The Evolving Science Advisory LANDSCAPE IN AFRICA

A Consensus Study Report

THE NIGERIAN ACADEMY OF SCIENCE

INGSA

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International Development Research Centre
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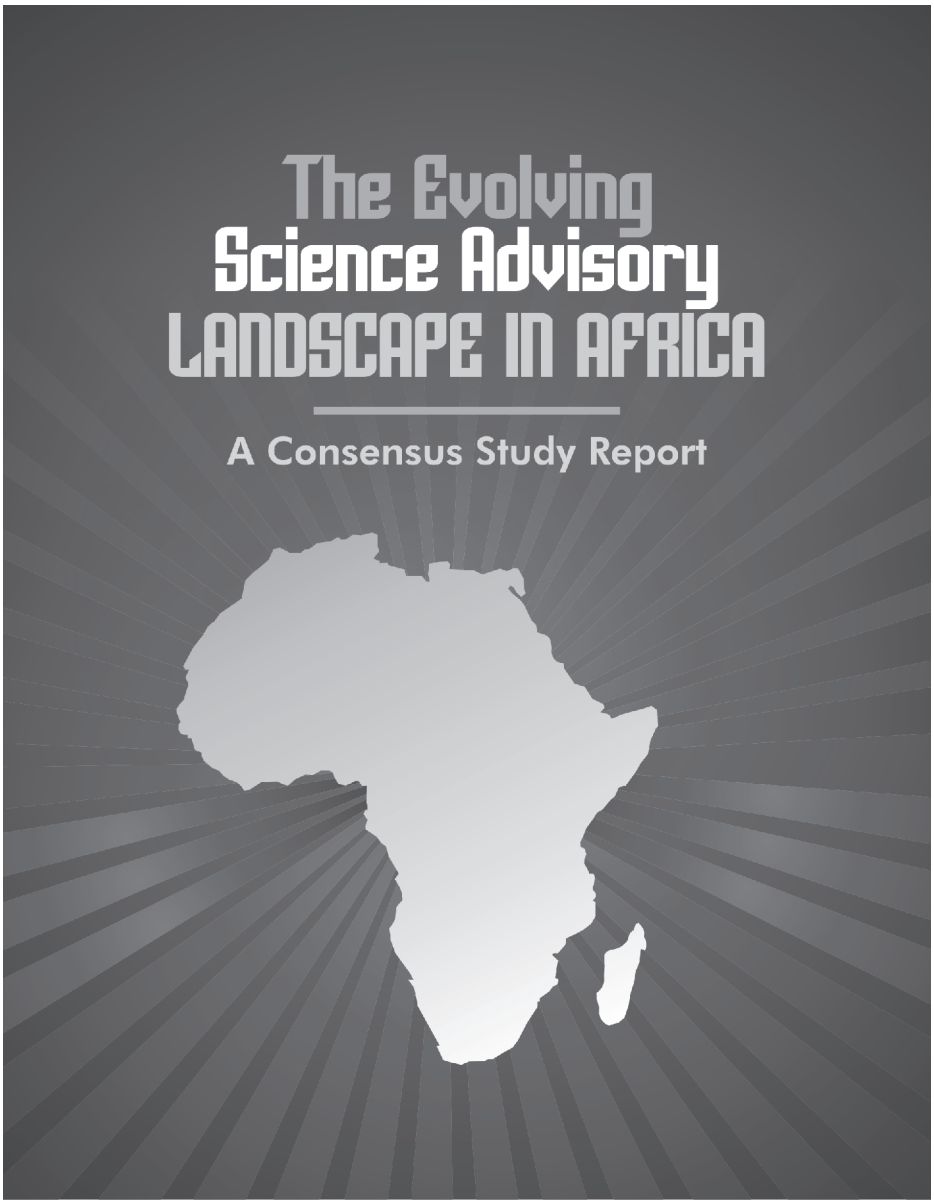
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CONTENTS

FIGURES AND TABLES

ACRONYMS

AAAS	American Association for the Advancement of Science
AAS	African Academy of Sciences
ACEPA	African Centre for Parliamentary Affairs
AcNALS	National Academy of Arts Letters and Sciences
ACTS	African Centre for Technology Studies
AEN	African Evidence Network
AESA	Accelerating Excellence in Science in Africa
AI	Artificial Intelligence
ALC	African Laser Centre
ALLEA	All European Academies
AMCOST	African Ministerial Conference on Science and Technology
ANSTS	Academy of Science and Technology of Senegal
AOSTI	African Observatory in Science Technology and Innovation
ARC	Agricultural Research Centre
AREP	Arab Regional Partner
ASADI	African Science Academies Development Initiative
ASRIC	African Scientific Research and Innovation Council
ASSAf	Academy of Science of South Africa
ASRT	Academy of Scientific Research and Technology
AUC	African Union Commission
BCURE	Build Capacity to Use Research Evidence
BMGF	Bill and Melinda Gates Foundation
CAS	Cameroon Academy of Sciences
CEBH	Centre for Evidence-Based Health Care
CLEAR	Centres for Learning on Evaluation and Results
CPA	Consolidated Plan of Action
CSA	Chief Science Advisor
CSA	Central Statistics Agency, Ethiopia
CSIR	Centre for Scientific and Industrial Research
CSO	Civil Society Organization
DHET	Department of Higher Education and Training
DPME	Department for Performance Monitoring and Evaluation
DRUSSA	Development Research Uptake in Sub-Saharan Africa
EAS	Ethiopian Academy of Sciences
EIPM	Evidence-Informed Policy Making
EPCC	Ethiopian Panel on Climate Change
EU	European Union
EURO-CASE	European Council of Academies of Applied Science Technologies and Engineering
EVIPnet	Evidence-Informed Policy Network
FEAM	Federation of European Academies of Medicine
GDP	Gross Domestic Product
HSRC	Human Sciences Research Council
IANAS	Inter-American network of Academies of Science
IAP	Inter-Academy Partnership
ICT	Information and Communications Technology

IDSR	Integrated Disease Surveillance and Response
INGSA	International Network for Government Science Advice
IPBES	Intergovernmental Science-policy Platform on Biodiversity and Ecosystem Services
IPCC	Inter-governmental Panel on Climate Change
IRDR	Integrated Research on Disaster Risk
ISC	International Science Council
KNAW	Royal Netherlands Academy of Arts and Sciences
LCDs	Least Developed Countries
MDA	Ministries, Departments, and Agencies
MED	Monitoring and Evaluation Department
MENA	Middle East and North Africa
MINRESI	Ministry of Scientific Research and Innovation
MRC	Medical Research Council
NASAC	Network of African Science Academies
NEPAD	New Partnership for Africa's Development
NGO	Non-Governmental Organization
NRF	National Research Foundation
OSTP	Office of Science Technology Policy
PSRC	Federal Policy Studies and Research Centre
SAM	Scientific Advice Mechanism
SAPEA	Scientific Advice to Policy by European Academies
SASPRI	Southern African Social Policy Research Institute
SDGs	Sustainable Development Goals
SEASA	Science and Engineering Academy of South Africa
SID	Special Interest Division
SoT	Statement of Task
SPIDER	Special Interest Division on Science Policy in Diplomacy and External Relations
STI	Science Technology and Innovation
STISA-2024	Science, Technology, and Innovation Strategy for Africa 2024
TCA	The Conversation Africa
TWAS	The World Academy of Sciences
UNAS	Uganda National Academy of Sciences
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNSAB	Scientific Advisory Board of the United Nations Secretary-General
ZaAS	The Zambia Academy of Sciences
ZeipNET	Zimbabwe Evidence Informed Policy Network

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. The 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 249 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 Science Council (ISC) - 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 IAP for Science, IAP for Policy, and IAP for Health.

ABOUT THE INTERNATIONAL NETWORK FOR GOVERNMENT SCIENCE ADVICE

The International Network for Government Science Advice (INGSA) is a collaborative platform for policy exchange, capacity building and research across diverse global science advisory organisations and national systems. Through workshops, conferences and a growing catalogue of tools and guidance, the network aims to enhance the global science-policy interface to improve the potential for evidence-informed policy formation at sub-national, national and transnational levels. INGSA operates as an affiliated body of the International Science Council (ISC), which acts as trustee of INGSA funds and hosts its governance committee. INGSA's secretariat is based in Koi Tū: The Centre for Informed Futures at the University of Auckland in New Zealand.
The mission of INGSA is to provide a forum for policy makers, practitioners, national academies, and academics to share experience, build capacity and develop theoretical and practical approaches to the use of scientific evidence in informing policy at all levels of government. Its primary focus is on the place of science in public policy formation rather than advice on the structure and governance of public science and innovation systems. It operates through:

- Exchanging lessons, evidence and new concepts through conferences, workshops, and a website
- Collaborating with other organisations where there are common or overlapping interests
- Assisting the development of advisory systems through capacity-building workshops
- Producing articles and discussion papers based on comparative research into the science and art of scientific advice

INGSA is committed to diversity, recognising the multiple cultures and structures of governance and policy development. It is not intended to lobby for, or endorse, any particular form or structure of science advice to governments. INGSA's primary objective to improve the use of evidence in informing public policy, rather than providing advice on the structure and governance of public science and innovation systems. As a loosely-knit association of individuals and organisations with interests in both the theory and practice of science advice, it is expected that the network will be shaped and reshaped over time according to the arising needs and interests of INGSA affiliates. Working groups are developed to take on targeted projects such as workshop planning and development of publications and other resource materials.

BACKGROUND AND STUDY PROCESS

The role of science advice is often to help realign the expectations of evidence creators and evidence users, and play the role of trust-maker and arbiter of sorts between parties with divergent interests. Over the past two decades in Africa, several players including the African science academies have made important strides in fulfilling the role of providing credible science advice to society. Some academies on the continent have carved out a clear niche in the science advisory ecosystem in their countries. Given the pivotal place of science in achieving the developmental goals that the continent has set for itself, efforts need to be put in place to further strengthen science research and advice in Africa, to help foster the sense of trust necessary to pursue action based on the most credible available evidence.

To better understand the role of science advice in Africa and the position that can be most effectively filled by diverse players (including the academies) in the future, the African chapter of the International Network for Government Science Advice (INGSA), with funding from the International Development Research Centre (IDRC) commissioned a consensus study- through the Nigerian Academy of Science (NAS) - on the science advisory landscape in Africa. A study committee of eight (8) experts from across Africa- Nigeria, Senegal, Kenya, Uganda, South Africa, and Egypt- was constituted to conduct the study. Subsequently, guided by the objectives of the study, the NAS Secretariat framed a Statement of Task (SoT), which the consensus study would address. Specifically, the committee was charged with the following SoT:

1. Examining science advice in Africa, and unique challenges in the African context.

2. Describing the science advice landscape and structures in Africa, as well as stakeholders' attitudes to science, scientists, and science advice in Africa.

3. Determining the extent to which African science academies have been able to serve in an advisory role in their respective countries and regions; highlighting the successes that have been recorded and the lessons learnt.

4. Identifying other structures that could also play a role in science advice to governments.

5. Recommending strategies for strengthening the advisory role of African science academies.

Given the above, the NAS Secretariat conducted a literature review steered by the SoT, and produced a report of preliminary findings on science advice broadly in the global context, and in Africa specifically. The Expert Committee had an inaugural meeting to further deliberate on the SoT and the preliminary report, as well as agree on the study plan. Additionally, during this meeting, the Committee took part in a stakeholders' roundtable discussion which had in attendance relevant stakeholders (scientists, policymakers, advisory bodies, science communicators, among others) from across the continent. The roundtable created a forum for various categories of stakeholders to share experiences and perspectives on science advice in Africa.

Based on the evidence gathered, a draft study report detailing key findings, responses to the study questions, and recommendations for strengthening the advisory role of African science academies was prepared. The Committee reviewed the report electronically and then met again to finalize the draft study report. The draft study report was then subjected to an independent review by a panel of external reviewers. After the reviewers' comments were addressed, the reviewed report was finalized by the Committee electronically.

The finalized report was then published and disseminated to relevant stakeholders.

MEMBERS OF THE EXPERT COMMITTEE

- K. Mosto Onuoha FAS- Committee Chair / President , the Nigerian Academy of Science (NAS)
- Jackie Kado- Executive Director, Network of African Science Academies (NASAC)
- Abubakar Sambo FAS- Vice President, NAS/ Chair, the Nigerian Ministerial Task Force on Power
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- Willie Siyanbola- Research Professor, Materials and Electronics Department, Centre for Energy Research and Development, Obafemi Awolowo University, Ile-Ife, Nigeria
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- Mitsunobu Kano- Professor, Department of Pharmaceutical Biomedicine, Okayama University, Japan

Although the reviewers provided constructive comments and suggestions, they were not asked to endorse the final draft of this report.

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INTRODUCTION

Science offers one of the few possibilities for an objective viewpoint on the world. When correctly employed, the science method gives logical and fact-based explanations for cultural, social, and physical phenomena. Crucially, science also offers a clear pathway for these explanations to become updated based on the most current credible evidence. As such, science can play a critical role in informing and directing human decisions and actions. Few other realms of human endeavour can supply this type of impartial and balanced guidance, with the ability to self-update in the case that the evidence and context shift.

This valuable and unique role played by science has led it to become fundamental to the growth, development and sustenance of societies across the world. Scientific knowledge, when properly translated, enables mankind to develop solutions to everyday problems, and make evidence-informed decisions. Today, metrics by which countries are classified as "developed," "developing," or "under-developed" are to a large extent intertwined with their ability to leverage science to make economic gains and to improve the lives of their citizens.

Recognizing the important role that science can play in development, it has become central to a number of regional and global agendas endorsed by African countries. The African Union's Agenda 2063, for instance, and the accompanying Science, Technology, and Innovation Strategy for Africa (STISA-2024), position scientific research as a key point of leverage to help address the continent's cross-border social, economic, and environmental challenges. In a similar vein, the Sustainable Development Goals (SDGs) acknowledge the scientific nature of the global challenges we collectively face, including climate change, disaster risk management, conflicts, inequality, poverty, as well as water and food security.

For science to play a guiding role in addressing the challenges outlined in these global agendas, knowledge and evidence must be transmitted from where it is generated (typically academia) into decision-making structures (typically government). African countries have a number of existing structures to encourage this transfer of knowledge, including advisors to government ministries, as well as sector-specific and early-warning advisory bodies. Additionally, a wide range of actors external to government seek to encourage the uptake of impartial evidence into the decision-making process, including non-profit think tanks, non-governmental organizations (NGOs), and civil society organizations (CSOs). The grand narrative tying these diverse organizations together is that their reliance on a scientific approach to knowledge generation allows them to "speak truth to power."

Despite the huge wealth of scientific knowledge already available today, and the extensive governmental and non-governmental organizational infrastructure in place to encourage its use, many African decision makers have not fully embraced the potential role of science. The lack of clear connections between knowledge creation and knowledge utilization is a multi-faceted and self-reinforcing problem. For instance, African scientists (even when producing good research) often fail to adequately or clearly communicate the value of their research to the policymakers

and the general public. At the same time, policymakers (even with the best intentions) lack the resources to utilize the results of research, and promote a good science culture. As a result of these misalignments, mistrust and misunderstanding between scientists, policymakers, and society have frequently become the norm. For there to be any real progress through the translation of science into useful tools for government and society, there needs to be adequate stakeholder trust in and support for the use of science in solving societal problems.

SCIENCE IN THE MODERN WORLD

Just as science has impact on society, society also shapes science. In an ideal case, most researches carried out in any society are need-driven; meaning that they seek solutions to pressing problems facing the society. Primary research is also significant in this process, by laying the groundwork of theoretical understanding that eventually contributes to solving societal and technological problems. While science can help to shape society by answering pressing questions and solving problems, the values and culture of the larger society guide the way that research is carried out in turn. For instance, the perception of different disciplines as being more "useful" to society than others, both in general society and within academia, contributes to what type of research is prioritized and receives financial support. This complex interplay of perceptions and incentives between those generating scientific knowledge, those using that knowledge, and the wider public determines the overall usefulness of the scientific enterprise to solving the problems faced by a particular society.

The era of modern science-the pursuit of knowledge about the physical world and human society-has had a significant impact on how humans live together. For instance, through seeking to understand the world around them, human beings have made a number of ground-breaking technological discoveries that have profoundly altered the way people provide for their basic physical needs. To name a few, these include the discovery of electricity, antibiotics, nuclear energy, air travel, genetically modified food crops, and continued advancement in information and communications technology (ICT). As these technological changes have shifted the foundation of our societies and the way we relate to each other, research in the social sciences has explored many of the complex challenges they have introduced. Similarly, research in the humanities has greatly expanded the possibilities for understanding the human condition in this changing environment, and has helped to lay the philosophical and ethical foundations for pursuits in the other scientific branches.

Internationally, countries that have been seen to develop rapidly-including South Korea, Singapore, Hong Kong, and Taiwan-are also those that have prioritized significant investments in their scientific research and development sectors. Part of this link is likely due to the positive economic benefits of increased research commercialization, and the introduction of technological innovations that improve people's quality of life. Additionally, social science research helps to streamline the delivery of crucial public goods and to improve business processes. Perhaps most importantly, however, increased prioritization and investment in the production of scientific knowledge also denotes a mindset shift away from dependency towards the intellectual confidence to pursue one's own path. As the African science academies have long acknowledged, it is this mindset shift that is the crucial ingredient often missing in many development programmes and agendas. A shift towards prioritizing the production and use of indigenous research knowledge indicates that policymakers are beginning to trust their own experts to guide them through the development process.

In the existing literature, the complex relationship between modern science and society, set within the 'science and society' paradigm, is often referred to as "science culture." Science culture can be defined as how a society understands and uses (appropriates) scientific knowledge. The term

science culture has evolved over the years, continually expanding to encompass a more holistic picture of the relationship. Science culture can be understood as a combination of 1) how a society understands science-related issues and concepts (science literacy), and 2) how a society is able to effectively use scientific knowledge (science appropriation). Science culture also refers to institutions established by governments to promote and explain the role and findings of science to the public. These institutions, such as science museums, may be indicative of priorities set by the respective governments.

Science literacy, as an aspect of science culture, has a historical origin and currently has many definitions, depending on what perspective is being applied. However, despite the varied perspectives, the overwhelming consensus is that it is critical to society's development. The phrase was first used in 1958, in an article discussing the American education system in relation to the significance of science in modern society.[1] The article identified science literacy a necessary step to essential citizenship. The core of the science literacy concept at that time was, therefore, that a significantly deep understanding of science is necessary for effective and engaged citizenship in the nation. Since that time, the concept of science literacy has continued to expand, gaining global significance. Simply put, science literacy today refers to what the larger society should know about science.[2] The focus of science literacy is to ensure that society is equipped with the knowledge, attitude, and tools, to understand information related to science, analyze this information, and form their own opinions.

The second aspect of science culture is science appropriation, or the effective use of scientific knowledge. According to Godin and Gingras,[3] there are three modes in which society can use science. These three modes are: (1) learning, (2) implication, and (3) socio-organizational. The learning mode refers to how society builds scientific manpower by training its members in scientific knowledge, values, norms, and attitudes. This training can happen in both formal and informal settings. The implication mode involves the interactions between the trained scientific manpower and wider society outside the sphere of their professional activities. Such interactions could, for instance, take the form of activities that promote and popularize science. Lastly, the socio-organizational mode of science use involves the development of groups and organizations that support the generation, growth, dissemination, diffusion, and regulation of science in society. In this dimension of science appropriation, organizations such as universities, research institutes, and some industries generate scientific knowledge; others such as science academies, professional societies, CSOs, and the media promote, diffuse, and communicate science; while government ministries, departments and agencies (MDAs) support and regulate the entire science system. All of these institutions are critical to how society views and uses scientific knowledge. The strength of any society's science culture directly corresponds to how effectively these organizations are able to carry out their specific functions whether as producers, proponents, or regulators of science, and also how effectively these different organizations are able to coordinate their actions towards a common purpose.

[1] Hurd P. (1958). Science literacy: it's meaning for American schools. *Educational leadership*. 13-16 and 52
[2] Durant J. (1994).What is scientific literacy? *European Review*. 2(01):83-89.
[3] Godin B, and Gingras Y. (2000). What is scientific and technological culture and how is it measured? A multidimensional model. *Public Understanding of Science*. 9: 43–58.

A country's science culture thus determines the scope of impact that the scientific enterprise can have in terms of improving quality of lives and advancing development. A wide array of stakeholders engages in a variety of activities to shape aspects of science culture, to increase science literacy and science appropriation. In general, the activities of these stakeholders fall along one of three axes: science communication, science diplomacy, and science advice (Figure 1). The borders between these different categories are murky, and many activities are likely to fall into multiple categories. Some initiatives may even seek to achieve goals that fall into all three of the categories. Nevertheless, this distinction provides a useful analytical framework to think about the different activities of stakeholders in the science policy ecosystem. Organizations employ science communication, diplomacy and advice in an effort to shape the broader science culture, both in their country and internationally. To do so, they target certain key audiences that are most likely to be amenable to their messaging. Science communication, for instance, is often targeted towards the broader society that may not be experts in specific scientific topics. Using educational initiatives and the media, science communication strategies seek to fortify the societal value given to science. Science diplomacy, in contrast, is often targeted at international audiences as a way of achieving broader foreign policy goals. International cooperation on scientific initiatives provides a seemingly-neutral channel for collaboration and mutual learning, even between stakeholders that may be antagonistic in other spheres.

Finally, the target audience of science advice is typically decision makers in a society. These decision makers might sit at local, national, or regional levels of government, or they may lead influential NGOs and private sector organizations. The key point is that science advice seeks to provide leaders at all levels of society with the most relevant and current evidence available to help guide their decision-making process. Ultimately, all of these various strategies are ways to shift the overall science culture so that science can play a more prominent role in development.

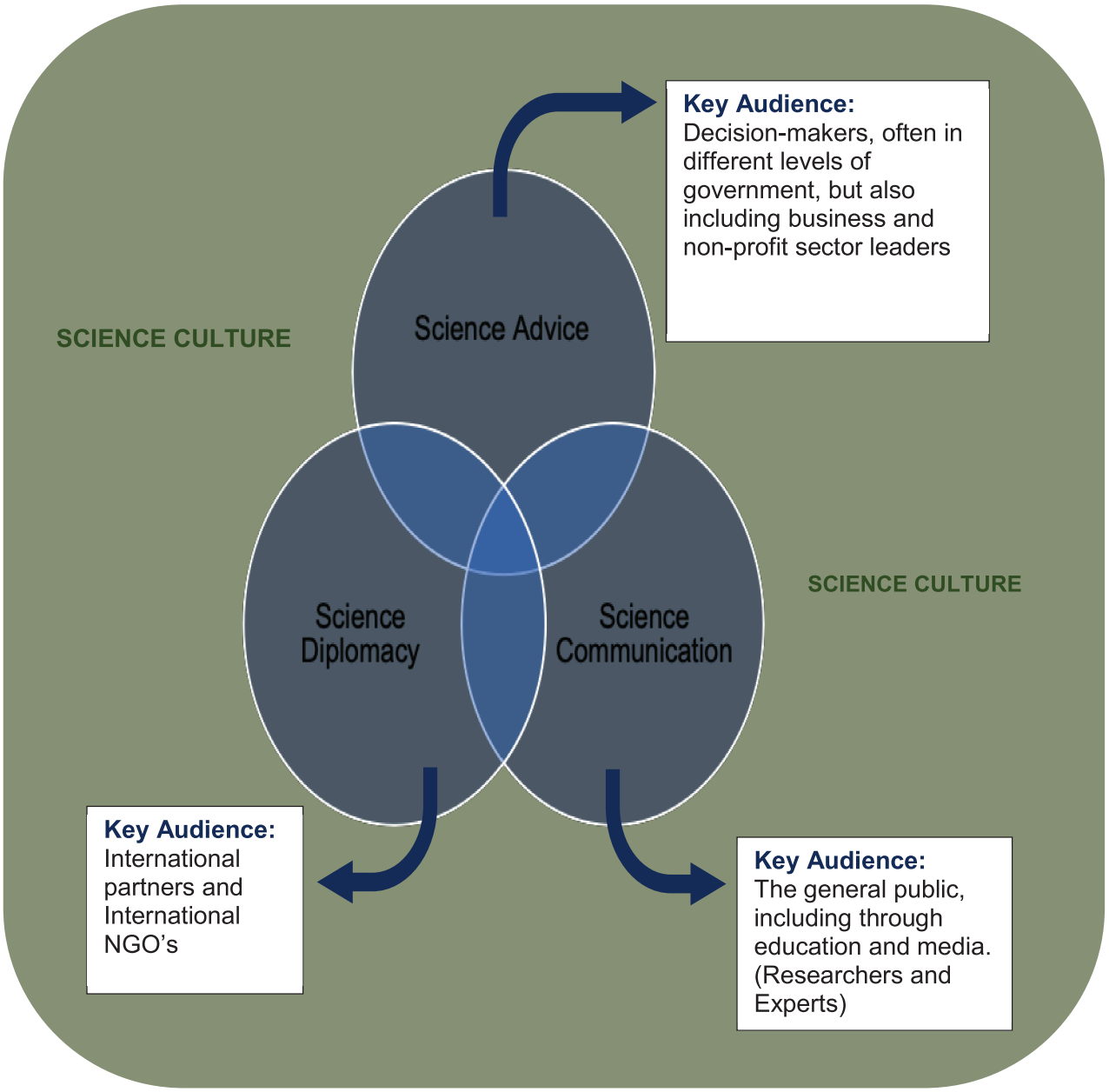

Figure1: A conceptual diagram of a country's science culture

Science Communication

Science communication straddles the disciplines of the natural sciences, the humanities, and the social sciences in its responsibility to communicate research findings and facilitate dialogue with, as well as between, science and the public. It is an essential component of research in all fields. Especially for publicly-funded research, science communication helps make the case to taxpayers and the public on why such investments are valuable in the medium to long-term. Increasingly, science communicators are preoccupied with conducting sophisticated public outreach and engagement campaigns to overcome the social paralysis that seems to accompany "wicked" problems such as, for example, the manifestation of some human activities as the cause of climate change. Science communication not only helps in involving the public in new scientific findings, but also in promoting the public acceptance of new technologies and in seeking input into policy development and policy implementation. Further, science communication serves the purpose of facilitating effective engagement between key stakeholders, the wider public, and governments on

important science-related issues. Ideally, science communication thus serves a dual purpose of (1) sharing the results of research and expanding science literacy, and (2) involving, more closely, the public in the development of research agendas.

The models applied to sharing scientific knowledge through science communication consist of either a deficit model or a more democratic model, based on shared knowledge between the public and scientists. The deficit model assumes that the public lacks knowledge about a specific topic, and seeks to fill that gap through direct messaging and dissemination. The more democratic model of science communication, today often referred to as the "science and society paradigm," rejects the application of a deficit model of communication in favour of a more consultative process of communication. This shift in paradigm favours communication models that seek to engage communities at all levels of society in more active and intensive interactions about the implications of scientific research to their lives. This more consultative model of science communication falls closely in line with the European Commission's 2012 *Monitoring Policy and Research Activities on Science in Society in Europe*[4] report, which states that:

> "…societal challenges can only be tackled if society is fully engaged in science, technology and innovation and it should be stressed that the dynamics of public and stakeholder engagement remains an important object for further research and experimentation".

From this perspective, the public is understood as a co-creator of the knowledge that impacts the public domain, with science communication as the tool to facilitate that co-creation. Just as important, however, is the relationship between science communication and policy development. In other words, simply co-creating knowledge through science communication is not enough. That co-created knowledge must, somehow, inform the actions taken by influential decision makers. Sir Richard Stilgoe has aptly summarized the challenge thus[5]:

> "…Engagement is about opening up policy, exposing it to criticism, challenging its assumptions (including those about knowledge and expertise) and forcing governments to make difficult decisions out in the open."

In many parts of the world, science communication is thus understood as something much broader and more meaningful than simply transmitting research findings. Science communication, from this perspective, is a continuous process of horizontal discovery and decision-making in which the concept of "expertise" is expanded to include those at all levels of society.

Modern ICT has opened a wealth of new opportunities to advance science communication, and today, much of science communication takes place in digital space. These shifts in medium simultaneously demand the emergence of a new generation of science communicators that possess digital and artificial intelligence (AI) skills. Achieving the type of deep engagement and

[4] MASIS report (2012). www.masis.eu

[5] Einsiedel E. (2008). Public participation and dialogue. In: Bucchi, M & Trench, B. 2008. Handbook of public communication of science and technology. London: Routledge.

thought required for a process of co-creation also faces its own unique challenges in the digital space. However, parallel to these challenges, opportunities also arise. For instance, digital media allow science communication take place through novel channels that combine the research work of biological and physical scientists, the productions and performances of artists, video games developers, creative technologists, curators, archives, social entrepreneurs, environmental and health policymakers, and citizen scientists. A diverse skill-set including research expertise, digital knowledge, artistic creativity, and political savvy is becoming increasingly important for science communicators globally, but also across Africa as more and more citizens join the internet age.

More governments around the world are considering defining overall standards for what they expect, incentivize, or even require science communication to achieve. Such policies, as previously established in Australia, China, and South Africa,[6] take the form of recommendations, regulations, or even national laws. Typically, these policies lay out some type of process to ensure that research findings are shared from the scientific community to civil society, the media, and a wide spectrum of other stakeholders. China, for instance, has a national law mandating the popularization of science and technology findings, adopted in 2002.[7] Colombia took a less coercive approach, with a national strategy for public engagement in science and technology that lays out mechanisms for various public MDAs to work together.[8] Since 1958, and last amended in 2010, the U.S. National Aeronautics and Space Act, which governs NASA, has included the statement, "provide for the widest practicable and appropriate dissemination of information concerning its activities and the results thereof."[9] Despite the international convergence of science communication policies, none of these countries achieve the ideal articulated in the "science and society" paradigm. National strategies are still predominantly focused on disseminating the research findings of researchers; particularly those in science and technology fields. Using science as the entry point into broader public engagement with and influence over the policy process is still limited in most countries.

Ultimately, the success of science communication in engendering the necessary levels of active engagement between experts and the public comes down to the issue of trust. A new international All European Academies (ALLEA) Working Group on "Truth, Trust and Expertise" (2017), and an ALLEA General Assembly in Sofia (2018) convened by the Bulgarian Academy of Sciences, highlighted the importance of establishing systems to support the trust and trustworthiness of science. The issue of trust in expertise is of pertinent importance in relation to efforts to institute systems for science communication within official governance structures. Mistrust can easily be created and propagated due to the unpredictable nature of the ways in which new knowledge is transmitted through socio-political dissent. New information that challenges particular vested interests can quickly become highly politicized, and new digital media allow a wealth of subtle and overt opportunities to manipulate the original message of the knowledge-creators. In a digitally fragmented world, individuals can pick and choose what types of information to trust, and research

[6] The new science and technology white paper of the South African government. https://www.dst.gov.za/images/2019/FINAL-White-Paper-to-Cabinet_11-March-2019.pdf.

[7] Law of the People's Republic of China on Popularization of Science and Technology http://en.ustc.edu.cn/2011/0510/c5381a49673/pagem.htm

[8] Estrategia nacional de apropiación social de la ciencia, la tecnología y la innovación. Departamento Administrativo de Ciencia, Tecnología e Innovación (COLCIENCIAS). 2010. https://www.colciencias.gov.co/sites/default/files/upload/paginas/estrategianacional-ascti.pdf

[9] Public law 111–314. December 18, 2010 enactment of title 51—national and commercial space programshttps://www.nasa.gov/offices/ogc/about/space_act1.html

has repeatedly shown that they prefer information that confirms their pre-existing assumptions. Breaking through these so-called "filter bubbles" presents immense challenges for science communicators seeking to engage in real dialogue with the public through digital platforms.

Science and Media in Africa

Science journalism is a key factor that contributes to the science culture in a society, and indirectly to the effectiveness of science advice efforts. Science journalists (print, broadcast, online) serve as mediators who help scientists deliver their science to the larger society. In the same way that science advisors are brokers between the scientific community and policymakers, the media can serve as intermediaries between scientists and the general public (and, indirectly, policymakers). In fact, media stories about science and technology may be the only point of access for lay people on science.[10] Though the relationship between science and media is an important one, it is often neglected; with scientists not viewing the media as the best channel for their message, or not even recognizing the need for communicating with the public.

A key factor affecting science journalism in Africa is the low level of science literacy amongst African science journalists. It has been reported that science journalists in Africa may not have adequate knowledge of science needed to report science issues in a critical and meaningful way.[11] Other factors that affect the quality and quantity of science reporting in Africa include the absence of a mandate for science reporting amongst media houses, lack of opportunities for capacity building, as well as mistrust on the part of scientists.

Despite these challenges, there are still some areas of hope. The Conversation[12] is a global platform which links academics and researchers with journalists to develop stories on their research for the consumption of the general public. In 2015, the African branch of this global organization- The Conversation Africa (TCA)- commenced operations and now has two sub regional offices; in Southern and East Africa. Since its inception, TCA has had successes in working with African scientists to get their message across to regional and international audiences. In 2019, the South African government formally joined the global move to support effective science communication and public engagement in science by introducing a new policy based on the findings of a white paper.[13] This new effort involves not just legislative backing for science communication; it also includes plans for funding, as well capacity building for scientists. Also, SciDev.Net, a global online science and technology news outlet, publishes two sub-Saharan African editions-one in English, and the other in French as well as an edition for the Middle East and North Africa (MENA). Additionally, the Nigerian Academy of Science, and the TWAS sub-Saharan Africa Regional Partner (SAREP) have awarded prizes in recognition of excellence in science reporting, and the popularization of science, respectively. The advent of new digital media also presents an opportunity for Africa to boost science communications and a number of such platforms for disseminating and promoting STI now exist in Africa. However, the greatest concern with this is the unchecked proliferation of false information masquerading as science.

Science Diplomacy

[10] Nelkin D. (2001) 'Beyond Risk: Reporting about Genetics in Post-Asilomer Press'. Perspectives in Biology and Medicine, 44 (2). 199–207.

[11] Media coverage of science and technology in Africa. UNESCO 2011.

[12] http://theconversation.com/global

[13] Joubert M. New policy commits South Africa's scientists to public engagement. Are they ready? The Conversation. April 7, 2019.

The concept of "science diplomacy" has emerged in recent years as the forces of globalization have expanded the scope of possibilities for international collaboration, as well as the challenges faced at the global level. Science diplomacy is an extension of the concept of "soft power" whereby a country uses non-coercive means to attract others to align their preferences. The goal of science diplomacy can either be to address a country's national needs by attracting international talent and expertise, resources, and knowledge, or its goal can be finding actions designed to address collective problems, whether cross-border or global in scale. According to the Royal Society and the American Association for the Advancement of Science (AAAS), science diplomacy may be segmented into three types of activities. "Science in diplomacy" uses science to give advice and guide foreign policy; "diplomacy for science" seeks to foster international scientific collaboration; and "science for diplomacy" seeks to leverage scientific collaboration to strengthen international relations.[14]

The desire to implement science diplomacy is not new, although it may not have previously had a distinct name. Joseph Needham— the Head, British Scientific Mission in China, 1942-1946—started the Science and Civilization in China Project between the UK and China. He also actively promoted an International Science Co-operation Service under the United Nations Educational, Scientific and Cultural Organization (UNESCO). Today, it is generally accepted that "good" science is done by "good" scientists and that scientists work for global good, and are capable of supporting international relations and non-traditional coalitions between states, businesses, and NGOs. Over long periods of interaction, scientific exchange can aid in diplomacy and conflict resolution between nations. Also, collaborative research on topical issues can serve as a pathway to other forms of political dialogue.

The International Network for Government Science Advice (INGSA) instituted the Special Interest Division on Science Policy in Diplomacy and External Relations (SPIDER) network. SPIDER is the first of several thematic sub-groups within INGSA that seeks to foster communities of practice around specific important and emerging issues in science diplomacy. Alongside SPIDER's focus on science, technology, and data diplomacy, INGSA also facilitates Special Interest Divisions (SIDs) on parliamentary science advice[15] (this division has already had valuable input into a global research project to determine priorities in parliamentary science advice), and an urban and cities division (since cities are central to so many global priorities and human wellbeing, it is critical that evidence-into-policy mechanisms are effective at all levels of governance). The 2019 INGSA research associates[16] undertook projects across the global South on the challenges limiting the uptake of evidence into policy in their regions. In the face of climate change and resurgent nationalism, science diplomacy will be more important than ever and perhaps, more difficult to achieve in the coming decades.[17]

Science Diplomacy in the African context

14 Gluckman P, Turekian V, Grimes R , and Kishi T. (2017). Science Diplomacy: A Pragmatic Perspective from the Inside. Science & Diplomacy, 6(4), 13.

15 https://www.ingsa.org/divisions/parliamentary/

16 https://www.ingsa.org/grant-programme/2019-research-associates/

17 Lee B. (2009) Managing the interlocking climate and resource challenges. International Affairs 85: 6 (2009) 1101–1116. Blackwell: Oxford.

Since 1967, the African Scientific Institute has taken great strides to advance science diplomacy on the continent by supporting African scientists to publish articles and books, and to attend and present their work at conferences and seminars. However, limited infrastructure for scientific research, and years of neglect from central governments have starved many African countries of the potential benefits of science diplomacy. In the face of limited government interest, private foundations have helped to facilitate both research and the sharing of research results between countries (i.e. science diplomacy) in Africa. For instance, the Carnegie Corporation of New York supports a vast network of researchers across the continent, and frequently brings them together in facilitated meetings to share their research findings and learn from each other. Such non-governmental platforms are thus a major mechanism for science diplomacy in the African context. The primary weakness of relying on private platforms, however, is that the disconnect from government and national priorities limits the effectiveness that science diplomacy can have. For example, Rwandan and Ugandan scientists collaborate on a vast range of topics; but if their respective leaders do not prioritize these channels of communication, then their ability to help relieve geopolitical tensions are constrained.

In addition, the continent's long history of colonialism and research extraction, coupled with challenging physical environments in many countries, has contributed to limited inter-country connections. For instance, whether travelling by air or by road it is notoriously inconvenient and expensive to move from one African country to another. Additionally, the Anglo-, Franco-, and Lusophone linguistic divisions have often made communication and knowledge sharing between different parts of the continent challenging. This historical path dependence has limited one of the greatest possibilities for science diplomacy on the continent: that which takes place between the 54 countries.

In recent time, African science academies play prominent role in the continent's science diplomacy landscape. The academies provide a link to regional and global networks of nationally-based organizations. However, this linkage function is now increasingly facilitated by two organizations, among others:

1. The Network of African Science Academies (NASAC) seeks to amplify "the voice of science" in Africa and across the globe. Presently, the network consists of twenty-nine national members. NASAC continues to champion the creation of new academies where none currently exists, and to strengthen those that do exist through capacity building convenings and grants. The independence of science academies is critical and remains the primary strength of their diplomatic role. NASAC has been fairly active since its inception in 2001 with its programme to organize scientific conferences on critical flagship programmes on women in science, climate change, water, and science education. To support these topics, independent and international advisory groups have been created to guide its policies and operations, providing further avenues for science diplomacy to take place within the continent.

2. INGSA's African Chapter (INGSA-Africa), established in 2016, is another important mechanism for science diplomacy on the continent. The primary objectives of INGSA-Africa are to strengthen evidence informed policy making (EIPM), to raise awareness about the need for science advice discussions at all levels of government, as well as to create a platform for sharing experiences, building capacity and researching practices across

diverse global science advisory systems. INGSA-Africa's main addition to science diplomacy is not by linking scientists per se, but rather by linking professionals seeking to influence their individual countries' science culture through science advice.

In addition to the efforts of NASAC and INGSA- Africa, the World Academy of Sciences (TWAS), in collaboration with the American Association for the Advancement of Science (AAAS), and the Academy of Science of South Africa (ASSAf), has organized several training programmes and courses for scientists and policymakers from across Africa.

Science Advice

Science advice may be described as "the process, structures, and institutions through which governments and decision-makers receive and consider science and technology input to public policy development."[18] Within this definition, it is clear that both science communication and science diplomacy are relevant in science advice, demonstrating the interconnection of the categories laid out in this report.

Science is not static; fields of science are constantly evolving and will continue to have an effect on the way mankind lives on the earth. Employing the scientific method, however, allows us to update our understanding of social and physical phenomena based on the best available evidence. The practice of science advice, therefore, is the effort to ensure that public policy (whether developed by governments, businesses, or NGOs), aligns with the best available evidence.

To achieve this, science advice strives to link scientists and policymakers. Science advice is not simply about delivering a packaged and discrete message, but rather about slowly building and regulating a system that generates advice and brings that advice to the attention of policymakers. As the world faces more and more challenges- including energy, emerging and re-emerging diseases, climate change, food security, gender inequity, and increasing urbanization-, science advice is an important tool for stakeholders grappling with these challenges.

According to Grimm et al,[19] there are three different models for interactions between scientists and policymakers in the science-policy interface; the technocratic model, the decisionist model, and the pragmatic model. In the technocratic model, scientific evidence directs the decision-making process; policies are based on evidence from scientists. This model is hardly the case in reality, given the various co-factors that contribute to the policymaking process, and the complexity of the policymaking process itself. This viewpoint places science outside of society where it transcends the messy political compromises that often characterize the policymaking process.[20] In some specific cases, such as policy about complex technical questions, this model may approximate reality. In the majority of cases, however, the technocratic model does not take into consideration the other factors that influence policymaking (i.e. public opinion, political ideology, electoral

[18] Quirion R, Carty A, Dufour P, and Jabr R. (2016). Reflections on science advisory systems in Canada. Palgrave Communications. DOI: 10.1057/palcomms.

[19] Grimm S, Gensch M, Hauf J, Prenze J, Rehani N, Senz S, and Vogel O. (2018). The Interface between Research and Policy-Making in South Africa: Exploring the institutional framework and practice of an uneasy relationship. Discussion Paper / Deutsches Institut für Entwicklungspolitik. DOI:10.23661/dp19.2018

[20] Weinberg A. (1974). Science and Trans-Science. Minerva. 10(2): 209-222.

contract, fiscal objectives and obligations). Policymaking involves not just making the right decision on paper, but making the right decision that does not alienate other viewpoints and interests. In the decisionist model, evidence is provided to policymakers, who decide how that evidence should best be used in the decision-making process. In this model, evidence informs policymaking rather than policy, as it is not the sole consideration for making decisions or choosing between alternatives. Finally, the pragmatic model offers a balance in the relationship between science and policy. In this model, scientists and advisors can proactively share recommendations with policymakers, who in turn can request for input from scientists at any stage of the policymaking process in a dynamic and on-going relationship.

The Science Advisory Process

The process of science advice typically involves the following steps[21]:

1. **Framing the question:** This involves setting a task/assignment for science advice. Depending on the problem and issue at hand, framing the question can be a straightforward request, with a primary question put forward to experts. However, in other cases, this may be more complicated, and a multi-stakeholder debate may be required to identify the questions that require answers.[22] In such instances, the inquiry goes beyond the primary question and looks into other issues around the central issues.

2. **Selecting the advisors/experts:** Once the right questions have been framed; the next step is to select the right expertise to provide the evidence to address the questions. The selected advisors should have the required expertise to address the questions, and more importantly, have the capacity to pull from evidence provided by other experts.

3. **Producing the advice:** Advisors/experts then gather available evidence and synthesize this into advice. Factors considered in synthesizing the evidence include the need to communicate areas of differences in opinion, manage uncertainties in scientific knowledge, and ensure the quality of the advice.

4. **Communicating the advice:** Once synthesized, the advice is then communicated in a clear and timely manner to relevant stakeholders, including policymakers.

5. **Uptake and utilization of the advice**

Established Structures for Science Advice

[21] Arimoto T, SatoY, and Matsuo K. Scientific Advice Science, Technology, and Policy Making in the Twenty-First Century with a special contribution by Hiroyuki Yoshikawa. University of Tokyo Press, 2016.

[22] OECD (2015), "Scientific Advice for Policy Making: The Role and Responsibility of Expert Bodies and Individual Scientists", OECD Science, Technology and Industry Policy Papers, No. 21, OECD Publishing, Paris. http://dx.doi.org/10.1787/5js33l1jcpwb-en

The four internationally established structures for science advice are as follows:[23]

Advisory councils: Several countries (including Japan, the United States, and the United Kingdom) have high-level councils to guide science policy. The memberships of such councils are usually multi-sectoral with representatives from academia, the private sector, and civil society.

Advisory committees: Policymakers may also turn to specialized committees, made up of individuals with relevant expertise, to provide advice on specific issues of concern. Such advisory committees maybe within government, or function outside of it.

National academies of science, learned societies, and networks: Over the years, national academies of science in developed parts of the world are reliable sources of scientific advice. In Africa, the national academies are increasingly becoming important sources of science advice. Additionally, coalitions of national academies such as NASAC, the International Science Council (ISC), and the InterAcademy Partnership (IAP), are also involved in EIDM at the regional and international levels.

Chief Scientific Advisers (CSAs): The concept of the CSA is one that has gained increasing popularity in recent times though not in Africa. A CSA is an individual, usually a scientist, appointed by a government to provide advice on issues that border on science and technology. A scientific adviser typically serves as an intermediary between the scientific community and other stakeholders including government, the media, as well as the general public. Throughout history, experts have been called on to give advice to governments as the need arises, but in recent years the concept of establishing an office of a scientific advisor has gained more popularity. The main role of a science advisor is to link the scientific community with policymakers. An advisor cannot be the conduit of all knowledge about a particular field, even if he/she is an expert in that field.

The United Kingdom has had a CSA since 1964[24], whose role is to advise the Prime Minister and the Cabinet. In the United States, the first science advisor to the President was appointed in 1946, and the position has had 28 occupants till date. The Scientific Advisor also serves as the Director of the Office of Science Technology Policy (OSTP)[25]. More recently, other countries have embraced the CSA concept, including Canada, Australia, New Zealand, Cuba, Czech Republic, India, Ireland, and Malaysia. There has also been an opportunity for engagement between CSAs from various countries. In 2014, the European Science Advisers Forum was started for CSAs from across Europe.

Though the CSA model has not been firmly established in Africa, there was an attempt which came close in Nigeria. In 2001, under President Olusegun Obasanjo's administration, the International Honorary Presidential Advisory Council on Science and Technology was set up- chair by Professor Mohammed Hassan, with 6 other members. This Committee was tasked with advising

[23] Wilsdon J, Doubleday R, and Hynard J. Future directions for scientific advice in Europe. University of Cambridge Press, 2015.

[24] Doubleday R, and Wilsdon J. (2012). Science policy: Beyond the great and good. Nature. 485:301-302.

[25] Sato Y, Koi H, and Arimoto T. (2014). Building the foundations for scientific advice in the international context. Science and Diplomacy. 3(3).

the then President on the development of science for the societal benefits, the use of science for regional cooperation, as well as STI capacity development initiatives that could be implemented by the Federal Ministry of Science and Technology (FMST)[27]. This council was operational for almost seven year; however, it was not sustained likely due to the absence of supporting legislature.

International Structures for Science Advice

At the global level, governmental structures for science advice include the advisory arms of regional and international consortia such as the European Union (EU), Scientific Advice Mechanism (SAM) and the Scientific Advisory Board of the United Nations Secretary-General (UNSAB). The EU-SAM comprises a group of 7 scientific advisors which provide advice to the College of EU Commissioners, and an advisory consortium of European academy networks called the Scientific Advice to Policy by European Academies (SAPEA), comprising Academia Europaea, All European Academies (ALLEA), European Academies Science Advisory Council (EASAC), European Council of Academies of Applied Science Technologies and Engineering (EURO-CASE), and the Federation of European Academies of Medicine (FEMA). This cluster works with SAPEA, with support from a secretariat, to provide science advice to the EU Commission[28].

The UNSAB was established in 2014 and has 26 independent scientists in its membership. The UNSAB's mandate is to provide recommendations that would "enlighten the work and decisions of the United Nations." One of the functions of the UNSAB is to provide advice on STI for sustainable development, and to strengthen linkages between science and policy.[29] Additionally, the UN also has bodies such as the Intergovernmental Panel on Climate Change (IPCC) established in 1988, and the Intergovernmental Science-policy Platform on Biodiversity and Ecosystem Services (IPBES) established in 2012 to address climate change and biodiversity, respectively, as well as the Integrated Research on Disaster Risk (IRDR). Also, in 2014, the INGSA was formed after a conference on science advice to governments, to serve as a platform for collaboration amongst relevant stakeholders to strengthen EIPM globally.

Among the non-governmental institutions for science advice, an influential category is the national science academies. Since the founding of the first science academy in 1660, academies all over the world have emerged as voices for science in their respective countries. In addition to being science advocates on the national level, there are also quite a number of regional and international coalitions of academies and associations that work to promote science for development. Examples are EASAC, NASAC, the InterAcademy Partnership (IAP), the International Science Council, and the Inter-American network of Academies of Science (IANAS). Other non-governmental bodies that provide science advice include think tanks, professional associations, individual scientists, as well as industries/business groups. The various structures for science advice have their advantages and disadvantages. Generally, scientific advisers, national academies, international bodies, government committees, and independent scientists tend to be more likely to achieve desirable outcomes.[30]

[26] Abbott A. (2001). Nigeria takes the initiative in African science. Nature 412, 668.
[27] UNESCO Science Report 2010. The Current Status of Science around the World.

Structures for Science Advice in Africa

In Africa, regional structures for science advice are particularly relevant. The AU, for instance, has played a major role in promoting evidence-informed policy at the regional level. For example, The African Union Commission (AUC) instituted the African Ministerial Conference on Science and Technology (AMCOST) to foster STI collaboration and strategic planning at the continental level. A major output of the first edition of AMCOST held in 2003, was the Consolidated Plan of Action (CPA). The CPA was a tool to ensure proper implementation of the AU's policy decisions on science, technology and innovation (STI).

In 2013, the AU created the African Observatory in Science Technology and Innovation (AOSTI). The AOSTI is a regional repository for STI data and policy analysis. Some of the AOSTI's key functions include championing evidence-based science, technology and innovation policymaking, Building capacity for STI policymaking amongst member states, monitoring and evaluating AU STI policy implementation, providing decision-makers in AU member states current data on global scientific and technological trends, and strengthening national and regional capacities for technology foresight and prospecting.

Based on the results of a review of the performance evaluation of the CPA, and developmental trends in the region, STISA-2024 became the successor to the CPA 2014. The goal of STISA-2024 is to tackle the targets of the AU's Agenda 2063, and connect the successes realized under the CPA to continued STI advancement in Africa. The Plan (STISA) has 6 priority areas (Figure 2), which encapsulate a vision for the future of Africa. The implementation of the STISA is set to be carried out in five phases, with a final evaluation of the strategy billed for 2024[31].

In 2014, as a further push for regional collaboration for STI, the member states of the AU adopted a statute to establish the African Scientific Research and Innovation Council (ASRIC). ASRIC was launched in 2018 to serve as a regional technical body to contribute to the realization of AU's developmental plans including STISA-2024. ASRIC aims to bring together key stakeholders including academies, scientists, CSOs, and the private sector for Africa's socio-economic advancement through STI. Specifically, some of ASRIC key functions are to marshal both expertise and resources to support scientific development on the continent, serve as a focal point for science: innovation, and policy; as well as foster collaborations in STI both regionally, and internationally.[32]

[30] Hutchings J, and Stenseth N. (2016). Communication of Science Advice to Government. Trends in Ecology & Evolution, 31 (1): 7

[31] "On the Wings of Innovation", the Science, Technology and Innovation Strategy for Africa (STISA-2024). Statutes of the Africa Research and Innovation Council. January 2016.

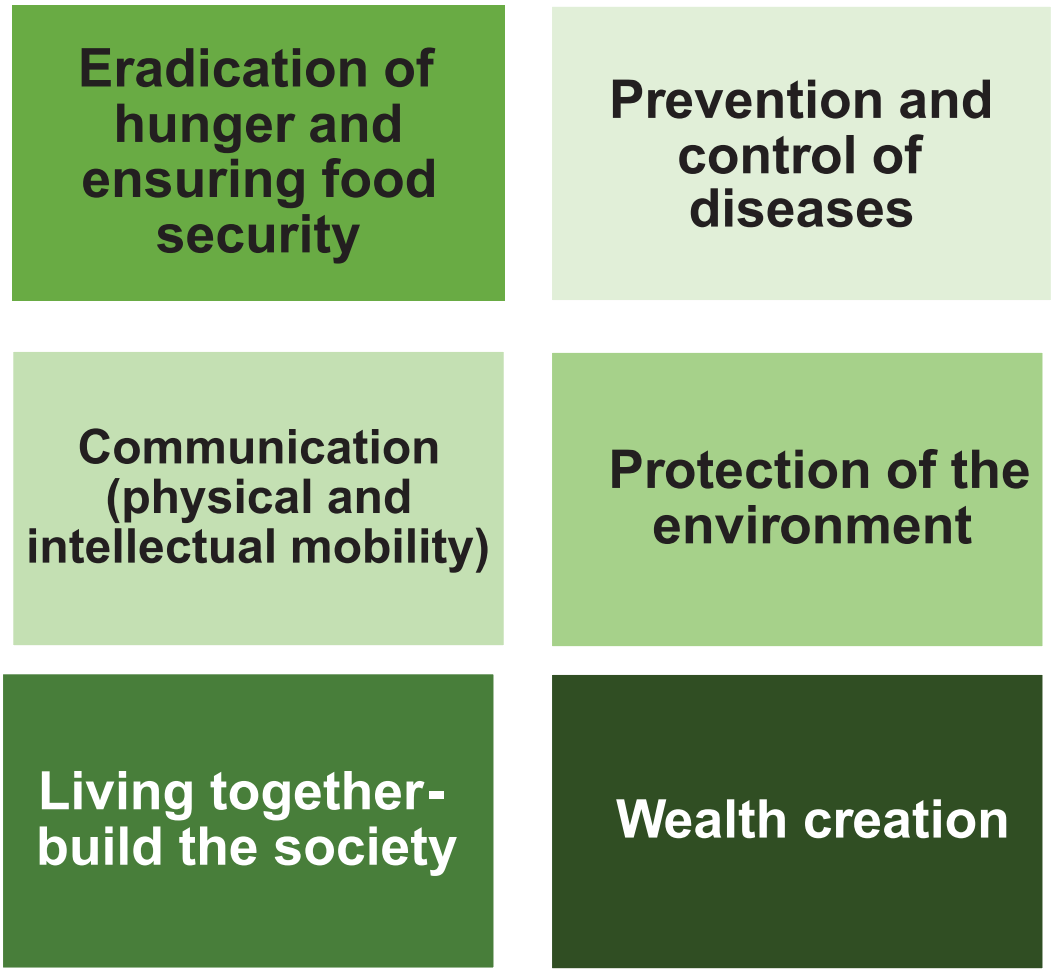

Figure2: STISA 2024 Priority Areas

Decision makers utilize a mixture of structures for evidence to guide decision making; from institutionalized formal channels, to proactive scientific bodies. None of the established structures for science advice, whether national, regional, or global, is flawless, and dependence on some form of amalgamation of advisory channels is the norm in most evidence-policy landscapes. Notwithstanding the range of available advisory structures, there are a number of similarities in terms of challenges in the systems. These include guarding the independence of advice; ensuring its acceptance; building trust with policymakers, sustaining transparency and accountability, and maintaining quality assurance of evidence.

Science advice plays an important role in policy and decision-making in many countries across the globe,[33] and the scientific perspective offers an impartial appraisal of the implications of policy interventions[34]. The benefits of science advice include the provision of evidence-based support for policy positions, strengthening of public trust that government policies are for societal good, as well as increase in confidence of policymakers in the objectivity of scientific advice.

[33] Doubleday R, and Wilsdon J (eds). (2013) Future directions for scientific advice in Whitehall. Alliance for Useful Evidence & Cambridge Centre for Science and Policy: London.

[34] Doubleday R, and Wilsdon J. (2012) Science policy: beyond the great and the good. Nature 485, 301–302.

The Evidence-Policy Interface in Africa

In recent years, Africa has experienced a boom in the quantity of its research output.[35] However, there are still weak links between research and policy making. There are many factors that contribute to this gap. A key challenge is the way knowledge repositories and systems function on the continent. Hubs for research endeavours particularly Higher Education Institutions (HEIs) are often out of touch with the rest of the society which should benefit from the dividends of their research[36]. Other impediments to research uptake include the time intensive nature of research, limited needs-driven research, lack of capacity to analyze policy recommendations on the part of policy makers, as well as poor research funding.[37]

Beginning in 2016, the Africa Evidence Network (AEN) has produced a series of maps which provide summaries of the Evidence-Informed Decision Making (EIDM) landscape of several countries in Africa, including Cameroon, Ethiopia, Ghana, Kenya, Malawi, Nigeria, Senegal, South Africa, Tanzania, Nigeria, Zambia, and Senegal. The AEN is a multi-stakeholder community of researchers, policymakers, and other relevant stakeholders in the evidence-policy interface. In addition, the AEN facilitates collaborations between stakeholders in the production and utilization of evidence for policy in Africa. These summaries produced by the AEN describe the key players in the evidence-policy interface in these countries, their roles, and the interplay between them.

South Africa

According to a review of the EIDM landscape in South Africa,[38] the main producers of evidence are universities, consultants, and independent research organizations. Between these producers of evidence and the consumers, there are two main types of brokers which increase the use of evidence for policy making; statutory bodies- including the Medical Research Council (MRC), the Centre for Scientific and Industrial Research (CSIR), the Human Sciences Research Council (HSRC), the Agricultural Research Council (ARC), and the National Research Foundation (NRF); and evidence-use initiatives/organizations- Centres for Learning on Evaluation and Results (CLEAR), Development Research Uptake in sub-Saharan Africa (DRUSSA), the Evidence-Informed Policy Network (EVIPNet), the Centre for Evidence-Based Health Care (CEBH), the Southern African Social Policy Research Institute (SASPRI), the Build Capacity to Use Research Evidence (BCURE) programmes, as well as the Department for Performance Monitoring and Evaluation (DPME).

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35 World Bank. 2014. A decade of development in sub-Saharan African science, technology, engineering and mathematics research (English). Washington, DC: World Bank Group.

36 Barugahara I. and Harber T. (2017) 'Complexities of linking researchers with policymakers in Africa'. Research for All, 1 (2): 375–86. DOI https://doi.org/10.18546/RFA.01.2.13

37 Fourie W. Six barriers that make it difficult for African states to use research for policy. The Conversation. November, 2017.

38 Choge I, Omondi O, Erasmus Y, Zaranyika H, Langer L, and Stewart R. (2014). Landscape review: An overview of role players facilitating evidence-informed decision-making in South Africa. Johannesburg: UJ-BCURE, Centre for Anthropological Research, University of Johannesburg

Zimbabwe

In the AEN evidence map for Zimbabwe,[39] by contrast, the main players in the country's EIDM landscape that generate evidence are government research institutions who provide evidence to government MDAs, universities, research regulatory bodies, multilateral and bilateral institutions, as well as CSOs (Figure 3). Identified evidence brokers in Zimbabwe include Zimbabwe Evidence Informed Policy Network (ZeipNET) and Zimbasa.

Uganda

The overview of Uganda's EIDM landscape[40] shows three important groups of stakeholders: those who commission research (government MDAs, CSOs, and private institutions), the producers (researchers), and the users (policymakers, research funders, the general public, and the media). This review highlighted limited knowledge in data use and limited appreciation of the importance of evidence in the policymaking process in Uganda. The producers of research in Uganda are typically highly skilled and educated, while the users and commissioners may not have the technical expertise to use the evidence that is generated, or to ask the right research questions that will generate useful evidence. The review of EIDM in Uganda called for better engagement of policymakers through dialogue, advocacy, and capacity building to promote the benefits of EIDM.

Kenya

Key players in Kenya's evidence-policy interface include government ministries and departments-primarily the Monitoring and Evaluation department (MED), consultants, NGOs, universities, research think tanks, and institutes[41] Capacity for data management, analysis, and use are inconsistent across various ministries, and there is "little or no analysis, dissemination or use of the data for policy decisions at the local levels due to the scarcity of resources for monitoring and evaluation." Recommendations made to strengthen Kenya's EIDM culture include capacity strengthening for policymakers at the national and county levels, the need for EIDM champions from the political class, improved engagement, and increased funding for research, monitoring, and evaluation.

Ethiopia

In Ethiopia[42], evidence for policy making is generated by universities, the Federal Policy Studies and Research Centre (PSRC), and research bodies, as well as international NGOs and funders (Figure 4). The PSRC manages the utilization of evidence among policymakers. Ethiopia's PSRC and the research units at the government agencies serve as the major evidence brokers by connecting available evidence users to guide policymaking (Figure 4).

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39 Munatsi R. (2016). Zimbabwe EIDM evidence landscape map. AEN EIDM Landscape Mapping Series No 17. Johannesburg: Africa Evidence Network (AEN) https://www.africaevidencenetwork.org/resources/landscape-maps/

40 Bagyendera J. (2016). Evidence-informed decision-making landscape for Uganda. AEN EIDM Landscape Mapping Series No 1. Johannesburg: Africa Evidence Network (AEN) https://www.africaevidencenetwork.org/resources/landscape-maps/

41 Mutua J. (2016). Evidence-informed decision-making (EIDM) landscape map for Kenya. AEN EIDM Landscape Mapping Series No 18. Johannesburg: Africa Evidence Network (AEN) https://www.africaevidencenetwork.org/resources/landscape-maps/

42 Hailemichael T. (2016). An overview of role players toward evidence-informed policydecision-makiing in Ethiopia: A landscape review. AEN EIDM Landscape Mapping Series No 6. Johannesburg: Africa Evidence Network (AEN) http://www.africaevidencenetwork.org/resources/landscape-maps/

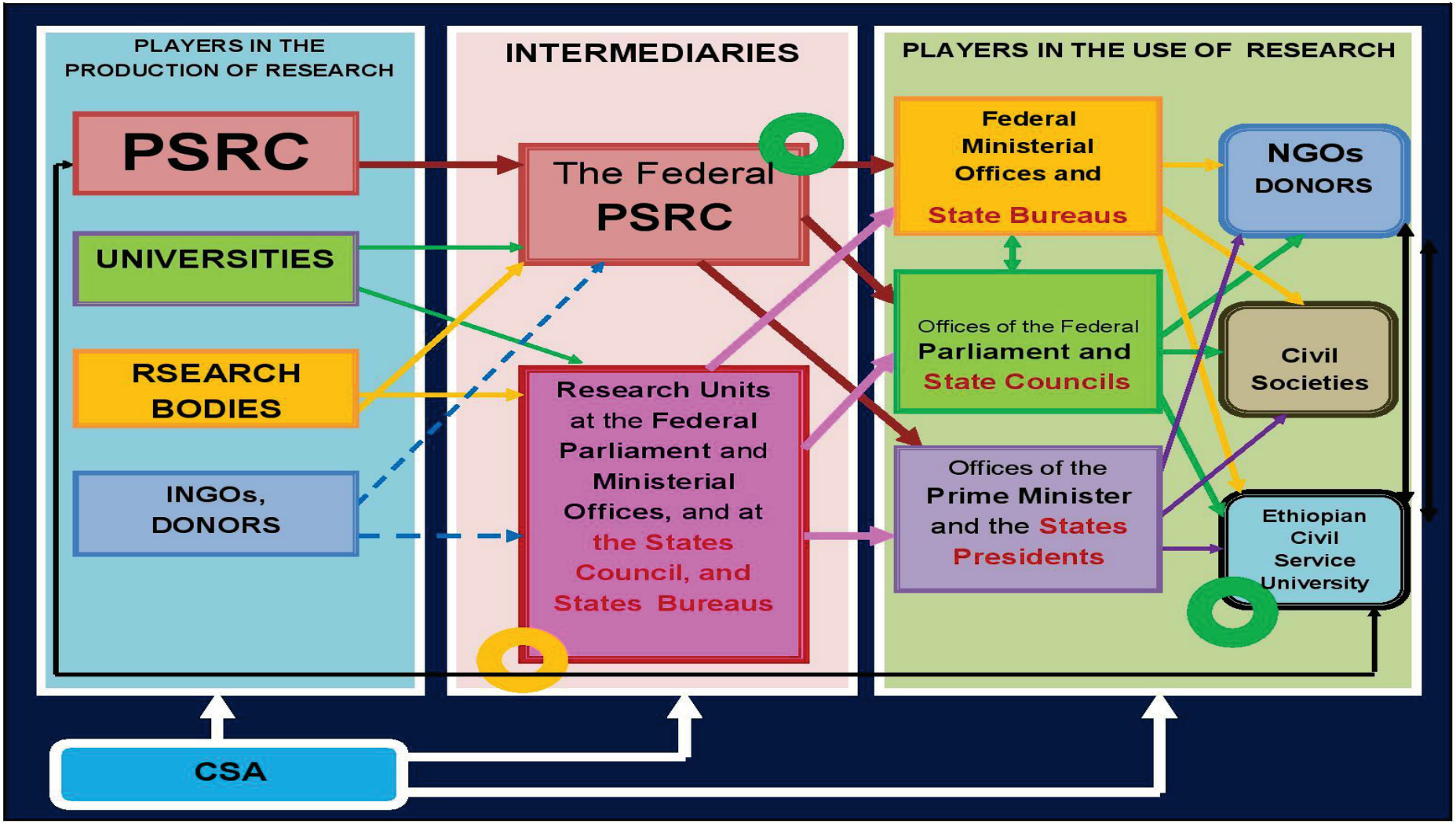

Figure3: Key stakeholders in EIDM in Ethiopia

Cameroon

In Cameroon, the stakeholders in the evidence-policy interface are government ministries—primarily the Ministry of Scientific Research and Innovation (MINRESI), government research institutes, universities, NGOs, and international bodies.[43] There appears to be no distinction between research producers and users; the main stakeholders create, as well as use research evidence. The review of the EIDM landscape in Cameroon also reported low levels of cooperation between relevant stakeholders: between universities and research institutes, between government ministries involved in research, and between policymakers and academia. The critical recommendation from this review was the need for synergy between stakeholders in the EIDM landscape (Figure 5).

Egypt

In 2014, Egypt launched a scientific advisory council to the president. The council is made up of 15 Egyptian scientists with expertise in diverse disciplines such as education, energy, information technology, agriculture, and health. The council supplies evidence for policy to the President, provides proposals for national projects and evaluates the progress of existing ones, determines the scientific validity of proposed initiatives for addressing challenges facing the country; and informs the government of state of the art and emerging technologies. The Council may form committees of technical experts which may include non-members to study issues of national significance. On occasion, the Council can invite experts and policymakers to participate in such discussions. The Council submits a report to the President every six months detailing policy recommendations. In addition to the newly established presidential council, most Egyptian ministers appoint consultants from universities and research centers to provide technical advice when needed.

As evidenced by the AEN's mapping exercise, there are large differences in the structure and capacity of the EIDM landscape in different African countries. Consequently, strategies to improve evidence uptake will likely differ by country, and will require leveraging the unique opportunities available in each context. A major gap in the evidence--policy interface that was found to be common across countries is the general lack of institutionalized connections between independent research organizations and the government. Most research producers work in silos with limited interactions with other stakeholders. Other common challenges include the limited capacity to obtain, examine, and disseminate data for decision making, and a lack of platforms to link researchers directly with policymakers.

[43] Ngang E. (2016). General overview of the research and evidence-informed decision-making landscape for Cameroon. AEN EIDM Landscape Mapping Series No 21. Johannesburg: Africa Evidence Network (AEN) https://www.africaevidencenetwork.org/resources/landscape-maps/

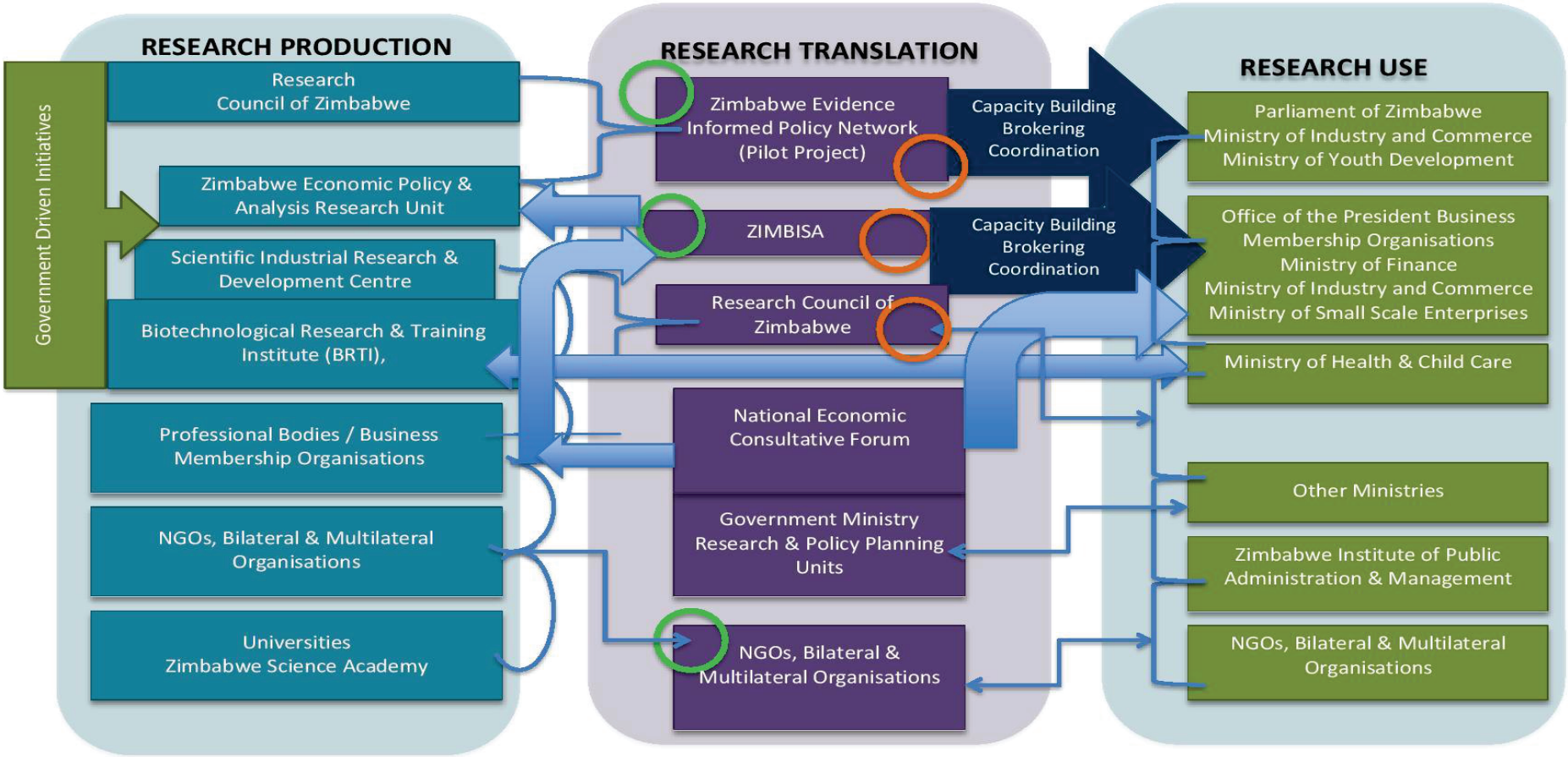

Figure4: Zimbabwe EIDM evidence landscape map

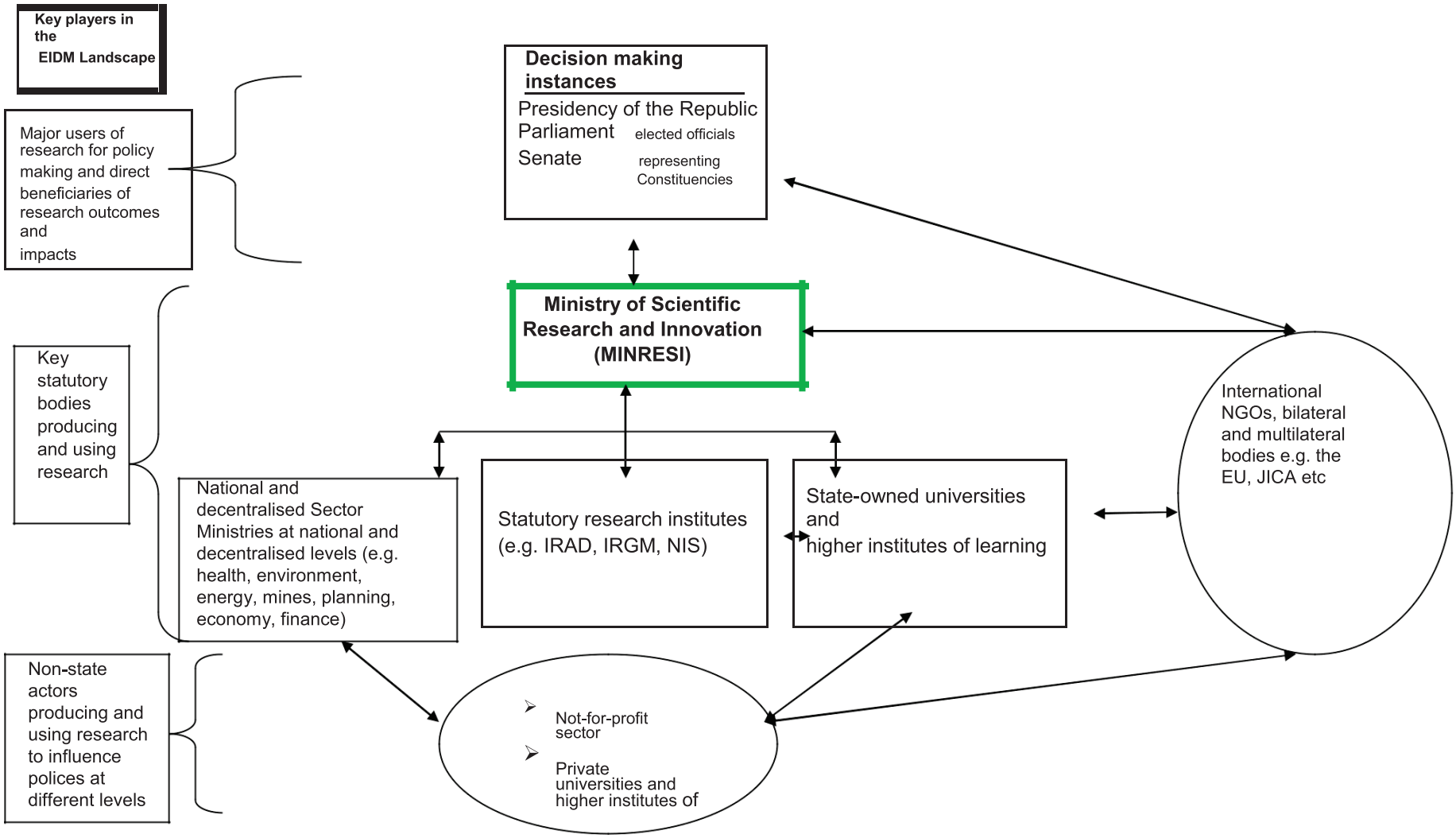

Figure5: Players in the EIDM Landscape in Cameroon

Think Tanks

Think tanks are groups of experts that provide advice on specific issues, and they play a significant role in the science advisory landscape in Africa. There are several of such groups that function in the science-policy interface on the continent, and this section highlights a few.

The African Centre for Parliamentary Affairs (ACEPA) is a regional think tank based in Ghana. ACEPA's focus is building the capacity of African parliaments and governments, and the Centre has worked with policymakers in 20 African countries in this regard. One of ACEPA's key programmes is strengthening the capacity of African policymakers in EIDM. Under this initiative, ACEPA has worked to support the capacity of research departments in the parliaments of Ghana, Uganda, and Zimbabwe. ACEPA also fosters collaboration amongst the research units of these parliaments, as well as between parliamentarians in the three countries[44].

The African Centre for Technology Studies (ACTS) with the head office in Nairobi, Kenya, is a development research think tank centered on facilitating the use of STI to achieve sustainable development in Africa. One of the ways that ACTS strives towards this is by providing advisory services on the application of science for sustainable development in Africa. ACTS activities are continent-wide. ACTS has provided guidance on issues such as environmental impact assessment standards, agriculture, bio-diplomacy, biotechnology, biosafety, as well as climate change adaptation and mitigation.

Another regional think tank that provides science advice is the African Institute for Development Policy (AFIDEP). AFIDEP employs a unique approach to enable evidence for policy by putting policymakers at the centre of the advisory process. Some areas that AFIDEP is currently working on include the drivers of antibiotic resistance in eastern Africa, multi-disciplinary research to produce scientific knowledge and implementable solutions for issues related to lung health in Africa, as well as collaborative research on sepsis in Africa.

Science Academies in Africa

The Network of African Science Academies (NASAC)

NASAC was established in 2001 with support from the AAS, and the InterAcademy Partnership (IAP). The Network began with 9 founding members- the AAS, and the national academies of Cameroon, Ghana, Kenya, Madagascar, Nigeria, Senegal, South Africa, and Uganda. Since then, 19 other academies across Africa (Figure 6) have become members of this network (Table 1). NASAC's key objectives are to serve as a platform for African science academies to come together with a collective voice on problems of scientific significance common to their home countries and provide evidence-based advice to relevant stakeholders. To achieve this, NASAC routinely organizes opportunities for engagement and collaboration between its member academies - conferences, seminars, workshops, expert groups, participation in international partnerships for

[44] http://acepa-africa.org/programs/Building-Capacity-of-Parliaments-for-EIPM

development, and issuing joint statements on relevant topics. One of the network's strategic priorities is to support the establishment of new national science academies in Africa, as well as to strengthen the capacity of established academies. NASAC has also developed a framework for the establishment and strengthening of science academies in Africa. Since its inception, NASAC has implemented its strategic actions in three phases. The first phase was focused on strengthening the NASAC Secretariat, awareness creation on the importance of academies, and increasing its membership. The second (still ongoing) phase is focusing on capacity building for member academies and ensuring sustainability. The third and current phase seeks to assess the progress made so far, increase the visibility of science academies as science advisors, and sustainability.[45]

Figure 6: Distribution of NASAC National Members

46 Kado J. Seventeen Years of Networking for Science Academies. A presentation at the Fourteenth Annual Meeting of African Science Academies (AMASA-14), Benin Republic, 2018.

*Countries with national science academies appear in blue.

NASAC is the African arm network of the global network of science academies, the IAP. It participates in many IAP initiatives, and has worked with other academies outside Africa on specific initiatives. These partner academies include the German Academy of Sciences Leopoldina, the US National Academies, the Royal Netherlands Academy of Arts and Sciences (KNAW), and EASAC. NASAC also partners with the ISC Regional Office for Africa, and the Swedish development agency (SIDA) to strengthen research capacity- by fostering collaborative research on sustainable development on the African continent[46] - linked to Agenda 2030.

NASAC offers a platform for its member academies to jointly issue policy advice on topics of regional significance. Some NASAC reports with direct policy recommendations are as follows[47]:

- The Grand Challenge of Water in Africa – Recommendations to Policymakers-offers policy recommendations to African government for the attainment of the Africa Water Vision 2025
- Harnessing Modern Agricultural Biotechnology for Africa's Economic Development - Recommendations to Policymakers-makes the case for the acceptance of agricultural biotechnology in Africa
- Climate Change Adaptation and Resilience in Africa – Recommendations to Policymakers-focuses on the need for climate change adaptation and resilience in Africa
- Changing Disease Patterns in Africa – Recommendations to Policymakers- provides frameworks for integrated approaches in health development

The African Academy of Sciences (AAS)

The African Academy of Sciences (AAS) is a pan-African continental-wide science organization, with a mandate to recognize distinguished African scientists, provide advisory and think tank functions for shaping Africa's STI strategies and policies and implement key STI programs addressing Africa's developmental challenges. AAS serves in an advisory capacity, generating evidence for science policies in Africa, in addition to executing programmes for science development. A major programme of the Academy, the Alliance for Accelerating Excellence in Science in Africa (AESA) instituted in partnership with the African Union Development Agency (formerly NEPAD), provides funding and agenda setting to support African scientists. AESA's mission is to create enabling environment for Africa scientists, encourage scientific distinction and research leadership, as well as support innovation for the good of the general society.[48] The AAS has been successful in contributing to the development of science in Africa[49].

The World Academy of Sciences

The World Academy of Sciences for the advancement of science in developing countries (TWAS) strives to promote sustainable development through STI developing countries. TWAS is a global

[46] http://nasaconline.org/index.php/2016/04/26/programmes/
[47] http://nasaconline.org/index.php/category/on-the-spotlight/
[48] https://www.aasciences.ac.ke
[49] https://www.aasciences.ac.ke/impact

science academy based in Trieste, Italy. Through three decades, TWAS has remained consistent in its mission to spread science to the society by supporting scientific excellence, capacity development for young scientists, and fostering collaboration between developing and developed parts of the world[50]. TWAS has five regional partners that coordinate its activities globally. The Academy of Science of South Africa (ASSAf) hosts the sub-Saharan Africa Regional Partner,, The Brazilian Academy of Sciences in Rio de Janeiro hosts the Latin America and the Caribbean Regional Partner (LACREP), the Jawaharlal Nehru Center for Advanced Scientific Research in Bangalore, India hosts the Central and South Asia Regional Partner (CASAREP), and the Chinese Academy of Sciences in Beijing, China hosts the East and South-East Asia and the Pacific Regional Partner (SAPREP).

Table 1: Member Academies of NASAC

Countries	**National Science Academies**
Algeria	Académie Algérienne des Sciences et Technologies (AAST)
Benin Republic	Académie Nationale des Sciences, Arts et Lettres du Bénin (ANSALB)
Bostwana	Botswana Academy of Sciences (BAS)
Burkina Faso	Académie Nationale des Sciences du Burkina (ANSB)
Burundi	Burundi Academy of Science and Technology
Cameroon	Cameroon Academy of Sciences (CAS)
Cote d'Ivoire	National Academy for Cote d'Ivoire
Egypt T	he Academy of Scientific Research and Technology (ASRT)
Ethiopia	Ethiopian Academy of Science (EAS)
Ghana	Ghana Academy of Arts and Sciences (GAAS)
Kenya	Kenya National Academy of Sciences (KNAS)
Madagascar	Madagascar's National Academy of Arts, Letters and Sciences
Mauritius	Mauritius Academy of Science and Technology (MAST)
Morocco	Hassan II Academy of Science and Technology in Morocco
Mozambique	Academy of Sciences of Mozambique (ASM)
Nigeria	The Nigerian Academy of Science (NAS)
Republic of Congo	Académie Nationale des Sciences et Technologies du Congo (ANSTC)
Rwanda	Rwanda Academy of Sciences
Senegal	Académie des Sciences et Techniques du Sénégal (ANSTS)
South Africa	Academy of Science of South Africa (ASSAf)
Sudan	Sudanese National Academy of Science (SNAS)
Tanzania	Tanzania Academy of Sciences (TAS)
Togo	Académie Nationale Des Sciences, Arts Et Lettres Du Togo (ANSALT)
Tunisia	The Tunisian Academy of Sciences, Letters and Arts
Uganda	Uganda National Academy of Sciences (UNAS)
Zambia	Zambia Academy of Sciences (ZaAS)
Zimbabwe	Zimbabwe Academy of Sciences (ZAS)
Regional	African Academy of Sciences (AAS)

National Science Academies in Africa

Science academies have existed in Africa for several years. The first national academy of science in Africa- Madagascar's National Academy of Arts Letters and Sciences (AcNALS) - was established in 1902, and since then scientists in other African countries have established national academies. For a while, African academies functioned primarily in an honorific role, by recognizing deserving scientists in their home countries and adding these scientists to their membership. The service provision dimension (science advice) of academies was somewhat relegated to the background.

A change in this dynamic was largely influenced by the inception of the African Science Academies Development Initiative (ASADI) Project in 2004. This ten-year project was supported by the Bill and Melinda Gates Foundation (BMGF), and implemented by the United States National Academies of Science (USNAS). The overall goal of the project was to strengthen the advisory role of science academies in Africa. Some specific objectives were to cultivate partnerships with African academies of science, foster collaboration between science academies, strengthen the capacity of academies to provide evidence for policymaking, build the capacity of academies' staff, organize fora for convening stakeholder engagement on EIDM, and to supplement advisory efforts on issues critical to Africa's development.

The project worked with the Ugandan National Academy of Sciences (UNAS), the Nigerian Academy of Science (NAS), as well as ASSAf as primary partner academies. The project also provided support at secondary partner level for the academies of Ghana, Cameroon, Ethiopia, Senegal, Kenya, and the African Academy of Science (AAS)[51]. During the span of the project, academies developed a close working relationship with international partners, working with them to organize various activities under the project. Over 100 staff and representatives of academies were trained in various areas such as financial management, and strategy development. Specifically, 20 workshops on pressing issues facing Africa were convened, 18 policy advisory activities were conducted, 29 study reports were produced, and infrastructure and materials upgrade was conducted in 5 academies[52].

Furthermore, it was during the ASADI project that the Annual Meeting of African Science Academies (AMASA) was instituted (known then as the ASADI conference) to foster collaboration among academies on the continent, and to aggregate a collective voice on challenges facing the continent. Reports of these annual meeting were also prepared, and disseminated to relevant stakeholders. Themes of AMASA conferences have included policy for development, health, food security, energy, climate change, and biotechnology. The AMASA conferences remain one of the lasting legacies of the ASADI initiative. Every year science academies on the continent still meet; hosted by one of the academies, and lend their collective voice to proffering recommendations for Africa's development.

Over the years, several African governments have commissioned their respective national academies to carry out specific projects, and the academies have made significant strides to strengthen their advisory function. Some national science academies have cultivated stronger ties

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[51] The African Science Academy Development Initiative African Science Academies as Partners in the Policy Development Process. 2008 Annual Meeting Report Brief.

[52] Enhancing the Capacity of African Science Academies: the final evaluation of ASADI. InterAcademy Council 2015.

with their governments. Examples of this are the academies of Morocco, South Africa, and Senegal. In these cases, the relationship is strengthened by the statutory support for the academies.

Alongside the national science academies, there are now also 14 national young academies in Africa. The young academies are an organization of early career scientists, usually affiliated with the senior national academy of their respective countries. The home countries of the existing African young academies are Benin, Burundi, Cameroon, Ethiopia, Ghana, Kenya, Mauritius, Morocco, Nigeria, Senegal, South Africa, Sudan, Uganda, and Zimbabwe. The young academies are affiliated with the senior academies in their countries and with the Global Young Academy.

In recent years, African national academies are becoming increasingly important in the continent's advisory landscape. To better perform its mandate, ASRIC has formed strong collaborations with NASAC and several national academies. Similarly, the United Nations Technology Bank for least developed countries (LCDs)- inaugurated in 2018[53]- is consulting with NASAC, established national academies, as well as representatives of the LCDs to create academies in African countries where they do not exist. This is based on the Bank's determination that academies are important tools for science advice, and would guide interventions of the bank in such countries.

A few national science academies are highlighted by sub region below:

Southern Africa

The Academy of Science of South Africa (ASSAf)

Historically, two bodies aspired to the position of being South Africa's national science academy – the Royal Society of South Africa (RSSAf), with a royal charter from the United Kingdom, and the Suid-Afrikaanse Akademie vir Wetenskap en Kuns (SAAWK), with a statute of the South African Parliament. However, the Academy of Science of South Africa (ASSAf) Statute was passed by the South African Parliament as Act 67 of 2001 to become the only national science academy of South Africa. The Academy's activities are guided by the Academy of Science of South Africa Act (Act No. 67 of 2001), as amended by the Science and Technology Laws Amendment Acts (Act 16 of 2011 and Act 7 of 2014), and a set of established regulations that collectively comprise the Academy's Constitution. ASSAf's core mission is to provide evidence-based advice to the government and the nation, as indicated by the motto: 'Science for Society'. ASSAf builds capacity in evidence-based studies and forum-based activities, supports a large-scale Scholarly Publishing Programme, and has a strong international presence and a wide acceptance of the Academy's key role in the national system of innovation. Two core activities are: the recognition for scholarly achievement and excellence in the application of scientific thinking for the benefit of society and to conduct systematic and evidence-based studies on issues of national importance, producing authoritative reports that have significant impact on policy-making.

Besides its strategic goals of recognition and reward of excellence, the promotion of innovation and scholarly activity, the promotion of effective, evidence-based scientific advice, the promotion

[53] UN Office of the High Representative for the Least Developed Countries. Press Release 4 June 2018. Technology Bank for least developed countries inaugurated in Turkey

of public interest in and awareness of science and science education and the promotion of national, regional and international linkages,

ASSAf has undertaken several consensus studies geared towards EIDM[54]. Some of these are:

- Strategic Approach to Research Publishing in South Africa
- HIV/AIDS, Tuberculosis and Nutrition- the Academy's premier consensus study in health
- Scholarly Books: Their Production, Use and Evaluation in South Africa Today
- Revitalizing Clinical Research in South Africa
- The PhD Study
- Diversity in Human Sexuality: Implications for Policy in Africa

The Zambia Academy of Sciences (ZaAS)

Zambia's national academy of science, ZaAS, was inaugurated in September 2005 with the goal of using science for Zambia's sustainable development. Since its inception, the Academy has worked to strengthen ties with its government. In turn the government supports the Academy on various occasions; specifically supporting the Academy when its authenticity as the national science academy in Zambia was called into question.[55] In 2013, ZaAS produced its first official policy statement - *Adaptation of Zambian Agriculture to Climate Change: A Review of the Utilisation of the Agro-Ecological Regions – A Summary for Policy Makers.* This document provided policy recommendations to address the impacts of climate change on Zambia's agricultural; sector.[56]

[54] http://assaf.org.za /
[55] The History of the Zambia Academy of Sciences 2005-2017.
[56] The Zambia Academy of Sciences. Adaptation of Zambian Agriculture to Climate Change: A Review of the Utilisation of the Agro-Ecological Regions – A Summary for Policy Makers. (2013).

HIV, TB, and Nutrition in South Africa

The relationship between nutritional status and chronic infectious disease was one of keen interest in South Africa in the early 2000's. There were questions- from policymakers and the general public- as to the bearings of nutritional interventions on the management of HIV/AIDS, and tuberculosis. In 2005, ASSAf constituted an expert panel to examine the tripartite epidemics (HIV, tuberculosis, and malnutrition) affecting South Africa at the time. The panel was charged with examining the existing literature on the intersection of nutritional status with infectious diseases, specifically, HIV and tuberculosis, and provide an evidence base on the results of nutritional intervention on these diseases. Through study panel meetings, workshops, and consultations with external experts, a report was produced detailing findings from the panel's review of evidence, as well as policy and research findings. In the report released in 2007, the study panel recommended that in terms of policy:

- The implementation of the existing integrated nutrition programme of the Department of Health be evaluated and adequately resourced for implementation to address under nutrition in all vulnerable groups, but especially in women and very young children
- An urgent national expert consultation should be convened to develop national guidelines for the feeding of infected infants that take into account all relevant studies
- Resources be directed to ensure food security based on locally available, affordable and traditional foods to vulnerable populations
- Everything possible should be done to promote and support adequate dietary intake of micronutrients at Individual Nutrient Level (INL) 98 levels
- HIV-infected pregnant women should are offered multivitamin supplementation (without Vitamin A) at INL98 levels
- The nutritional care of individuals with active TB should focus on adequate diversified diets including locally available, affordable and traditional foods
- The existing legislation and regulations should be enforced for all products claiming medicinal benefit with respect to HIV or TB
- More nutritionists and dieticians should be trained and employed and utilized in all programmes addressing the HIV and TB epidemics, and the nutritional knowledge of all health care workers in community, clinic and hospital settings should be improved and extended

West Africa

The Nigerian Academy of Science (NAS)

The Nigerian Academy of Science (NAS) was established in 1977 and incorporated in 1986. In recent years, NAS has collaborated with various categories of stakeholders. The Academy has cultivated relationships with Nigeria's government and its ministries and agencies including the Federal Ministry of Science and Technology, and health, as well as industries, and the media. Some of NAS' reports with policy recommendations are listed below:[57]

- *Reducing Child Mortality in Nigeria*
- *Integrated Disease Surveillance and Response*
- *Agriculture for Improved Nutrition of Women and Children in Nigeria*
- *Non-Communicable Diseases: Preparedness, Prevention and Control of the rising burden in Nigeria*
- *Accreditation Report of the Research and Development Agencies of the Federal Ministry of Science and Technology*
- *Integrated Disease Surveillance and Response: Report of the Stakeholders Awareness Creation Workshop*
- *The State of Science Technology and Innovation in Nigeria*
- *Agriculture for Improved Nutrition of Women and Children in Nigeria*
- *Strengthening Biosecurity and Disease Surveillance in Ogun State*
- *Genetically Modified Organisms in Nigeria: Concepts, Prospects, and Prudence*

The Senegal Academy of Science and Technology (ANSTS)

The Academy of Science and Technology of Senegal (ANSTS) was inaugurated in 1999.The ANSTS has contributed to generating evidence for policymaking, and promoting the role of science in development. In recognition of its role in providing science advice, the President of Senegal attends and performs the ceremonial opening of the Academy annually. There, the President also formally receives the report(s) of studies commissioned by the government, and when necessary, commissions new studies to be undertaken by the Academy. Some contributions made by the Academy include:

- *The Development of Science and Technology Education in Senegal*
- *The Importance of Advancing Ocean Science and the Need to Better Integrate Knowledge into Decision Making in Africa*
- *Rehabilitation and Revalorization of Saline Soils in Senegal*

[57] http://nas.org.ng/

Accreditation of FMST Agencies

Nigeria's Federal Ministry of Science and Technology (FMST), is the arm of the nation's government charged with galvanizing STI for national transformation and societal empowerment. The Ministry carries out this mandate through its sector specific agencies and parastals focused on such areas as biotechnology, Information and Communication Technology (lCT), space research, engineering materials development, and energy.

In 2011, the FMST commissioned the NAS to conduct an accreditation exercise of 19 of its major agencies in a bid to ascertain to what extent each agency was fulfilling its role toward the achievement of the Ministry's vision and mission. The NAS constituted accreditation teams comprising its fellows, in addition to other senior scientists. The teams visited the agencies, and used an accreditation tool (with accompanying guidelines) for the exercise.

An accreditation report was prepared by NAS and submitted to the FMST. The Academy proffered some recommendations for improving the functioning of the FMST's agencies including:

- Ensuring that every agency has an appropriate enabling Act backing its existence
- Constituting governing boards for the agencies for proper corporate guidance and accountability
- Adequate and timely funding for the activities of the agencies
- Encouraging synergy amongst agencies with related mandates should be encouraged to synergize efforts
- Institutionalizing formal collaborations between universities and the agencies as this would be mutually beneficial to both
- Regular accreditation of agencies to ensure accountability and prompt solutions to challenges

East Africa

The Ethiopian Academy of Sciences (EAS)

The Ethiopian Academy of Sciences (EAS) was established by Proclamation 783/2013 in March 2013. EAS serves as an advisor to the Ethiopian government, and promotes the advancement of STI.[58] EAS has undertaken a number of studies commissioned by government ministries[59]. Some of these are as follows:

- EAS coordinated the Ethiopian Panel on Climate Change (EPCC), an interdisciplinary initiative to monitor and respond to climate-related environmental changes.
- EAS produced a review and workshop reports on green technologies. As part of its efforts on green technologies, EAS assigned its Engineering and Technology Working Group to identify senior experts to review the status of green technologies in Ethiopia, and best country experiences in promoting, utilizing, and adopting green technologies in various socioeconomic sectors
- A Strategy for Standardizing the Assessment of Performance in Scholarly Publishing in Ethiopia
- Policymakers' Booklet on The Demographic Dividend: Imperative for Ethiopia's Transformation
- Ethiopian Panel on Climate Change First Assessment Reports
- Integration of Nutrition into Agriculture and Health in Ethiopia Policy Brief

The Uganda National Academy of Sciences (UNAS)

The Uganda National Academy of Sciences (UNAS) is the national academy of science in Uganda, and was instituted in 2000. The mandate of the Academy is to provide science advice to relevant stakeholders in Uganda. UNAS has engaged in various consensus studies and many other policy programmes to provide advice to government and society; some of these are:[60]

- The Role of Science Academies in Generating Evidence-Based Advice for Effective Policy Decision Making: The case of Climate Change
- Nutritionalisation of Agriculture in Uganda-Role of Agriculture in improving the Nutritional status of women and children
- Policy recommendations for the proposed secondary Education curriculum Reform in Uganda
- Policy Recommendations for improving the Teaching and Learning of Science in Uganda
- A Decision-Making Framework for Malaria Vaccine: Planning for a National Decision on Malaria Vaccine
- The Scope of Biosafety and Biosecurity in Uganda: Policy Recommendations for the Control of Associated Risk
- Mainstreaming Nutrition with Agriculture in Uganda: Role of Agriculture in Improving the Nutritional Status of Women and Children

[58] https://www.eas-et.org/about-us/eas
[59] https://www.eas-et.org/resources/eas-consensuses-studies
[60] https://www.unas.org.ug/brochure/UNAS%20Brochure.pdf

- The Advisory Committee on Vaccines and Immunization: Improving Vaccine and Immunization Coverage in Uganda
- Policy Brief – Roundtable Declaration on Sustainable Utilization of Energy and biodiversity Resources for Wealth Creation and development

North Africa

The Academy of Scientific Research and Technology (ASRT)

Egypt's Academy of Scientific Research and Technology (ASRT) is one of the oldest academies on the continent; it was established in 1971. Similar to other national academies ASRT works to promote scientific excellence and development, while providing scientific solutions to national problems. The ASRT is active in science advice. Its structure contains 20 different multidisciplinary expert councils; each specialized in certain areas such as transport, water, food and agriculture, as well as health. These councils are responsible for performing foresight studies, developing blueprints for scientific development, and provide scientific advice to different Egyptian institutes in areas related to their expertise. The councils identify issues of national relevance, and produce policy recommendations -through the Academy's board- to the policymakers. In some instances, the Academy commisasions studies based on requests from governmental bodies. In 2014, the ASRT established the Egyptian Science, Technology and Innovation Observatory (ESTIO) to serve as a driver for evidence informed STI policy making in Egypt. Some key functions of the observatory are to measure STI indicators, generate data on STI trends, as well as evaluate the performance of research institutes and HEIs[61].

One of the main challenges facing the advisory function of the Academy in Egypt is the tenuous relationship with governmental institutes, and the difficulty in ensuring implementation of policy recommendations. Recently, to address this, the Academy's councils adopted a new mechanism for engaging different stakeholders throughout the various stages of its studies.

Hassan II Academy of Science and Technology

Efforts to establish a national academy of science in Morocco began in 1993, and cumulated with the official launch of the Hassan II Academy of Science and Technology in 2007. The Academy's mandate includes the furtherance of scientific development, provision of evidence for policy, and promotion of a good science culture in Morocco. The Academy enjoys both full legal and funding support from its government, a situation unique to only a few academies on the continent.

The Academy convenes an annual plenary session which serves as an avenue for researchers to disseminate research findings in selected fields of science. The Academy is also involved in other stakeholders' engagement activities such as science clubs, science competitions, as well as youth and science events.

[61] http://www.estio.eg.net

Central Africa

Cameroon Academy of Sciences (CAS)

The Cameroon Academy of Sciences (CAS) was inaugurated in 1990, following the recommendations of the National Council for Higher Education and Scientific Research. The vision of the academy is to be the prime mover of science and technology; synthesizing scientific knowledge and making it available to decisionmakers, helping them make decisions about investments and priorities in science and technology, and promoting the conduct of science and innovation in the economic, social, and cultural development of Cameroon.

The Academy has interacted with and continues to interact with many sector ministries and the parliament. A protocol of collaboration between the Academy and the Ministry of Scientific and Technical Research was signed in 2001. Major interactions have been through consensus studies and workshops. These convening activities have been triggered by sector requests or foresighting of CAS.

Some of the policy relevant reports include[62]:

Consensus studies reports

- *A Simplified Communication Guide on Climate Change for Parliamentarians and Municipal Councillors in Cameroon*
- *Recent Advances in Onchorcercaiasis and Implications for Control*
- *Process Evaluation of Vitamin A Supplementation of 5 – 59 Months Old Children in Cameroon*
- *Elements for a National Biotechnology Policy Framework for Cameroon*

Workshops reports

- *Conserving and Managing Biodiversity in Central Africa: Global challenges and Local Solutions*
- *Malaria Research and Control in Cameroon: present status, institutions and actors*
- *Exploring Opportunities to Reduce Food Insecurity in the Sudano-Sahelian Zone of Cameroon*
- *Nutrition and Health in Cameroon: Combating the Crisis*
- *Tackling Cardiovascular Disease/Non-communicable Diseases in Cameroon*
- *Drug Resistance to Anti-malaria Drugs in Cameroon: Strategies for Control*
- *Impacts of Climate Change on Health, Water Resources and Agriculture in Cameroon: Considerations for Adaptation Strategies*
- *Modern Biotechnology: Genetically Modified Crops, Foods and Feeds – Cameroon Perspectives*

[62] http://www.casciences.org

Biotechnology in Cameroon

In 2014, in view of the potential far reaching impacts of biotechnology on various sectors in Cameroon, the CAS was commissioned by the country's Minister of Scientific, Research and Innovation to consider the elements of a national biotechnology policy framework. Subsequently, the CAS, selected experts to prepare a working document of what the nation's biotechnology policy should look like. Then, in consultation with stakeholders at the national and international levels, a 2 day stakeholders' forum was designed as a platform for stakeholders' perspectives on the draft policy.

The stakeholders' forum took place on the 24th and 25th of November 2014, and drew stakeholders from academia, industry, and civil societies. During the forum, through discussions and working groups, stakeholders made amendments to the working document, with some recommendations as follows:

- Biotechnology activities should take into consideration the major constraints in the country's agricultural sector
- In terms of health, the importation, adaptation, and application of existing biotechnologies for the production of bio pharmaceutics should be encouraged
- A national microbial resource centre should be created in Cameroon for the development of biofertilisers and biopesticides- which could serve agroindustries- and the protection of the environment. The Biotechnology Centre should also be supported to boost industrial and agricultural production in Cameroon
- Risk management is essential before any activity in biotechnology is undertaken. Biotechnology should be promoted as an innovative and lucrative industry

The Academy's recommendations were presented to the Minister in a report titled *Elements for a National Biotechnology Policy Framework: Report of Stakeholders Workshop.*

CHALLENGES TO SCIENCE ADVICE IN AFRICA

The African continent faces a number of unique challenges that continue to affect its growth and development. Poverty, high disease burden, environmental sustainability, food security, adverse weather events, and insurgency are pressing issues facing the continent as a whole. The African continent also faces a number of unique opportunities, including rapidly growing populations, expanding infrastructure and industry (in some countries), an increasingly educated and globally-engaged youth population, and vast natural resource wealth. African governments have stated their recognition of the role of STI as a tool to leverage these opportunities and overcome the challenges, and the AU developed the STISA 2024 strategy, as well as the ASRIC to utilize STI as a tool for Africa's development by 2024. The success of these plans and initiatives will require scientific evidence to guide policies for Africa's development. And for scientific evidence to successfully guide policies, the African continent needs a revitalized science culture—and crucially the sense of trust and common purpose that accompanies this revitalization.

Looking into how the science culture can be strengthened in Africa, it is necessary to assess the quantity and quality of research output generated on the continent. In an assessment of Africa's scientific enterprise between 2003 and 2012,[63] it was recorded that although research output doubled annually during that decade, Africa still accounted for less than 1% of global research output. This finding was disproportionate to Africa's 12% share of the global population within the period. This imbalance might be linked to the levels of funding allocated to science and research in African countries. Though African governments have agreed to invest at least 1% of gross domestic product (GDP) in research and development, this pledge has yet to be fully met.[64]

According to the World Bank, a key challenge to research for development is the kind of research questions that African researchers seek to address. Typically, these are not rooted in issues significant to the evidence consumers, i.e. policymakers and the general public[65]. It is therefore not surprising that African policymakers and society are apathetic to science, as it is not generally perceived as providing solutions to their problems. The challenge with the appropriateness of African scientific research, contributes to the difficulties in synthesizing advice for governments.

Furthermore, in Africa there is a disconnect between the generators of scientific evidence and the consumers of that evidence.[66] There appears to be a misunderstanding on both sides, with policymakers (and non-scientists) viewing scientific evidence as inaccessible and difficult to understand, while scientists and science advisors do not understand why policymakers do not use research findings that they believe are clear and convincing. In strengthening science advice in Africa, the responsibility lies with the scientific community and science advisors to actively cultivate and maintain the trust and interest of other relevant stakeholders. This can come through common identification and acceptance of research priorities.

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63 A decade of development in sub-Saharan African science, technology, engineering and mathematics research (English). World Bank. 2014. Washington, DC: World Bank Group. http://documents.worldbank.org/curated/en/237371468204551

64 Lagos plan of action for the economic development of Africa 1980-2000

65 Research for Development – A World Bank Perspective on Future Direction for Research" Policy Research Working Paper 5437. World Bank (September 2010)

66 Jones B. (2011). Linking Research to Policy: The African Development Bank as Knowledge Broker, Series N° 131, African Development Bank, Tunis, Tunisia.

Some challenges impeding effective science advice in Africa are stated below.[67]

Absence of an enabling political ecosystem: Typically, in Africa, there is little opportunity for interfacing between decision makers and science advisors, and avenues for science advice are restricted to personal relationships and sway. This lack of institutionalized science advisory systems is a challenge, but also an area of opportunity. A related problem is little or no reward for researchers' efforts at enabling adoption of their results by decision makers. Emphasis is on scientific publications for promotions/change of grade.

Trust and dependability: Decision makers look for advisors that are perceived to be credible, trustworthy and unbiased politically. Individual experts and organizations that may fit in to this category are limited in African countries.

Capacity deficiencies: Many African researchers see getting involved in the science advisory space as potentially damaging to their credibility. Many of them do not have the tools/capacity to function effectively in the science-policy space. For instance, many are ill-equipped to communicate their science properly and succinctly to policymakers. This problem creates a need for capacity strengthening and reorientation of the African scientific community. A positive point in this regard is the creation of INGSA-Africa, and the Chapter's continued efforts in organizing capacity building activities for policymakers and scientists in Africa.

Interdisciplinary and transdisciplinary research and partnerships: Most issues facing society are interdisciplinary in nature. As such, addressing these requires collaboration between researchers and stakeholders from diverse disciplines and sectors. However, interdisciplinary research is not the norm in Africa. The introduction of a transdisciplinary approach to research is also new amongst academic stakeholders and serves the purpose of moving beyond the disciplines to look at 'wicked problems' in a collaborative way. The African scientific community needs to form partnerships with stakeholders from relevant non-scientific disciplines and sectors in conceptualizing of research, conducting research, and communicating the findings of research to the larger society. This will ensure that the scientific voice is heard outside of scientific and academic circles.

[67] https://www.ingsa.org/conference-news

CONCLUSIONS AND RECOMMENDATIONS

Science advice for policy is mainly thought of in relation to the use of evidence by policymakers or as just one of the steps in the policymaking process.[68] It may be thought of as a result;[69] focused on providing solutions to problems[70]. The science-policy interface in Africa is more complex than this, with diverse systems, activities, and actors which come into play at every step in the policy making cycle.

The media has a role to play in drawing the attention of stakeholders to available evidence for policymaking; politics most often responds to cries from society. To this end, science needs to be communicated better to the general public to stimulate policy action by governments. There needs to be better collaboration between scientists and media professionals to get a clear message across. NGOs and civil societies can also serve as links between advisors and policymakers.

The expert committee makes the following recommendations to strengthen the science advisory landscape in Africa:

1. Legistlative support for structures and systems for science in Africa is necessary to strengthen the role of science advisory committees. There cannot be effective science advice without effective policies and structures. Additionally, political goodwill at the highest levels of government is required to facilitate adoption of evidence for policymaking. Additionally, policymakers are encouraged to understand, assimilate and use scientific evidence for policymaking. Training programmes tailored to fill this gap might be helpful. Parliament and governments should recognize the need to seek evidence by EIPM.

2. African scientists need to develop innovative ways of engaging African policymakers during their limited tenures. Investments in research take a long time to bear results; therefore, researchers have to find short-midterm methods of providing answers to burning policy questions, without abandoning long term research. In doing so, they take cognizance of the time constraints of policymakers' tenure and the public crave for immediate "dividends of democracy" across the continent.

3. Standards for credible science must be set to improve the quality and utility of scientific output in Africa. An interdisciplinary as well as transdisciplinary approach to science advice is important. Africa's challenges have social and cultural dimensions which should be considered in making policy recommendations. African scientists must be encouraged to undertake interdisciplinary and transdisciplinary research.

4. As described in this report, multiple channels for science advice can exist in any single African country. There needs to be coordination between these channels. There is need for a united front; a meeting point for advisors to collaborate.

[68] Scott C, and Baehler K. (2010). Adding value to policy analysis and advice. Kensington: University of New South Wales Press.

[69] DPMC. (2014). The policy project—Responsive today, shaping tomorrow. Wellington: Department of the Prime Minister and Cabinet

[70] Halligan J. Policy advice and the public sector. In Peters B, and Savoie D (Eds.), Governance in a changing environment (38–172). Montreal: McGill-Queen's University Press 1995.

5. African countries have to decide what structures for science advice work best. Science academies have a role to play in this regard, because they are recognized institutions on the continent that are independent and apolitical. It is important to further create synergies between the science academies, the ministries of science and technology where they exist, and other structures for science advice such as parliamentary research departments or offices.

6. Science academies in Africa play an essential role in Africa's advisory landscape. Intensified efforts are required to initiate and increase the number of national science academies in countries where they do not exist. And where academies exist, they should be supported to increasingly function in their role as advisors to their respective government.

7. The Annual Meeting of African Science Academies (AMASA) has the potential to strengthen science-policy linkages in Africa. Participation in these meetings should extend beyond academicians to include top level policymakers. This would provide an opportunity for direct interaction between evidence and policy. Statements from AMASA events on pertinent issues facing Africa should be properly disseminated to relevant stakeholders at the regional and national levels.

Finally, a positive concept of the science advisory ecosystem in Africa is one that allows for diversity in the mechanisms and channels for science advice, particularly in light of differences in subregional and national political landscapes. There is a wealth of existing organizations and structures to provide science advice across the continent- the key to their future success and inputs will be developing the sense of trust that will allow them to collaborate and work together more effectively.

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