B. Deliverables

The following deliverables are expected from the Consultant:

1. An inception report showing appreciation of the assignment and detailing the methodology and tools to be used in the assessment
2. draft report that will include review of the current statistics (including investment) available in the country with a focus on those relating to gender, higher education, Science, Technology and Innovation;
3. Detailed recommendations for strengthening gender based STI at national level and the possible role of Universities and the FAWoVC
4. A final report incorporating suggestions from FAWoVC
5. a publishable report on the status of STI in the selected country

C. Qualifications

Applicants will be evaluated against the following prequalification criteria:

a. Good references for reliability, dedication and an ability to work unsupervised;
b. Familiarity with the STI, higher education and gender issues in Africa;
c. Demonstrated knowledge of African universities systems and setting;
d. Competent in participatory approaches to enable engagement at different levels (stakeholders- research, universities, Non-governmental Organisation; Private Sector);
e. Ability to work in teams;
f. Facilitation, communication and writing skills; and,

D. Duration of the task

The task is expected to be undertaken between July and October 2019. The country studies should be completed and reports submitted by 31st October, 2019.

E. Reporting

It is the responsibility of consultant to ensure timely and quality reporting for each phase and deliverable in the assignment. All reports will be submitted to the Vice Chancellor, Busitema University the Contract Manager and correspondent for the Forum for African Women Vice Chancellors for this assignment on dates as may be agreed during the inception and stipulated in the contract.

Annex 2: Detailed Methodology Used for the Study

Overall, the review used a collaborative and participatory approach, examining the strengths and weaknesses of STI and gender policy implementation processes in Uganda, with a view to making recommendations to facilitate acceleration of implementation processes at all levels including partnership, coordination and integration of gender into national STI strategies and investment plans. Key questions identified include:

a) How do the STI and gender institutional and governance structures facilitate overall coordination? What are the strengths and weaknesses? How have they performed?

b) How effective is the relationship between the different organs and departments of government and designated technical agencies (DTAs) involved in STI and gender mainstreaming? What has worked well? What can be improved?

c) To what extent have the partnerships at various levels been effective, especially in enhancing girls' interest in STEM study and women's progression in STI careers? How can they be improved? What complementarities can be leveraged with existing and potential strategic/implementing partners?

d) To what extent has STI and gender knowledge management been effective - in terms of generation, access and sharing of knowledge and learning on STI and gender status, capacities and developments in the country? What can be improved?

e) How can the implementation of the national STI and gender policies be strengthened and made more effective in terms of interconnections between country processes, knowledge management, capacity development and partnerships?

f) To what extent have the DTAs and actors leading the different STI sub-systems been able to narrow the gender gap? What have been the strengths and weaknesses of the gender integration process? To what extent and how effective has been the integration of gender into the national STI strategies and investment plans? Is the portfolio of services and initiatives, and the pace at which they are being provided, appropriate to respond to the gender parity goals and objectives? What are the key lessons? What have been the challenges and how can they be overcome? How could they be improved?

g) To what extent has awareness been enhanced and capacities for STI and enhancing gender parity built? To what extent have national stakeholders and partners been involved in the development of the national STI ecosystem?

The approach reviewed and analysed the coordination structure and mechanisms, the partnership and complementarities with the existing (and potentially new) strategic and implementing partners, the KM strategies in place (plans and tools), and the capacity development strategies. Furthermore, the approach examined the institutional arrangements for STEM education and STI professional practice.

The review involved a mapping of the key actors, elements and initiatives as synthesised from reports and online searches, and targeted interviews to offer additional perspectives on the science education and associated innovation sub-systems. Data and information detailing gender-based capacity gaps, challenges, opportunities and future prospects for Uganda was generated. The assessment linked the national science education and innovation sub-systems and proposes strategies to increase participation of girls and women. Since the country case study was commissioned by FAWoVC, it largely focused on and reflected the status of STI as it applies to higher education/universities in terms of access, staffing, services offered, available opportunities, governance issues etc.

The study team reached out to, and engaged with, a broad range of local stakeholders (Government Ministries, Departments and Agencies of STI, Gender and Education; Research agencies; Universities – administration, staff and students; other key stakeholders in the private sector and civil society) in the conduct of the study, to gather opinions and validate the feasibility of the recommendations. The study also drew upon relevant case studies –national and international. The study drew on the following streams of data:

- *Desk-based Literature Review:* The study drew primarily on findings from literature review of documented experiences and accounts of women and girls participation in STI. Based on identified research questions, formulated in the context of the gender empowerment in the knowledge society framework, to guide the development of search strategies, the study team identified relevant studies and reports by undertaking online searches to place gender within national, regional and international STI ecosystem contexts.
- *Interview Consultations and Surveys:* A cross section of the national STI ecosystem actors and stakeholders were consulted – organisations and personalities (public, private, civil, academia) engaged in gender advocacy, mentoring and empowerment activities were identified through online research and informant interviews; identified the key individuals were contacted and engaged through semi-structured interviews in person, skype or telephone. Electronic and in-situ surveys were administered to selected organisations and individuals.
- *Case Studies:* A case study of Busitema University was undertaken and additional illustrative examples of the practices that have aided or impeded women and girls participation in STI in Uganda were sourced from the desk-based literature review and validation interviews. In particular, a detailed analysis of the methods and tools that have been used at Busitema University was made to identify and describe best practices that may be in existence at higher education institutions and how such practices could be adopted and/or scaled up in other universities.
- *Charting, Collating, Summarising and Reporting the Results:* The material was sorted according to key issues and themes outlined in the GE&KS analytical framework. Information was collated to present an overall summary of the existing and potential incentive regimes and trends in Uganda, from which conclusions and recommendations were drawn to help advance the development of more robust intervention strategies.
- *Stakeholder Validation:* The Working and Final Draft versions of the report were sent to a select group of knowledgeable experts for review and comments. A national stakeholder validation meeting was organised in conjunction with the Office of the President and Ministry of Science, Technology and Innovation on 31st October 2019, during which the findings of the study were presented and discussed. The consultations helped add methodological rigor, and enabled stakeholders to provide additional references and information to include in the report, as well as valuable insights about other issues pertinent to the study. Based on these validations, the draft document was enriched, complemented with further literature reviews and then finalized.

The study methodology relied on quantitative and qualitative methods, each aiming at specific but complementary approaches. The approach asserted that responsible empowerment of women and girls to participate in the STI ecosystem is the result of the interaction of key elements of: enabling environment (spaces), innovation, beneficiaries, promoters (inputs/drivers) and service providers. This was very essential for mapping and assessing the ecosystem actors. The various elements identified in the GE&KS framework were assessed along STI ecosystem activity domains (of identifying, training, connecting and sustaining, funding, enabling/regulating, and celebrating STEM girls and STI career women) along the 8-step skills staircase for basic education and professional formation and

practice; and as practiced or promoted by the various categories of ecosystem actors (academia, private investors, governments and civil society) to describe and help understand the complex systems and interactions involved in the STI ecosystem in Uganda.

Following this assumption and approach, the study synthesised the study results, conclusions and recommendations in the context of two components:

a) the **necessary conditions and incentives** related to women empowerment and its drivers - taking into account their impacts, comparative advantages, the degree of ownership/legitimacy among local stakeholders, risks and sustainability; and,

b) the **sufficient conditions**, i.e. i) the vision, strategies and pathways for providing and establishing the necessary conditions for incentivising women participation in STI; ii) the engagement of target groups and needed partners; iii) the effective drivers of change to long-held beliefs and stereotypes; iv) the conducive enabling environment based on legitimacy and alignment; v) coordination challenges and decision-making processes; vi) M&E procedures and learning spaces; vii) readiness of leading and partner organizations; and, viii) the cost-benefit of providing and sustaining the incentives associated with the activity domains of the STI system.

Annex 3: Women in the medical, engineering and agricultural sciences in Uganda – selected achievers

Prof. Josephine Nambooze Kigundu is an emeritus professor of public health at Makerere University School of Public Health. She was the first female Ugandan to qualify as a physician circa 1959. Following graduation from Makerere, she undertook postgraduate studies in the United Kingdom and the United States, returning to Uganda in 1962. She joined the staff at Makerere University in 1962 as a lecturer in public health and maternal and child health. She was given the responsibility of supervising Kasangati Health Centre, a teaching facility of Makerere University School of Public Health which she later headed. She later made senior lecturer, associate professor, and full professor in those fields. She also served as the World Health Organization (WHO) representative to Botswana and as director of support for health services development at the WHO regional office in Brazaville, Congo.

Dr. Specioza Naigaga Wandira Kazibwe, graduated with the Bachelor of Medicine and Bachelor of Surgery degree from Makerere University in 1979. She later obtained the degree of Master of Medicine, was awarded the honorary degree of Doctor of Science (SD), by Harvard School of Public Health, Department of Population and International Health. She was Vice President of Uganda from 1994 to 2003, and the first woman in Africa to hold the position of vice-president of a sovereign nation. She also served as Minister for Agriculture, Animal Industry and Fisheries.

Dr. Margaret Blick Kigozi, commonly known as Maggie Kigozi, joined Makerere University School of Medicine in 1970, just before she turned 20, graduating in 1974 with the degree of Bachelor of Medicine and Bachelor of Surgery. She is a consultant at the United Nations Industrial Development Organization (UNIDO) and formerly served as the Executive Director of the Uganda Investment Authority (UIA), from 1999 until 2011. Kigozi has had the following additional roles: Chief Scout of the Uganda Scouts Association; Associate Professor of Economics at Makerere University; Member of Global Banking Alliance for Women (GBA) Advisory Board; Patron, Uganda Change Agents and Junior Chamber International; Director of the Board of Uganda Export Promotion Board; Member, board of directors, Crown Beverages Limited – Manufacturers and distributors of Pepsi-Cola in Uganda; The founder of Uganda Investment Authority Women Entrepreneurs Network; Focal Point Officer for the Africa Asia Business Forum; Patron Ugandan Diaspora Network; Sportswoman who has represented Uganda in lawn tennis, table tennis, hockey and squash; Chancellor of Nkumba University.

Prof. Harriet Mayanja Kiiza holds a Bachelor of Medicine and Bachelor of Surgery obtained in 1978, a Master of Medicine in Internal Medicine, obtained in 1983 from Makerere. She studied immunology and pathology at Case Western Reserve University, graduating with the degree of Master of Science in 1999. She is a Fellow of the American College of Physicians. She has worked as a lecturer in also served as the head of the Department of Internal Medicine, both at the medical school and at Mulago National Referral Hospital, appointed Dean of the Makerere Medical School, at Makerere University College of Health Sciences in 2010. She was one of ten outstanding female professors honoured by Makerere University in March 2010 with the Gender Equality Award, to celebrate women achievements in higher education and to support girls from disadvantaged backgrounds to access higher education. She graduated from Medical School in 1980 and got my Masters in 1984.

Dr. Lydia Mungherera (1958-2017) – when she was elected the President of Uganda Medical Association in 2000, she was the first woman to hold that position in the 65-year history of the body. In 2013, when she became the president of the World Medical Association, she was the first black woman to hold that position. She represented African NGOs on the UNAIDS board and was a member of technical working groups that developed the UNAIDS Agenda for Women and Girls.

Mrs. Catherine Zawedde Kisumba (1936-2017) excelled as an all-round student but had a special knack for mathematics. Catherine graduated in 1960 as the first Ugandan pharmacist from Bristol College of Science and Technology, worked for some time in the UK, then returned to Uganda in 1962. Catherine worked diligently as pharmacist in many hospitals in Uganda, including Mulago, Gulu, Masaka and Bombo. She rose through the ranks to become a Principal Pharmacist and a tutor at the Pharmacy Technician training school at Mulago Hospital. After ten years of exemplary service, she joined the private sector. By 1980, she was running her own pharmacy - Equator Pharmacy in Kampala. For many years she was a member of the Executive Committee and Pharmacist Advisor of the Uganda Red Cross Society. She also represented the Pharmaceutical Society of Uganda on the Committee on the National Formulary.

Hon. Jane Ruth Aceng holds a Bachelor of Medicine and Bachelor of Surgery (MBChB), a Master of Medicine (MMed) in Paediatrics, and a Master of Public Health (MPH), all from the Makerere University College of Health Sciences. She is the Minister of Health appointed to that position in June 2016. Before that, from June 2011 until June 2016, she served as the director of medical services

Hon. Christine Joyce Dradidi Ondoa holds the degree of Bachelor of Medicine and Bachelor of Surgery (MBChB), obtained in 1994, from Makerere University Medical School. She also holds the degree of Master of Medicine in Paediatrics (MMed). She currently serves as the Director General of the Uganda AIDS Commission since 2014. Prior to that, she served as a Senior Presidential Advisor on Public Health. She was a member of the board of directors of the Global Alliance for Vaccines and Immunization (GAVI). She was Minister of Health from 2011 to 2013. Prior to that, she was the Executive Director of Mbarara Regional Referral Hospital,

Annex 3: Women in the medical, engineering and agricultural sciences in Uganda – selected achievers

Hon. Joyce Moriku Kaducu graduated with a Bachelor of Medicine and Bachelor of Surgery in 2002 from Mbarara University School of Medicine; Master of Medicine in Paediatrics in 2008 from Makerere University School of Medicine. In 2015, Gulu University awarded her a PhD in Neuroscience. She is the Minister of State for Primary Health Care since June 2016, and the elected Member of Parliament for Moyo District Women Representative in the 10th Parliament (2016 to 2021)

Ambassador Edith Grace Sempala - graduated from Peoples' Friendship University of Russia, then known as Lumumba University in 1979 with a Bachelor of Science and a Master of Science in Civil Engineering, who has served as Director and Senior Adviser at the World Bank since 2008. She previously served as Uganda's representative to the Nordic countries, the United States, the African Union, Ethiopia and Djibouti.

Eng. Winnie Byanyima trained as an aeronautical engineer, worked as a flight engineer for Uganda Airlines, Member of Parliament, Director of the Directorate of Women, Gender and Development at the headquarters of the African Union, Director of the Gender Team in the Bureau for Development Policy at UNDP, Executive director of Oxfam International, and now Executive Director UNAIDS and a Deputy Secretary General at the UN.

Eng. Proscovia Margaret Njuki studied at the University of Nairobi, graduating with a Bachelor of Science in electrical engineering in 1974, the first female Ugandan to graduate as an engineer. She began work as a telecommunications engineer at the then Uganda Television (UTV). She rose through the ranks and in 1994, was appointed the head of UTV engineering services. In 1995, she was appointed Commissioner of UTV. She was Board member before assuming the chairmanship at Uganda Electricity Generation Company Limited (UEGCL), founder-member of the Association of Women Engineers, Technicians and Scientists in Uganda (WETSU), since 1989 and member of the Institution of Professional Engineers in Uganda on which she served on its executive council from 1990 until 1993.

Eng. Ziria Tibalwa Waako holds a Bachelor of Science and a Master of Science, both in Electrical Engineering from Makerere University. She also has a Master of Business Administration in Leadership, awarded by Walden University, in Minneapolis, Minnesota. She worked with the now defunct Uganda Electricity Board (UEB). When UEB was dissolved in 2001, she transferred to the Uganda Electricity Transmission Company Limited (UETCL). In 2012, she was appointed as Director of technical regulation at the Electricity Regulatory Authority, serving in that capacity until she was promoted to CEO at the regulatory agency in 2016.

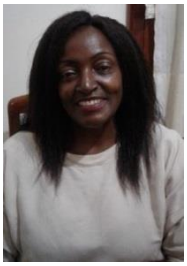
Hon. Monica Azuba graduated in 1978 with a Bachelor of Science in Civil Engineering. She was employed by the now defunct Uganda Commercial Bank (UCB) .When UCB was purchased by Standard Bank of South Africa in 2002, she stayed with the institution, rising to the position of Facilities Manager at Stanbic Bank Uganda Limited; served as a member of the board of Uganda National Roads Authority (UNRA) and was appointed Minister of Works and Transport in June 2016.

Hon. Irene Nafuna Muloni graduated from Makerere University with honours in Bachelor of Science in Electrical Engineering (BSc.E.Eng) in 1986 and MBA from Capella University. She is also a Certified Public-Private Partnership Specialist, accredited by The Institute for Public-Private Partnerships, Inc. (IP3) and the Water, Engineering and Development Centre (WEDC) of Loughborough University. From 2002 until 2011, she worked as the Managing Director of the Uganda Electricity Distribution Company Limited (UEDCL). In 2011, she entered elective politics, by successfully contesting for the Bulambuli District Women's Representative in the 9th Ugandan Parliament (2011 - 2016). She has held the portfolio of Minister of Energy and Minerals since 2011.

Annex 3: Women in the medical, engineering and agricultural sciences in Uganda – selected achievers

Hon. Lillian Nakate Segujja studied at Uganda Polytechnic Kyambogo, which later became a component of Kyambogo University, where she obtained a Diploma in Architectural Draftsmanship in 2000. In 2007, she graduated from Makerere University with a Bachelor of Science (BSc) degree in Civil Engineering. And a Master of Science in the same field in 2011. She worked as an Assistant Engineering Officer for Luweero District Local Government from 2001 until 2006. In 2007, she was appointed as the Town Engineer for Wobulenzi Town Council, and Acting District Engineer for Luweero District. In 2011, she went back into the private sector. She is now a Member of Parliament and sits on the parliamentary committee on science and technology and is the deputy chairperson of the parliamentary committee on physical infrastructure.

Eng. Josephine Kasalamwa Wapakabulo/Thomas studied at Loughborough University as an electrical and electronics engineer, obtaining a BEng, MSc and a PhD in the field. She also holds an Executive MBA from the INSEAD Business School in France. She served as the founding Chief Executive Officer of Uganda National Oil Company (UNOC) from June 2016 to August 2019.



Eng. Grania Rosette Makatu Rubomboras studied engineering at Makerere University, graduating with a Bachelor of Science in electrical engineering in 1978. She also obtained a Master of Business Administration, from Makerere University Business School and holds a Master of Science in project management. She joined the now defunct Uganda Electricity Board in 1992 and rose through the ranks to the position of Managing Director, by 2003. When UEB was dissolved in 2004, Rubomboras spent several years as a programme officer at the Rural Electrification Agency. In her role as regional project manager of the Nile Equatorial Lakes Subsidiary Action Program, Interconnection of Electric Grids Project, she serves as the head of its power department. In May 2017, Rubomboras was recognized for her work in integrating the national electricity grid networks of five member-countries of the Nile Basin Initiative, namely: Burundi, Democratic Republic of Congo, Kenya, Rwanda and Uganda. The recognition was at the annual "African Utility Week Power Industry Awards" held in Cape Town.

Ms. Dativa Kagobora Tizikara graduated with a first class degree in Electrical and Electronics Engineering from Makerere University. She was the only girl that was on the 6-person team from Uganda that participated in the meeting of the Vehicle Design Summit (VDS) teams to build the vision 200 prototype – a 6-passenger, hybrid, 100 mpg electric vehicle that was showcased at the dream exposition in Torino, an event celebrating automotive history and future opportunities. The consortium consisted of twelve (12) Universities from Europe, fifteen (15) from North and South America, eight (8) from Asia and only Makerere University from Africa which designed the Electrical System and Data networking. She obtained an MSc in Electrical Engineering (Telecommunications Track) from the University of Twente and and has provided expertise as a Radio Planning and Optimization Engineer for major Telecommunications networks in Uganda. She currently works as an Assistant Lecturer in Department of Electrical and Computer Engineering, Makerere University. She is also a co-founder of Ubloom Alliance Limited, an organization she founded with three other women with an aim to grow the number of women in Uganda pursuing STEM fields.

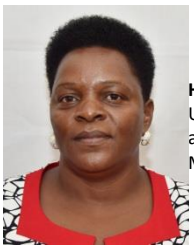
Eng. Godliver Businge enrolled at African Rural University but realising she wanted to become an engineer, she transferred to the Uganda Rural Development Training Vocational Institute (URDT). She chose construction as her major, learning brick laying and concrete, mechanical engineering, carpentry, joinery, metal work and fabrication. She earned a scholarship from URDT, worked part-time in the metal workshop, and won a home design competition in 2009 for Uganda Vision 2035. She graduated from the program then attended St Joseph's Technical Institute in Kisubi, Uganda. In 2011 she set up two pico hydroelectric power stations in Kagadi. She earned a civil engineering degree in 2012, graduating at the top of her class. Following her graduation she declined a job offer from the Ugandan Minister of Education, citing her intention to further her education. Businge works as the head technology trainer for Global Women's Water Initiative (GWWI), teaching women and youth in Kenya, Tanzania, and Uganda how to build water access and conservation technology. She teaches the construction of bio-sand filters, water tanks and ventilated improved pit latrines.

Eng. Nana Hill Kagga Macpherson holds a Bachelor's degree in Chemical Engineering but is better known as the “engineer with a passion for film” – having been presenter for the popular Ugandan TV show Jam Agenda on WBS, actor and presenter in the US film industry in Hollywood and in several music videos and TV ads; and creator and producer of the a full-length feature film, The Life which was shown on M-NET, and a popular Ugandan TV Series Beneath The Lies - The Series, under the brand, Savannah MOON Productions. She also worked with Tullow Oil.

Annex 3: Women in the medical, engineering and agricultural sciences in Uganda – selected achievers

Hon. Victoria Sekitoleko obtained a BSc in Agriculture majoring in Farm Management and Extension (1970–1973) from Makerere University. She is a former Minister of Agriculture, a post she held from 1986 to 1995. She was FAO Sub Regional Representative to Eastern and Southern Africa (1995–2004), to the African Union (AU), and to the Economic Community for Africa (ECA) (2005–2006), and to China, Mongolia, and South Korea (October 2006 – April 2011. She is currently Chairperson of the governing board of Uganda Agribusiness Alliance and active member of the Business and Professional Women Kampala (BWP) and Uganda Women Entrepreneurs Association Limited (UWEAL.

Hon. Mary Goretti Kitutu Kimono graduated in 1987 with a Bachelor of Science degree in Chemistry and Geology. Her Master of Science was obtained in 1998 from the Faculty of Geo-Information Science and Earth Observation of the University of Twente. In 2011, she obtained a Doctor of Philosophy from Makerere University. She is the elected Manafwa District Women's Representative, in the 10th Parliament (2016 - 2021) and the State Minister for the Environment.



Hon. Peace Regis Mutuuzo attended National Teachers College Kakoba, now a component of Bishop Stuart University in graduating with a Diploma in Secondary Education. She then joined Makerere University, graduating with a Bachelor of Environmental Science. Later, she obtained a Master of Public Administration and Management from Uganda Management Institute. She is the Minister of State for Gender and Culture in the Ugandan Cabinet since June 2016

Hon. Ida Erios Nantaba has a Bachelor of Tourism degree, obtained in 2003 from Makerere University. She is the State Minister in the Ministry of Information and Communications Technology since June 2016. Prior to that, from 15 August 2012 until 6 June 2016, she was Minister of State for Lands.She is also the elected Member of Parliament for Women in Kayunga District Constituency.

Hon. Jenipher Kacha Namuyangu graduated with a Bachelor of Science in Forestry, in 1993 and Master of Science in Agroforestry from to Makerere University She is the Minister of State for Local Government since June 2016 and previously served as Minister of State for Industry (2003-2006) and Minister of State for Water Resources, from 1 June 2006 until 27 May 2011. From 1994 until 1996, she served as the Youth Representative for Eastern Uganda to the National Resistance Council, the parliamentary institution at that time. From 1997 until 1998, she served as a Lecturer at Nyabyeya Forestry College. She then joined the Ministry of Lands and the Environment, in the Forestry Department, as a Seed Source Development Officer, serving in that capacity from 1998 until 2001 when she re-joined politics and was elected to Represent the Women of Pallisa District in parliament. She was again re-elected to the same position in 2006.

Prof. Mary Jossy Nakhanda Okwakol graduated with a Bachelor of Science degree in Zoology from Makerere University in in 1974 and was retained at the university as a junior lecturer. She immediately started on her Master's degree and completed it in two years. She only became a full lecturer in 1988, before starting on a PhD at Oxford, which she completed in 1992, became an Associate Professor in 1996 and a full professor in 1999. She was the first woman Vice Chancellor of a Public University in Uganda (Busitema University), as well as the first woman Professor of Zoology at Makerere University. She is currently Chairperson of the Forum for African Women Educationists (FAWE) Uganda Chapter, honorary secretary of the FAWE Board and Executive Director of the Uganda National Council for Higher Education (UNCHE).

Annex 3: Women in the medical, engineering and agricultural sciences in Uganda – selected achievers

Prof. Joyce Kikafunda graduated from Makerere in 1975 with BSc. in Agriculture first class; a feat only equalled 20 years later. She then proceeded to Canada to pursue a master's degree in Food Science and Technology, before heading to Mexico and Cameroon and returned to Uganda in 1983 to take up the appointment of lecturer in the Department of Food Science and Technology, which was just starting, heading the department for 12 years. She became a full professor in 2009 and saw the department grow to an institute and School of the College of Agriculture and Environmental Sciences (CAES) of Makerere University before being appointed Uganda's High Commissioner to the UK.

Dr. Florence Muranga is the Director of Presidential Initiative for Banana Industrial Development. She is a lecturer at Makerere University, in the School of Food Science & Technology, and she has won 'the Presidential Scientific Innovation Excellence Award for the 2005/2006 Presidential Science Award Cycle.

Dr. Theresa Sengooba holds a PhD in plant virology from Sokoine University of Agriculture, an MSc in plant mycology and BSc in botany and zoology from Makerere University. She worked for the National Agricultural Research system (NARO) from a research scientist grade to Director of Namulonge Crop Resources Research Institute and later Deputy Director General. She has contributed to agricultural institutional management at various levels including serving on several steering committees of regional crop based commodity programs and on boards of the International Plant Genetic Resources Institute (IPGRI) and the International Potato Centre (CIP). She chaired the Millennium Science Initiative Technical Advisory Committee between 2007and 2013 and served on a PanAfrican program, the African Biosafety Network (ANBE) as a member of TAC from 2010 to 2013.Dr Theresa Sengooba is the senior advisor to the Program for Biosafety system (PBS), a program hosted by the International Food Policy Research Institute (IFPRI) and implemented in Uganda by the National Council for Science and Technology.

Dr. Fina Asinisi Opio obtained her M.Sc. in 1979 from the University of Nairobi and PhD in Plant Pathology in 1992 from Sokoine University of Agriculture. From a Programme Leader of the Beans Programme and Principal Research Officer, she rose to become the Director of Research of Namulonge Agricultural and Animal Production Research Institute of NARO; served as Vice-President of the Uganda National Academy of Sciences to which she was elected in 2006, member of the Council of Science and Technology She is member of the Indian Phytopathological Society, the Agricultural Technical Committee, African Crop Science Society and several other professional societies. She served as Executive Director of the Association for Agricultural Research in East and Central Africa (ASARECA), and is now a Professor at Bishop Stuart University.

Dr. Imelda Kasheija holds a PhD in plant breeding and rose through the ranks in the National Agricultural Research Organisation to become Director of Kachwekano Zonal Agricultural Research and Development Institute before being appointed Deputy Director General in charge of Outreach at NARO Headquarters.

Prof. Christine Dranzoa holds a Bachelor of Science (BSc) in Zoology, obtained in 1987; Master of Science (MSc), in Zoology, obtained in 1991, and Doctor of Philosophy (PhD) in Biology in 1997 all from Makerere University. She joined Makerere University in 1992 as a Lecturer in the Faculty of Veterinary Medicine and served as the head of the Wildlife Section in the Department of Veterinary Anatomy from 1992 until 1996. From 1997 until 2005, she served as the head of the Department of Wildlife and Animal Resources Management, a department she had co-founded with her colleagues. In 2005, she was appointed Deputy Director of the School of Postgraduate Studies at the university, serving in that capacity from 2005 until 2010. In 2010, Dr. Dranzoa was appointed to lead a three-person task-force to prepare for the creation of Muni University of Technoscience. In January 2012, when the university became operational, Professor Dranzoa became the founding Vice Chancellor.

Annex 3: Women in the medical, engineering and agricultural sciences in Uganda – selected achievers

Prof. Maud Kamatenesi Mugisha studied Botany and Zoology, graduating with a Bachelor of Science degree. Her Master of Science in Environment and Natural Resources Management degree and her Doctor of Philosophy in Medical Ethnobotany and Ethno-pharmacology were also from Makerere. Soon after writing her final examinations in Botany and Zoology at Makerere in 1996, she was recruited as a Teaching Assistant in the Faculty of Science. From 1998 until 2000, she served as Lecturer and Head of Department, Uganda Fisheries Training Institute. She later served as the Head of Fisheries Extension Education and Administration at FTI. From 2010 until 2011, she served as the Deputy Dean, Research and Graduate Studies, in the Faculty of Science, Makerere University. From February 2011 until May 2014, she served as the Dean of the School of Biosciences, College of Natural Sciences at Makerere University. On 2 May 2014, she was appointed Vice Chancellor of Bishop Stuart University, a position she currently occupies

Dr. Emma Naluyima is a veterinarian by profession and an urban farmer. She holds a Bachelor of Science in Veterinary Medicine and a Master's degree in Public Health from Makerere University. Naluyima has been recognised as one of Uganda's best farmers since 2014. She is a renowned champion of entrepreneurship in agriculture through her farm, One Acre Unlimited, on which she grows crops rears livestock. The secret to her success is innovative integration of crop and livestock production, based on recycling of farm resources to provide natural fertilisers and pesticides as well as biogas. On her one-acre farm, she maintains 30 breeding sows and 5 boars, several fish ponds under greenhouse fish farming with a capacity of 6,000 fish, a quarter an acre of well-kept banana plantation, greenhouses for vegetables, five zero grazed dairy cows and a machine for making hydroponic fodder. The farm generates about US$ 100,000 a year and receives over 10,000 visiting farmers annually. Dr. Naluyima won the 2019 Africa Food Prize.

Dr. Gladys Kalema-Zikusoka is a wildlife veterinarian and conservationist working with the endangered mountain gorillas of East Africa. Her professional studies began when she won a scholarship to study at the University of London Royal Veterinary College, graduating with a Bachelor of Veterinary Medicine. After graduating from the University of London, she established the first veterinary department in the Uganda Wildlife Authority. Later, she obtained a Master of Veterinary Medicine, a certificate in the management of non-profit organizations and a Master of Business Administration. Kalema-Zikusoka has received a number of honours, awards, and other public recognitions of her environmental and humanitarian work. She was profiled in the BBC documentary, Gladys the African Vet. She has also been featured in documentaries in National Geographic, Animal Planet, MNet and Uganda Television. Her Gorilla Conservation Coffee social enterprise aims to improve the lives of farmers living around national parks with gorillas in Uganda by training them on how to grow and process good quality coffee, while paying them premium prices to improve their livelihoods – stopping them from poaching and collecting firewood from the forest to make ends meet.

Ms. Catherine Amusugut graduated with a Bachelor of Science in Geology and Chemistry from Makerere university. Later, in 2010, she obtained a Master of Science in Petroleum Geoscience, from the University of Aberdeen. She works as a Geologist at the Petroleum Exploration and Production Department (PEPD), in the Ministry of Energy and Mineral Development, since January 2007.

Ms. Pauline Irene Batebe graduated in 2005 with a Bachelor of Science degree in chemical and processing engineering. In 2010 she graduated from the Royal Institute of Technology, in Stockholm, Sweden with a Master of Science in Mechanical Engineering, with focus on sustainable energy engineering. She then entered the University of Manchester where in 2011 she was awarded the Master of Science degree in Advanced Chemical Process Design, with a focus on Refinery Design and Operation. She serves as the chairperson of the Uganda Refinery Holding Company (URHC), a subsidiary company of the Uganda National Oil Company (UNOC) and Principal Refining Engineer in the Ministry of Energy and Mineral Development, since February 2009. She is the government technocrat whose primary responsibility is building the oil refinery, the crude oil pipelines and petroleum products pipeline

Mrs. Jane Nambakire Mulemwa studied chemistry and biology at Makerere University, graduating with a Bachelor of Science. From 1976 until 1979, she studied for her master's degree in chemistry also at Makerere. She attended Queen's University Belfast from 1980 until 1982, graduating with a Doctor of Philosophy in chemistry in 1982. She returned to Uganda in 1982 to be a lecturer in chemistry and science education at Makerere University. In 1988, she served as senior lecturer in chemistry and science education at the Department of Science and Technical Education, serving in that capacity until 1998. She then joined the Education Service Commission, rising to the rank of deputy chairperson. In 2015, she was appointed to chair the newly created Petroleum Authority of Uganda, the autonomous regulator of the petroleum industry