



Molecular biologist and entrepreneur Khady Sall helps to guide students towards jobs in biotechnology and artificial intelligence.

## WISE COUNSEL FROM AFRICA

Seize opportunities, speak up, be diligent, say four female researchers shaping science in Africa.

**W**omen in Africa are expected to shoulder an even higher share of domestic responsibilities than many of their counterparts in the rest of the world. And those working in science, technology, engineering and mathematics (STEM) fields also have to battle against chronic funding shortages and gender-based discrimination. This second collection of profiles includes perspectives from another four female scientists in sub-Saharan Africa on how to achieve career success.

### **KHADY SALL FIND WORK THAT FIRES YOU UP**

I did my PhD at Oregon State University in Corvallis on the genetics of seed dormancy and drought tolerance. When I finished in 2017, I hesitated a bit about a career in academia. It wouldn't be satisfying for me if it had no direct impact on my community. I wasn't motivated to apply for many postdocs because I felt like

that would be doing a PhD 2.0 – I didn't want to commit to another four years. But I knew that I would also struggle to build a research career from nothing if I came back to Senegal.

Seeing the action film *Black Panther* triggered something in me. The vision it portrays – of how local language, culture and ancestral knowledge can be integrated with science – was something I had spoken about at many conferences. About two months later, I woke up one day and bought a plane ticket home.

People think that development in Africa

should look like that in the United States or France. But is everything going well in those places right now? We are always going to be behind if we are aiming for 'the United States in 2022'. Sustainable development has to be rooted in the culture, preserving local languages and integrating ancestral practices that are good for the environment. It has to resemble you and where you want your country to go. You can get there by being authentic and you can do that by teaching science in the local language, such as Wolof, a language of Senegal, Gambia and Mauritania.

This is the reason I came back to grow SeeSD, a non-profit organization I started in 2015 to promote science, technology, engineering, arts and maths (STEAM) education, critical thinking and scientific literacy to young people in Senegal. Compared with getting a job in the United States, working in Senegal is not predictable or stable. It's seriously not easy – the day-to-day is a struggle.

But, I chose the struggle. I was pushing myself and pushing my SeeSD colleagues, too. We were young, we lacked experience, we made mistakes, but we learnt by doing. I've grown so much since I came back. You have to negotiate the lack of funding, human resources and training. We started something out of nothing.

You have to navigate the politics, too. Some people associate having ambitions with becoming a politician and they can suspect you of having a different motive. This can make local funders skittish about supporting your organization.

But we clearly need to expand STEM education. The ramifications of the COVID-19 pandemic are showing us the dangers of not guiding students towards jobs in biotechnology and artificial intelligence that will define the future. If we are not part of the global economy, leveraging knowledge to create technologies, then we are doomed.

Gender bias is an issue for women everywhere, and here I also encounter bias against young people. I try to overcome these biases by speaking through my work. It's not my personality to promote myself on social media as an influencer or at international conferences.

Instead, I push my work ahead. Sometimes people don't know who is behind the work. But eventually, it's your achievements that validate you. If you prove you can do it, you show that you are a capable person. This is why I was asked to set up master's and bachelor's degree programmes in molecular genetics and bioinformatics at the Virtual University of Senegal in Dakar. We are working to set up the laboratory space for both teaching courses and research. These programmes are not yet established, and everything has to be started from scratch.

I don't have kids of my own because I'm so focused on my work. I'm satisfied that I get to

be independent. I can have an idea, work on it and see it become a reality. I like that.

I work with a lot of women and, as a supervisor, I have to be flexible because they have so much going on with their families. There needs to be more female-founded businesses out there to accommodate women better, because women give so much back to businesses.

The hardest part about being a female entrepreneur is that you will definitely need to work twice as hard as a man to succeed. People will tend to underestimate you. But at some point, you should be unapologetic about your leadership. Just get the work done. Show your organizational skills.

In 2020, I led a project to manufacture face shields for health-care workers across Senegal for protection against COVID-19. It required coordinating several organizations. Some people doubted that, as a young woman, I could be an assertive leader. At one point, I had to reaffirm that I was in charge and keep us going. Not everyone liked that, but who cares? Once you reach your goal, you have proven yourself.

And you need to find something that really fires you up – work that you find amazing. That will give you the drive and energy you need to get ahead of the older men.

The experience you gain from your PhD can be applied to the African context: 'we are in start-up countries'. The skills I learned doing my master's and PhD – starting something from scratch, trying to get a publication and gaining independence and critical thinking



**Elizabeth Kimani-Murage had to learn to find time to do all the necessary work.**

– those expertise are much needed here. They are extremely useful for getting things done.

**Khady Sall** is an entrepreneur, molecular biologist and assistant professor at the Virtual University of Senegal in Dakar. She founded the non-profit organization Science Education Exchange for Sustainable Development and the Ubbil innovation lab in Dakar.

## ELIZABETH KIMANI-MURAGE WORK HARD AND BE DILIGENT

After I got my master's degree in 2004 from Moi University in Eldoret, Kenya, I took a three-year research traineeship at the African Population and Health Research Center (APHRC) while I applied for PhD programmes.

My focus at the APHRC was on food insecurity and malnutrition in the urban poor in Nairobi. For my PhD, I got a scholarship to the University of the Witwatersrand (Wits) in Johannesburg, South Africa, to investigate the double burden of malnutrition – stemming from obesity in adolescents and under-nutrition in young children.

When I was admitted to my PhD programme in 2007, my child was 2 years old. My husband said he would help to take care of the baby, and we decided the child would grow up in Kenya. I knew I had to finish my PhD within three years. I negotiated alternating three months in South Africa with two months working remotely from Kenya. It was really hectic. I worked past midnight many nights.

But it was worth the effort, because Wits provides a high-quality education and I could complete the programme in a short time. In Kenya, it can take up to ten years to get a PhD and many people give up. I also wanted to gain experience outside Kenya.

When I returned to the APHRC in 2010, my colleagues called me a publishing machine. I was a prolific writer and I was able to publish my master's and PhD work. I have also partnered with a lot of co-authors.

I pass along my mum's advice to me: nothing good comes along easily. You have to be diligent and work hard. You cannot sit back and expect results. As a young researcher, I learnt to find time to do the work, managing projects and logistics during the day, and finding quiet time to learn the science of writing.

I got into that culture of working, finding an hour or two in the evenings to write a few paragraphs. If you don't find that time, you'll never write.

Work-life balance is a big challenge for all researchers, but as a woman here, you also have the major responsibility of your family. I promote exclusive breastfeeding for the first six months of a baby's life in my work, and was



Environmental scientist Veronica Okello develops sustainable approaches to clean up heavy metals.

keen to do this when my second child was born. But it's a real challenge when you are working. I had to wake up early to express breast milk, go home to breastfeed at lunchtime and then express again after work and stay up until midnight to feed the baby. It was exhausting and difficult.

My workplace had some policies that were supportive of pregnant mothers, but we didn't have a breastfeeding room on site at that time. Now we do, and my research in this area helped to influence that. Kenya's policies for working mothers are generally supportive, but there could be improvements, such as extending maternity leave beyond three months. The APHRC has just started an on-site childcare facility for babies.

Women are respected as much as men at my workplace, but for true gender equality to happen, institutions might need policies to ensure that women's careers advance at the same rate as men's. Women take leave to care for children, they do the reproductive work and most of the care in those first years. For example, as part of evaluations for promotions, policies could take into account that extra work that women do.

**Elizabeth Kimani-Murage** is a public-health researcher and head of maternal and child well-being at the African Population and Health Research Center in Nairobi.

## VERONICA OKELLO SPEAK UP AND SEIZE OPPORTUNITIES

I was a part-time lecturer at Masinde Muliro University of Science and Technology in Kakamega, Kenya, when I was offered a PhD fellowship at Binghamton University in New York in 2008. By then, I was married, with two boys, aged 3 and 5.

My husband and my late mother were so supportive. They said, "You go. We're going to help you." Every summer, my husband came to the United States with the children, and every Christmas he sent my ticket to visit home. He sent money for my car and apartment, and called every day: if it was 7 p.m., my fellow graduate students knew who was calling when my phone rang. I returned to Kenya in December 2014 and became a lecturer at Machakos University in February 2015. I teach undergraduate and graduate students analytical and environmental chemistry and the fundamentals of nanotechnology. I founded the Go Green Chemistry Club for students; club members plant trees and do environmental clean-ups and science projects.

My research focuses on developing green, sustainable approaches to clean up heavy metals, such as chromium, arsenic and lead, that pollute the environment. For example,

chromium-6 is a carcinogen, but chromium-3 is benign, so we are looking for environmentally friendly compounds that can reduce chromium-6 to chromium-3.

Doing research after returning to Kenya has been challenging. I had many more publications on my CV during my PhD programme than in the time after it. But collaboration has done wonders. I have relied on my US network to help me win six grants to adequately equip our laboratory from scratch. Collaborating with established professors here and at other universities in Kenya has also helped me. A group of lecturers, hired at my university between 2015 and 2018, write grants together to buy equipment for research and teaching.

I tell young female researchers in Kenya that there are many opportunities – but you have to step out of your comfort zone and look for them. They will not come to you. You have to put in the work.

Often, I see people raised in Kenya who are timid and scared of approaching their professors. They think that being quiet is being nice. But I advise young researchers to have a great personality and to respectfully talk and air their views. Approaching professors for opportunities is a way to be on the right path. And once an opportunity comes, grab it and run with it.

Young women who have already started their families can face big challenges. I advise these women to see whether their spouses can

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support them in pursuing further studies – not necessarily abroad, but maybe in their own country.

Once early-career researchers have a university position, they should identify someone at their institution to be their mentor. For me, this was Zachary Getenga, an analytical chemist who has consistently guided me on how to write grant proposals. He watches out for me. I'm in my eighth year as a lecturer and should have been promoted already. But in our promotion system, single-author papers count for more than grants or publications with multiple authors. I feel so demotivated by this. But he tells me to keep going, to build my profile.

The policy committees of Kenyan universities are typically dominated by men. If I sat on one of these committees, I would change the promotion policy to award points to people who bring in grants and equipment to the university. I have brought in analytical equipment, including an electrochemical analyser, worth more than US\$28,000 – that is a lot of service to the university!

As a woman in science, the most limiting factor we have is time. Writing grants takes a lot of time and effort that competes with my teaching, administrative meetings and family time. I try to create my own time – this is why I'm doing this interview on Zoom from my car. You have to create the time when you want to succeed.

**Veronica Okello** is an environmental chemist and lecturer in the department of physical sciences at Machakos University in Kenya.

### ASTER TSEGAYE SEIZE INTERNATIONAL OPPORTUNITIES

When I graduated from Addis Ababa University with a biology degree in 1987, I was assigned to a haematology laboratory in what was then the Ethiopian National Research Institute of Health (which now forms part of the Ethiopian Public Health Institute). In those days, when you graduated from higher education you were assigned a job. I didn't know anything about haematology. All I knew was that it was an 'ology'.

A lesson for the younger generation is that if you don't get what you like, like what you get. I had to learn on the job from senior lab technicians who were always busy. So, by doing all the 'busy work' jobs, such as clerical work and washing lab equipment, I made sure the technicians had time in the afternoons to teach me and check my work. Even though I had a higher academic degree, I admitted my limitations, acknowledged their expertise and respected them. In the evenings, I taught myself from a textbook. Two years later, I was teaching a



MAHER HAILESSIE FOR NATURE

**Aster Tsegaye encourages young researchers to apply for work in overseas laboratories.**

haematology course at the institute's School of Medical Laboratory Technology. Next, I started a master's thesis on anaemia caused by hookworm infection.

At that time, in the mid-1990s, HIV was gripping sub-Saharan Africa. I had a chance to work on the Ethiopia–Netherlands AIDS Research Project, a decade-long collaboration to conduct research on HIV/AIDS, which set up an HIV reference laboratory in Ethiopia and trained Ethiopian researchers in epidemiology. Through that programme, I began my PhD at the University of Amsterdam in 2000. It meant starting when my second baby was 11 months old and my older son was almost 3. My mum, who never finished secondary school, said, "Go for it." She offered to look after my kids.

Still, it was hard to leave them. The first time you go away, you can promise them you'll bring chocolates back. But after that, they beg you not to go. My PhD was a sandwich programme, which meant spending three months in Amsterdam and nine months in Ethiopia for each of the four years.

Now, there are opportunities to do a PhD in Ethiopia, but I think having exposure and experience in international laboratories, and working with other scientists and with high-tech equipment is important. I would advise young researchers to develop their research and then apply for grants or scholarships for international opportunities.

Doing science is even more challenging amid unrest, but we should contribute to peace and stability wherever we can. It's important not to panic and to stay calm. Social media

should be used to promote peace and not to disseminate negative or fake news.

Whatever challenge we have, there is always a solution. When I returned to Addis Ababa University in 2007 and joined the school of medical laboratory sciences as a professor, it was one of the least-equipped schools on campus. I proposed that we standardized what we were teaching on our courses across other major universities in Ethiopia for training medical lab professionals to work on HIV/AIDS, and we did that in partnership with the American Society for Clinical Pathology based in Chicago, Illinois.

Although I've had opportunities to work in high-tech labs, I preferred to build the capacity of my department here. I am a firm believer in capacity building. We convinced management at the Centers for Disease Control and Prevention in Ethiopia (the US public-health agency established a presence here in 2001) that our students needed hands-on experience. I coordinated the procurement and distribution of immune-cell-count analysers and clinical chemistry equipment to eight universities that taught medical laboratory science. I didn't build my own lab, but I'm satisfied with what I did at that stage, because now we are harvesting that expertise.

**Aster Tsegaye** is an immuno-haematology researcher at Addis Ababa University and a fellow of the Ethiopian Academy of Sciences.

**Interviews by Kendall Powell.**

Interviews have been edited for length and clarity.