

Managing COVID19 pandemic in Africa

[By Dr. Deoraj Caussy, Epidemiologist, Integrated Epidemiology Solution, <https://www.drdeorajcaussy.com>]



Introduction: COVID-19 is a viral disease caused by SARS-CoV-2 virus that belongs to the coronavirus family whose notorious members include SARS and MERS with known high mortalities. As the pandemic unfolds in Africa it is pertinent to ponder on its eventual impacts on a continent in which the majority of countries have weak health system, inadequate surveillance and limited laboratory capacity coupled with insufficient experienced and trained personnel to effectively respond to the pandemic. To compound

the situation there is no currently available proven vaccines or medicines, necessitating the application of classical public health measures and seeking innovative solutions in the local context. Each of these measures is fraught with flaws and limitations.

Coping strategies through Preparedness and Response: A clear policy with a pandemic preparedness plan is essential for pro-actively coping with COVID-19. At the beginning of the pandemic only 74% of African countries had an influenza pandemic preparedness plan that was inadequate to deal with a COVID-19 pandemic. This situation has been addressed by the formulation of a Global Strategic Preparedness and Response to COVID-19 by WHO. Components of global strategy has been operationalized into a stepwise plan such as the Africa Joint Continent Strategy for COVID-19 outbreaks jointly formulated by the African Unions and Africa-CDC. The WHO Regional Office for Africa is assisting the development of national pandemic preparedness plan, based on the country risk-assessment profile. However, implementation of the plans is beset with many challenges that could be turned into opportunities.

Challenges and opportunities: Control and Prevention of COVID-19

Virological risk assessment: Policy makers navigate the perilous choice of protecting lives and preserving scarce resources, often based on incomplete risk assessment. The biggest challenges to risk assessment centres on hitherto unknown properties of the virus: the exact duration of virus shedding before and after appearance of symptoms as well as the proportions of roles of asymptomatic persons in driving the epidemics. Also, largely unknown at this point is whether the virus induces life-long immunity. Invariably all control programs are flawed when they exclusively target detection of symptomatic subjects, either through fever screening or exit at ports of entry and contact tracing of positive cases and isolation of symptomatic cases. This is because almost one third of the asymptomatic cases will escape this control option and can initiate community-wide infection. The typical patterns of transmission of SARS-CoV-2 starts with an infected person contaminating health personnel who in turns sets off a chain of transmission by infecting their families and the whole community eventually. This issue can be circumvented by random community surveillance and testing.

Infrastructure an integral part of program implementation: Controlling the epidemic will require substantial infrastructure. The legacy of smallpox eradication left the infrastructure and surveillance tools of contact tracing that led to the control of Ebola in Zaire in 1976. But by and large Africa has lagged behind in developing resilient infrastructure for collectively dealing with the threats of emerging pathogens. This shortcoming has been recognized in the International Health Regulations (IHR-2005) which encourage countries to build its core capacities. A WHO Assessment of IHR core capacities in 2018 for Africa shows that many countries are lagging behind in key core capacities, with overall health emergency being only 32%, surveillance 59% and point of entry being 31%. In light of the COVID pandemic, WHO has prioritized strengthening core capacity support to countries with weak health systems and gaps in preparedness capacity. This provides an opportunity for levels 1-3 countries to build capacity for responding to emerging pathogens and for levels 4-5 countries to share their experience and expertise within the region.

Experienced and trained Manpower: Under the best of conditions, a significant number of healthcare workers have tragically lost their lives through lack of infection control training or protective equipment. During the 2016 Ebola virus outbreaks, West Africa demonstrated that front line workers can be trained in a short time. We have an opportunity to increase our medical social capital in Africa, and find ways to retain our trained manpower. The COVID-19 outbreaks provide an opportunity to train and retain African medical social capital for future emerging pathogens.

Social: Extended families are the fabric of life and our interactions and behaviours are guided by century-old traditions and beliefs. The policy of social distancing, while successful outside Africa, will pose practical issues for most of rural Africa as it will deprive many vulnerable populations of food, medicine and healthcare. The alternative solution is to break the chain of transmission through wearing mask and washing of hands with soap and water, but according to the UNDP report only 60% of Africa has access to clean water. The alternative is hand sanitizers, which must be developed from endogenous sources and to promote use of traditional African herbs.

Financial: It is estimated that 10% of national GDP is required to fight COVID-19, and WHO estimates USD640 million required to support countries. Countries will need financial support to upgrade the health infrastructure and procure medical equipment, respirators, ventilators, etc. However, despite the Bamako Agreements recommending African leaders to invest an average of 10.5% of GDP in health, Sub-Saharan Africa spent only 6.5% GDP on health in 2012. To meet the shortfalls active partnering has to be sought and forged with the Group of Twenty (G20) along with the World Health Organization (WHO), International Monetary Fund (IMF), World Bank Group (WBG), United Nations (UN), and other international organizations including tapping the COVID-19 Solidarity Response Fund of WHO and UNICEF.

Conclusion: There no a priori reasons to believe that the disease will impact Africa with less severity because of the young age composition or warm climate. The Ebola virus epidemic highlighted the need to build a resilient health system that can adapt and respond to evolving needs. The absence of vaccine necessitates adapting classical public health measures in the local context, using innovation in choice of materials and methods.

From the President



What uncertain times we live in? If anybody told me that 2020 would be the year of re-evaluating our normalcy, I would have laughed! Well, as you can imagine, that person would have had the last laugh!

2020 has also been a surprise for the Board and Secretariat of NASAC. We have had to re-evaluate all of our plans, re-schedule or cancel several of our activities, and deal with the repercussions of different government restrictions that impact directly or indirectly on our activities. For instance, any activities that required the assembling or international traveling of participants from March 2020 were cancelled. We also learnt to do more with less, and worked diligently offline to deliver on our mandate.

Fortunately, like we have all come to learn, *'this too shall pass'*. We plan and carry on with our initiatives during and post-COVID-19. Yes, we will implement them a little different, but to implement, we shall. Thank you for your continued support and learning with the Network, new ways to stay true to our core mandate. Your continued support is truly appreciated.

In April 2020, NASAC released a statement on COVID-19 in both [French](#) and [English](#). That was a commendable effort, and a *'very first'* for the French translation. We are now working tirelessly to deliver all NASAC communication in various media and platforms

in both French and English. As you can imagine, this will be a mammoth task, but it is doable. Thank you for your patience as we transition to this new normal, hopefully by end of June 2020.

Still on COVID-19, several NASAC members also circulated statements, communiqués or memos in respect to the pandemic. We have grappled with how best to transform our initiatives into becoming virtually relevant in order to still register the desired milestones. Our online presence is now under scrutiny.

Again, I dare say that our new normal is awkward and feels bizarre because that is not how we have been cultured or socialized to work and interact. A *'mindset shift'* has been necessary to stay on track with our commitments.

May I pause here and request you to give us feedback on what coping-mechanisms your academy or organization has embarked on to stay institutionally relevant during this COVID-19 pandemic? How has it explored the virtual space of interactions? What about engagement with policymakers, society, and fellow scientists? Please take a moment to respond and provide us with feedback on email nasac@nasaonline.org. We would like to feature these stories in the next Issue as we strategize on how best to provide network support to some of these initiatives.

In this issue of *The Science Networker*, we draw our continent's attention to five main avenues that will enable us manage the COVID-19 pandemic. As you have seen, the practices being propagated are simple yet very complex and demanding to implement. Dr. Deoraj Caussy, an Independent Epidemiologist and a member of the Mauritius Academy of

Sciences, discusses Africa's preparedness and response strategy. Besides this, he also highlights the five critical challenges and opportunities in the control and prevention of COVID-19. These are clustered to include focusing on the virology, infrastructure, manpower, social and financial aspects of the pandemic.

You will recall that we covered the Fifteenth Annual Meeting of African Science Academies (AMASA-15) in our December 2019 issue. In this issue, we are happy to inform you that the report has now been published. We take this opportunity to share with you the Executive Summary of the AMASA-15 Report. The full version of the report can be found on the NASAC website under the 'Resources' tab.

This issue also highlights a few actions from our members on COVID-19 in the section '*On the Spotlight*'. We finally inform you of the newly elected Board of the Botswana Academy of Sciences (BAS), and conclude with an academy

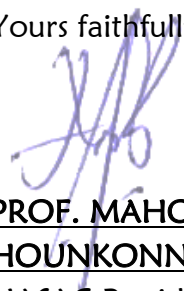
report from the Zambia Academy of Sciences (ZaAS).

Please remember to give us also feedback on this April-issue and provide us with new stories to include in the June-issue.

Remember also the COVID-19 prevention message: *Wash your hands regularly, avoid touching your face, sneeze or cough into your flex-elbow, and wear a facemask whenever you are in public.*

Do stay safe!

Yours faithfully,



PROF. MAHOUTON NORBERT
HOUNKONNOU

NASAC President and Chair of the Board

Recent Activities and Events

AMASA-15 Report on: *Science, Technology and Innovation for Food Security and Poverty Alleviation in Africa: The Role of Academies*

Held on 13-16 November 2019 in Accra, Ghana



L-R: Prof. Mostapha Bousmina, Former President of NASAC; Prof Henrietta Mensa-Bonsu, FGA, President, Ghana Academy of Arts and Sciences (GAAS), Prof Kwabena Frimpong-Boateng, FGA, Minister for Environment, Science, Technology and Innovation, Republic of Ghana; H.E Nana Akufo-Addo, President, Republic of Ghana; amongst other government dignitaries

The Fifteenth Annual Meeting of African Science Academies (AMASA-15) was held in Accra, Ghana on 13-16 November 2019. The primary focus of the AMASA-15 was to discuss how science, technology and innovation can be utilized to address issues of food security and poverty alleviation in Africa. The theme of the meeting was, '*Science, Technology and Innovation for Food Security and Poverty Alleviation in Africa: The Role of Academies*'.

More than a hundred (100) participants from twenty-two (22) countries¹ were present, representing several academies, universities and research institutions. The event was also graced by high profile government officials and dignitaries who mostly participated during the official opening session of the conference.

The event kicked-off with a learning collaborative session on *Science Diplomacy*, which was interactive and provided an opportunity for academies to learn from each other. Other

¹ Countries represented:

interactive sessions held in the course of the conference tackled topics such as, *Bringing Science to the Public*, the *Science Agenda for Agriculture* and *Harnessing SEM (science, engineering and medicine) to address Africa's challenges*.

The Science Diplomacy session was hosted by the TWAS Sub-Saharan Africa Partner (TWAS-SAREP) addressed the relevance of using diplomacy in science especially in low- and middle-income countries (LMICs). LMICs were deemed as crucial in improving international relations between countries, especially in managing global commons and transboundary or shared resources, building partnerships and improving international relations.

The event also organized three main scientific sessions² focusing on the following:

1. Session one tackled the *science* that determines achievements in food security and poverty alleviation. This session looked into the scientific knowledge available and requirements for shifting Africa's attention towards realizing the aspiration for food security and poverty alleviation.
2. Session two focused on cutting-edge *technologies* that are readily available or can be developed to meet the challenge of sustaining food productivity, reducing food loss and waste and recovering produce that is currently being wasted.
3. And finally, the Session three on *innovation* highlighted the success stories and innovative solutions that are available or can be developed to meet the challenge of feeding a growing, mostly disadvantaged, population by producing more food using scarce resources.

The American Academy of Arts and Sciences hosted an interactive session titled *Challenges for International Science Partnership (CISP)*. The session sought to identify policy recommendations and best practices to mitigate challenges for international science collaborations between the United States of America and Africa.

The European Academies Science Advisory Council (EASAC) also hosted an interactive session to launch the NASAC/ASSAf/LEO³ report on *Neonicotinoid Pesticides: Use and Effects in African Agriculture*. The session initiated both communication and dissemination of the report.

The conference was officially opened by H. E. Nana Akufo-Addo, The President of the Republic of Ghana. In his opening statement, he emphasized the key role African academies have in moving their countries onto the path of sustained progress and prosperity. He stated that all aspects of life are now ruled by science, technology and innovation.

The Ghana Academy of Arts and Sciences (GAAS) used the opportunity of AMASA-15 to also host GAAS' sixtieth anniversary dubbed '*Beyond 60 years of Scholarly Excellence – New frontiers and Prospects*'. Prof Henrietta J.A.N. Mensa-Bonsu, the President of GAAS

² 18 Scientific papers that cut across the three sub themes (Science, Technology and Innovation) were presented.

³ NASAC/Academy of Sciences of South Africa/German National Academy of Sciences Leopoldina

highlighted the evolution of GAAS over the 60 years, give the historical perspective, and captured the progress made in her speech. She also articulated the new prospects for the academy in the coming years as a member of NASAC.

The meeting ended with a state-sponsored luncheon to celebrate the 60-years anniversary of GAAS and to mark the end of the AMASA-15. In the end, the following key recommendations were made from AMASA-15:

Overall Recommendations: (i) African scientists should work closely with the agricultural and industrial sectors in their respective countries to bring about social and economic transformation towards food security and wealth creation for the citizenry. (ii) More investment is needed in research and development, capacity development, engagement of scientific community with policymakers and diplomatic corps. (iii) The recognition by policymakers and diplomatic community on the benefits of scientific inputs into discussions is critical.

Science Diplomacy: (i) Academies should work with TWAS-SAREP to develop a strategic document that articulates and puts into context the meaning of science diplomacy in Africa. (ii) Academies should establish an office or appoint a person responsible for science and diplomacy in their secretariats. This office would be responsible for activities that drive the academy's agenda in fulfilling its science-diplomacy mandate. (iii) The academies must articulate relevant activities that promote science diplomacy besides the scientific issues that are global in nature.

Pesticides in the Food Security Alleviation Equation: (i) The Neem tree and pyrethrum are natural occurring pesticides and their massive production can be encouraged among farmers. (ii) There is a need to educate farmers and other users on the effects of the pesticides they use.

Institutions: There was a need for all institutions present at AMASA-15 to work together, share ideas and draw lessons from experiences. In doing so, partnerships will be forged with academies to support African countries' realization of both poverty alleviation and food security, which are sustainable development goals 1(No Poverty) and 2 (Zero Hunger) respectively.

Announcements and Appointments

The Botswana Academy of Science

Botswana Academy of Science (BAS) held its second elective General meeting on Friday 31 January 2020. The out-going President Prof Modisi thanked Network of African Science Academies (NASAC) and the Academy of Science of South Africa (ASSAf) for providing support to BAS in its formative stage. He also acknowledged support from the University of Botswana (UB), Botswana University of Agriculture and Natural Resources (BUAN), Botswana International University of Science and Technology (BIUST) and the Botswana Institute for Technology, Research and Innovation (BITRI).

For his part, the treasurer Prof Masesane reported that BAS was awarded a Capacity Building Grant by the NASAC-Inter Academy Partnership program and this allowed the Academy to purchase computer equipment and accessories. In collaboration with the Association of African Universities, the Academy conducted a five days training workshop on strengthening scientific writing skills for publishing research outputs in peer-reviewed journals. Further, the Academy facilitated a National Forum on the 4th Industrial Revolution (4IR) at the request of the Department of Research, Science and Technology, Ministry of Tertiary Education, Research, Science and Technology.

In addition to the activities highlighted by the treasurer, the Secretary General reported that the Academy participated at the Annual General Meeting of African Science Academies (AMASA) held in Ghana and the formative meeting of the Botswana National Chapter of Organization of Women in Science for the Developing World (OWSD) amongst others. The Secretary General noted that the unavailability of a full time Secretariat for the Academy was a major impediment to the growth of the Academy.

After the reports from the Treasurer and the Secretary General, elections were held for positions in the Board of the Academy. The new Board that was elected include Prof Masesane as the President, Dr Mine as the Deputy President, Dr Koosaletse-Mswela as the Secretary General, Dr Mogopodi as the Deputy Secretary General, Prof Batlang as the Treasurer and Dr Batlokwa, Dr Tacheba, Dr Bagwasi as members of the Board. The out-going President, Prof.

Modisi will be a member of the Board until a President elect is elected in January 2022.



Some of the attendees of the BAS AGM at the UB conference Centre on the 31st January 2020.

On the Spotlight

ACTIONS ON COVID-19

NASAC STATEMENT: The statement, which was released on 7 April 2020, aimed at articulating priorities for action worth considering so as to prepare for, control and mitigate the health consequences of COVID-19 in Africa and provide an impetus for change. The statement highlighted 6 critical areas as priorities that African governments should consider:

1. Assess the risk of COVID-19
2. Develop a unified continent strategy for preparedness and response
3. Mobilize resources now
4. Create and enhance partnerships
5. Conduct research that generates evidence for action
6. Reduce inequity in the healthcare system

THE SUDAN NATIONAL ACADEMY OF SCIENCES made a statement on COVID-19 pandemic. In that statement, the concluding paragraph read as follows: *'Viruses are ultimate parasites that use our cells to propagate and then be transmitted to others. It is clear that close contact for a considerable period of time is needed for transmission. Our best practice to halt the epidemic in the absence of a vaccine or established effective treatment is to restrict human contacts, effect precautionary measures individually by washing hands with soap and water, wearing mask and at community levels by establishment of field hospitals preparing for the worst scenario to prevent spread of any potential infectious agent. Appropriate measures to strengthen and better prepare the fragile national health system to cope with any outbreak of the virus in the country should be taken, by mobilizing the entire might of the state including the regular forces and faculties of medicine and public health institutes and their staff to help in controlling the virus. Whether nationally regionally or globally, complacency and acting irresponsibly are dangerous and can be catastrophic.'* Khartoum 23/3/2020

THE BENIN NATIONAL ACADEMY OF SCIENCES, ARTS AND LETTERS (ANSALB) set up a COVID-19 crisis committee that has so far issued three (3) major statements. The first one, released on 28 March 2020, assessed the situation of the pandemic due to the new coronavirus 2019 and its consequences in Benin in order to contribute to an effective response. The second statement, released three (3) weeks later, examined the evolution of the pandemic in terms of scientific aspects, undertaken socio-economic and political measures. Here, the Academy recalled that it remains mobilized to fully play its part, and assist decision-makers make evidence-informed decisions by providing multidisciplinary expertise. Finally, the third statement focused on measures to lift the sanitary cordon and lock-down. Here, the Academy recalled, among other things, the scientific basis of lifting the lock-down, the choice of Benin, and made recommendations to this end. ANSALB maintained the conviction that this period requires individual and collective efforts to respect and enforce the meticulous guidelines provided by the various health sectors both nationally and globally.

Member-Academy's Feature

THE ZAMBIA ACADEMY OF SCIENCE (ZAAS)



Introduction and Background

The Zambia Academy of Sciences (ZaAS) was established under the Societies Act of the laws of Zambia in 2005 and officially launched in the same year by Zambia's Minister of Science, Technology and Vocational Training. ZaAS is the official National Academy representing Zambia in local and foreign engagements through the global network of science academies and organizations. To consolidate its position as an Apex science advisory body in Zambia, the Government of Zambia is in the process of legislating the Academy under its own Act of Parliament and thereby giving the Academy prestige and recognition it deserves.

Mandate

The Academy's mandate is to provide evidence-based independent advice to government and the public on matters requiring scientific solutions. The objectives of the Academy are to: (a) provide advice and consultation to institutions, the public and private sectors in relation to science and technology, research and education; (b) promote independent scientific thinking, technological discovery and innovation; (c) promote establishment and maintenance of high scientific endeavour; and (d) recognise outstanding contributions of individuals or organizations to the advancement of the sciences in Zambia.

Governance and Structure of the ZaAS

The Academy is governed by the Governing Council headed by the President and is run on day to day basis by a Secretariat which is headed by the Executive Secretary. Programs of the Academy are administered through specialised committees for; Science, health sciences, engineering and technology, and the social sciences. Each of the committees are headed by a chairperson. Scientists from different specialized committees sit on various local and international committees and working groups which have produced various publications, thus contributing to global scientific knowledge.

Advice offered to Government and public

In the past ten years, ZaAS has offered advice to government and society on several matters through publications (booklets, policy advisory notes and communiques), press releases, and through traditional media including television and radio. Advice has been issued on issues such as the role of science and mathematics in Zambia's development; nutrition and stunting among Zambia's children; climate change and its impacts on Zambia's agro-ecological regions, energy mix options, deficit projections both in the past and future, outbreaks of pestilences including Fall army worms, and communicable and non-communicable diseases in Zambia. Government

has acknowledged and used some of the advice in issuing policy statements on climate change, nutrition and stunting in Zambia, energy and in the planning for tackling army worms.

Membership of the Academy

ZaAS has made remarkable growth over the past 15 years and currently consists of 55 Fellows and Members who are nominated and elected from among top scientists from all fields of science.

Local and International Collaboration

Locally, ZaAS works very well with government through the Ministry of Higher Education and other agencies including; the National Science and Technology Council (NSTC) through which, the Academy has been receiving some funding from government since 2018 and works very closely with the National Food and Nutrition Commission of Zambia under the Ministry of Health. Internationally, the Academy is engaged in the work of and/or as a member of various scientific bodies including; the Network of African Science Academies (NASAC), Inter Academy Partnership (IAP), International Science Council (ISC), International Union of Academies (Union Académique Internationale), African Scientific Research and Innovation Council (ASRIC), World Academy of Sciences (TWAS), Commonwealth Science Advice Network, International Human Rights Network (IHRN) of Science Academies and Scholarly Societies, Ministers of Science Meetings of SADC countries and the African Union. To this effect, ZaAS directly or indirectly collaborates with several academies, including; African Academy of Sciences, Academy of Science of South Africa, the Nigerian Academy of Science, The Royal Society, Tanzania Academy of Sciences, Zimbabwe Academy of Sciences, Kenya National Academy of Sciences, Hassan II Academy of Science and Technology, Ghana Academy of Arts and Science, German Academy of Sciences the Leopoldina, and Austrian Academy of Sciences.

The Academy has received international recognition and is among the league of established national academies and is curving its own position regionally and internationally.

Hosting the Annual Meeting of African Science Academies (AMASA-16)

For the first time, ZaAS will host the Annual Meeting of African Science Academies (AMASA-16) in November 2020, and government, through the Ministry of Higher Education, is closely working with ZaAS to ensure success of the meeting. Despite the global COVID-19 pandemic, Zambia is hopeful that the pandemic will not last long enough as to affect the hosting of AMASA-16.

Contact details:
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Members and Fellows of the Academy pose for a photo at the 2019 General Assembly under the theme: **Food and Nutrition in Zambia's Economic Development**



L-R: Prof. Enala T. Mwase (V/President), Prof. Kavwanga Yambayamba (President), Prof. Bishal Upreti (Nepal Academy of Sciences), Prof. Daya Reddy (then Co-Chair of IAP Research), Mr. Owen Mgemzulu (then Permanent Secretary, Ministry of Higher education), and Mr. James S. Phiri (Executive Secretary – ZaAS)

At the Induction ceremony of Members and Fellows of the Academy at the General Assembly under the theme: **Climate Change – A call to Action for Zambia.**

About NASAC

The Network of African Science Academies (NASAC) was established on 13th December 2001 in Nairobi, Kenya and is currently the affiliate Network for InterAcademy Partnership (IAP) for Africa.

NASAC is a consortium of merit-based science academies in Africa and aspires to make the “voice of science” heard by policy and decision makers within and outside the continent. NASAC is dedicated to enhancing the capacity of existing national science academies and champions in the cause for creation of new academies where none exist.

The Secretariat

Mrs. Jacqueline Kado
Executive Director



Mr. Philbert Okello
Finance Officer



Ms. Rahab Gitahi
Programme Officer



Ms. Fatuma Achieng
Administrative and Programmes Assistant

As at November 2019, NASAC comprised of the following twenty-eight members:

1. **African** Academy of Sciences (AAS)
2. **Algerian** Academy of Science and Technology (AAST)
3. Académie Nationale des Sciences, Arts et Lettres du **Bénin** (ANSALB)
4. **Botswana** Academy of Sciences (BAS)
5. Académie Nationale des Sciences du **Burkina** (ANSB)
6. **Burundi** Academy of Sciences and Technology (BAST)
7. **Cameroon** Academy of Sciences (CAS)
8. Académie Nationale des Sciences et Technologies du **Congo** (ANSTC)
9. Académie des sciences, des arts, des cultures d'Afrique et des diasporas africaines, **Cote d'Ivoire** (ASCAD)
10. Academy of Scientific Research and Technology, **Egypt** (ASRT) – *Provisional Member*
11. **Ethiopian** Academy of Science (EAS)
12. **Ghana** Academy of Arts and Sciences (GAAS)
13. **Kenya** National Academy of Sciences (KNAS)
14. **Madagascar's** National Academy of Arts Letters and Sciences
15. **Mauritius** Academy of Science and Technology (MAST)
16. Hassan II Academy of Science and Technology in **Morocco**
17. Academy of Sciences of **Mozambique** (ASM)
18. **Nigerian** Academy of Science (NAS)
19. **Rwanda** Academy of Sciences (RAS)
20. Académie des Sciences et Techniques du **Sénégal** (ANSTS)
21. Academy of **Science of South** Africa (ASSAf)
22. **Sudanese** National Academy of Science (SNAS)
23. **Tanzania** Academy of Sciences (TAS)
24. Académie Nationale Des Sciences, Arts Et Lettres Du **Togo** (ANSALT)
25. **Tunisia** Academy of Sciences Arts and Letters
26. **Uganda** National Academy of Sciences (UNAS)
27. **Zambia** Academy of Sciences (ZaAS)
28. **Zimbabwe** Academy of Sciences (ZAS)

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