

PHILISWA NOMNGONGO

The water that shaped a scientist – From a 2 am water collection to nanotechnology research

For Prof Philiswa Nomngongo, the journey into water research began long before she entered a laboratory. Growing up in rural Pondoland, she knew from childhood that access to clean water could not be taken for granted. Today, a researcher at the University of Johannesburg, she uses analytical chemistry and nanotechnology to investigate pollutants in South Africa's water systems – while helping to develop the next generation of scientists.

Article by Kim Trollip.

Growing up in Pondoland, between Lusikisiki and Flagstaff in the Eastern Cape, a young Philiswa Nomngongo would get up at 2 am to collect water. Getting there early was a matter of necessity. If she wanted water before the cows disturbed the spring, she had to get there first.

"At that time, nothing struck me as, is this water clean? All we wanted was clear water. Years later, when I was studying environmental chemistry and learning that water contains all these different things, I remembered the water in my village and started wondering: what does my water contain?"

Nomngongo developed a love of chemistry at school, thanks largely to her science teacher, Mr Fred Iumba. Despite the lack of proper laboratory facilities, Iumba found ways to make chemistry tangible by demonstrating reactions with familiar household substances and explaining the chemistry behind everyday things.

"He made it so interesting to us," says Nomngongo. His influence extended beyond the classroom. He encouraged his pupils to apply to university and pursue careers in science, and Nomngongo believes his encouragement helped set many of them on their eventual career paths. "I always say if it wasn't for him, I don't think I'd be a professor today."

She went on to study chemistry at university, initially considering several possible career paths. In her second year, however, an applied chemistry course brought environmental chemistry into focus. The students went to the rivers, collected water and analysed it for parameters such as pH. For Nomngongo, the experience triggered an unexpected connection. "I remembered my water in my village," she says. "And when we were being taught that water contains things, I wondered, what does my water contain in my own village?"



Philiswa Nomngongo is a South African professor of analytical chemistry and the South African Research Chair (SARChI) in nanotechnology for water at the University of Johannesburg.

The question stayed with her. Rather than entering the workforce after graduating, she decided to continue studying until she could conduct that kind of analysis herself.

Learning to lead

Nomngongo's development as a researcher was shaped by another important mentor, Prof Jane Ngila, who supervised her Master's and doctoral studies. She remembers learning from her supervisor's discipline, long hours and determination to complete the task at hand. But perhaps more importantly, she learned about supervision.

While still a student, Nomngongo was given responsibility for overseeing laboratory activities as a "lab captain". The laboratory included Master's and doctoral students, and being entrusted with that responsibility gave her an early taste of what it meant to lead others. It planted an ambition. "I thought, I would like to be a supervisor one day," she recalls.

The experience is significant because capacity development has since become one of the most rewarding aspects of her own career. Today, Nomngongo is a professor in the Department of Chemical Sciences at the University of Johannesburg and holds the DSI-NRF SARChI Chair in Nanotechnology for Water. Her research uses analytical chemistry, environmental science and nanotechnology to detect, monitor and ultimately help address pollutants in water systems.

Making the invisible visible

Some of the pollutants that concern Nomngongo are surprisingly ordinary, including pharmaceuticals, personal-care products and other chemicals that are part of everyday life. They can eventually enter water systems, yet many so-called emerging pollutants are not routinely monitored or regulated in the same way as more established contaminants.

Antibiotics, for example, raise concerns about antimicrobial resistance, while substances such as per- and polyfluoroalkyl substances (PFAS), often known as "forever chemicals", and

microplastics are attracting increasing attention.

For Nomngongo, the problem is compounded by knowledge gaps. Research into emerging contaminants in South Africa is often concentrated on particular rivers or locations, leaving large parts of the country without a clear picture of what is present in their water.

"There may be many studies, but that does not mean we have a picture of what is happening across the whole of South Africa. We need to understand what is happening in different places, because the pollutants and the risks are not necessarily the same everywhere."

Her work, therefore, involves developing analytical methods that can identify pollutants, understand how they move through environmental systems and assess their potential implications for people and ecosystems. Nanotechnology has become an important part of this work. For Nomngongo, it is not simply about using an advanced technology because it is fashionable. It can also solve a very practical research problem.

Analytical chemistry can be expensive, particularly when specialised materials are required for extracting and detecting pollutants. Nomngongo and her research team develop their own materials in the laboratory, including nanomaterials that can mimic commercially available products. The approach can reduce costs while allowing researchers to produce and reuse materials rather than repeatedly purchasing expensive commercial products.

Her research consequently sits at an intersection: analytical chemistry provides the tools to identify what is in the water; environmental science helps explain how pollutants move through the system; and public-health considerations help determine what those findings could mean for people and animals.

Returning to the questions of childhood

That intersection has taken Nomngongo back into rural

communities – and, in a sense, back to the questions that first began forming when she was a child.

One WRC-supported project examined water sources in villages in the Eastern Cape where boreholes had been installed almost two decades earlier. Nomngongo wondered whether the boreholes were still functioning and whether they were still sufficient for communities that had grown considerably since the infrastructure was installed. Rather than deciding in advance where the communities obtained their water, the researchers asked residents to show them.

They sampled boreholes, springs and streams and investigated the quality of the water people were using. The research found that a functioning borehole did not necessarily mean that sufficient water was available. In some communities, boreholes operated according to schedules, with different areas receiving access on different days. Elsewhere, residents relied on springs and streams when boreholes were not working.

The findings also highlighted the vulnerability of some water sources. Livestock could contaminate springs, while changes in settlement patterns and sanitation infrastructure could potentially affect groundwater quality.

Yet one of the most valuable lessons for Nomngongo came from listening to the communities.

People already knew which water sources they trusted, which tasted salty, which were hard, and which they avoided. Their knowledge did not necessarily use scientific terminology, but it contained observations that could be tested scientifically. “They may not use the scientific term ‘water hardness,’” she says, “But they understand the practical implications – why they would not use certain water for certain purposes.”

For Nomngongo, this reinforces the importance of approaching

communities without assumptions about what they do or do not know. Scientific measurements can validate and explain observations, while community knowledge can help researchers understand what is happening on the ground. That collaborative approach is increasingly important as her research moves towards examining the impacts of small towns and other activities on nearby rivers.

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Many smaller towns are located alongside rivers that remain important sources of water downstream. Waste entering a river in one location can therefore affect communities, agriculture or bulk water users further downstream. Nomngongo wants research to contribute to those conversations rather than ending when the laboratory analysis is complete.

“What is the point of identifying these problems if we are not going back to the communities and sharing what we have found?” she asks.



Nomngongo with some of her students in the lab. She describes capacity building and teaching as some of the most fulfilling aspects of her career.



Nomngongo grew up in Pondoland, between Lusikisiki and Flagstaff in the Eastern Cape.

A changing water landscape

Climate change is adding another layer of uncertainty. Nomngongo has seen changes in rainfall patterns in the Eastern Cape, including sampling periods that were expected to represent dry seasons but instead experienced substantial rainfall. Seasons that once felt predictable are becoming less so.

These changes matter for both water quality and water availability. Heavy rainfall can increase turbidity and wash pollutants and solid waste into water systems, while warmer conditions can affect microbial activity.

The result is greater uncertainty about patterns that researchers might previously have expected to see. For Nomngongo, this strengthens the case for more intensive water-quality monitoring, particularly in areas where formal water systems are limited, and communities remain dependent on local sources.

She is particularly interested in rural areas, where small towns, growing settlements, waste management, agricultural activities and hospitals can all potentially influence water quality. There is also a wider lesson here. Protecting water requires understanding what is happening around it.

Staying curious

For a researcher whose career began with a simple childhood question, curiosity remains central to Nomngongo's advice to young scientists. "Being curious" is what keeps her moving forward, she says, encouraging researchers to ask questions, work hard and focus on problems that matter to society. In addition to being curious, young researchers also need to be adaptable and creative, willing to solve problems in unfamiliar circumstances and, importantly, prepared to learn and sometimes to unlearn too.

Some of the most valuable lessons may come from unexpected sources. "You can learn from a community member who has never been in school," she says.

Collaboration is equally important. Water challenges rarely fit neatly within disciplinary boundaries, and researchers need to work with people who have different expertise – including social scientists and communities themselves. "For me, scientific impact is not necessarily about making a spectacular discovery. I prefer to be in the back seat, watching the people I have trained take the lead. Some of my former students are now working in academia, while others are contributing to the water sector. Seeing them succeed is one of the greatest rewards of my career."

Her ambition as a second-year student was to be part of research that made a difference and to discover something useful. It did

not have to be a Nobel Prize. Sometimes, she says, making a difference means being able to tell people what is happening in their water – and what can be done about it.

For the girl who once woke at 2 am to reach a village spring before the cattle, that curiosity has travelled a remarkably long way.

To read more about Philiswa Nomngongo's research, visit: <https://scholar.google.com/citations?user=GZajrk8AAAAJ&hl=en&oi=ao>



Taking water samples in the field.