THE NIGERIAN ACADEMY OF SCIENCE

International Science Council

Shaping the future of researchers in developing countries

Workshop Report

The Nigerian Academy of Science
Academy House
8A, Ransome Kuti Road
University of Lagos, Lagos, Nigeria.
PMB 1004, University of Lagos Post Office,
Akoka, Yaba, Lagos, Nigeria

Tel: (+234) 08089622442

Website: www.nas.org.ng

Email: admin@nas.org.ng

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*Participants in a photo session at the **ICSU/CFRS/NAS** workshop titled: "Shaping the Future of Researchers in Developing Countries" held on 8th and 9th March 2018 at the REIZ Continental Hotel, Abuja, Nigeria.*

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ACRONYMS

AMASA- Annual Meeting of African Science Academies
AU-PET: African Union Panel on Emerging Technologies
CFRS: Committee on Freedom and Responsibility in the conduct of Science
CSOs: Civil Society Organizations
ECOWAS: Economic Community of West African States
FTE: Full Time Employment
GDP: Gross Domestic Product
GERD: Gross Expenditure on Research and Development
IAA: International Association of Academies
IAP: InterAcademy Partnership
IAP-R: InterAcademy Partnership for Research
ICSU: International Council for Science
ICSU- ROA: International Council for Science - Regional Office for Africa
ICSU-RCA: International Council for Science - Regional Committee for Africa
ILO: International Labour Organization
INGSA: International Network for Government Science Advice
IRC: International Research Council
JAMA: Journal of American Medical Association
LIRA: Leading Integrated Research for Agenda 2030 in Africa
LOC: Local Organizing Committee
MDAs: Ministries, Departments and Agencies
NAS: Nigerian Academy of Science
NASAC: Network of African Science Academies
NEPAD: New Partnership for Africa's Development
PPP: Private Public Partnership
R&D: Research and Development
RID: Research, Innovation and Development
S&T: Science and Technology
SADC: South African Development Community
SDGs: Sustainable Development Goals
SGCI: Science Governing Council Initiative
STEM: Science, Technology, Engineering, and Mathematics
STI: Science Technology and Innovation
UN: United Nations
UNESCO: United Nations Educational, Scientific and Cultural Organization

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FOREWORD

The workshop on "Shaping the future of researchers in developing countries" by the International Council for Science (ICSU)'s Committee on Freedom and Responsibility in the conduct of Science (CFRS) held in collaboration with the Nigerian Academy of Science (NAS) over a two-day period was a very exciting and successful meeting. Other stake holders involved were the ICSU Regional Office for Africa (ROA). The workshop had been some time in planning and eventually held at the Reiz Continental Hotel, Abuja, Nigeria. Professor Gueladio Cisse (ICSU-CFRS) was the major driving force for this event to hold, ever since the NAS proposed the idea of hosting the Workshop in 2017, by the President of NAS, Professor Mosto Onuoha (FAS). The workshop eventually took place following extensive discussions between CFRS and NAS, with Professor Soga Sofola FAS, chairing the Local Organizing Committee (LOC), in collaboration with some Fellows and the Executive Secretary of NAS, Dr. M. Doyin Odubanjo along with staff of the NAS Secretariat.

The meeting got started with a welcome and opening address by the President of NAS, Professor Onuoha FAS. At the opening ceremony were addresses from the Chair of CFRS, Professor Leiv K. Sydnes as well as Professor Oye Ibidapo Obe FAS, who gave the keynote address. The ball was set rolling by the Coordinator, Professor Cisse who enumerated the four main themes of the Workshop i.e. Theme One - Ensuring Rights, Freedom, Needs, Duties and Responsibilities For African Researchers, Theme Two- Main Drivers of Brain Drain/ Brain Loss And Good Examples of Mitigating Circumstances, Theme Three- Creating an Enabling Environment For Researchers, and Theme Four- Security of Employment and Sustaining Support for Specific Groups of Scientists e.g. Young and Female Researchers. The division of participants into groups ensured that everyone participated in the deliberations and at the end of each thematic session, the rapporteurs did their presentations followed by lively discussions. The spread of thematic presenters was wide, varied, and with international flavour.

The 2-day Workshop was an eye opener of what is required especially in the African context to improve on research competencies. It also emphasized the need for countries to devote a minimum of 1% of Gross Domestic Product (GDP) to Science Technology and Innovation (STI), especially research. In addition, emphasis was laid on the need to attract and encourage the young researchers, who really need to be mentored and supported financially. There was a very good session on female researchers who are thought to require special attention in view of their many gender-specific roles which include looking after their families, in addition to research. The presence of many female participants ensured a very lively discussion.

The Workshop ended on a very good note and all participants looked forward to a follow up meeting, in order to assess the progress that is being made. The NAS was quite impressed by the quality presentations, as well as the wide variety of presenters. This monograph essentially chronicles the deliberations that took place and we hope that it will assist African nations, in particular, to latch on to the ideas that were raised. NAS is grateful to ICSU/CFRS for the support and opportunity to host the event.

Olusoga Sofola, FAS	**Leiv K. Sydnes**	**Babatunde Samuel Agbol**a
Chair, LOC/NAS	*Chair, ICSU-CFRS*	*Chair, ICSU-RCA*

ABOUT THE NIGERIAN ACADEMY OF SCIENCE

The Nigerian Academy of Science (NAS) is the foremost independent scientific body in Nigeria which was established in 1977, and incorporated in 1986. NAS is uniquely positioned to bring scientific knowledge to bear on the policies/strategic direction of the country, and is also dedicated to the development and advancement of science, technology, and innovation (STI) in Nigeria. The aims and objectives of the Academy are to promote the growth, acquisition, and dissemination of scientific knowledge, and to facilitate its use in solving problems of national interest. The Academy strives to do this by:

- Providing advice on specific problems of scientific or technological nature presented to it by the government and its agencies, as well as private organizations
- Bringing to the attention of the government and its agencies problems of national interest that science and technology can help solve
- Establishing and maintaining the highest standards of scientific endeavours and achievements in Nigeria, through the publication of journals, organization of conferences, seminars, workshops, and symposia, recognition of outstanding contributions to science in Nigeria, and the development of a working relationship with other national and international scientific bodies and academies

As with national academies in other countries, NAS is a not-for-profit organization with a total membership (since inception) comprising 233 Fellows elected through a highly competitive process who have distinguished themselves in their fields both locally and internationally. Some of her members have served as Vice-Chancellors of universities, Directors-General of government parastatals, and Ministers in federal ministries. The Academy, given its clout, also has the ability to attract other experts from around the country and internationally when needed. NAS is Nigeria's national representative on such bodies as the International Council for Science (ICSU) - the umbrella body for all science associations and unions, and the InterAcademy Partnership (IAP) - the umbrella body for all national science academies globally. The Academy is also a member of the Executive Committees of the InterAcademy Partnership for Research (IAP-R), and the Network of African Science Academies (NASAC).

ABOUT THE INTERNATIONAL COUNCIL FOR SCIENCE

The International Science Council (ISC)- formerly the International Council for Science (ICSU) - is an international organization devoted to international cooperation in the advancement of science. Its members are national scientific bodies and international scientific unions. ICSU was founded in 1931 to promote international scientific activity in the different branches of science, and its application for the benefit of humanity. It is one of the oldest non-governmental organizations in the world and represents the evolution and expansion of two earlier bodies known as the International Association of Academies (IAA; 1899-1914), and the International Research Council (IRC; 1919-1931). As of 2017, it comprises of 122 multi-disciplinary national scientific members, associates, and observers representing 142 countries and 31 international, disciplinary Scientific Unions. ICSU also has 22 Scientific Associates.

The ICSU's mission is to strengthen international science for the benefit of society. To do this, ICSU mobilizes the knowledge and resources of the international scientific community to:

- Identify and address major issues of importance to science and society.
- Facilitate interaction amongst scientists across all disciplines and from all countries.
- Promote the participation of all scientists - regardless of race, citizenship, language, political stance, or gender - in the international scientific endeavour.
- Provide independent, authoritative advice to stimulate constructive dialogue between the scientific community and governments, civil society, and the private sector.

The ICSU Secretariat ensures the day-to-day planning and operations under the guidance of an elected Executive Board. Three Policy Committees, Committee on Scientific Planning and Review (CSPR), Committee on Freedom and Responsibility in the conduct of Science (CFRS) and Committee on Finance, assist the Executive Board in its work and a general assembly of all members is convened every three years. ICSU has three regional offices -for Africa, for Asia and the Pacific, as well as for Latin America and the Caribbean.

ICSU activities focus on three areas: international research collaboration, science for policy, and universality of science. The ICSU's principle of universality of science states: *"the free and responsible practice of science is fundamental to scientific advancement and human and environmental well-being"*. Such practice, in all its aspects, requires freedom of movement, association, expression, and communication for scientists, as well as equitable access to data, information, and other resources for research. It requires responsibility at all levels to carry out and communicate scientific work with integrity, respect, fairness, trustworthiness, and transparency, recognizing its benefits and possible harms. In advocating the free and responsible practice of science, ICSU promotes equitable opportunities for access to science and its benefits, and opposes discrimination based on such factors as ethnic origin, religion, citizenship, language, political or other opinion, sex, gender identity, sexual orientation, disability, or age. Adherence to this principle is a condition of ICSU membership. The Committee on Freedom and Responsibility in the conduct of Science (CFRS) serves as the guardian of the principle, and undertakes a variety

of actions to defend scientific freedoms and promote integrity and responsibility. Its mission is to raise international awareness and promote freedom and responsibility aspects related to the conduct of science. It does this by issuing advisory material, organizing scientific meetings, and by considering cases of individual scientists whose human rights are infringed upon.

In July 2018, ICSU was merged with the International Social Science Council (ISSC) to become the ISC.

INTRODUCTION

Background

Science and technology (S&T) have been globally recognized as tools for the efficiency, productivity, and industrial competitiveness of nations. Technological advancement is the speed with which countries identify, utilize, and diffuse new knowledge for the actualization of their strategic goals for sustainable development, and relevance in global economics. For science to translate to improved quality of life, wealth, and employment creation, it must be focused at bringing new goods and services in the global domain that are innovative and problem solving. S&T efforts are expected to be geared towards the development of economies through the utilization of scientific research. Developments in science open up new opportunities and solve societal challenges among countries. The strength and depth of institutional structures for generating and applying this knowledge makes the difference for the ranking of countries as scientifically/technologically advanced or not. The scientific outputs of many developing countries have not been optimally utilized, and so these countries continue to remain at the bottom of developmental indices. There is therefore the need to put in place explicit strategies, mechanisms, and institutions to translate scientific knowledge to development.

The African scientific community is noted to be plagued by diverse challenges that hinder their ability to keep up with their counterparts in other parts of the world. These issues were observed to be those of government policies and poor funding for science, poor understanding of the relationship between science and national development, poor infrastructure, exodus of scholars to other countries (brain drain/brain loss), poor career opportunities for young researchers, lack of mentorship, limited involvement of women in scientific endeavours, among many others. Making strides in science and technology is a critical determinant of the development status of countries. Countries that have excelled in science and technology are the most developed, while those with a weak scientific and technological base are the least developed. It is imperative that a series of concerted actions are adopted and sustained by countries to permanently institute a scientific and technological culture in Africa. Some of these actions would involve coherent science policy, stepping up funding for scientific education and research, setting up viable networks for scientific information exchange and mutual support, integrating science into development strategies, and more. Building local capacities for research in science is essential to ensure the sustainable development of Africa. As part of efforts in this regard, the ICSU-CFRS, in collaboration with ICSU's Regional Committee for Africa (RCA) and the NAS organized a two-day international workshop focused on reshaping the future of science research and researchers in developing countries. The workshop, which took place on the 7th and 8th of March 2018 in Abuja, Nigeria, brought together experts to discuss the rights, freedom, needs and responsibilities of African researchers. Participants were drawn from France, Norway, New Zealand, Switzerland, South Africa, Ghana, Cameroun, Nigeria, Kenya, Australia, Egypt, Senegal, and Burkina Faso. This report highlights the deliberations from the meeting.

Opening and Welcome Remarks

The meeting was declared open on Wednesday 7th March 2018. The President of the Nigerian Academy of Science, Professor Mosto Onuoha FAS, welcomed all participants to Nigeria's capital city, giving a brief talk about the city which was established just about 35 years ago despite the almost 60 years of the country's independence.

The ICSU Director of Operations, Mr. Charles Erkelens, also gave opening remarks, thanking NAS and ROA for hosting the meeting. He also stated that the progress of science in Africa is the heart of the ICSU Regional Office for Africa (ICSU-ROA). In the attainment of this goal, ICSU-ROA coordinates a number of programmes like the Leading Integrated Research in Africa for Agenda 2030 (LIRA 2030), in addition to hosting the African chapter of the International Network for Government Science Advice (INGSA-Africa). He concluded by appreciating NAS and all delegates for creating time to attend the workshop and looked forward to having a rewarding two days.

Dr. Daniel Nyanganyura, the Regional Director of ICSU-ROA expressed delight at being in Nigeria twice within the past 6 months, having attended the thirteenth Annual Meeting of African Science Academies (AMASA-13) and 40th anniversary of NAS in November 2017. He thanked NAS for making his stay memorable and for being one of the very active members of ICSU. He remarked that the RCA and CFRS are good examples of two ICSU committees working together to provide a platform for scientific advancements and good collaboration. He continued by emphasizing the importance of the meeting's focus to Africa, stating that the meeting would serve as a forum that would promote the ICSU's mandate for Africa; and that discussions will be followed-up critically to ensure that recommendations are attended to by all relevant sectors/stakeholders. He enjoined all the delegates to have a good stay and contribute to the discussions. He emphasized the need for team work, because the issues to be discussed are critical to Africa's development and the participants drawn from African scientific communities have practical insights of the issues.

A brief introduction to the workshop was given by Professor Gueladio Cisse, of the ICSU-CFRS. He remarked that the CFRS is very committed to the success of the workshop. He expressed appreciation to all European delegates, the Local Organizing Committee (LOC), and all who worked tirelessly to make the meeting a possibility. He continued his presentation by remarking that one of the propelling forces for convening of the workshop is the 1974 UNESCO Recommendation on the Status of Scientific Researchers (reviewed in 2015, in which ICSU was involved). In this report, it was sadly noted that the progress in implementing the international recommendations is limited in many African countries; it was therefore important to understand the critical issues on the subject, and measure what has been put in place by some countries towards actualizing the UNESCO proposition.

He presented the workshop goal which was to initiate a discussion among different sources of expertise about how different countries have made progress on the status of researchers while the discussions were to focus on the following themes:

1. Ensuring rights, freedom needs, duties and responsibilities for African researchers.
2. Main drivers of brain drain and brain-loss and good examples of mitigating measures.
3. Creating an enabling environment for researchers.
4. Security of employment over years and sustaining support to specific groups (e.g. young and female researchers).

KEYNOTE ADDRESS: NATIONAL/REGIONAL INVESTMENT IN SCIENCE, RESEARCH, TECHNOLOGY AND INNOVATION

Oye Ibidapo-Obe FAS
Past President, NAS/Distinguished Professor of Systems Engineering

It is important for African governments, the private sector, and researchers to be interested in investing in science and research output of African researchers. Some of the benefits of innovative research include prestige, global attention, enhanced connectivity and collaboration, and the advancement in the global ranking of countries for accelerated growth, job enabling environments, and security of employment. Investments in science are fuelled by three 'Ts'- Time, Talents, and Technology/Treasures. Investments must be seen by researchers as a pathway to long-term benefits because the gains come after a period of time. As it has been established that African researchers have the uniqueness of meeting the prevailing needs and upturning the economies of their countries and local environment through the scientific work, they must seek to be pioneers in scientific endeavours to bring in visible and invisible gains (patents and intellectual propriety rights). They must identify ways to win the confidence of investors to fund research. Research in areas like agriculture, water and environment, transportation and health can be explored by researchers in developing countries.

For Nigeria, the effort to promote interest in research has led to the establishment of the National Research and Innovation Foundation with a bill at the National Assembly awaiting deliberations and approval/presidential ascent. Some of the key issues in the bill are:

- Setting up national priorities on research, innovation, and development (RID)
- Promoting outputs of RID to achieve industrialization and overall national economic development
- Setting directions for sectoral synergy between existing research councils, ministries departments and agencies (MDAs), and research institutes in line with national priorities
- Facilitating fund raising activities to support STI in areas of national needs and priorities

With this in the pipeline, the next steps would involve:

- A dedicated 1% of the national budget for STI through a foundation to be independently managed through a private public partnership (PPP)
- Indigenous small and medium scale producers of building and infrastructural development materials are to be encouraged
- Research work and value addition for indigenous agricultural products should also be encouraged.

Continentally, the African Union High-level Panel on Emerging Technologies (APET) was established to promote STI in Africa, but there is very little known about what is being done. For Africa to move forward and meet up with global research and development trends, technological innovations are essential. Research in developing countries must provide better welfare for the citizens (for example human security). There must be active participation by Africans in emerging research frontiers like drones and agriculture, studies in genetics, mutation, and diseases affecting Africans, next generation medicines (employing nanotechnology), synthetic biology, and precision agriculture etc. There is a need for synergy, sufficient coordination, and articulation of the research efforts on the continent to ensure impact and global recognition. The issue of brain drain will be stopped if there is an enabling environment for promoting research, if the welfare of researchers and teachers is improved upon, and if there is improved funding for research. The curriculum for science should also be relevant to the national/regional content. Every research endeavour must have a medium to long-term purpose.

Theme One: Ensuring Rights, Freedom, Needs, Duties and Responsibilities for African Researchers

FREEDOM AND RESPONSIBILITY IN SCIENCE EVERYWHERE

Leiv K. Sydnes
Chair of CFRS/Professor of Chemistry, University of Bergen

The vision of ICSU to become the International Science Council (ISC)] is to advance science as a global public good with scientific knowledge, data, and expertise being universally accessible, their benefits universally shared, and the practice of science being inclusive and equitable in opportunities for scientific education and capacity development. ICSU acts as the global voice of science, which means:

- Speaking for the value of science and the need for informed understanding and decision-making, thereby creating an enabling environment for capacity building and research opportunities;
- Stimulating and supporting international scientific research on major issues of global concern, enabling the use of science-based solutions to solve problems of the society;
- Articulating scientific knowledge on such issues in the public domain, creating awareness on the importance of science to national development;
- Promoting the continued and equal advancement of scientific rigour, creativity, and relevance in all parts of the world, making the world aware of the threats to research integrity and output; and
- Defending the free and responsible practice of science by advocating for freedom of movement for scientists all over the world.

The interface between science and the society is that science has a tremendous value in its own right because the value and importance of research for the human society is undisputable. Public trust in science and technology is a pillar whose strength is critically dependent on transparency and the collective reputation of research output and researchers. So, the research community has to act in such a way that research is regarded as ethical by a significant majority of people.

Science is expected to be universally acceptable and applicable, with the free and responsible practice of science being pivotal for scientific advancement and human and environmental well-being. The universality of science requires freedom of movement, association, expression, and communication for scientists, as well as equitable access to data, information, and other resources for research. It requires responsibility at all levels for the conduct and dissemination of the scientific work with integrity, respect, fairness, trustworthiness, and transparency, recognizing its benefits and possible harm. Scientists are expected to have an impact where there is freedom of movement and are individually accountable for their public communication. They must be aware of their potential impact on both science and society regardless of the audience. Scientific communication has to be accurate and reflect the status of scientific evidence and future implications. As such, the

impact of scientific results should be realistic. Scientists ought to be transparent in communicating the limits of their expertise and make the distinction between those areas in which they are experts and other areas where they merely express views. In addition, scientists must understand the different audiences that they communicate with, and what those audiences require in terms of understanding the subject matter.

There are four cardinal points to drive home this universal agenda which should be properly addressed to secure productive application of science in the service of society and they include i) research integrity; ii) capacity building; ii) free movement of scientists; and iv) communication of science to the public.

ENSURING RIGHTS, FREEDOM, DUTIES AND RESPONSIBILITIES FOR AFRICAN RESEARCHERS

Nazar Hassan
Senior Regional Specialist for STI, UNESCO Regional Office for Sciences for the Arab States, Cairo, Egypt

The 1974 UNESCO Recommendation on Science and Scientific Researchers focused on improving the status of researchers through addressing science ethics and science policy, where the science community becomes part of the decision-making process of countries; the need for setting up national policy mechanisms for science and technology; and developing explicit national science and technology policies; addressing the need for sciences and related subjects to be taught at all levels of education; and the importance of publishing results and respecting intellectual property of researchers. Some countries such as South Korea, China, Singapore, Malaysia, and Brazil have successfully developed STI platforms. On the other hand, countries with weak national innovation systems were mostly in Africa.

For these successful countries, the gross expenditure on research and development (GERD) was a very impressive percentage of the gross domestic product (GDP) which was noted as an index of the STI performance for the countries, and increased steadily through the evaluation periods of 2007-2013. Also, in these countries, the focus of science education was science, technology, engineering, and mathematics (STEM). South Korea and Singapore made concerted efforts to build a robust STI through education by the establishment of a highly motivated and educated populace. This was reported to be largely responsible for spurring this country's high technology boom and rapid economic development. In the case of Singapore, the leadership indicated that the only way towards developing the country in one generation was through educating the people (identified as the only resource the country has). Other countries, such as Brazil or Argentina, did not reach the thresholds because Brazil needed more full-time employment (FTE) researchers, and Argentina needed more investment.

On the other hand, the reasons ascribed as responsible for the poor state of African countries include unfavourable economic conditions, lack of finances, absence of long-term commitments on the part of political forces, and a superficial understanding of the role of

science and technology in the socio-economic transformation of society. In the past, many African countries had been fully involved in setting up national policy mechanisms for science and technology, and in developing explicit national science and technology policies. Examples are:

1. Côte d'Ivoire set up a Ministry of Scientific Research (MoSR) in 1970.
2. Senegal had a Directorate for Science and Technical Research (DGRST) by 1974.
3. Ethiopia's Science and Technology Commission (ESTC) was established in 1975.
4. Ghana, Mali, and Niger had all set up their national research councils (NRCs) by the end of 1970s.
5. Somalia inaugurated an Academy of Sciences and Arts (AoSaA) in 1979.

However, despite all these efforts, African scientific and technological potential have fallen short of expectations. A study undertaken by UNESCO in 1981-1982 in West Africa revealed that many of the national science policy-making bodies, though in existence for many years, had not been able to perform the functions for which they were created. Reasons were the lack of qualified personnel, lack of equipment, and lack of financial resources. Some countries established science policy bodies without any scientific tradition or even infrastructure.

Since the adoption of the 1974 UNESCO "Status of Researchers" report, the landscape of scientific research and the context of science have greatly changed. Research has become more complex and specialized and involves a greater level of uncertainty. The focus of science has shifted more towards technology, with more and more deployment of investments for S&T. Research has been transformed, reshaped, and is currently being exploited by nations for efficiency and economic competitiveness.

Political, social, and economic matters are increasingly changing and reshaping the scientific enterprise in both their aims and focus as this is becoming more globally oriented, economically oriented, and more privatized. With the emerging trends, researchers are currently under considerable pressure due to the following reasons:

1. Pressure to receive funds from donor agencies, publish or perish, and get promoted. This has the negative tendency for misconduct and fraudulent research output.
2. Less Government controls on military or private sector research practices, so they tend to have more funding opportunities than academic researchers which ideally should be otherwise.
3. Inappropriate collaboration arrangements between scholars and the private sector.
4. Inadequate training in methods and traditions of science for researchers in developing countries.
5. Increasing scale of the research landscape eroding the peer review mentorship.
6. Commercial pressure towards privatization. Scientists are shifting to more private sector funds hence impartiality of scientists is increasingly coming under questioning.

A 2003 survey by the Journal of American Medical Association (JAMA) found that 30% of the surveyed researchers were receiving funds from the private sector in the biomedical

field. In 2007, 60% had personal relationships with private sector implying that conflicts of interest issues were apparent.

Good science and research is not good enough. Science must translate into innovative technologies at the marketplace, and it all starts with the proper education and capacities to acquire technology (technology transfer), develop it (R&D), apply, utilize and localize it (technology diffusion), and the management of the interface between technology transfer and diffusion (by both government and industry). The take home point for African countries is the need for improvement in the quality of the educational system. More focus should be on science education (STEM) with a review of the primary and secondary schools' curricula, and national priorities should advance experimental research for speedy technology transfer and technology diffusion. There should be capacity building programs for STI policy development among all stakeholders (parliamentarians, government staff, etc.)

FREEDOM AND RESPONSIBILITY IN THE CONDUCT OF SCIENCE: CHALLENGES AND OPPORTUNITIES IN AFRICA

Daniel Nyangangura
Regional Director, ICSU- ROA

Science is the development of knowledge through research; the systematic exploration and explanation of the world. It has an inherent and important cultural value, satisfying human curiosity and enriching human understanding. Science provides the basis for socio-economical-technological development, as well as policies and practices that shape the future. Universal and equitable access to scientific data and information promotes the capacity of countries to generate the new knowledge necessary for establishing their own development pathways in a sustainable manner.

The long-term strategic vision of the global scientific community is that science is:

- used for the benefit of all - scientific advancement promotes human wellbeing and environmental sustainability
- practiced by all - freedom of movement, association, expression, and communication for scientists, equitable access to data, information, and other resources for research
- practiced without discrimination (no bias due to ethnic origin, religion, citizenship, language, political, gender, disability, or age)
- practiced with integrity, respect, fairness, trustworthiness, and transparency, recognizing its benefits and possible harm
- appreciated - excellence in science is to be valued
- effectively linked/translated to policy making and socio-economic development

The ICSU agenda for the universality of science is entrenched in the mandate of the CFRS with a goal of helping to build an international science community that will fully participate in science as an inherently global enterprise. This requires:

- free exchange and communication among all scientists i.e. engagement in scientific discourse without repercussions, or fear
- equitable and non-discriminatory access to the tools of science
- responsibility on the part of all scientists in the conduct of their scientific work.
- science-society dependence- defining the responsibilities of science towards the society and vice versa.

Though universality and freedom for scientists is desired, a myriad of challenges thwart the efforts intended to advance the actualization of this vision such as:

- Lack of transnational scientific mobility (human and resources) due to measures such as visa restrictions
- Lack of information on what services are available to promote the universality of science
- Scientific communities (intra and inter disciplines) are poorly networked
- Accessibility to/sharing of scientific data, scientific analytical tools, and research equipment affects the reliability and accuracy of research output
- Science-policy interfaces are weak because many intergovernmental platforms/ scientific communities are not interlinked and there is the lack of political will. Efforts must be intensified to strengthen the scientists - policy makers engagement
- Lack of continental/local financial resources to support research in Africa. This affects the freedom of research topics and encourages scientific fraud/bias
- Lack of proper channels for scientists to disseminate results to the policy makers and the public

Some of the proffered solutions towards addressing the challenges are:

- Regional intergovernmental structures (AU, NEPAD, NASAC, SADC, ECOWAS) should establish prominent presence and make the case for African researchers in the global space
- ICSU's presence through its member unions, regional offices, and committees should be felt and well-known
- Scientific networks (disciplinary focused) should be connected together through multi-disciplinary research and generation/sharing of relevant databases
- Local financial resources should be harnessed to support research with less dependence on external funding

Discussions

Participants were divided into groups to discuss the theme and report back during plenary

Theme: Ensuring rights, freedom, duties and responsibilities for African researchers

Key Questions

What enabling conditions can influence freedom?

- What responsibilities do researchers have in addressing local problems?
- How can African local content and diversity be related to the research work by scientists?

Key challenges affecting freedom Reward systems for scientific output not encouraging

- Opportunities for capacity building are limited
- Poor infrastructure for good research
- No CSO for advocacy for science

Recommended steps to promote the freedom for researchers in Africa

1. Accountability/ethics in sciences should be core to the work of African researchers in order to enjoy freedom for researchers.
2. ICSU (ISC) should work and collaborate with African organizations such as the Network of Africa Academy of Sciences (NASAC), Association of African Universities (AAU), etc to implement its vision and mission.
3. There should be a roadmap to promote scientists in Africa - from high school through to the university level.
4. New ways/methodology for teaching science in African institutions is needed. This also includes focusing on preparing/training teachers for all levels, particularly at the basic level where practical aspects of teaching and learning science should be related to everyday life.
5. A database on scientists and scientific research in Africa (Who is Who in Science in Africa) should be established.
6. The ICSU-ROA should be very proactive in contextualizing science and cultural issues in Africa.
7. Access to, and maximum utilization, of the ICSU website (which has very useful resources) should be imbibed by researchers.
8. ICSU-ROA advocacy for research in science should target young scientists, policy makers, politicians, and the private sector. This also requires an improved means of communication with the stakeholders in the language that would be understood by them.

Theme: Creating an enabling environment for researchers

Key issues:

Need for a new matrix to understand how research and development is performing in Africa.

The effect of involvement of the political class in national research systems of African countries.

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Suggested solutions

1. Discussions between researchers and the political class should be integrated into the economic planning of countries, taking into account the potential for the exploitation of research results for national benefit. Also, networks where researchers and politicians could communicate openly and freely are most pertinent.
2. Researchers should publish in the indexed national level scientific journals with good impact factors. There is a need for governments to hear what is happening in the scientific clime of their countries that would project national interest.

3. Ethics and intellectual property committees should be established in universities to encourage patenting. This would improve the quality of results by creating new innovation and obtaining more patents.

4. A platform to facilitate researchers' collaboration should be created and participation encouraged. This platform could also serve as a space to explain the content and potential gains of the research carried out.

5. The economic, environmental, and social issues of research should be highlighted when requesting support from governments. This could influence their decision. The expected results must be capable of impacting the economy of countries.

6. Research topics of researchers should be of national interest (that may impact social and economic development). There should cultural change among researchers to embrace targeted research.

7. While it is important to look for international expertise, it is also important to use national expertise from local universities in the implementation of national development programs.

8. An African model for local research should be developed.

Theme Two: Main Drivers of Brain Drain/Brain Loss, and Good Examples of Mitigating Measures

KEY FIGURES AND FACTS ON BRAIN DRAIN AND ITS DRIVERS

Gueladio Cisse
ICSU-CFRS / Swiss Tropical and Public Health Institute

To begin the discussion on brain-drain and its drivers, some basic concepts were defined:

- **Brain-drain** is the migration of educated and skilled labour from poorer to richer countries/ departure of the most talented at an appreciable rate
- **Brain waste** is the inappropriate use of highly skilled workers
- **Brain circulation** describes the cycle of moving abroad, taking a job abroad and later returning home
- **Brain exchange** is the two-way flow of expertise

The global picture of brain drain is as follows:

- In 2014, 3.5 million international students enrolled in tertiary institutions in the G20 countries
- Six countries host 67% of the world's mobile students: United States (23%), United Kingdom (12%), Germany (11%), France (10%), Australia (7%), and Japan (5 %)
- Stock of emigrants and highly educated emigrants into G20 countries came mainly from 10 countries-Mexico, Ukraine, China, India, Kazakhstan, United Kingdom, Poland, Germany, Philippines, and Romania
- Highly educated women going into the G20 countries come from ten main countries: Philippines, Kazakhstan, Poland, Romania, Ukraine, China, Germany, Mexico, United Kingdom, and India
- For Africa, the data is scarce and where seen it is unreliable. However, a few estimates are available. The figures seen shows that third-level students from sub-Saharan Africa are the most mobile in the world and, since the 1990s, African countries lose 20,000 qualified medical professionals every year, as half of all medical doctors trained in Africa leave to work abroad and 27,000 skilled Africans left the continent for industrialized countries between 1960 and 1975

Brain drain is affected by two main factors:
a). Push(ing out) factors: These are factors that make the local environment uncomfortable and create a high tendency for the best brains to leave the African environment and take up opportunities in countries other than their places of origin (often times in Europe and America). The push factors are detrimental to Africa and her scholars, and make it possible for them to prefer self and dump national interest.

b). Pull(ing in) factors: These factors create a suitable and attractive environment abroad thereby encouraging departure from country of origin to another. These are constantly being improved upon and encourage African scholars to remain in foreign lands. These are very motivating and make it possible for the scholars to attain international recognition through the work done.

Table 1: Factors affecting brain drain- push versus pull factors

Push factors	Pull factors
• Low and eroding wages and salaries/ unsatisfactory living conditions • Under-utilization of qualified personnel • Lack of satisfactory working conditions • Declining quality of the educational system • Discrimination in appointments and promotions • Low/poor prospect of professional development • Lack of research and other facilities, including support staff • Inadequacy of research funds, professional equipment and tools • Social unrest, political conflicts and wars/ lack of freedom	• Higher wages and income/higher standard of living • Better consideration of qualifications for promotions and career advancement • Better working conditions, job and career opportunities, and professional development • Substantial funds for research, advanced technology, modern facilities, availability of experienced support staff • Modern educational system; prestige of "foreign" training • Meritocracy, transparency • Intellectual freedom and political stability

Source: www.aracorporation.org

One emerging concept is brain circulation, where the scholars/scientists do not cut ties with their country of origin, but instead build a chain of affiliations and networks. Brain circulation is now considered a more appropriate term for the movement of contemporary scholars. Nations with more scientists going out and/or coming in have papers that are highly cited. This is a great advantage and should be encouraged. The circulation of skills and manpower can be a positive force contributing to the development of countries of origin. Across all regions, mobile scholars have about 40% higher citation rates than non-mobile counterparts. Regardless of region, mobility pays in terms of citations.

To forestall brain -drain:

- Countries with the strongest science systems should train, keep, and attract outstanding researchers
- The African Union should take steps to deal with the issue and its drivers. The push factors have to be addressed
- Africa must understand R&D efforts as a continent and its impact in the science space
- Diaspora networks should be encouraged. Diaspora networks offer a major opportunity to transform the historical "brain drain" into "brain gain"
- African diaspora networks should reach out to home countries and mentor younger ones
- Nations that have less-established systems should realize that their greatest impact is by recruiting established scholars through international collaboration

INTERNATIONAL TRAINING OF YOUNG AFRICAN SCIENTISTS FOR CAPACITY BUILDING IN THEIR HOME COUNTRY

Valerie Schini-Kerth
ICSU-CFRS/Strasbourg University

The number of students enrolled in foreign tertiary institutions worldwide, over a period covering 1975-2015, runs over 13million. Over 50% of this number seek to acquire post graduate and doctoral education, and mostly in Europe. This means it is the young scholars that are leaving, i.e. those at the prime of their careers. In comparing the disciplines that seek education abroad, the engineering/manufacturing/construction has over (30%), followed closely by natural sciences/mathematics/statistics (22%).

The reasons for African scientists studying abroad are:

- Access to quality education
- Need to acquire skills that are not being taught back home
- Getting closer to international labour markets that offer higher returns on education
- Improving employability in increasingly globalized labour markets
- Expand knowledge regarding other societies
- Explore international scientific cooperation networks
- Contribute to technology upgrading and capacity building in their home country

Africa is seriously affected by brain drain with little to no brain circulation. The continent's indigenous knowledge is a virgin area waiting to be tapped.

BRAIN DRAIN AND BRAIN LOSS: URGENT NEED FOR MITIGATING MEASURES

Emiola O. Olapade-Olaopa FAS
Provost, College of Medicine, University of Ibadan

Traditionally, migration is thought of as being only by highly skilled persons. However, not-so-highly skilled workers are now migrating, causing increasing concern about global socio-economic effects of migration. On the positive side, migration may not always mean loss of economic development or social disruptions. If properly managed, brain drain can be beneficial for developing countries because of foreign earnings/remittances, technological transfers, professional advancement, increased social diversity, and global recognition.
Brain drain is affected by many factors including:

- **Push factors:** make a person think about leaving
- **Pull factors**: draw people to particular destinations
- **Hold factors:** deter expatriates from leaving their new countries
- **Reject factors:** discourage expatriates from returning to their native countries or force them to return when they do. There are many reject factors in Africa that make returnees exit again despite attempts to stay

- **Confounding Factors:** a mix of all the other factors and others that may emerge

Though some gain occurs through brain drain, it is a precarious trend that has to be checked because the consequences cut across loss of professionals, loss of resources, depression innovation in R&D, inability of countries to respond to national emergencies, disruption of hierarchy/succession and mentorship, erosion of skill acquisition and application opportunities, and loss of cultural identity. Loss of human capital affects countries' capacity for innovation and the adoption of modern technologies.

The types of brain drain prevalent in the African context were expressed as:

- Primary external brain-drain: Migration from an African country to a developed country
- Secondary external brain-drain: From any less-developed African country to other developing countries within the continent
- Internal brain-drain: which may involve moving from the public to private sector or skilled persons not being employed in their fields of expertise, but taking jobs for income sake.

The demographics of brain-drain in Africa are

- Worse for smaller countries: Cape Verde (82%), Seychelles (77%) Gambia (68%) and Mauritius (56%)
- Highest from: South Africa, Morocco, Egypt, Nigeria, Kenya & Ghana
- Involve mostly female and medical professionals
- Migrants typically more educated than natives of host countries
- Successes attained are not necessarily transferred to succeeding generations.

The effort to address this development is necessary and urgent. There must be an acknowledgment of the phenomenon by governments and other stakeholders; acceptance of consequences by nations and institutions; initiation of necessary policies to address the challenge; as well as sustained efforts across tenures and administrations of governments and other stakeholders.

There is an urgent need for mitigating measures to ameliorate the consequences to the global workforce. Suggested mitigating efforts by sector were presented as in Table 2 below.

Table 2: Suggested mitigating measures for Brain Drain

Governments	Researchers	Institutions
Change orientation of population from 'West-is-best' philosophy by espousing value of nation-building Reconcile individual needs with the socio-economic, demographic, and financial realities of the country in the global context Ensure multi-sectoral and inter-sectoral involvement and international co-operation Encourage private sector investment in public sector Enforce public purpose for public/private education Depersonalize public service and encourage systems building Improve service conditions of (highly) skilled public servants	Stimulate data gathering on Brain Drain and its effects on research output Have accurate and scientific information on migration Create a database for new workforce research Construct metrics of migration for better understanding of the phenomenon Create better mechanisms to respond to the challenges	Controlled movement of highly skilled workers through partnerships between donor and host countries Increase training of locals and reduce systemic bottle-necks to diversity Encourage temporary stays and exchange programs for expatriates Restrict duration of stays or immigration from at-risk countries Hold recruitment agencies and employers accountable for visa violations Facilitate return-migration by creating better mechanisms to evaluate and reward productivity in donor countries

Discussions

Theme: Main drivers of brain drain/brain loss and measures for mitigation
Key Issues:
What are the drivers of brain drain in Africa?
What are measures that can mitigate against brain drain?

The key issue about brain drain pertains to young talented researchers leaving their countries for better choice/greener pastures in other countries without returning to their own countries. Reasons vary from country to country but generally are influenced or driven by economic instability and uncertainty, social unrest, unfriendly government policies, as well as non-conducive work environment.

Suggested measures for mitigating brain drain:

1. Policy makers must take measures to fund research as this is very important in making policy.
2. Formulate appropriate policies. Such policies that guarantee scholars a good position upon return from diaspora will ensure that African countries have experienced people in relevant sectors.
3. Modification should be made on the funding schemes for basic and applied research.
4. Curricula modification for all the levels of education should be adopted.
5. Governments should come up with good pay packages to motivate and give job satisfaction.
6. People studying abroad should still be engaged for their opinions and contributions when they are away. They must a have a sense of being relevant in the home country.
7. Researchers on short term training should be followed up to know when they will return to their home country.
8. Researchers should make data available, should network, and collaborate freely.
9. Environmental problems affecting researchers (security, conflicts etc) should be addressed.

Recommendations to address the brain drain syndrome include:

- Countries should adopt and promote appropriate value systems to remove undue emphasis on material wealth
- Increase investment in improving the quality of science education. This may include are vision of curriculum in secondary and primary schools and implementation of policies that will impact positively on the quality of education
- Efforts to strengthen the relationship between scientists and industry should be intensified
- Governments and the private sector should make adequate grants to researchers in their home countries
- Re-entry grants should be provided to pull back researchers on completion of studies abroad. This may also include an agreement between host and guest countries

- Countries should set in place mechanisms to stimulate and maintain a knowledge-driven economy, and facilitate cutting-edge research
- Scientific efforts should be geared towards problems that are peculiar to Africa
- A tracking system for monitoring researchers sponsored for studies abroad should be set in place by concerned institutions
- The number of researchers sponsored to study abroad should be reduced while improving on the quality of in-country research facilities at the same time
- Corruption, with regards to utilization of awarded grants and scholarships, should be checked
- Research linkages and collaboration opportunities should be provided and encouraged
- Upscale the involvement of academies in addressing the problem of brain drain.
- A two-way flow of knowledge between the researcher in diaspora and his colleagues in his home country should be encouraged.

Theme Three: Creating an Enabling Environment for Researchers

HOLDING BACK THE EXODUS OF AFRICA'S RESEARCHERS

Hilary Inyang
Founder / President, Global Institute for Sustainable Development, Advanced Analysis, and Design (GISDAAD)

The wealth, health, and stealth of any global region or country depends largely on the development, nurture, retention, and deployment of its human resources into sustainable development initiatives that can generate and provide socio-economic benefits to its citizens. Brain drain causes the transfer of human capital across regional or national frontiers, and has been very detrimental to African development as the best brains in Africa are often the ones that exit to the diaspora, when ideally they should be available to advance national development through their skills and expertise. A 2013 United Nations report revealed that about 2.9 million Africans (one out of nine) with tertiary education were working in developed countries outside the continent. In order to meet the African development targets set in the Africa Agenda 2063 and other initiatives, as well as those of national development plans, programmes for the creation of more opportunities for researchers, knowledge enfranchisement, incentives for research excellence, and improvement of research facilities need to be implemented such as:

- Motivation and incentives for researchers and technologists to contribute to national economic development should be adequate. There should be competition among African institutions related to science output and impact
- Creation of reward systems, including national competitive grants administered by national agencies to faculty members and students. Countries like South Africa, Morocco, and Rwanda have such systems in place
- Collaborations with agencies, business groups, and community groups to translate research and development results to policies and enterprise development programmes as well as a deeper engagement of Africans in diaspora
- Conversion and improvement of the African academies of science into the African Academy of Sciences, Engineering and Medicine (AASEM)
- Institutionalization of an African Continental Research Foundation (ACRF) and national science and technology advisory boards
- Establishment of the African Continental University System (ACUS) and Establishment of two Regional Science, Technology, and Entrepreneurship Parks (RSTEP) in each regional economic community (REC)
- Positive moves in research support have been made by some African countries:
- South Africa's efforts for a continent-wide program envisioned in the Forum on China-Africa Cooperation (FOCAC) which includes the setting up and operating of research centres in Africa
- Africa Institute of South Africa which is chartered to perform Africa-relevant research and professional support activities for researchers
- Nigeria's Technical Aid Corps which supplies experts including researchers to other African countries that have shortage of experts

- Egypt's recently announced plan to provide opportunities such as research grants and scholarships to researchers and students from other African countries in Egypt

Brain drain rates decrease with increase in economic development. So, in order to stem the exodus of researchers from Africa, the following measures need to be implemented at the continental and national levels:

i). Deeper engagement of researchers in the creation and implementation of public policies, entrepreneurship support schemes, and governance.
ii). Involvement of African researchers in knowledge-based networks that provide incentives and rewards for excellence to researchers without bias.
iii). Provision of research opportunities through grants, taskforces, consortia for researchers, as well as affordable centralized and well-equipped facilities throughout the continent.
iv). Creation and operation of an African Continental Research Foundation.

THE PASRES MODEL (STRATEGIC SUPPORT PROGRAM FOR SCIENTIFIC RESEARCH) IN CÔTE D'IVOIRE

Yaya Sangaré
Executive Secretary, Strategic Support Program for Scientific Research (PASRES)

PASRES is the Strategic Support Program for Scientific Research in Côte d'Ivoire and was set up in 2007 to help meet the challenge of research funding and scientific succession in Côte d'Ivoire, with support from the Ivorian and Swiss Governments. PASRES is a member of the Science Granting Councils Initiative (SGCI), with membership from 15 African countries. The SGCI objectives are to:

1. Manage research.
2. Design and monitor research programs.
3. Formulate and implement policies, based on robust science, technology, and innovation (STI) indicators.
4. Support knowledge transfer to the private sector.
5. Establish partnerships with each other and with other science system actors.

PASRES objectives are:

- Contributing to the training of the human capital of Côte d'Ivoire
- Providing support to laboratories and research stations
- Contributing to the development of the country through the use of knowledge generated by science

The main activities of the PASRES initiative are to:

- Fund research projects (70%): Allocating masters and PhD scholarship grants, financing north-south and south-south scientific exchange missions, and rehabilitating research centres and laboratories

- Strengthen the capacity of researchers (20%): Organizing workshops and training seminars for students, researchers, and academic lecturers. Also, initiating conferences/debates on issues of national interest
- Valorize research findings (10%): Editing and publishing two scientific journals related to social sciences **(RSS PASRES)**, as well as environment and biodiversity **(REB PASRES)**. PASRES also provides financial support to researchers to help them publish in scientific journals and provides support to researchers to register patents.

Since 2008 (the year the program really started), 1521 project proposals were received by PASRES. Of these 1521 projects, 187 (8.13%) received funding from PASRES for an accumulated amount approximating to USD 6,500,000. In 10 years of operation, PASRES has funded 63 post-doctoral candidates; 114 PhD students; 2 non-governmental organizations (NGOs); and given 164 scholarships. In all, more than 1000 researchers were involved in the projects funded. At the level of the valorization of research findings; PASRES has 62 publications, 22 scientific communications and 2 patents. There is better understanding of the issue of competitive funds by Ivorian researchers and improved academic promotion of young researchers leading to an increase of the number of doctoral students.

Some concrete actions carried out in Cote d'Ivoire in recent years to improve the research environment include:

- Creation of the Fonds Inter-professionnel pour La Recherche et Le Conseil Agricole (FIRCA) (2003)
- Creation of the PASRES (2007)
- Implementation of Article 18G of the General Tax Code
- Research allowances increased
- Rehabilitation of universities
- Equipping research laboratories with new materials
- New decree on the organization and functioning of universities
- More involvement of the private sector (awards granted by the business community, including Nestlé Research Center and Unilever)
- Scientific cooperation agreements (renewed or signed) with foreign countries (France, Switzerland, Germany, Canada)

CREATING ATTRACTIVE CONDITIONS FOR RECRUITMENT AND RETENTION OF RESEARCHERS IN AFRICA: THE CASE OF SENEGAL

Oumar Sock
Perpetual Secretary, Académie des Sciences et Techniques du Sénégal (ANSTS)

According to a report by the African Academy of Sciences (AAS), titled *Africa beyond 2030: leveraging science and innovation to secure sustainable development goals,* science, technology, and innovation was noted to be a tool that will drive the future of Africa; and

that STI is critical to the achievement of the 2030 Agenda for sustainable development and the SDGs. STI has a leading role in improving productivity and economic growth, promoting social inclusion, and promoting environmental sustainability.

Africa is home to 15% of the world's population, but has only 3.6% of the total number of scientists in the world. Africa produces just 3% of global GDP, accounts for 2% of world's research output, and just about 1.3% of world's research spending. The African deficit of scientists and researchers is doubly aggravated, on the one hand by the small number of students in the sciences and scientific researchers (currently trained in universities and research centres of the continent), and on the other hand by brain drain.

Africa has made some efforts to address the trend through some strategies such as:

- The recommendation of the AU to devote at least 1% of gross domestic product to research;
- The adoption by the AU of the Science, Technology and Innovation Strategy for Africa (STISA-2024), with the mission to accelerate the transition of African countries to be innovation-led, and knowledge-based economies;
- The decision of the AU to establish the African Scientific Research and Innovation council (ASRIC)as an institutional framework for the implementation of the STI agenda;
- The setting up of the African Union Panel on Emerging Technologies (APET);
- The creation of new universities, higher education centres of excellence, African Institutes of Mathematical Sciences (AIMS), and academies of science and technology

For country-specific interventions, Senegal, after noting the need to fundamentally reform its higher education and research system, held a meeting -the National Conversation on the Future of Higher Education (CNAES)- from which 78 recommendations were made. All the recommendations issued by the CNAES were grouped, evaluated financially, and studied by the Presidential Council on Higher Education and Research from which presidential decisions taken by the Head of State include:

- Reorientation of the higher education system towards STEM, and short vocational training to promote access and diversification of higher education
- Improving the steering of the higher education research system and reforming the governance of public higher education institutions
- Putting information and communication technologies (ICT) at the heart of the development of higher education and research, to improve access to higher education and the efficiency of the system
- Establishing a culture of peace in public higher education institutions; making students participants in their training to promote their success and improve their living conditions
- Promoting the careers of teachers, researchers, administrators, as well as of

technical, and service personnel

- Giving new impetus to research and innovation, and opening the Senegalese research space to Africa and the world
- Improving the management of universities' budgets and resources, by setting up modern and transparent procedures and mechanisms
- A Higher Education and Research Development Plan (2013-2022) was developed and estimated at about 302 billion CFA (about 503 million USD). Over the period 2013-2017, through the efforts of the state of Senegal, and the technical and financial partners, 424 billion CFA (about 707 million USD) was already mobilized

Progress regarding investment in R&D in the last decade has been mixed across the continent. Algeria, Botswana, Kenya, Rwanda, Namibia, and Tunisia, have increased their national annual gross expenditure on research and development (GERD). But GERD had declined in South Africa while the Gambia, Malawi, and Mozambique, are heavily reliant on foreign sources for their GERD. To make up for Africa's backwardness, and effectively fight the brain drain, it is absolutely necessary to invest even more in scientific research and STI.

CREATING AN ENABLING ENVIRONMENT FOR RESEARCHERS: THE BURKINA FASO PERSPECTIVE

Serge Diagbouga

Technical Adviser, State Secretariat for Scientific Research and Innovation, Ministry of Higher Education, Scientific Research and Innovation, Ouagadougou, Burkina Faso

The STI landscape in Africa is characterized by an unattractive research environment, inadequacy of the organization and management of the national scientific research systems, limited availability of research positions, an absence of research laboratories and high-performance technical platforms, as well as inappropriate salary/incentives. This represents the long-time challenges affecting the development of research teams and quality research to support economic and social development in many developing countries, particularly in sub-Saharan Africa.

In Burkina Faso, with the creation of the Ministry of Scientific Research and Innovation, there has been a gradual implementation of a better organized environment regulated by laws, and more encouraging provisions for researchers. The sector for scientific research and innovation houses five ministries namely: Scientific Research, Health, Agriculture, Animal Resources, and the Environment. The government efforts in favour of a research-friendly environment include the setting up of steering and governance bodies to oversee and improve the management of the scientific research sector. These include:

- the sectoral framework for research and innovation dialogue (CSD-RI),
- the National High Council for Scientific Research and Innovation (HCNRSI) which is a national forum for foresight, reflection, and consultation on research and technology

which proposes reasoned opinions on issues of national importance relating to research and innovation and provides the broad guidelines and strategies for the formulation of national and international policy on scientific research and innovation.

- Management boards of the ministerial sectors
- Boards of state public establishments (BPE)
- Scientific and technical advice (CST)
- Scientific and management advice
- Ethics committees which comprise a legal system made up of the law of orientation of scientific research and innovation (LORSI); law on biosafety, law regulating plants and laws regulating the genetic improvement of livestock

The LORSI sets the legal framework and the basic orientations of scientific research and innovation in Burkina Faso. It specifies the legal and institutional framework for the production and integration of knowledge as a process for sustainable development of the nation by:

i. Establishing an effective framework for organizing and conducting research and innovation for the emergence of a knowledge-based society with a high-quality scientific culture.
ii. Ensuring adequate funding for research and innovation.
iii. Stimulating the dissemination and exploitation of the results of the research.

To showcase the commitment of the government, budgetary allocations and other funding for scientific research were enacted through the establishment of the:

a) National Fund for Education and Research (FONER)- (Fonds National pour l'Education et a Recherche) which supports the funding of bench-top fees for PhD students and researchers' study trips.
b) National Center for Information, School, and Professional Orientation, and Scholarships (CIOSPB), which finances doctoral scholarships.
c) AU/SAFGARD specialized office of the African Union for the promotion of agricultural research and development of the semi-arid zones of Africa with a mission to promote coordination and cooperation in the field of agricultural research, technology transfer, and commercialization.
d). National Fund for Research and Innovation for Development FONRID (Fonds National de la Recherche et del' Innovation pour le Dévelopement): a state-owned public institution to boost national research and innovation as essential levers for the achievement of national development objectives.
e). A new salary grid for awarding allowances and salaries of researchers promoted by the African and Malagasy Council for Higher Education CAMES (Conseil Africain et Magache pour l'Enseignement Supérieur (CAMES).
f). Awarding financial incentives for publication of relevant results of scientific research and innovation, tax incentives for the creation of companies to promote research results, granting of scholarships and support to innovators and inventors to enable them to perfect their results.

g). The Award of Excellence for the scientific research work of an individual or team that makes significant contribution to the progress of science economic, social, and cultural development of Burkina Faso. This award covers all areas of research and innovation and is held every two years consisting of a certificate, a trophy, and a financial allocation of 10,000,000 CFA Francs equivalent to USD20,000 with special prizes awarded to youth and women in research.

In conclusion the speaker acknowledged that the Burkina government has indeed taken concrete political steps at the organizational, legal, and endorsement levels of scientific research. There is a very strong vision and commitment of the highest authorities to place science, technology, and innovation among the main levers of the country's development agenda.

Discussions

Theme: Creating an enabling environment for researchers

Key issue: How are African countries creating the enabling environment for researchers?

Contributions on efforts made by the AU and countries at creating an enabling environment were:

- African Union declared a goal to reinforce STI as a driving force for continental development. STI systems in Africa have been improved in the last 10 years in order to achieve UN 2030 Development Goals but it is still not enough. GDP percentage devoted to STI has been increasing but it has not yet reached the proposed 1 %
- Nigeria has the potential for accessing funding from external sources other than the government. The efforts of the government have to be encouraged in order to increase funds for doing research. Interactions with the private sector must be increased in order to fulfil that goal
- The encouragement of young researchers doing their Ph.D. work in Nigeria has been a positive measure in order to create a better research environment
- Cote d'Ivoire has implemented a national R&D project system which has contributed to the improved research environment through capacity building for project design. Funding from the private agricultural sector for doing research has also become very significant
- Senegal has implemented an international collaboration network which has attracted significant funding, not only for creating an enabling research environment but also for creating an enhanced educational system in technical careers which are needed for research development
- Burkina Faso has implemented an organizational system which is contributing to a better environment for national researchers
- Overall STI infrastructure has been improving slowly in the last decade in African countries but there still is a need to improve the research environment in Africa
- Though all these strategies are in place in various countries, the STI investment by African countries has to be improved in order to have a better representation in the global space
- The networks of scientists in diaspora must support their home countries. There should be cross country/cross discipline and cross-cultural collaborations, merit-based award systems should be strengthened, and collaborations for laboratory access intensified.
- The politicians must be involved so as to obtain government backing or contributions to research
- Establishing a network of scholars in diaspora to contribute to the development of their native countries, even though they are still based abroad through brain circulation

- Involvement of local and international experts in developing research topics
- Motivation through having conducive environments for conducting research in home countries
- Having duty exemptions on laboratory equipment procured or donated by development partners
- Setting up primary and secondary networks of researchers who have returned from abroad to share experiences and best practices
- Developing countries should increase the budgetary allocation to facilitate provision of facilities for research in their countries
- Government of individual countries should collaborate with development partners to provide institutional-based research grants
- Recipients of foreign training grants should be provided with equipment as well as relocation and travel grants as applicable
- Incentives and motivation be provided for researchers in developing countries publishing in high impact factor journals
- Government should be made to understand the importance of research through advocacy and sensitization campaigns

Theme Four: Security of Employment and Sustaining Support to Specific groups of Scientists (e.g. Young and Female Researchers)

HAVE AFRICAN ACADEMICS SEEN RESEARCH AS SWIMMING AGAINST THE TIDE?

Inês M. Raimundo
ICSU-RCA

The UniRank (2018) states that the best universities in Africa span 10 countries (as shown in Table 3 below). This classification is based on: staff qualifications, number of publications in reputable journals, the number of grant research projects and infrastructure. The research environment of many institutions is shaped by government priorities; lack of funds; high dependency on donors, etc. African researchers have the capacity to participate in international competitions for research funds, so doing research in Africa cannot be seen as swimming against the tide because there are many ways of going about research without depending on state budget.

A number of factors drive or hinder research (Table 4). Though these seem like a myriad, there are some solutions for them. Reputable female scholars should serve as mentors for the younger generation of female scholars, good support should be given to women by their spouses or parents, and there should be equal study opportunities for both genders.

Table 3: Top Universities in Africa, 2018

#	University	Country	#	University	Country
1	University of Pretoria	S/A	11	University of Lagos	Nigeria
2	University of Cape Town	SA	12	Ahmadu Bello University	Nigeria
3	University of Witwatersrand	SA	13	Rhodes University	SA
4	University of Kwazulu Natal	SA	14	Cairo University	Egypt
5	University of Johannesburg	SA	15	University of Ibadan	Nigeria
6	University of Stellenbosch	SA	16	Universiteit van die Vrystaat	Uganda
7	North-West University	SA	17	Universidade Eduardo Mondlane	Mozambique
8	University of Western Cape	SA	18	Cape Peninsula University of Technology	SA
9	University of Nairobi	Kenya	19	University of Khartoum	Sudan
10	The American University in Cairo	Egypt	20	University of Nigeria	Nigeria

Source: UniRank 2018 https://www.4icu.org/top-universities-africa/ (03/03/2018)

Table 4: Factors that drive or hinder research

Forces that drive research	Forces that hinder research
Structural factors **1) Socioeconomic and political situation of the countries** a) GDP b) Political and military situation **2) Government priorities- which could be** Agriculture, forests, energy, water, gender, and infrastructure. **3). Academic or university mandate/duty** **i) Institutional mandate** a) Mission and vision of the academic institution b) Ranking demand and prestige among other universities **ii) Individual mandate** a) Academic career progression which is mandatory b) As an international and national reference c) Possibility for publication in reputable journals d) Hobby/pleasure	**1) Collective burdens** Lack of resources- particularly funds Low value given to researchers – in many African countries, politicians have more voice than scholars Lack of strategic plans for sustainable development **2) Individual burdens** Researcher have to supply their basic needs such as housing, transportation, children's fees, marriage Lack of stimulus – no academic awards/recognitions/appreciation High administrative burden and classes to teach – from to 2-3 subjects (12 hours per week) - Children's care and other domestic responsibilities

SECURITY OF EMPLOYMENT AND SUSTAINING SUPPORT FOR FEMALE RESEARCHERS

Patience Osadebe FAS
Dean, School of Postgraduate Studies, University of Nigeria, Nsukka

Job security or security of employment is a matter of individual, family, and society concern. Security is the state of being at ease, free from danger or from risk of loss, assured in opinion or expectation, and not having doubts. Job security is a feeling or assurance of having the same job until retirement.

Legislative and regulatory efforts have been made to ensure that in the jobs people settle for, there is the possibility to stay through, progress, and actualize career dreams until retirement or a higher appointment. For example, the International Labour Organization (ILO) and other labour unions exist for such causes. There are some vulnerable groups in the employment terrain, the youth and the women, who are predisposed to employment insecurity because of unusual circumstances surrounding their lives.

The security of a job is a two-way approach dependent on the employer and employee. The employer is expected to ensure regular payment of salaries, setting up growth and development support policies, having regular promotion for deserving employees, and carefully implementing welfare policies. Good welfare packages, by employers, keep staff morale high and sustain their interest in the organization thereby minimizing attrition or disengagements.

On the other hand, employee responsibilities include discipline, dedication, lawfulness, acquisition of leadership skills, keeping abreast of developments in one's field, and avoiding redundancy through conscious and deliberate self-development and continuing education programmes.

For women, job security is challenging as there is a natural tendency for employers of labour to discriminate against them because of perceived possibility of not coping due to family life and child-bearing. The female researcher is faced with combining family care work with employment as they have to simultaneously fulfil their responsibilities in bearing and raising the next generation. If women are to succeed in both duties, adequate support has to be provided.

Suggested support systems include:

- Deliberately apportioning specified spaces (certain percentages) of appointments/grants to female applicants as they often spend a greater part of their career life raising children and keeping homes
- Some awarding bodies should have different age limits that favour female researchers
- Female applicants should have the benefits to utilize age waivers
- Females should have access to specific awards targeted at women only. Such awards include

a) L'Oreal -UNESCO Women in Science Awards granted annually to 15 promising young women scientists for doctoral and Post-doctoral research.
b) L'Oreal-UNESCO for Women in Science partnerships which is a global network of international, regional, and national fellowship programmes designed to support young women who are representative of the future of science. So far more than 2720 women in more than 112 countries have been supported to pursue research both at home and abroad.
c) L'Oreal-UNESCO International Rising Talents Programme designed to speed up the advancement of young women in science globally. Beneficiaries are usually chosen from among previous doctoral and post-doctoral awardees of the L'Oreal for Women in Science national and regional programmes.
d) American Association of University Women (AAUW) International Fellowship for Women: AAUW awards international fellowships for full-time study or research in the United States and is awarded to women who are not citizens or permanent residents of the USA.

e) Schlumberger Foundation Faculty-for-future fellowships for women - Awarded to women from developing and emerging economies for pursuit of PhD and post-doctorate studies in STEM disciplines in leading universities worldwide.
f) Amelia Earhart Fellowship for women in Aerospace-related Sciences and Engineering - Established after the famed pilot Amelia Earhart and awarded annually to 35 women for pursuit of PhD/doctoral degrees in aerospace-related sciences.

Others are the Adobe Research Women in Technology Scholarship, Microsoft Research Women's Fellowship, USAID's PEER women in Science Mentoring Program, Forte Fellows program for Women (an MBA program), FINCAD Women in Finance Scholarship Program, Dorothy Marchus Senesh Fellowship for Women, and the Elsevier Foundation Awards for Early-Career Women Scientists in the developing world

In conclusion, from the avalanche of awards, grants, fellowships and mentorship programmes instituted, and made specific for women, it is obvious that the world is making conscious efforts to bridge the long-existing gap between the men and women in STEM research and innovation. If these gender-specific opportunities are increased to involve more awarding bodies, and more competent women, better outcomes will be obtained. Also, the employment of women in research institutions should be mainstreamed through stipulation of staff-distribution ratio that will provide for fair gender representation by national accreditation bodies. Young girls should be empowered through mentoring in STEM towards informed career choices while the participation and representation of women in STEM-based academies and associations should be enhanced.

CHALLENGES FACING YOUNG AFRICAN SCIENTISTS IN THEIR RESEARCH CAREERS: IMPACT AND APPROACH TO A SUSTAINABLE SUPPORT

Adewale Adewuyi
Redeemers University Nigeria.

Though research has been established to be important in the development, productivity, and growth of any nation, many African countries have invested little in research. R&D investment from countries surveyed across Africa ranged between 0.2% and 0.48% of the GDP and only three countries (Malawi, Uganda, and South Africa) were reported to have reached 1% of their GDP.

In a bid to gather evidence on the state of S&T in Africa, a qualitative exploratory study involving young researchers was conducted by TReND Africa with respondents coming from Nigeria, Senegal, Ghana, Malawi Zambia, Tanzania, Benin, Zimbabwe, Kenya, and Democratic Republic of the Congo. The study focused on personal attributes, how research interests were developed, challenges faced, and suggestions to improve research among young researchers in Africa. Findings from this study mentioned showed that:

- The government was the most important funding source of R&D activities in Kenya and Uganda (and to some extent Zambia). The countries stood out as the only countries where the higher education sector itself accounted for a considerable share of R&D funding

- Scientists in South Africa had the highest number of scientific papers published over that period. However, Tunisia topped the list when the number of papers produced was divided by the number of people in the country, known as scientific production per capita

Listed challenges facing many young African researchers include: lack of funding, issues with communication and writing in foreign languages, lack of state-of-the-art laboratories, lack of mentoring, excess work load, and inappropriate policies.

Recommendations on how to increase the visibility African scientific production were proffered to be the need to:

- Encourage the creation and operation of high quality science and technology publishing houses in Africa
- Improve access of African researchers to journals with high impact/index factors
- Promote and encourage incentives for publishing in journals referenced in the citation index
- Create open and free access publication outlets for Africa, with improved review committees
- Boost the intra-African cooperation in STI while maintaining strong collaborations outside Africa
- Make policy makers understand the link between research and national development

Although the goal of Africa is to achieve 1% of GDP invested in R & D, it is not clear whether African countries have made progress towards meeting this target due to a lack of data. Over the years, Africa's history of measuring and monitoring scientific information relies on estimates or data based on indirect measurements (most of which are from international organizations outside Africa). The absence of robust common STI indicators has also limited the continent's ability to make evidence-based decisions regarding STI. Africa needs to build its capacity in STI.

Discussions
Theme: Can African academics see research as swimming against the tide.
Suggested actions on what can be done include:

- Increasing awareness of female contribution to science and the various opportunities available (scholarships and institutions) for promoting the development of female researchers
- Opportunities should be made available across age limits for women (being flexible with the age limits) and there should be encouragement of ambitious women
- Successful models in advanced countries should be adopted to address cultural hindrances and limitations
- Favourable legislations in other countries should be adapted
- Regulations to make structural change easier should be adopted
- Grants should be based on merits and not sentimental factors

The national academies of science should be at the forefront in driving these recommendations/actions

Key issue: Providing Security of employment and sustaining support for female African scientists.

Recommendations for achieving this include:

- Providing an enabling environment (such as having a crèche) at the workplace for working mothers
- Disciplinary measures against misconduct such as sexual harassment in the work place should be enforced by the employer; and women emancipation groups should support the fight against sexual harassment at the workplace
- There should be favourable employment policies for working mothers.

Key issue: Challenges facing young African scientists in their research careers; impact and approach to a sustainable support.
Suggested strategies include:

- Difficulty in publishing papers in credible journals should be addressed
- Plagiarism in research work should be discouraged to ensure development of credible papers for publication
- Publication ethics should be promoted by supervisors as part of mentorship
- Research should be aimed at addressing national issues
- There should be adequate facilities to carry out research
- Financial support should be provided for young researchers

Key issue: Measures for developing the careers of female and young scientists
Suggested steps for improving the outputs from female and young scientists are:

- Improve linkage between young/female scientists and the industries
- Local and international collaboration should be encouraged
- Mentorship by older scientists is vital
- Scholarship should be based on gender quota
- There should be constant and consistent motivation
- Role models should be showcased to motivate female young scientists
- Training on writing skill should be provided e.g. proposal writing
- Advocacy should start from the grass roots to encourage female scientists
- Encourage postdoctoral research visits in Africa

More females should be enrolled in national academies

RECOMMENDATIONS

Following discussions, it was agreed that African decision makers must give science and technology the highest priority in their strategies since development is not possible without scientific know-how. It is only through the judicious use of science and technology that African countries can cope with the stiff competition brought about by the globalization process which is rapidly integrating national economies. It is imperative that a series of concerted actions be adopted and sustained to permanently institute a scientific and technological culture in Africa.

Some of the recommendations at the end of deliberations for future consideration and follow up include:

- ICSU (ISC) should collaborate with African organizations such as the Network of Africa Academy of Sciences, African University Associations, etc, to popularize and implement its vision and mission
- Countries should set in place mechanisms to stimulate and maintain knowledge-driven economies, including facilitating cutting-edge research
- Governments of individual countries should collaborate with development partners to provide institutional-based research grants
- Developing countries should increase budgetary allocations to facilitate provision of facilities for research in their countries
- Research topics of researchers should be of national interest to drive social and economic development. There should be a cultural change among researchers to embrace targeted research.
- Discussions between researchers and the political class should be integrated in the economic planning of countries; taking into account the potential for the exploitation of research results for national benefit. Networks where researchers and politicians could communicate openly and freely should be established
- Africa's STI agenda 2023 (STISA 2023) must be popularized among governments to ensure that the percentage of GDP devoted to STI reaches the proposed 1 %
- The curriculum for the teaching and learning of science must be redesigned to include emerging trends in research
- New ways/methodologies for teaching science in African institutions are needed. This will include focusing on preparing/training teachers for all levels, but particularly at the basic level where teaching and learning science should be related to everyday life
- A database of scientists and scientific research in Africa (Who-is-Who in Science in Africa) is needed. An African model for local research should be developed
- Awareness should be increased regarding the contribution of women to science and the various opportunities available (scholarships and institutions) for promoting the work of female researchers

- The economic, environmental, and social issues of research should be highlighted when requesting support from governments. This could influence their decision. These results must be capable of impacting the economy of countries
- Research linkages and collaboration opportunities should be provided and encouraged
- The national academies of science should be in the forefront in driving these recommendations/actions

A prosperous scientific climate in Africa, based on inclusive growth and sustainable development, is achievable through people-driven research and development. Investments in various economic sectors in Africa should be intensified to promote retention of research talent in Africa.

Appendix

SPEAKERS' ABSTRACTS AND PROFILES

Oye Ibidapo-Obe FAS
NAS, Nigeria

Keynote address: National/Regional Investment in Science Research and Technology/Innovation (SRTI).

Abstract
The purpose of Research especially in Science and Technology is to expand the knowledge frontier, through copious investment in human capital and thereby innovating and adding value to human development. SRTI is key to achieving the development goals in all sectors of the economy (the Science Technology and Innovation Strategy-STISA 2024, STISA 2063, SDG 2030 and Vision 20:2020.).

Development is the aggregate value of comfort to life, through Agriculture and Food Security, Rural Development, Water and Environment as well as Education, Health, Transportation, Economy etc. Researchers in developing countries should therefore focus primarily on aspects of knowledge expansion that relate to human welfare.

This presentation shall discuss Research, its benefits as well as the thematic areas of research (the local content policy) including the innovations in the technology advances of primal benefit to the developing nations (Drones, Gene Drives, MicroGrids, AI, Precision Agriculture, 3D Printing, Water Purification, Next Generation Medicines, Next Generation Batteries, Synthetic Biology).

There are national, regional and continental efforts by the various agencies responsible for Science and Technology in these countries(Nigeria for example under the National Science, Technology and Innovation Policy(NSTIP) seeks to promote the deepening of STI in all sectors of the economy; there are also efforts at NEPAD and the African Union(AU),tendered in January 2018 Addis Ababa Ethiopia, through the various Specialized Technical Committees(STC) on Agriculture, Rural Development, Water and Environment as well as that on Education, Science and Science and Technology.

Profile

Professor Oyewusi Ibidapo-Obe, BSc, MMaths, PhD, FAS, FAAS, FAEng., FASCE, OFR is a Distinguished Professor, former Vice Chancellor University of Lagos (2000-2007) and the Federal University Ndufu Alike Ikwo Ebonyi State (2011-2016). He graduated from the University of Lagos in 1971 with a 1st Class Honours Degree in Mathematics and a Doctorate degree from the University of Waterloo in 1976. He attended developmental programmes at Oxford University, MIT, and Harvard University etc. over the past 3 decades. He has had several teaching and research engagements in the Universities of Waterloo, Toronto, Texas Southern, Southern and Penn State etc. Prior to his appointment as Vice Chancellor; he served meritoriously as Head of Department and Dean of the Faculty. Professor Ibidapo-Obe was Chairman Presidential Committee on Brain Drain; Pioneer National Coordinator of the UNDP-TOKTEN as well as the pioneering Managing Director of UNILAG CONSULT. He was President of the Nigerian Academy of Science (2009-2013). Professor O Ibidapo-Obe is the Pro Chancellor of The Technical University Ibadan. He was honoured by the President of the Federal Republic of Nigeria in 2004/5 with OFR (Officer of the Federal Republic)

Leiv K. Sydnes
Department of Chemistry, University of Bergen, Norway

Theme 1: "Ensuring Rights, Freedom, Duties and Responsibilities for African Researchers"
Title: Freedom and Responsibility in Science Everywhere

Abstract

The Principle of Universality of Science is spelling out the framework for the conduct of science in a global perspective. Implementation of the principle is met with challenges that vary from region to region, and even country to country, and Africa is no exception in this regard. In the keynote various issues will be discussed to set the stage for fruitful discussions during the workshop.

Profile

Leiv K. Sydnes obtained his PhD from University of Oslo, Norway in 1978. After a postdoctoral period at University of Western Ontario, Canada, he became professor at University of Tromsø, Norway, in 1980 and then, in 1993, at University of Bergen, Norway. His main research interest is synthetic organic chemistry. He went through the presidential succession in International Organization of Pure and Applied Chemistry (IUPAC) in 2002-2007 and chaired IUPAC's Committee on Chemical Research Applied to World Needs (CHEMRAWN) 2008-2015. In 2002 he became involved with the Organization for the Prohibition of Chemical Weapons (OPCW) in connection to the revisions of the Chemical Weapons Convention and discussions of educational and ethical issues. Professor Sydnes has also for years been involved in outreach activities. This includes writing newspaper articles and making TV programs about chemistry for the general public. And since 2012 he has chaired the CFRS committee in ICSU.

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Nazar M. Hassan
UNESCO, Egypt

Theme 1: "Ensuring Rights, Freedom, Duties and Responsibilities for African Researchers"

Title: "Recommendations on Science and Scientific Research: Considerations of the New Issues affecting the Global Research Platform "

Abstract

Since the adoption of the 1974 UNESCO "Status of Researchers" Report, the landscape of scientific research and the context of science has greatly changed. Research has become more complex and specialized and involves greater level of uncertainty. And since the 1990s, the science focus has shifted more towards technology, and with more and more deployment of S&T, research has been transformed and is currently been evaluated by the notions of efficiency and economic competiveness and not directly connected to the scientific activities themselves. Today political, social and economic matters are increasingly reshaping the scientific enterprise in both their aims and means, and it is becoming more economically oriented and more privatized! Furthermore, in 1974 the total researchers

accounted for worldwide were about 20,000 only. Forty years later the number had risen to 6 million researchers, and today the number globally has surpassed 7.8M researchers. This paper presents examples on the trends of implementation of the recommendations of the UNESCO 1974 "Status of Researchers" report and some of the associated challenges met around the world. The paper also presents the new main recommendations of UNESCO included in the 2017 report on "Recommendations on Science and Scientific Researchers", and how some of these recommendations could be adopted in the African context towards the successful utilization of research and science and technology for sustainable development in the continent.

Profile

Nazar M. Hassan (b. 1964; Sudan) has been Senior Regional Science and Technology Specialist for the Arab States at UNESCO since 2009, where he has initiated several networks to build up the region's techno-preneurship culture. Previously, he worked in Beirut (Lebanon) as Senior Economist in the Sustainable Development Division of UN ESCWA. Mr. Hassan has a number of published papers and reports in the areas of sustainable development goals, science policy development, and strategic energy management, together with a number of patents in renewable energy. He is one of the co-authors of the Arab States chapter within the 2016 UNESCO World Science Report. Mr. Hassan is an engineer by profession, and he received his PhD in 2003 from University of Massachusetts, Amherst in the United States, with a focus on Sustainable Energy Development.

Guéladio Cissé
Swiss Tropical and Public Health Institute, Switzerland

Theme 2: "Main drivers of brain drain and brain-loss and good examples of mitigating measures"

Title: Key figures and facts on brain-drain and its drivers

Abstract

The concept of "brain drain" has been developed at the origin to describe and analyze the outflow of scientists to particularly the United States and Canada, in the 1950s and early

1960s. The increase in the following decades of studies on the topic and the gain of an interest to it by more international organizations brought a better understanding of its multifaceted dimensions (wider consideration of both negatives and positives). This also led to the enrichment of the terminology with new words (e.g. brain-gain, brain-in-drain, brain-waste and brain-circulation). The phenomenon presents different regional specificities and evolves dynamically worldwide over time, depending on several drivers (e.g. attractiveness of new development hubs, local and hosting countries' political environments, emerging conflict areas, new opportunities in origin countries). The statistics from some countries or regions are not always available or accurate for an exhaustive global comparative analysis. Nevertheless, some recent reports point out very interesting figures and facts. The keynote will cover some of the conceptual discussions, highlight some facts and figures and bring introductory insights on the actions needed for making the transformation of brain-drain into more brain-circulation and brain-gain.

Profile

Guéladio Cissé obtained a PhD in sanitary engineering in 1997 from the Swiss Federal Institute of Technology in Lausanne (EPFL). He is an environmental epidemiology researcher, currently Research Director and Head of the Ecosystem Health Sciences Unit within the Department of Epidemiology and Public Health at Swiss Tropical and Public Health Institute (Swiss TPH). After 5 working years in his home country, he occupied senior positions abroad for more than 20 years. Successively lecturer and researcher at the Inter-state engineering school for rural equipment in Burkina Faso (6 years), regional research coordinator and managing director at the Swiss Center for Scientific Research in Cote d'Ivoire (9 years) and research group leader at Swiss TPH (8 years). Prof. Cissé contributed to the training and supervision of several younger researchers in various academic partnership projects between Switzerland and Africa. He is member of the ICSU/CFRS since 2015 and a number of other international scientific panels and committees.

Valérie Schini-Kerth
Faculty of Pharmacy, University of Strasbourg, Strasbourg, France

Theme 2: Main drivers of brain drain and brain-loss and good examples of mitigating measures

Title: International training of young African scientists for capacity building in their home country

Abstract
International student mobility is rapidly growing with 0.8 million foreign student engaged education program worldwide in the late 1970s and 4.6 million in 2015 (OECD). Studying abroad is an opportunity to access quality education, acquire skills that may not be taught at home, improve employability, contribute to capacity building in their home country, enable their home country to integrate into global knowledge networks, and shape future international scientific co-operation networks. Regarding Africa, a low number of international students (254 000) are enrolled in tertiary education levels predominantly in Europe, especially in France (42%, related to factors such as historical ties, language), United Kingdom (14%) and Germany (8%). International enrolments are particularly pronounced at the doctoral level with, in France, three times more international students in the doctoral schools than in the master's programs. The journey of African doctoral students from Senegal and Côte d'Ivoire enrolled at the Life Science doctoral school of Strasbourg University will be presented, as well as the challenges they are facing after their PhD once returning to their home country, including professional integration, research facilities and environment, access to scientific literature and funding, and support from the local scientific community.

Profile
Valérie Schini-Kerth is since 2000 Professor of Pharmacology at the Université de Strasbourg, France. After her training in Pharmacy, she obtained a Master Degree in Molecular and Cellular Pharmacology in 1985 and PhD in Pharmacology in 1988 at the Université de Strasbourg. Her post-doctoral training (1989) at the Mayo Clinic (Rochester, Minnesota) before being appointed as an assistant Professor at Baylor College of Medicine (1989-1992; Houston, Texas). From 1992 until 2000, she was a research scientist at the

University Clinic of Frankfurt (Germany). Her major research interests focus on cardiovascular pharmacology and, in particular, on the pivotal role of the endothelium in the control of vascular homeostasis in health and diseases such as hypertension and diabetes. She is studying mechanisms underlying endothelial dysfunction, a hallmark of major cardiovascular diseases, and approaches to prevent and/or delay the development of an endothelial dysfunction in particular using natural products.

E. Oluwabunmi Olapade-Olaopa FAS
College of Medicine, University of Ibadan, Nigeria

Theme 2: "Main Drivers of Brain Drain and Brain Loss and Good Examples of Mitigating Measures"

Title: Brain drain and brain loss: the urgent need for mitigating measures

Abstract
Globalization and knowledge-based economics is increasing competitiveness and mobility of highly skilled professionals; social and information communication technology networks increase the visibility of talent. Aided by the combination of socio-economic difficulties in developing countries and favorable immigration policies of developed countries to attract and retain a qualified labor force, the unabated migration of highly skilled Africans to more developed countries now assumes increased social and economic relevance. The combination of increasing mobility of highly skilled persons and declining human capital indices on the African Continent warrants mitigating measures. In the past, several measures were suggested and implemented with varying degrees of success. A deliberate strategy that utilizes contemporary mitigating measures that leverage on the main drivers of brain drain to design systems that ensure net gains accrue when highly skilled persons emigrate. The aim of this presentation is to define the problem and its consequences and reconstruct the evidence for contemporary paradigms that address the issue in the context of globalization and the advancement of a knowledge-based economy.

Profile

Professor Olapade-Olaopa's career spans molecular biology, urology, medical education and health systems research and development. His contributions to the latter two disciplines include the most current census and survey of medical schools, national accreditation and physician tracking systems in Sub-Saharan Africa. Additionally, he directed the development of the first homegrown undergraduate competency-based medical/dental education curricula in Sub-Saharan Africa (the 2010 University of Ibadan MBBS and BDS curricula), and the development of the first 'Nigeria Undergraduate Medical and Dental Undergraduate Curriculum Template 2012' both of which have gained national and international acceptance. He has edited several major medical education and surgical training books including the WHO Manual for Emergency and Essential Surgical Care in Sub-Saharan Africa (circa 2017). Professor Olapade-Olaopa is the current Provost of the College of Medicine, University of Ibadan and the Executive Secretary of the Association of Medical Schools of Africa.

Yaya Sangare
Strategic Support Program for Scientific Research (PASRES), Côte d'Ivoire

Theme3: "Creating an enabling environment for researchers"

Title: Funding Research in Cote d'Ivoire: PASRES model

Abstract

PASRES, the Strategic Support Program for Scientific Research in Côte d'Ivoire, is a Research Funding Program set up on June 15, 2007 in the framework of the Swiss and Ivorian cooperation.

PASRES is actively involved in the implementation of a major initiative of fifteen (15) African countries called the Science Granting Council Initiative (SGCI). Exchanges between the different member-states have made it possible to propose solutions for improving the research environment in Africa.

In Côte d'Ivoire, more specifically, a number of decisions have been taken in recent years to improve the research environment. Concrete actions have been taken both in terms of infrastructure and the working and living conditions of researchers.

This communication will present the contribution of PASRES, a funding institution, to improving the research environment in Côte d'Ivoire.

Profile

Doctor Yaya SANGARE has a double competence: in Material Sciences and Organizational Management.

Holder of a Ph.D. in Physics of Materials obtained at Université de Montpellier (France) and a DESS/CAAE at Institutd'Administration des Entreprises de Poitiers (France), he taught at the Institut National Polytechnique de Yamoussoukro and later joined the Côte d'Ivoire Chamber of Commerce and Industry as the Director in charge of Training and Professional development.

He then held various positions in both Ivorian and Burkinabe private sector companies. This career path allows him to fully understand the expectations of the private sector and foster relations between this sector and that of Research and Innovation.

Since 2007, Dr SANGARE is the Executive Secretary of the Strategic Support Program for Scientific Research (PASRES) in Côte d'Ivoire. This program is one of the main support structures to research and innovation in Côte d'Ivoire.

Oumar Sock
National Academy of Sciences and Techniques of Senegal, Senegal

Theme 3: Creating an enabling environment for researchers

Title: Creating attractive conditions for recruitment and retention of researchers in Africa: the case of Senegal.

Abstract

Africa is home to 15% of the world's population, but has only 3.6% of the total number of scientists in the world. Today, Africa produces just 3% of global GDP and accounts for 2% of world research output, and just 1.3% of world research spending.

The African deficit of scientists and researchers is doubly aggravated, on the one hand, by the small number of students in sciences and scientific researchers currently trained in universities and research centers of the continent, and on the other hand by brain drain.

Brain drain is mainly related to unattractive working conditions for researchers in Africa, insufficient recruitment of researchers, and the often advantageous research conditions offered in developed countries.

In this context, one can point out the strong awareness of most African countries of the leading role of scientific research in sustainable development process. As a result, many initiatives are being taken to increase the number of researchers and faculty in science, technology and innovation, improve the status of researchers, reduce brain drain, and even encourage the return of African diaspora researchers.
In the present keynote paper, we will present the ongoing initiatives in Senegal in this area of improving the status of researchers and their working conditions.

Profile
Mr. Oumar SOCK is Professor of Analytical Chemistry. He obtained his Bachelor of Science degree in Physical Sciences from Cheikh Anta Diop University, Dakar (UCAD), a Master of Science and a Doctorate 3e Cycle in Electrochemistry both from University Louis Pasteur, Strasbourg-France, and a State Doctorate degree in Electrochemistry from University Paris 12 where he has been Assistant Professor for seven years. He was awarded "Best Thesis" by National Center for Scientific Research (CNRS, France) and joined UCAD in 1987. He became successively Director of UCAD's Technical and Vocational Teacher Training College (1990-1995), Director of Polytechnic College of Engineering of UCAD (1995-2003), Vice-Chancellor of University Assane Seck of Ziguinchor (2009-2013), Manager General of Higher Education of Senegal (January 2013-December 2014). He retired in December 2014 and is currently Perpetual Secretary of National Academy of Sciences and Techniques of Senegal.

Prof. Sock has been Director of Electrochemistry and Membrane Processes Laboratory of Polytechnic College of Engineering (1994-2010), National Coordinator of World Bank's Higher Education Programs in Senegal during more than ten years, President (2004-2012) of CITEF-AUF, a network of francophone colleges of Engineering from Africa, Europa, Asia and America.

Serge Diagbouga
State Secretariat for Scientific Research and Innovation, Ministry of Higher Education, Scientific Research and Innovation, Burkina Faso

Theme 3: Creating an Enabling environment for researchers

Title: Enabling environment for researchers: the case of Burkina Faso

Abstract
The research environment coupled with motivating salaries, have been the main challenges for research capable of supporting economic and social development in many developing countries. In Burkina Faso, the political awareness of the need to boost research and innovation as essential levers for the achievement of national development objectives led to the creation of the National Research and Innovation Fund for Development, the development of the National Strategy for the Valorization of Technologies, Inventions and Innovations and that of the National Policy for Scientific and Technology Research and the adoption of the orientation law for scientific research and innovation. They are the expression of a strong vision and commitment by the highest authorities to place science, technology and innovation among the main levers of the country's development, in accordance with the provisions of the OIC, ISESCO, AU and ECOWAS of which Burkina Faso is a member. Several concrete actions were implemented in terms of the organization and management of research, the legal and regulatory framework, the valorization of research results, the strengthening of technical platforms, the securing of research sites and the revaluation of researchers' salaries with the aim of creating a favorable environment for researchers.

Profile
I'm senior scientist and Associate Professor of Microbiology and Immunology at IRSS and University of Ouagadougou. Currently, I act as Technical Adviser for the State Secretary in Charge of Scientific Research and Innovation in Burkina Faso. I hold a PhD in Immunology, a Master degree in Fundamental and Applied Toxicology, a doctorate in veterinary medicine and several diplomas of Pasteur Institute in Paris and several certificates.
I served as Director General of centre MURAZ (2003-2009) and as the National Tuberculosis Program Manager (2010-2012). I got substantial experience in clinical research. I acted as Principal Investigator in several research projects and coordinated

many research partnerships with support from national and international funding agencies. I'm author of more than 50 peer-reviewed articles and more than 100 abstracts at international congresses. I'm member of several international scientific societies. I conducted several missions as independent consultant for several national and international organizations.

Inês Macamo Raimundo
Eduardo Mondlane University, Mozambique

Theme 4: Security of employment over years and sustaining support to specific groups (e.g. young and female researchers)
Title: Have African Academics seen research as swimming against the tide?

Abstract
The Times Higher Education's World University Ranking 2018 states that the best universities in Africa span 10 countries, from Uganda in the east to Nigeria in the west, Morocco in the north to South Africa in the south of the continent. This is based on research, staff assurance and publications. When we look at the ranking, it is fairly easy to ascertain that, Lusophone universities are the less ranked. Meanwhile, universities or tertiary education institutions are growing as mushroom while public investment in research is still low. Research enhances universities and gives the passport to publications and consequently to higher academic ranking levels. Some will argue that lack of resources, mainly finance hinder research, but in nowadays of advancement of technologies there are other ways of doing research. Using indirect methods (available data), engaging with international scholars, stimulating participation in competitions such as LIRA 2030 can be some strategies that can be used to strengthen research. Doing research in Africa cannot seem as swimming against the tide as there are many ways of doing research without depending on State budget. African researchers have that capacity of participating in international competitions for funds for research.

Profile
She is an Associate professor of Human Geography and has been employed by the Eduardo Mondlane University for more than 25 years. She is a geographer by training and has a doctorate in Forced Migration. Her research focuses on migration as a cross cutting subject related with migration per se (diaspora, cross border and internal migration), food security, HIV, climate change, environment and gender. She has sought to understand the impact of climate changes and migration, the determinants of migration in Southern African cities, relationship between HIV and migration as well as food insecurity. Since 2015 she has been member of International Council for Sciences-Regional Committee for Africa while she is Commonwealth Geographical Bureau representative for Southern African and member of academic networks such as Migration and Inclusive Growth, African urban Research Initiative, other regional academic organizations such as African Urban research Initiative, African Food Security Network and Hungry Cities Partnership.

Adewale Adewuyi
Redeemer's University, Nigeria

Theme 4: Security of employment over years and sustaining support to specific groups (e.g. young and female researchers)

Title: Challenges facing young African scientists in their research careers: Impact and approach to a sustainable support

Abstract
Africa is the world's second largest and second most-populous continent. Although the economies of most African countries are considered growing but this does not reflected in the level of research capacity building and productivity growth. There are challenges limiting the potentials of young scientists in Africa. There is need to identify and proffer sustainable supports or solutions to the present challenges facing young African scientists in their careers.

The review covers a qualitative exploratory study involving young researchers who attended workshop on teaching and research in natural sciences for development in Africa held in Malawi in September 2015 and PubMed data search using nine search terms, which covers training programs in Africa, academic training activities, and research articles.

The study revealed most challenges as; lack of mentorship, funding, communication and writing skills, motivation, lack of effective policy and heavy workload. The report highlighted need for creating awareness of research ethics and strengthening of basic research ethics infrastructure in Africa. There is need to also improve funding for institutional and research network strengthening in Africa, with particular attention given to expanding opportunities for young researchers.

Profile

Dr. Adewale ADEWUYI holds a PhD in Industrial Chemistry from University of Ibadan, Nigeria. Over the years, his research activities have been on the industrial applications of underutilized seeds and seed oils in tropical Africa which cuts across synthesis of surfactants, biofuel and major oleochemicals and their use in waste water treatment, environment, medicine and food. He has published over 55 research articles in highly reputable, internationally recognized journals. He has presented several papers at local and international conferences; many of which have won him awards. Dr Adewuyi is a prolific writer and a dynamic speaker. He is a recipient of several awards and grants. Presently, Dr Adewuyi Adewale is a Senior lecturer at Redeemer's University, Nigeria and his dream is to play an active role in building Science and Technology in Africa.

WORKSHOP PARTICIPANTS

SN	NAME	AFFILIATION
1.	Hassan Ajibade	TVC News Cameraman
2.	Hilary Inyang	Global Education and Infrastructure Services (GEISE)
3.	Bonny Alams	Science and Tech Digest Magazine
4.	Joe Ahaneku FAS	NAS/Nnamdi Azikiwe University
5.	Mobolaji Dasaolu	NAS
6.	Scholastica Lan	Consultant
7.	Ameh Ugbede	University of Abuja
8.	Akanji Musbau FAS	University of Ilorin
9.	Leiv K. Sydnes	ICSU-CFRS
10.	Daniel Nyanganyura	ICSU-ROA
11.	David Black	ICSU/ University of New South Wales (UNSW)
12.	Fatima Ahmed	Raw Material Research and Development Council (RMRDC)
13.	Ines Raimundo	ICSU-RCA
14.	Sunday Atawodi FAS	NAS
15.	Roger Ridley	ICSU-CFRS
16.	James Owusu-Kwarteng	University for Development Studies (UDS), Ghana
17.	Patience Osadebe FAS	University of Nigeria, Nsukka
18.	Idowu Olayinka FAS	University of Ibadan
19.	Samuel Ayonghe	ICSU-RCA
20.	Richard Glover	ICSU-ROA
21.	Adewuyi Adewale	Global Young Academy (GYA)/ Redeemer's University (RUN)
22.	Jacques Andre Ndione	ICSU-RCA
23.	Alex Abutu	Online Editor
24.	Fossuo Fabienne	Center for Public Interest Law, Cameron
25.	Alberto Nunez-Selles	ICSU-CFRS
26.	Oumar Sock	Académie des Sciences et Techniques du Sénégal (ANSTS)
27.	Cisse Gueladio	ICSU-CRFS
28.	Yussuf Shola	National Center for Technology Management (NACETEM)
29.	Mustafa Salihu FAS	NAS
30.	Valerie Schini-Kerth	ICSU-CFRS
31.	Nazar Hassan	United Nations Educational, Scientific and Cultural Organization (UNESCO) Cairo
32.	Olusoga Sofola FAS	NAS
33.	Nebyat Ayele	African Union Scientific Technical Research Commission (AU-STRC)
34.	Diagbouga Seige	State Secretary Scientific Research, Burkina Faso

35.	K. Mosto Onuoha FAS	NAS
36.	Ekanem Braide FAS	NAS
37.	Ekundayo Olusegun FAS	NAS
38.	Emmanuel Ibrahim	University of Abuja
39.	Charles Erkelens	ICSU
40.	Nomasomi Gasa	ICSU-ROA
41.	Paul Okonkwo FAS	NAS
42.	Emiola Olapade-Olaopa FAS	NAS
43.	Zakariyya Adaramola	Daily Trust
44.	Oguntunde Abayomi	National Biotechnology Development Agency (NABDA)
45.	Rabiu Na'Allah	NABDA
46.	Roluke Ogundele	AIT
47.	Collins Ajibola	Kiss FM
48.	Okunato Mayowa	TVC News
49.	Okacha Patience	AIT Camera
50.	Nkechi Isaac	Leadership
51.	Agbaje Gabriel	NAM
52.	Onakpa Michael	University of Abuja
53.	Tanimowo Tunde	University of Abuja
54.	Charity Oshi	Blue print Newspaper
55.	Quattara Annette	Programme d'Appui Stratégique à la Recherche Scientifique (PASRES)
56.	Sangare Yaya	PARSES
57.	Bernard David	NACETEM
58.	Agubosi Oluchi	University of Abuja
59.	Ajagbonna Peter	University of Abuja
60.	Hussaini Garba	Daily Times
61.	A.K. Mu'azu	NCSCT
62.	Buga Lawal	RMRDC
63.	Nasir Naeem	University of Abuja
64.	Binta Shama	Blueprint
65.	Samuel Shofuyi	NAS
66.	Nicholas Ibeh	NAS
67.	Doyin Odubanjo	NAS

THE NIGERIAN ACADEMY OF SCIENCE

ACADEMY HOUSE
8A Ransome Kuti Road
University of Lagos, Akoka, Lagos.
P.M.B. 1004 University of Lagos Post Office Akoka, Yaba, Lagos, Nigeria.
Tel: +234 808 962 2442
Email: admin@nas.org.ng Website: www.nas.org.ng