

A FOCUS ON THREE
CSIR TEAMS WITH

**WOMEN
MAKING
AN IMPACT**



science & innovation

Department:
Science and Innovation
REPUBLIC OF SOUTH AFRICA



CSIR
Touching lives through innovation



CSIR women in cosmetics development
From left, Vivey Phasha, Dr Sreejarani Pillai and Phatheka Ndzotoyi.

DIVERSE SKILLS WITH **BEAUTIFUL RESULTS**

Cosmetics might elicit a number of impressions and reactions – anything from stylishly packaged creams and cures to essential items for optimal self-care, or even disdain at such vanity... What few would think about is how the perfect combination of agroprocessing, medical science, chemistry and nanotechnology skills can work together to result in high-quality, safe and homegrown skincare products that contribute to South Africa's R27 billion beauty market¹.

Phatheka Ndzotoyi, Vivey Phasha and Dr Sreejarani Pillai join their skills as part of the CSIR's agroprocessing team to not only grow the agri-entrepreneur sector, but also develop advanced and regulatory-compliant products focusing on skin, body and hair care.

Ndzotoyi, a CSIR senior researcher, with more than 21 years' experience in cosmetic product formulation and manufacturing, says her expertise lies in process and product development, making use of both synthetic and natural ingredients to produce stable products that comply with regulations for trade in formal markets.

CSIR technologist Phasha explains that her expertise is in various aspects of chemistry, pharmacy, skin anatomy and physiology. She says this enables her to "design and execute a new cosmetic product development protocol so that it adheres to safety aspects and is 'skin safe'". She adds that, "My other areas of expertise include chemistry research, where I conduct plant material processing, extracting and analysis to determine active compounds for various applications."

Pillai, a CSIR principal researcher, says, "My expertise is in material sciences, which includes nanostructured materials, nano/micro emulsions and topical delivery systems." Her research focus is on developing innovative technologies for the encapsulation and delivery of topical active ingredients to improve product performance to assist the growth and competitiveness of cosmetic and dermatological industries and SMMEs.

To produce their perfectly blended personal care solutions, each of these women plays her respective role.

"I conduct research, development and innovation in the areas of biodiversity and agriculture. For example, I develop processes for value addition of indigenous resources (plant species) to help agri-entrepreneurs with ingredient development for cosmetic application. The developed plant extracts are further processed into cosmetic formulations. The developed ingredients and products are tested for compliance with cosmetic regulations to ensure quality and efficacy. Being able to verify that the product can do

what it claims, gives agri-entrepreneurs opportunities to trade in formal local and international markets to earn better income," Ndzotoyi explains.

Phasha is currently working on the development, formulation and safety testing of personal hygiene, hair and skincare products, while Pillai develops nanostructures, nanoemulsions, and/or encapsulation of actives for topical cosmetic and dermatological applications. "We also design and develop conversion processes to transform the materials into advanced products," she adds.

CAREER HIGHLIGHTS

Ndzotoyi relates career highlights at each of her previous employers that contributed in some way to her skills – from the first, the opportunity to formulate baby, body and skincare products; and the second, exposure to ingredient formulation development for food, pharmaceutical and cosmetic application. But, she says, "The biggest highlight in my entire career is my current job at the CSIR. The role is diverse and there are lessons in each day. I am involved in stakeholder engagement, writing proposals and research reports, securing income for research work, conducting laboratory work, managing projects and finances, doing presentations at local and global settings – and it promotes teamwork."

Phasha's list of highlights includes having worked with various entrepreneurs incubated at the CSIR, where she helped them with cosmetic product development, which resulted in numerous new products launched in the market. Apart from the publications that she has authored and co-authored with recognition; another highlight earned her the Best Poster Award at the CSIR Emerging Researchers Symposium in July 2022.

She narrates, "The poster focused on a recently completed study on addressing skin pigmentation by using a fungal derivative in a dermatological formulation. The study developed an ingredient and proved its efficacy and safety in tests, whereafter it was incorporated in cosmeceuticals for commercialisation purposes."

¹ The changing face of South Africa's beauty landscape - Fashion Handbook South Africa

My message to my 16-year-old self is that perseverance is everything because nothing comes easy in life. Hard work and dedication always pay off. Science requires a lot of patience and lessons learnt are applicable in various aspects in life. Take advantage of every opportunity and show up!

I would tell my 16-year-old self that the journey is going to be tough and there will be challenges and obstacles which require you to keep going; always remember why you embarked on the journey. Perseverance, hard work and always inviting God in your journey will lead you to achieving your goals.

I would say, it's an incredibly exciting time to be a researcher. Science is driven by curiosity and if that is done with integrity and passion, you can learn a lot, and develop new ideas and technologies that can impact lives for generations.

Pillai counts as a highlight her many publications in international peer-reviewed and accredited journals with an H-index of 16. Her research efforts aim to solve problems raised by industry with a high research impact. "My research team supports industries and small, micro and medium enterprises through collaborative research and has attracted more than R12 million in research funding. I am also mentoring PhD and Masters' students, as well as interns to develop their career plans, complete degrees and obtain new skills."

WORKING AS A TEAM

"What makes us a strong team is dedication, determination, focus and being proactive," Ndzotoyi compliments her team members and says, "Having worked with Vivey for more than five years is encouraging, she has an excellent work ethic, loves her research work and puts in 100% plus in everything that she does. She is also a team player and works well with colleagues in other disciplines in the CSIR. I value Sreeja's excellent interpersonal skills and work ethic. Her attention to detail provides the team with excellent scientific results. She values people and is very knowledgeable in her research area."

Phasha ascribes the team's success to "Always being committed to the mastery of the projects at hand – we strive to meet and exceed the expectations of our clients"; while Pillai draws attention to the perfect fit of their diverse skills, "As a team, we have common goals, open communication, mutual trust and respect. Everybody delivers on their individual roles and takes accountability. We are also diversified in terms of our skill sets."



PHATHEKA NDZOTOYI

CSIR senior researcher

- BSc (Chemistry and Applied Chemistry)
- Postgraduate Diploma (Management)
- Master of Management (Innovation Studies)



VIVEY PHASHA

CSIR technologist

- Master of Medical Science (Medical Biochemistry)
- BSc Honours (Formulation Science)
- Postgraduate Diploma (Cosmetic Product Formulation – cum laude)
- Programme in Total Quality Management (NQF 6)
- BSc (Chemistry and Statistics)



DR SREEJARANI PILLAI

CSIR principal researcher

- MPhil (Chemistry)
- PhD (Physical Chemistry)
- MSc (Applied Chemistry)
- Postgraduate Diploma (Personal Care Formulations)
- Certificate (Organic Formulations)
- BSc (Chemistry)



I would tell my 16-year-old self 'to breathe' and enjoy the journey. Dream big and go for it. Believe in yourself and focus on yourself. Work hard, but do not be too hard on yourself; it will all work out just fine in the end. And choose science... it is your passion.

I would say, in this journey, the same as life in general, be flexible and open because the possibilities that lie ahead are endless and they are greater than what you know now (a life lesson that I am still learning even today).

My message to my 16-year-old self is to be excited about the opportunity to learn, flexible to unlearn bad habits and humble to re-learn all that makes you a winner in all aspects of life. Use your past and present to create the best version of your future self without compromising your truth and values. Be multidirectional in life, don't get fixated on only one thing.

I was fortunate enough that at age 16 I was already in varsity, and I knew that I was not going to stop studying until I had completed my PhD; but what I would tell my 16-year-old self is to be patient with myself, trust the journey and be more assertive because I am already here.

CSIR women in photonics
From left, Dr Lungile Thwala, Dr Mabotse Tjale, Dr Masixole Lugongolo and Dr Patience Mthunzi-Kufa

GETTING AHEAD OF DISEASE WITH **LASER PRECISION**

When Dr Patience Mthunzi-Kufa, Dr Lungile Thwala, Dr Masixole Lugongolo and Dr Mabotse Tjale talk about shedding light on disease – from its diagnosis to its progression and the best treatment regimens – they are not only referring to increasing their understanding. These women in the CSIR's biophotonics team literally shine a light on disease.

Mthunzi-Kufa leads the team of scientists from various scientific backgrounds in the development of laser-based diagnostics for HVI-1, TB and Covid-19, as well as developing a photonics-based tool to diagnose substandard medication.

"My work varies from defining the biophotonics research group's strategy, sourcing funding, driving business development, overseeing the group from an operational level; to supervising MSc and PhD students, guiding junior researchers, promoting research as a career at schools, serving on different advisory platforms and participating as an honorary lecturer at universities, among other things," she says.

Thwala is trained in nanomedicine and drug discovery, with an educational foundation in chemistry and biology. She develops new pharmaceutical medicines and diagnostic tools or improves existing medicines or devices that have not been working efficiently for patients. She is currently developing cost-effective, laser-driven diagnostic devices that are easy to use at point-of-care settings and in low-resource settings. "These devices are intended to enable early diagnosis of diseases of socioeconomic importance, such as HIV, TB and cancer. Our aim is to use photonics-based technologies, not just to detect diseases early, but to also determine the stage or state of the specific disease. This will enable medical personnel to initiate the most effective curative measure or preventative procedure as early as possible.

Lugongolo's expertise is in cell biology (cell culture), where she introduces different biological materials, such as viruses, antibodies, drugs and other foreign substances, into cells to study and understand their effects. "For instance, in one of my projects, I infected cells with HIV or Covid-19 and, after a period of incubation, the cells were irradiated to determine the effects of the particular disease and light on the cells, as well as the effects of laser

irradiation on these pathogens. I am currently researching the capabilities of optical biosensors, in other words light-based techniques, for the detection of HIV/Covid-19 at the point of care," she explains.

According to Tjale, she has trained in various fields in biology, but her expertise is more inclined towards molecular biology and immunology. Her experience at both pharmaceutical and academic institutions adds to her versatility and understanding of many fields in biology. At the CSIR, her projects aim to develop a laser-based biosensor that will be able to detect TB in its active stage in different patients. She also uses these biophotonics-based techniques to understand HIV latency, which is a major hindrance to curing HIV.

CAREER HIGHLIGHTS

Mthunzi-Kufa loves leading the group of vibrant, young – and award-winning – scientists. "They are hungry for victory and are happy about science, generating intellectual property that has a direct impact on improving the quality of life of people in South Africa and globally, as well as securing research funding that allows us the pleasure of producing cutting-edge research outputs."

Thwala is one such passionate scientist. She says, "The highlight of my career is being able to contribute to the scientific world and producing real-life marketable products. I have developed formulations that were tested in clinical trials and may go to the market soon. With 10 years' experience as a researcher in pharmaceuticals, I have worked in different labs locally and abroad. I have also had the opportunity to publish my work in several peer-reviewed journals."

Working for the CSIR is a dream come true, says Lugongolo, and obtaining her PhD was "the realisation of a dream I never even dreamt". One appreciates this better when she talks about her first two career highlights, the not-too-easy road she had to travel to get to the CSIR – and the power of having someone who really believes in you.

After completing her National Diploma in biotechnology at what was then the Technikon of Natal, she struggled to find a job and did odd jobs. Volunteering as a laboratory technician/assistant at Wits Technikon in 2002 paved the way for her second career highlight.

She recounts, "Mr Lee Alagiozoglou, my molecular biology lecturer, recommended that I further my studies. Despite all my excuses and reasons, including a lack of funds, he did not take 'no' for an answer. With his advocacy, the institution gave me a bursary that covered 87% of my BTech tuition fees in 2003. He also encouraged me to pursue an MTech, and he helped me apply for funding, also becoming my MTech supervisor."

Tjale says, "In addition to publishing in peer-reviewed journals, my career highlight has been working with young passionate postgraduate students, supervising them in their respective degrees and actually seeing some of them graduate *cum laude*."

WORKING AS A TEAM

Team leader Mthunzi-Kufa says what strengthens the team is "Using our resilience as individuals to strategically achieve our goals, both in our personal lives and professionally. The ability to share ideas, being transparent with each other, and the willingness to win as a team create that trust, which drives us to succeed."

Thwala values that, as a team, they learn from and support one another. "In the biophotonics lab, the work we do involves all the science disciplines – physics, chemistry and biology and, within that, many expertise or specialisations. So, it is not possible for one person to be a master of all. Hence, to do the excellent work that we are known for, we depend on one another. Most of my team members have different training backgrounds from mine; this makes me dependent on their expertise to complete my projects. It is imperative for us to work closely, and I enjoy that because I love working in teams. It also helps to have a manager who is always so supportive and encouraging of our progress as scientists."

"I appreciate working in this team because where I am weak, there is someone who fills that gap, the goals are met, and the team succeeds," says Lugongolo.

"Science is a broad subject on its own and one can never understand all the concepts required to perform one's work," adds Tjale. "Coming from a biological background and joining a team that is more focused on physics and chemistry, I have seen the value of teamwork. Teamwork means exchanging ideas and expertise and that is how one grows, especially in our field."



DR PATIENCE MTHUNZI-KUFA

CSIR research group leader for biophotonics

- BSc (Biological Sciences)
- BSc Honours (Biochemistry)
- MSc (Medical Biochemistry)
- PhD (Physics)



DR LUNGILE THWALA

CSIR senior researcher

- BSc (Chemistry and Biology)
- MSc (Chemistry)
- PhD (Pharmacy and Biomedical Sciences)



DR MASIXOLE LUGONGOLO

CSIR senior researcher

- NDip (Biotechnology)
- BTech (Biotechnology)
- MTech (Biotechnology)
- PhD (Biophotonics)



DR MABOTSE TJALE

CSIR senior researcher

- BSc (Biochemistry and Microbiology)
- BSc Honours (Microbiology)
- MSc (Microbiology)
- PhD (Veterinary Tropical Diseases)



My message to my 16-year-old self is that it is possible, and to dream big!

My message to my 16-year-old self is to be curious, to have an open mind and to not be afraid of being wrong. I would tell her that she has the power to change the path of history. Science is a field that requires constant curiosity and investigation. It is also an area in which one is never done learning and may often be wrong. This is okay since it shows that you are constantly pushing boundaries and making new discoveries.

Allow yourself to dream big, even if it seems crazy. God is always listening, and you are what you think. Do not be shy about your talents; if you are good at mathematics and science, embrace it. Girls tend to be too modest about their gifts, however, they need to learn how to embrace them and dream.

Women in Earth observation

From left: Karen Steenkamp, Dr Nobuhle Majozi and Dr Cecilia Masemola.

LEVERAGING THE EARTHLY SECRETS **REVEALED FROM SPACE**

Hearing about the work of Karen Steenkamp, Dr Nobuhle Majozi and Dr Cecilia Masemola and how they, by relying on data gleaned from way up there, are able to help farmers and other decision-makers way down here, makes one wonder if Big Brother knows that the sisters are stealing the show...

Steenkamp's expertise is in the field of Earth observation where various Earth-orbiting satellites are used to obtain information about our planet. The geospatial content the satellites provide is essential for the analyses of any spatial feature that can be observed from space. She says, "It is an amazing field to be in, working with cutting-edge technology and developing applications for fields varying from climate change to urban planning."

She currently works on the Advanced Fire Information Service (AFIS), which started in 2004. Steenkamp explains, "AFIS provides risk assessment, detection and mapping of wildfires by using different instruments onboard satellite platforms. The information is used to reduce the time lag between fire ignition and response from emergency agencies, as well as to assess post-fire impacts on communities, infrastructure and property. We provide this information to government departments, municipalities, utility companies, fire protection associations and many other users to mitigate and manage the devastating impact of wildfires."

Majozi says, "My area of expertise is in geoinformation science, Earth observation applications and water resources." She looks at, for example, vegetation water use or the moisture in soil in natural and agricultural environments. She also uses remote-sensing technology for gauging the water quality and quantity in terrestrial systems. This information is used by, among others, the Water Research Commission, which also funds the research and applications produced. "I use innovative satellite airborne and drone remote-sensing technologies, together with in situ Earth observation for quantifying and monitoring water resources and hydrological cycle components."

Her current work at the CSIR focuses on a Department of Science and Innovation project benefiting farmers. It includes producing a model to quantify crop water use, as well as soil moisture. The project is currently in its third year. "Farmers want to know the amount of water in their soil; for example, they cannot apply fertiliser if there is a moisture deficit in the soil. We also focus on medium-scale farmers, and the system we are developing is meant to be more affordable for these farmers. I am working on the water algorithm, using machine learning and artificial intelligence. Right now,

I'm trying to evaluate the random forest model to see how it performs in retrieving soil moisture from synthetic aperture radar data."

Masemola uses the "geospatial big data, machine learning and cloud computing, such as Google Earth Engine and Amazon Web Services (AWS), to study environmental change, especially agricultural and biological invasive dynamics." She says, "I am currently working on developing a smart agriculture web application to provide an Internet of Things solution for agriculture. We use machine learning, artificial intelligence and big data to provide insights into how farms are performing and what they can do to improve their yield. I am also involved in a New Earth Observation Frontiers project where I am using radiative transfer models to simulate a dataset of synthetic data that will facilitate the task of inverting measured hyperspectral data to predict terrestrial ecosystems properties. The project is sponsored by the National Research Foundation."x

CAREER HIGHLIGHTS

Having been with the CSIR for 23 years, Steenkamp's highlights are numerous. "My career started at the satellite ground receiving station at Hartebeeshoek, which later became part of the South African National Space Agency. Learning of the complete value chain from satellite operations to product development remained with me throughout my career. Another highlight was working in Belgium in collaboration with VITO (Flemish Institute for Technological Research) on extending the SPOT¹ vegetation dataset with the NOAA² time series. This time series, at 1 km spatial resolution, enables vegetation and various other analyses from more than 40 years of satellite data."

Her most recent highlight was the development of an Automated Land Cover Classification system that runs in the AWS cloud. "This was a joint project with a private company and it is the first automated system in South Africa that produces a 73-class land cover classification from Sentinel-2 data acquired over a year. This system produces classification, accuracy assessment and change detection at a spatial resolution of 20 m. It enables the Department of Forestry, Fisheries and the Environment to produce land cover maps every year in record time."

1 SPOT is a high-resolution optical imaging Earth observation satellite system. The French acronym means *Satellite Pour l'Observation de la Terre*.

2 NOAA is the National Oceanic and Atmospheric Administration in America.

Majozi's career highlight doubles up as an opportunity to encourage others to persevere. She graduated with her PhD in 2020, just before the worldwide Covid-19 lockdown. She started her PhD in 2013 after joining the CSIR in 2011, but life threw her with several curveballs – her mom passed away, leaving her with the responsibility of providing for her siblings; two of whom were at college and one who was at university at the time. She also became a mother, and her daughter has had to travel with her since she was 18 months old. "The fact that I could finish my PhD under very difficult circumstances, is a huge highlight. It has also given me multiple opportunities to encourage others who are tempted to give up in trying times," she says.

Every project that Masemola has worked on has been a highlight. "It is always a challenge to work with big data and remote sensing – I love that challenge. I have been involved in a variety of projects, including the development of an online platform for invasive plant research, where I used remote sensing to detect and map invasive plants."

WORKING AS A TEAM

Majozi and Masemola both emphasise that their different skills are complementary and contribute to well thought-through and relevant tools for decision-makers, and, says Masemola, "the development of software that addresses the unique challenges faced by emerging farmers in South Africa."

"We have crop structure experts, nutrient experts and team members with technical skills – everyone brings those skills to the table. We also relate well to each other and because the team members are so different, we have learnt tolerance and to give each other space so that we can work harmoniously," concludes Majozi.



KAREN STEENKAMP

CSIR senior researcher

- MSc (Geography and Environmental Management)



DR NOBUHLE MAJOZI

CSIR senior researcher

- PhD (Geo-Information Science and Earth Observation)



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