



# DEPTH

ISSUE03

A PUBLICATION OF THE UNIVERSITY OF KWAZULU-NATAL

**THE EXCELLENCE AND  
INNOVATION ISSUE:  
MEET OUR ROCKSTARS**



**UKZN'S STRATEGIC PLAN:  
OUR OUTLOOK FOR THE NEXT 10 YEARS**



UNIVERSITY OF  
KWAZULU-NATAL<sup>TM</sup>  
INYUVESI  
YAKWAZULU-NATALI

**INSPIRING GREATNESS**





UKZN PIETERMARITZBURG CAMPUS



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# EDITOR'S NOTE

**“UKZN’s 2023–2032 Strategic Plan highlights the Institution’s commitment to foster innovation and engage in cutting-edge research so that it not only makes an increasing intellectual impact internationally, but also benefits society by addressing immediate challenges and societal needs. The numerous innovative projects, many of which draw on the latest technologies, championed by our academics that are featured in this edition of *In-Depth* are testimony to this commitment.”**



**MS NORMAH ZONDO**

**EXECUTIVE DIRECTOR:**  
CORPORATE RELATIONS DIVISION

**W**elcome to the third edition of UKZN’s *In-Depth* magazine which focuses on the exciting innovations spearheaded by our researchers across our Schools and Disciplines which are not only breaking new ground, but also addressing the pressing issues of our times and thus benefitting society at large.

Our lead article focuses on UKZN’s 2023–2032 Strategic Plan which was released earlier this year. The plan is embedded in the ongoing Project Renewal - a systematic review of the University’s principal structures including a renewal of the College model to strengthen teaching and learning, research and community engagement, together with the arrangement of professional services to support these core areas. The plan will advance the Institution’s academic project and result in the production of graduates with high levels of knowledge, skills and values.

The Fourth Industrial Revolution (also referred to as 4IR or Industry 4.0) is a new chapter in human development, enabled by extraordinary technological advances that merge the physical, digital and biological worlds.

While debate continues on its pros and cons, it offers the potential to harness technologies for the benefit of humankind - especially marginalised communities who often bear the brunt of the many ills - from climate change to food insecurity and health challenges that beset modern society.

UKZN’s 2023–2032 Strategic Plan highlights the Institution’s commitment to foster innovation and engage in cutting-edge research so that it not only makes an increasing intellectual impact internationally, but also benefits society by addressing immediate challenges and societal needs. The numerous innovative projects, many of which draw on the latest technologies, championed by our academics that are featured in this edition of *In-Depth* are testimony to this commitment. They include a web application that has the potential to revolutionise how mortuaries across South Africa capture data, which would assist in preventing unnatural deaths; a technologically assistive prosthetic arm - the Touch Hand; Quantum Satellite and Fibre Communication technology to maintain the security of information; designing, developing, and

testing aerospace propulsion and flight systems; off-the-shelf hardware teamed with a robot carrying artificial intelligence to keep the lights on for longer; and a ‘smart’ plug that reduces electricity consumption by up to 30%.

Many of these projects have commercial possibilities, with patents having been applied for in some cases.

We also feature other innovative projects in the fields of education, agriculture and healthcare - many of which are already benefiting members of marginalised communities.

The profile of veteran UKZN academic, Professor David McQuoid-Mason - who has been dubbed ‘the Father of Street Law’ in South Africa and ‘the Father of Clinical Legal Education in Africa’ - details his work in these fields in more than 132 countries. He has taught Law from his base at UKZN for 52 years and has championed human rights education since the dark days of apartheid.

We hope you enjoy this bumper edition of *In-Depth*.

We value your feedback. Let us know what you think via the contact details provided in this edition. ☐

# UKZN RELEASES ITS STRATEGIC PLAN 2023-2032

WORDS BY SITHEMBILE SHABANGU

**UKZN is embarking on a 10-year strategic plan which will “future-proof” the University and guide its trajectory over the next decade.**



## SOME OF THE UKZN CAMPUS BUILDINGS.

Following an extensive consultative and participatory process which involved all key stakeholders from within and outside the University, UKZN has released its 2023-2032 Strategic Plan.

Described by Vice-Chancellor and Principal Professor Nana Poku as “the most ambitious our University has ever developed since it was reconfigured in 2004”, the Plan aims to position UKZN as an international research-intensive Higher Education Institution that contributes to practical approaches to the challenges facing humankind at every level. The Plan is expected to advance the Institution's academic project and result in the production of graduates with high levels of knowledge, skills and values who will be the agents of change needed by society.

UKZN has a proud heritage of academic excellence and a history of making a transformative impact regionally, nationally, and globally. It remains deeply committed to advancing African scholarship and being an Institution of choice for staff and students. As a transformative University which nurtures and develops academic talent and diversity among its students and staff, UKZN aspires to create a deep service culture that inspires greatness across

## THE PLAN NOTES THAT UNIVERSITY'S AMBITIONS OVER THE NEXT TEN YEARS ARE TO:

- ✓ “BE A UNIVERSITY TO WHICH STUDENTS, STAFF AND ALUMNI ARE PROUD TO BELONG, AND WHERE OUR VALUES UNIFY US IN WHAT WE DO AND HOW WE DO IT.
- ✓ BE A PLACE WHERE PEOPLE CAN ACHIEVE GREAT THINGS, WITH THE FINEST POSSIBLE CONDITIONS FOR STAFF AND STUDENTS TO DO WHAT THEY DO BEST AND WORK TOGETHER AS A CONNECTED COMMUNITY.
- ✓ EMBED SUSTAINABLE, RESPONSIBLE APPROACHES IN ALL OUR PRACTICES, ENABLING EVERY ONE OF OUR PEOPLE TO PLAY A PART IN A HEALTHIER FUTURE FOR OUR UNIVERSITY AND PLANET.
- ✓ BE COMMITTED TO EQUALITY AND DIVERSITY, AND TO EQUAL OPPORTUNITIES FOR ALL.
- ✓ SET HIGH EXPECTATIONS OF OURSELVES AND HOLD EACH OTHER TO ACCOUNT FOR DELIVERY.”



the Institution, among its partners and the communities it serves.

The review of the UKZN 2017-2021 Strategic Plan revealed that substantial achievements were realised in the critical areas of human capital development; infrastructure expansion; advances in research productivity and quality; transformation of students and staff profiles; and the leveraging of new Information and Communications Technology for teaching and learning.

The UKZN 2023-2032 Strategic Plan builds on the strengths, challenges and lessons learnt from the 2017-2021 Strategic Plan and seeks to make further improvements. It is embedded in the ongoing Project Renewal - a systematic review of the University's principal structures, including a renewal of the College model to strengthen teaching and learning, research

and community engagement, together with the arrangement of professional services to support these core areas. In this regard, the Strategic Plan proposes the reconfiguration of key divisions of the University.

The Plan is also cognisant of the global and national operating environment underpinned by the Sustainable Development Goals (SDGs), and regional and national development blueprints including Africa Agenda 2063 and the South African National Development Plan (NDP) 2030. Poku noted that the Plan was developed "taking cognisance of the national and global trends and context of Higher Education, particularly stiff competition for faculty and students; declining government funding; and increasing demands for accountability. It underscores UKZN's quest to promote partnerships, enhance its position in the global ranking of universities, and leverage the

growing application of Industry 4.0 technologies in teaching/learning and research."

This Strategic Plan 2023-2032 identifies five Strategic Goals – namely, Excellent Teaching and Learning; Excellent Student Experience; Excellent and High Impact Research Innovation and Entrepreneurship; High Impact Societal and Stakeholder Community Engagement; and Targeted Internationalisation, as well as corresponding enablers that will expand the University's growth and competitive edge while addressing emerging needs in the operating environment.

It also has an enterprise risk management plan that will be used to guide its overall risk management approach. Monitoring and evaluation will be used to measure accomplishments and detect deviations while ensuring that corrective actions and adjustments are made. The



**The Strategic Plan assumes that classroom teaching and campus life will remain core to UKZN but will require digital extension and enhancement. Therefore, in the next 10 years, the University's growth parameters have been prioritised as follows:**

- ✓ UKZN will make provision for extended online education and other programmes for experiential learning to meet the needs of communities far from its campuses.
- ✓ A cap in the growth of the headcount in student enrolment at 45 000 is anticipated for 2023-2032 with a growth in postgraduate enrolment of up to 30% of total student enrolment.
- ✓ The growth of the Institution will be restricted to the current geographic spread between the cities of eThekweni and Msunduzi. An exception is the Health Sciences, where there is a need for an extended platform into rural areas for the provision of training and services.

Higher Education sector performance indicators and measures were used to develop a framework for the implementation plans and for the monitoring and evaluation framework. Additional performance indicators were generated by divisions within the University. Reliable performance measures from the UKZN 2017-2021 Strategic Plan were also adopted for the UKZN Strategic Plan 2023-2032.

The Plan is underpinned by UKZN's value system—the REACH<sup>7</sup> principles (Respect, Excellence, Accountability, Client Orientation, Honesty and Trust) that all at the University will aspire to live by daily. Said Poku, "These principled values point to a future where we will expand our world-leading research to address the most challenging global questions and exploit our capability for interdisciplinary research; and transform the way our students learn to make them the most employable

graduates and truly global citizens who continually take advantage of new and emerging technologies to meet the needs of the 4th Industrial Revolution. In all we do, we must ensure that all our activities make a positive difference to society."

UKZN Chancellor Dr Reuel Khoza described the UKZN Strategic Plan 2023-2032 as "a momentous milestone in the history of the University that lays the foundation to propel the Institution to great heights in its endeavour to maintain and further strengthen its status as the Premier University of African Scholarship, with global stature." He added, "To achieve this aspiration will entail significant investment in human, physical and financial resources. Effective implementation of the Strategic Plan will require robust and non-bureaucratic structures and systems to achieve the UKZN vision, a clear sense of urgency and destiny", and expressed

his confidence that "with the support of our partners – in government, industry, and the international community – we will strive to promote the academic project with the aim to make UKZN a hub for high-impact research, innovation, and entrepreneurship as well as graduate studies and research."

The UKZN Council said it was excited to be part of this ambitious and forward-looking blueprint of the University for the next 10 years, "applauding the hard work and diligence of the members of the task team that developed this Strategic Plan and the stakeholders who provided input in the strategic planning process". Council added that it looks forward to working collectively to implement the UKZN 10-year Strategic Plan 2023-2032. □

# TURNING THE TIDE ON ANTIBIOTIC RESISTANCE

WORDS BY BAWINILE NGCOBO

**According to a report published in *The Lancet*, AMR is now the leading cause of death worldwide, eclipsing HIV and AIDS and malaria. The report estimates that the resistance itself caused 1.27 million deaths in 2019, and that antimicrobial-resistant infections played a role in 4.95 million deaths.**

**A**s the world continues to battle the SARS-CoV-2 pandemic which has claimed millions of lives globally and caused massive socio-economic damage, antimicrobial resistance (AMR) – dubbed a ‘silent global pandemic’ by scientists – continues to exist under the public’s radar, posing a huge threat to global health.

Antimicrobials – including antibiotics – are a group of agents that reduce the possibility of infection and sepsis. Derived from moulds or made synthetically, they are absorbed into the body with the aim of killing bacteria or preventing their multiplication. AMR occurs when bacteria, viruses and parasites change over time and no longer respond to medication, making common infections harder to treat and increasing the risk of spreading diseases, severe illness and death. Many factors have accelerated the spread of AMR globally, including the misuse of antibiotics in humans, livestock and agriculture, as well as poor access to clean water, sanitation and hygiene.

According to a recent report published in *The Lancet*, AMR is now the leading cause of death worldwide, eclipsing HIV and AIDS and malaria. The report, which was the first comprehensive analysis of its global impact, estimates that the resistance itself caused 1.27 million deaths in 2019; and that antimicrobial-resistant infections played a role in 4.95 million deaths.

A team of experts comprised of Professor Tricia Naicker, Director of UKZN’s Catalysis and Peptide Research Unit; Professor Thavi Govender from the University of Zululand; Professor Gert Kruger, Senior Researcher in the Catalysis and Peptide Research Unit; Professor Per Arvidsson, Director: Science for Life Laboratory, Karolinska Institute, Sweden; and Dr Byron Peters, Process Chemist at Merck & Co., USA, are working towards reversing the mechanism of bacterial resistance through generating inhibitors that can ultimately restore the activity of existing antibiotic drugs.



**PROFESSOR TRICIA NAICKER.**

Led by Govender, the scientific team began its work in 2015, and recently developed a patent on the technology, with the first part of the work recently published in the prestigious *ACS Infectious Diseases* journal.

“ $\beta$ -lactam antibiotics are some of the most widely employed antibiotics and their successful use in the treatment of infectious diseases is well documented,” said Naicker. “However, bacterial resistance to all known  $\beta$ -lactam antibiotics is escalating globally and the resultant loss of treatment options for infectious diseases is a threat to public health. One of the major reasons for bacterial resistance to  $\beta$ -lactam antibiotics is bacteria’s production

of metallo- $\beta$ -lactamase enzymes that hydrolyse the  $\beta$ -lactam ring of the antibiotic, thereby inactivating the molecule.

“Existing antibiotics have lost their potency due to infections caused by resistant bacteria, which is a serious problem. The report published in *The Lancet* looked at 204 countries and territories affected by antimicrobial resistance - the worst affected being low-and-middle income countries, although higher income countries also face alarmingly high levels of the challenge.

“Our work has led to a patent of innovative new molecules targeting drug-resistant bacteria that have allowed the activity of existing

antibiotics to be restored. This is very important since no such clinical inhibitors are currently available on the pharmaceutical market.

"Apart from the challenges involved in the actual scientific work, we had to manage limited access to the labs as a result of lockdown and students and colleagues contracting COVID-19 which delayed the work, with the biggest challenge being loadshedding while performing experimental work that requires accurate periodic measurements and the use of high-end equipment. However, there were good moments. Six MSc students and two PhDs have graduated while three PhDs are ongoing. Three postdocs were trained, all our milestones have been achieved, the work is set to be published in high-ranked journals and a patent has been filed with the help of the UKZN InQubate office. We also established a host of national and international collaborations and networks," said Naicker.

The youngest associate professor in UKZN's College of Health Sciences, Naicker specialises in method development within the synthesis of biologically important intermediates/drugs in the field of antibacterials. She was awarded the 2020 Raikes Medal by the South African Chemical Institute. The medal acknowledges a member of the Institute under the age of 40 whose original chemical research in South Africa shows outstanding promise, as displayed in articles they have published in reputable

journals. Naicker is only one of three researchers – and the first woman – from UKZN to win the Raikes Medal since its inception in 1961. Part of the Discipline of Pharmaceutical Sciences since 2013, she is consistently rated in the Top 10 Young Researchers at UKZN and holds various other national awards from the Department of Science and Technology and the National Research Foundation.

"The ability to control compounds on a molecular level in the field of drug discovery and a love of academia" are what drive Naicker to continuously succeed. She is also driven by innovation, which she said is important for discovery or improvement of products/methods/ways of doing something as well as the betterment of society, improved socioeconomic status, protecting the environment, and living in a sustainable world.

With estimates that at least 30% of antibiotics prescribed are unnecessary, and that 60% of all antibiotics are used in agriculture, Naicker said the misconception that antibiotics treat all illnesses must be done away with. "We need to break the misconception that antibiotics are a miracle drug to treat all illnesses. Over the counter medicines can be your best bet when you're feeling ill. Approach your pharmacist or doctor for advice on how to feel better while your body fights off an infection," she said.

Naicker plans to partner with a pharmaceutical company or investor to drive the team's

innovation into the clinical trials required prior to Food and Drug Administration approval.

She urged emerging scholars to be diligent and never cut corners: "No matter how small the task, always do it to the best of your ability. There are no worthwhile shortcuts when it comes to your career path, duties at work or research responsibilities. Collaborate, communicate, stay loyal and work hard to maintain strong partnerships within your field. Always maintain honesty and integrity with your research."

The project was funded by the National Research Foundation, Technology Innovation Agency, UKZN's College of Health Sciences, as well as the South African Medical Research Council via a prestigious BRICS grant.

In a bid to garner public support for the proper use of antibiotics, a global action plan to tackle the growing problem of resistance to antibiotics and other antimicrobial medicines was endorsed at the 68th World Health Assembly in May 2015. World Antimicrobial Awareness Week is commemorated annually from 18 to 24 November as a global campaign to improve awareness and understanding of AMR and encourage best practices among the public, One Health stakeholders and policymakers who all play a critical role in reducing the further emergence and spread of AMR. □

## ACCORDING TO THE WORLD HEALTH ORGANIZATION, STEPS CAN BE TAKEN AT ALL LEVELS OF SOCIETY TO REDUCE THE IMPACT AND LIMIT THE SPREAD OF RESISTANCE.

### ✓ INDIVIDUALS

- Only use antibiotics when prescribed by a certified health professional.
- Never demand antibiotics if your health worker says you don't need them.
- Always follow your health worker's advice when using antibiotics.
- Never share or use leftover antibiotics.
- Prevent infections by regularly washing hands, preparing food hygienically, avoiding close contact with sick people, practising safer sex, and keeping vaccinations up to date.
- Prepare food hygienically, following the WHO Five Keys to Safer Food (keep clean, separate raw and cooked, cook thoroughly, keep food at safe temperatures, use safe water and raw materials) and choose foods that have been produced without the use of antibiotics for growth promotion or disease prevention in healthy animals.

### ✓ POLICY MAKERS

- Ensure a robust national action plan to tackle antibiotic resistance is in place.
- Improve surveillance of antibiotic-resistant infections.
- Strengthen policies, programmes, and implementation of infection prevention and control measures.
- Regulate and promote the appropriate use and disposal of quality medicines.
- Make information available on the impact of antibiotic resistance.

### ✓ HEALTH PROFESSIONALS

- Prevent infections by ensuring your hands, instruments, and environment are clean.
- Only prescribe and dispense antibiotics when they are needed, according to current guidelines.
- Report antibiotic-resistant infections to surveillance teams.
- Talk to your patients about how to take antibiotics correctly, antibiotic resistance and the dangers of misuse.

- Talk to your patients about preventing infections (for example, vaccination, hand washing, safer sex, and covering nose and mouth when sneezing).

### ✓ AGRICULTURE SECTOR

- Only give antibiotics to animals under veterinary supervision.
- Do not use antibiotics for growth promotion or to prevent diseases in healthy animals.
- Vaccinate animals to reduce the need for antibiotics and use alternatives to antibiotics when available.
- Promote and apply good practices at all steps of production and processing of foods from animal and plant sources.
- Improve biosecurity on farms and prevent infections through improved hygiene and animal welfare.

### ✓ HEALTHCARE INDUSTRY

- Invest in research and development of new antibiotics, vaccines, diagnostics and other tools.



# UKZN PATHOLOGIST'S APP COULD REVOLUTIONISE MORTUARY OPERATIONS

WORDS BY LEE RONDGANGER

**After becoming aware of the challenges facing mortuaries in KwaZulu-Natal, a UKZN academic has developed a system with the potential to transform how mortuaries capture data.**

It may sound macabre, but Dr Salona Prahladh is fascinated by corpses.

As a Forensic Pathologist who graduated from UKZN with a MBChB and a Master's in Forensic Pathology, Prahladh's job is to investigate unnatural deaths. Her passion for this discipline inspired her to develop a ground-breaking web application that has the potential to revolutionise how mortuaries across South Africa capture data, which would assist in preventing unnatural deaths.

Prahladh has received R400 000 in government funding to develop the app that has been showcased at various entrepreneurial conferences. After completing her medical degree in 2008 and her two-year internship at King Edward VIII Hospital, Prahladh decided to specialise in Paediatrics in 2012. However, after six months, she knew it was not for her. "Seeing mothers with their sick babies and how little support they had was too heart-breaking," she recalls.

A mentor suggested forensic pathology, she visited a mortuary, and the seed was planted.

"In discussions on cases, I found the autopsies and the histopathology very interesting. I decided to apply to the registrar programme in 2012. I was admitted and it has been my passion ever since. I was very lucky because we did not have much exposure to autopsies during undergraduate medicine," she said.

While conducting research for her Master's in Forensic Pathology, Prahladh became aware of the challenges facing mortuaries in KwaZulu-Natal. Her dissertation focussed on missed injuries in motor vehicle accidents and she discovered that finding data was cumbersome as each incident was entered manually in a file by a secretary at a mortuary.

This often resulted in incomplete or lost information. "For example, finding very basic information would require me to go into an archive full of cases from the 2000s and physically search through each file. It was very difficult to do my research and many cases were not documented." This inspired Prahladh to design a cloud-based web application to



DR SALONA PRAHLADH.

store autopsy reports in a digital format and track trends in data.

Traditionally, after performing an autopsy, a doctor would manually complete an SAP 359 form complete with diagrams, and place it in a file. "This app will allow doctors to use the camera on their phone to take photos of the diagrams and the provisional report and store it. These records will always be available on the cloud. The app can also be used at mortuaries in rural areas or hard-to-reach places that lack access to data or cellphone signals because it has the ability to store information and its own storage capacity. The information can thus be stored even if one doesn't have data at the time or access to the internet and it will automatically upload to the app once one does," explained Prahladh. In addition, the portable autopsy data application tool records information in compliance with legal and ethical obligations under the Protection of Personal Information Act.

Prahladh believes that the app will assist in preventing unnatural deaths. Given the volume

of data that it will make available, it will also facilitate the development of policy and legislation, inform research, and promote public health. "For example, we can use the data to map trends and incidents. If a sudden spike in road deaths is detected in a certain area, the relevant authorities can be informed in order to take action. Similarly, it will show spikes in tuberculosis and other diseases and even drug overdoses. We will be able to flag trends because the data will be easily accessible on one system," she said. Appropriate community interventions can then be adopted in the areas with an increase in such cases.

While the app has been tested in the real world, it is not yet in use as it is awaiting approval by the provincial and national health departments. "The app can be used in all spheres of clinical medicine but my dream for now is to see it rolled out in mortuaries in KZN," said Prahladh. "I love this province because this is where I grew up, did my schooling and was awarded my medical degree. I would thus like to see the app piloted in KZN." □

# BRINGING SMILES TO THE FACES OF KZN'S CHILDREN

WORDS BY LEE RONDGANGER

**A UKZN academic and world renowned cleft lip and palate (CLP) surgeon has made it his life's work to bring smiles to children's faces affected by CLP, changing the trajectory of their lives for the better.**



**PROFESSOR ANIL MADAREE (LEFT) AND A COLLEAGUE.**

**P**rofessor Anil Madaree, the chief specialist and head of Plastic and Reconstructive Surgery at UKZN is world-renowned for his work on cleft lip and palate (CLP) surgeries and is a sought-after speaker at plastic and reconstructive surgery conferences.

He spends hundreds of hours every year offering his services in developing countries free of charge.

Although Madaree is proud of his academic achievements and appreciates the global plaudits for his work, he says his primary source of

satisfaction is bringing smiles to the faces of children and their parents.

Madaree's life-long passion for CLP surgery recently earned him a PhD for his novel study on CLP surgical techniques on patients in KwaZulu-Natal (KZN).

The study revealed distinct epidemiological differences among CLP patients in KZN and he also introduced three new surgical techniques, including a novel method of lip repair.

Born in Chatsworth, Durban, Madaree studied Medicine at the then Durban Medical School in the 1970s alongside the likes of Steve Biko and Dr Nkosazana Dlamini-Zuma.

After completing medical school, he decided to specialise in plastic surgery and furthered his studies at the University of Pennsylvania in the United States in 1990. He spent six months in that country honing his skills in CLP surgeries and returned to South Africa in 1991 to head up the Plastic and Reconstructive Surgery department at UKZN.

Madaree explained that a CLP occurs when patients are born with a congenital abnormality.

"There are different grades of defects. A defect in the lip can go through from the front of the lip to the back and that will affect the lip alone. It can also go into the gum or even go right





back along the roof of the mouth, from the soft to the hard palate. Some will occur on one side of the mouth, while others can occur on both sides." If left untreated, the abnormality opens children up to being bullied or encountering other unwanted attention such as staring or questions about their appearance.

Madaree added that a defect in the lip affects speech and reduces opportunities of gaining employment later in life.

"Employers are more likely to employ someone without a cleft lip, even if the person with a cleft lip or palate is smarter and more qualified for the job. It's a physical deformity that can be repaired and allows the individual to take their rightful place in society and compete at a normal level," he said. The other challenge of a cleft lip or palate is that it makes eating and drinking difficult and solving these problems was the basis of Madaree's research and development of new techniques.

His first study examined records from 2002 to 2017 which contained around 1 500 cleft cases and after analysing them, categorised them in groups.

"We found that there were certainly significant differences," he said.

His second study involved repairing the cleft lip. While several techniques are currently available, Madaree devised a new method which he said is yielding better results. He has presented this, which ensures a more natural look, to surgeons around the world.

"Each time you do it, you find yourself doing something different. So, what I did 20 years



**BEFORE**



**AFTER**

ago is not what I do today. And in five years' time, it will be a bit different as you continue to hone your skills. My main question is, 'How can I make this look even better each year?' So, the study focused on epidemiology and my personal way of describing how to surgically improve the process for these children."

He explained that the technique aims to get the lip to look as symmetrical as possible

"If you have a cleft lip on one side, the other side will be normal. So on the opposite side, you want to make it look as close as possible to the normal side." For Madaree, completing CLP surgery is all about the rewards that come afterwards - the brand new smiles on children's faces and their delighted parents.

"I find it especially gratifying because you can repair that lip and can really change the way a child looks. When you are done and you give the mother her child and she cannot believe they look so different, that is the biggest reward," he said.

The doors the surgery opens for children later in life are also priceless.

"Left untreated, a child with a cleft palate may be considered mentally challenged by other people because of the way they talk, yet they are mentally absolutely normal. I have had cleft and palate patients who have graduated as lawyers and doctors. If you can spend that time and repair that lip or palate, you can give a child a bright, normal future," said Madaree. □

# NEW WOUND THERAPY TAILORED TO NEEDS OF THE PATIENT

WORDS BY GREG DARDAGAN

**Professor Mahendra Daya has developed a prototype device for taping the skin to assist in wound healing and therapy. The launch of the customised medical device is expected to revolutionise wound therapy.**

**H**is parents were tailors and his early life was deeply enmeshed in the tailor community and trade in Durban's Victoria Street quarter.

And from the age of about nine until he graduated from the then University of Natal's (now UKZN) Medical School when he was 25, Professor Mahendra Daya worked in a family tailoring and outfitting shop altering garments by machine and doing delicate material handwork.

Daya (57) took the measured, gentle tailoring approach he developed during his youth with him into his medical career, eventually specialising in micro and hand surgery, tumour surgery in the head and neck regions, and soft tissue sarcoma surgery.

Now, in collaboration with InQubate at UKZN where he is an associate professor/principal specialist in the Plastic and Reconstructive Surgery Department, he has developed a prototype device for taping the skin to assist in wound healing and therapy. An application has been lodged to patent the invention and on completion of prototype testing, the commercialisation phase will begin.

Daya received funding of R440 000 for his research from various bodies including the Technology Innovation Agency's (TIA) Rapid Fund, and the Department of Economic Development, Tourism and Environmental Affairs (EDTEA).

"Completing this project will have a beneficial impact on society globally, especially in the wound-healing space," he said. "In the past decade, the costs of advanced wound healing technologies have increased. Our Tape Assisted Closure (TAC) device will compete with others that harness mechanobiological interventions in wound healing and it has the potential to be a game-changer once further PhD and postdoctoral research publications enter the public domain.

"The use of a mechanical device aims to make the taping of wounds easier for the user and sterile off-the-shelf product for wound therapy.



**PROFESSOR MAHENDRA DAYA.**

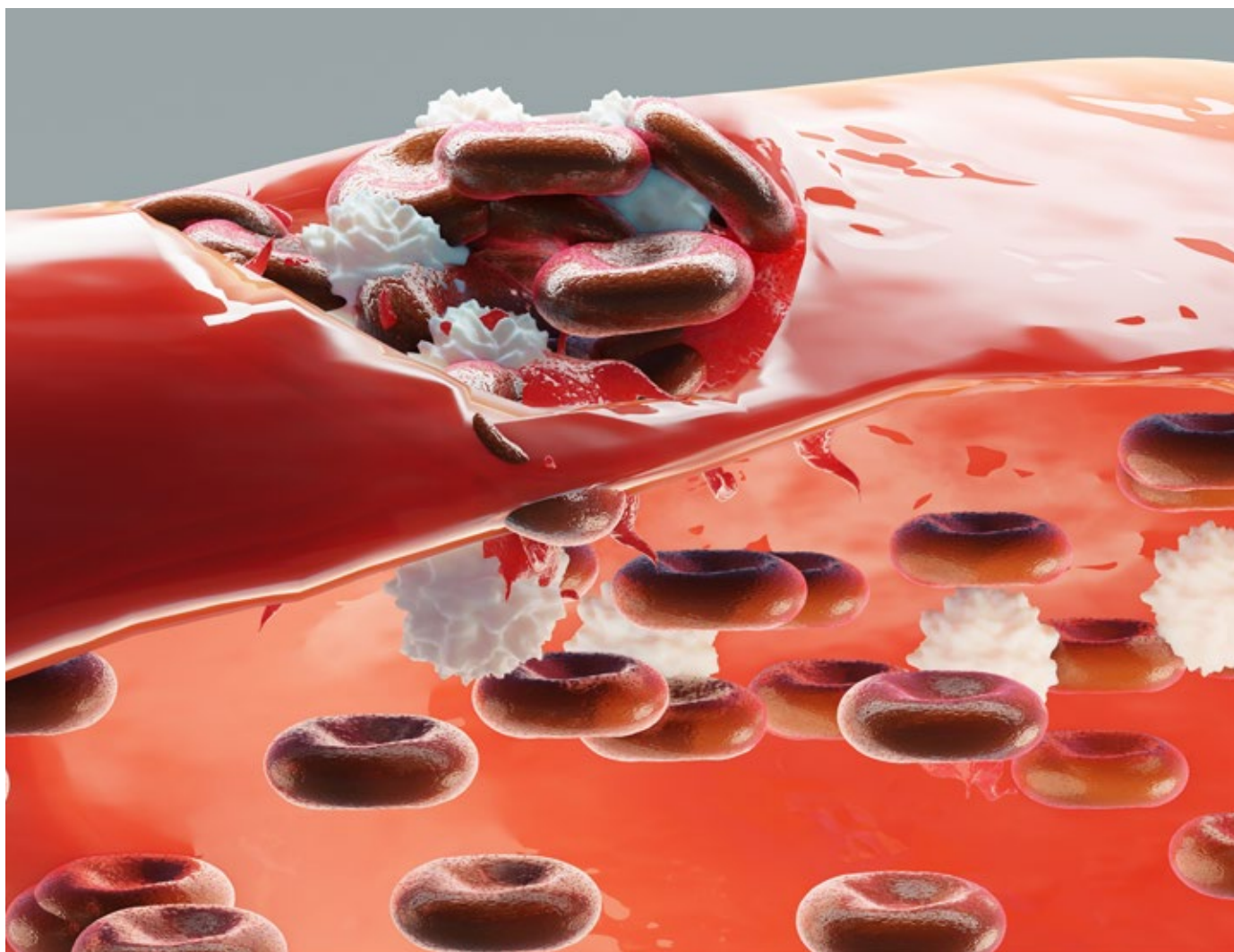
In simple terms, wound closure is produced over time by applying a mechanical force onto the tissues surrounding the wound."

The customised medical device is designed for use in an emerging, non-invasive medical technique known as mechano-assisted wound therapy or TAC.

"The invention offers a low cost and simple technique for treating cutaneous wounds which may make surgical procedures unnecessary or simplify any surgery needed," said Daya.

"The device dispenses tape to match the size of the wound it is being applied to and allows the user to apply it without assistance, thus





reducing costs and time. Without the use of our device, a second person needs to assist with cutting the tape as it is applied.

"Training in the use of the device is quite straightforward."

He said all other devices need to be attached to the surrounding skin by sharp pins or some portion of the device has to be sutured into place. "Attachment of devices is by surgical intervention and the skin remains pierced, which may cause pain and discomfort while a device is being engaged to produce skin stretching.

"The prototype we invented requires no direct skin purchase - the application is topical. The device delivers adhesive paper tape, enabling application to the surrounding tissue and the wound. The device operator will be able to use the tape to transmit mechanical force to the wound without any further assistance.

"The tissue is manipulated while applying the tape to exert and maintain the mechanical force, holding the migrated skin limited by the portion that can be easily stretched over the wound. In time, the properties of skin, referred to as viscoelastic, allow for the tension in the skin to relax. This allows additional skin to be recruited for further skin stretching. With each serial application, more skin is recruited to

produce wound closure. The end process could be assisted by surgery," said Daya.

"The invention was my brainchild, and its development took over five years - from concept to prototyping and preliminary trials - to finalise. This work would have not been possible without the leadership, support and funding from InQubate, the EDTEA and TIA. Special thanks go to Rajen Naidoo, the consultant on the project, and mechanical engineer, Johann Bredenkamp, for taking the concept to design, prototype and test despite our many challenges."

As a youngster, Daya's ambition was to become a mechanical engineer as he was fascinated by racing cars which represent excellence and peak performance. However, he entered Medical School at the University of Natal on his father's insistence, graduating in 1989.

In 1992, he began training as a general surgical registrar, which included a three-month rotation in Plastic and Reconstructive Surgery, going on to complete three-and-a-half years of general surgery before starting training in Plastic and Reconstructive Surgery in 1995, qualifying in 1998.

Daya launched his career as a specialist consultant at Wentworth Hospital in 1999 and soon became well known for his

expertise in microsurgery, a reputation which has grown over the years to the impressive status he enjoys today.

In 2001, he was appointed lecturer/principal specialist at UKZN in Plastic and Reconstructive Surgery.

Since his appointment, his scholarly output has been significant, despite a high clinical, managerial and teaching workload. He made the Top Published Academic Researchers list at UKZN in 2008 and 2009 and has authored 29 journal publications - two of which received literary awards from the Association of Plastic, Reconstructive and Aesthetic Surgeons of Southern Africa (APRASSA) - and co-authored a chapter in the Handbook of Lower Extremity Reconstruction.

He is recognised as a world expert for pioneering work related to his PhD which explored the use of paper tape for tissue, scar modulation and wound healing.

"The most important thing for me now is to influence and mentor those who have worked with me, passing on my knowledge and know-how.

"I have no doubt the launch of our device will revolutionise wound therapy." □

# MEET PROFESSOR RIAAN STOPFORTH: OUR INNOVATIVE ENGINEER DEDICATED TO IMPROVING PEOPLE'S LIVES

WORDS BY BAWINILE NGCOBO

**A team of engineers is working overtime to propel the prosthetics field forward and make this technology more accessible to the public.**



**ZAAHID IMRAN, STHUTHI VARGHESE, JODE FOURIE, CLIVE HANDS, DANIEL LLEWELLYN TRASK AND PROFESSOR RIAAN STOPFORTH WATCH AS LUNGILE KENNETH DICK TESTS THE FUNCTIONALITY OF THE TOUCH HAND.**

Imagine a future where amputees can use a prosthetic hand to feel and touch objects, performing a variety of complex motions that replicate and mimic those of the human arm and affording them the freedom to live independent lives.

Now also imagine that this cutting-edge medical technology is available at a price that is affordable to the general population.

This is the future imagined by UKZN scholar and innovator, Professor Riaan Stopforth and his team through Touch Hand, a low-cost, multi-grip robotic prosthesis originally designed by him and UKZN MSc graduate, Mr Drew van der Riet.

Touch Hand is a project of Touch Prosthetics, Africa's leading innovator in prosthetic hand

development. The company is housed in UKZN's School of Engineering in the Stopforth Mechatronics, Robotics and Research Lab.

Globally, more than three million people have had one or both arms or hands amputated, the vast majority of whom live in developing countries. Given the high cost of commercially available prostheses, many amputees have no option but to use a hook or claw prosthesis, or nothing at all.

Touch Hand is a low-cost, highly customisable, upgradable, and modular design of controllable fingers and a thumb which make it look and feel as real as possible. The 3D printing suits each amputee's unique needs. Touch Hand incorporates a unique sensory feedback system that provides an amputee with a restored sense of touch. This was made possible by

revolutionary research in the area of upper-limb electromyography (EMG) prosthetics.

"Many people have lost their hands due to accidents or war situations. The amputees that we have used to test Touch Hand indicated that they never thought they would be able to perform such tasks. The prosthesis therefore means that they can be independent," said Stopforth.

Stopforth added that although his team can never duplicate the complexities of a human hand, they have created "a wonderful product" that they hope will one day have almost the same capabilities as a human hand. "Our current project is decoding the signals from the amputee's muscles, then allowing the different actuators that control the prosthetic hand's fingers and moving parts to work."





## PROFESSOR RIAAN STOPFORTH CELEBRATES THE FEAT OF BECOMING THE FIRST ACADEMIC ENGINEER IN SOUTH AFRICA TO OBTAIN A LICENSE TO FLY DRONES.

The Touch Prosthetics team works with Mr Lungile Dick as its primary subject to test and develop Touch Hand. Dick, who has a background as a professional tennis player with provincial colours, lost his hand following an accident 15 years ago while repairing a machine at a company. Now employed as a trainer at a Volkswagen facility in Gqeberha, Dick said Touch Hand improves an amputee's quality of life, adding that he is encouraged by young students' involvement in the project. "The fact that the project is looking into the prospect of an affordable hand in Africa and in developing countries is very exciting," he said.

Since its invention in 2013, Stopforth has worked with other scholars to improve Touch Hand's design. While he noted that the first hand "looked rough", it was one of the first low-cost but advanced prosthetic hands to have been developed. Every new version of Touch Hand incorporates an improvement informed by problems experienced by amputees. "Other than the mechanical improvements, we are also trying to make improvements in the coding and electronic design that make a lot of the decisions. Progress is slower than we hoped for, but with limited resources, only a few students working on the project, and the limitations of the current technology, it's still good."

Stopforth said the commercial cost of a technologically assistive prosthetic arm currently stands at more than R100 000, making it inaccessible to many, while Touch Hand can be produced for around R20 000. "The cost fluctuates due to the exchange rate, different international influences and customisation, but we could probably develop a hand for R20k or so," he added.

The Touch Prosthetics team is gearing up to participate in Cybathlon 2024, an international

Olympics-style event for bionic athletes which challenges teams from all over the world to develop assistive technologies for everyday use. The team comprises of members from UKZN, Nelson Mandela University, University of Pretoria and Stellenbosch University. The team participated in the 2020 games where it represented Africa in all disciplines and the Southern Hemisphere in the Arm Prosthesis Race, coming in at 11th place out of 13 teams ahead of Germany and the United Kingdom.

"We are looking for sponsors, especially since we will probably be hosting the African hub," said Stopforth. "We are competing with the world and global technologies with limited funds and a small group of people while other institutions and organisations have big budgets and teams.

"Comprehensive, consistent funding would rapidly advance the project. There are numerous ways in which businesses can benefit by getting involved. Besides helping people, they would qualify for tax incentives and receive marketing exposure," commented Stopforth.

He called on universities to innovate and collaborate on research as this increases the prospects for positive breakthroughs in the country and on the continent. "Universities have the advantage of being able to try new technologies and ideas even if they don't initially appear plausible. If it doesn't work, a new research initiative is born and if it does, it's a breakthrough."

Stopforth's research interests include mechatronics, robotics, bio-mechatronics, drones and aviation, and accident investigation. His previous projects include search-and-rescue robots that can be used by firefighters, autonomous robots for industrial environments, and medical

monitoring devices. "I've worked on drones that can identify victims who are trapped in a fire. South Africa is the first country in the world to issue ICAO (International Civil Aviation Organization) approved remote pilot licences through the South African Civil Aviation Authority and I was the first academic engineer to obtain a Remote Pilot Licence which allows me to fly drones up to 400 feet. I've also been consulted by medical practitioners such as an orthopedic surgeon to find ways to prevent infection in prosthetics, and an anesthetist to monitor and control the anesthetic. My interest in medical and soft robotics assisted King's College London with their endoscopic probe which was developed in South Africa under my supervision.

"As an academic, I am driven to conduct research that has application and purpose. So much research is just theory and for publication, but the work cannot be applied or used to benefit people. Lower research output may not make me popular as an academic, but I am undertaking research that improves people's lives," he said.

So what does the future hold for the Stopforth Mechatronics, Robotics and Research Lab? Stopforth said the research group continues to focus on research on medical devices, as there is a need for further research in this niche field. "Recent events have shown there is an urgent need to solve problems in the medical sector. We are exploring research on medical devices used to solve problems during the height of the COVID-19 pandemic. We have been assisting different hospitals and doctors in the past two years, and in that way not only helping people, but medical staff and patients," he said. □

# UKZN ACADEMIC SHOWING HIS METTLE IN CANCER RESEARCH

WORDS BY GREG DARDAGAN

**Developing and making use of novel treatments for various forms of cancer, including triple negative breast cancer, would enable the country's pharmaceutical sector to grow, boosting the economy.**



**PROFESSOR MATTHEW AKERMAN.**

**U**KZN and Pietermaritzburg have always been central in the life of researcher and academic, Professor Matthew Akerman who is investigating the use of metallodrugs in the diagnosis and therapy of human cancers.

Akerman was born in the KwaZulu-Natal capital (Pietermaritzburg) and grew up in a suburb less than two kilometres from the then University of Natal's (UN [now UKZN]) Pietermaritzburg campus where many of the neighbours were professors or lecturers.

Academia was also in the family genes - Akerman's grandmother, who lived with them, was a senior lecturer at UN. "She would fetch me from pre-primary school and take me to her classes at the University where I would sit at the back of the lecture hall and colour in pictures

while chatting to students," said Akerman. "Education and civil service were important to my family. My mom was an English teacher and later the principal of Pietermaritzburg Girls High School while my dad was the head of the Pietermaritzburg City Engineers Department before he retired early due to health issues."

Akerman studied Chemistry at the University, attained his doctorate there and has been lecturing at the Institution for the past 12 years.

On the question of whether his research could lead to a cure for the disease, Akerman said cancer is in reality a group of several types of the disease and although they all have a common theme of rapidly dividing cells, they are quite different. "The new copper compounds we are working on are an exciting development, but it is more likely that they could be

used for treatment in a sub-set of cancer types. We have shown good results against non-small cell lung cancers and are now examining the application of the compound against a glioblastoma. The initial data looks promising, and we are investigating whether these results will translate into vivo success."

Akerman added that the main objective of the project is to develop novel copper(II)-based metallodrugs which can act as both chemotherapeutics when synthesised using natural isotopes of copper as well as tumour imaging agents using  $^{64}\text{Cu}$ . "Since copper is an endogenous metal, it is anticipated that it will lessen the severity of the side-effects associated with current chemotherapies. The redox activity of the copper(II) ion, which is likely to induce cell apoptosis through inducing DNA strand breaks in vivo, is also a relatively novel



mechanism of action. This may help to overcome the issue of resistance in secondary tumours (metastases) - an established problem with current chemotherapies.

"About 70% of cancer deaths occur in low and middle-income countries," said Akerman. "The high mortality rate is often linked to late diagnosis and the high cost of treatment. In South Africa and sub-Saharan Africa in general, there is a disproportionately high rate of triple negative breast cancer - the variant is difficult to treat if detected late and generally responds poorly to most of the currently available treatment regimens. We have shown that our copper compounds have a particularly good selectivity index for this type of the disease."

He said South Africa is in a unique position to develop radiopharmaceuticals with the facilities available at the South African Nuclear Energy Corporation (Necsa). "This would also lower the cost of treatment, allowing for wider access to treatment for a set of diseases with a high mortality rate. In addition to the therapeutic actions of the proposed compounds when using copper in its natural state, there is another dimension to the research project when the unique facilities at Necsa are considered. By radiolabelling the compounds with the  $\beta$ -particle emitting  $^{64}\text{Cu}$  isotope, the applications of the compounds may be extended to tumour imaging," said Akerman. "Since South Africa has these unique facilities, it would be in a strong position to become a world leader in this field. It could also generate the required isotopes at a reduced cost, allowing medical practitioners to test patients more frequently. This would allow for earlier detection and therefore lower mortality rates among cancer sufferers. If the cost of detection and treatment can be reduced, which should be possible, this would enable more equitable access to healthcare for the population in general."

Akerman was recently accepted by the National Cancer Institute (NCI) which is part of the National Institutes of Health in the United States to test compounds against a wider platform of tumours. This will hopefully offer insight into other applications of the compounds.

Copper is widely regarded as one of the most promising alternatives to platinum-based drugs as it is believed that endogenous metals are likely to cause fewer side-effects. The metal's favourable characteristics have driven research on a wide range of copper(II) chemotherapeutic agents.

"People are often surprised I have never left Pietermaritzburg, but I have had access to world-class teachers and lecturers here - there are amazing people and facilities on our campus," said Akerman. "I met my incredible wife, Kate, while at University. She also has a PhD in Chemistry and is a gifted teacher who is the head of Science at St Charles College in Pietermaritzburg." □



**PROFESSOR MATTHEW AKERMAN UNWINDS  
THROUGH SOME FISHING.**

# OPTOMETRIC READING TESTS FOR CHILDREN DESIGNED BY UKZN ACADEMIC

WORDS BY GREG DARDAGAN

**A passion to improve the reading skills of children with learning difficulties and visual impairments inspired Dr Urvashni Nirghin to develop and validate an isiZulu Paediatric Rate of Reading Test.**

**S**enior lecturer and researcher at UKZN, Dr Urvashni Nirghin has designed optometric English and isiZulu Paediatric Rate of Reading (PRR) tests for use on normal sighted and low vision primary school children.

During her research, Nirghin - who lectures and supervises both undergraduate and postgraduate candidates at the University's Optometry discipline - identified the lack of such tests as well as there being no PRR tests or reading rate norms which take cognisance of the South African context.

"With my main interest in paediatric optometry in the fields of vision and learning, I did my master's degree and PhD in this field and developed the two tests."

She said the English and isiZulu PRR tests comprise words familiar to South African learners between the ages of six and 12. The words are arranged on different test plates of varying sizes corresponding to a range of visual acuities suitable for youngsters with normal to low vision. The tests assess reading rate, the correct number of words read, types of errors made, and total time taken.

"The tests are extremely useful as they assess the reading performance of primary school children which can be compared with their peers and national standards, identify visual factors contributing to poor reading performance, and are used in the management of visual problems such as low vision devices and vision therapy to assess their progress," said Nirghin.

The design and validation of both the tests involved various phases. "The first phase included formulation of the content of the test to include the most common words used in books prescribed by the Department of Basic Education for primary school children. Through an extensive literature search and consultation with graphic designers, the tests were created. Thereafter, they were validated by experts in the field including optometrists and linguists as well as against international examination. The tests were then assessed for reliability on a sample population of primary



**DR URVASHNI NIRGHIN.**

school children in KwaZulu-Natal and proved valid and reliable," she said.

Nirghin is continuing to analyse results from her postdoctoral research which began in 2021. "I aim to develop the manuals for the tests with published reading rate norms and present them to optometrists, the Department of Basic Education and various other stakeholders in the healthcare sector while engaging in further similar studies focusing on vision and learning.

"Given my passion for paediatric optometry and more specifically the impact of vision on learning in children, I would like to see more collaboration between the Department, Optometry and the various healthcare sectors for more holistic management of early childhood developmental concerns and learning. I hope to play a pivotal role in such collaboration."

Discussing her early years, Nirghin said university life introduced her to a world of choices

but she had stayed focussed on her ultimate goal which was to be successful in life. "While at university, there were a lot of challenges, including financial responsibilities and staying in touch with my personal academic expectations. I found satisfaction in my achievements and personal growth. Thinking back to university life brings a smile to my face, not because I have forgotten the challenges, but rather the fact that I overcame them and still enjoyed each moment of that journey. I also reflect on the amazing friendships I developed with colleagues, some of whom have become lifelong friends."

A single mother of two daughters, Nirghin says she reflects on her life's journey and sees herself evolving into a better human being, with each obstacle encountered serving as an opportunity to excel in all areas of her life. "Just as I grow in my education and career, self-reflection and realisation are absolutely vital. With each passing day, I strive to have a positive impact on all those around me." □



# RESEARCH AIMS TO SECURE BRICS AGAINST SECURITY THREATS

WORDS BY TASCHICA RAMLACKAN

**What is expected to be groundbreaking research that will aid in securing the emerging BRICS economies against security risks such as social, medical, technological, and military threats is currently being undertaken at UKZN by a team of academics and postgraduate students.**

**L**ed by principal investigator, Professor Nirmala Gopal, UKZN academics and postgraduate students are conducting a study to identify ways to secure the five leading emerging economies, Brazil, Russia, India, China, and South Africa (BRICS) against criminological, economic, social, psychological, medical, technological, and military threats.

The two-year study aims to make sustainable and realistic recommendations to address security threats across the five countries. "Each year after a BRICS Summit, the alliance bloc adopts and releases a declaration whose primary purpose is to improve the lives of its citizens and beyond. This project recognises that security is multifaceted, and each facet significantly ensures holistic security," said Gopal.

In February 2023, the project hosted an International Round Table Conference in Cape Town. A follow-up international conference was also held in Gujarat, India. Gopal, who is a professor of Criminology at UKZN, said the primary purpose of the conferences and related seminars is to showcase the empirical and desktop research results of students and academic researchers in the team.

The study aims to establish a world-class reference-lab centre of multidisciplinary experts in security studies that designs security mechanisms for sustainable economic cooperation, protection, and mutual growth. It also aims to identify threats to deepening cooperation and to demonstrate the nexus between a peace and security-orientated BRICS, the Sustainable Development Goals (SDGs), and global sustainability.

These objectives are synchronous with the United Nations' SDGs, specifically SDGs 8, 9, 16, and 17 that focus on economic growth, productivity, peace, and justice through solid institutions. "The research is predicated on the notion that the contemporary international system has been dominated by a hegemon that pulls the political and economic strings of other countries. BRICS represents the economic interdependence of member states for multilateral benefits beyond the confines of regionalism and the political alliance of the



**PROFESSOR NIRMALA GOPAL**

wealthy nations. Other emerging economies are seeking membership of BRICS, further drawing it onto the centre stage of global power politics and threats. It therefore needs to invest in peace and security initiatives to facilitate sustainable development," said Gopal.

At least five national and international academics and three postgraduate students are participating in the project. Gopal noted "the transdisciplinary nature of the study, which is the new order of academic research — multiple voices for holistic and well-rounded solutions". She added, "Although it is just emerging from its infancy, the team and I are looking forward to the empirical results. The first round table conference served as an appetiser for what is sure to be exciting, ground-breaking research. As the South African principal investigator, together with the expert research group, I

will make policy recommendations on making BRICS more secure."

Gopal began her career in primary education in 1986. Her pursuit of knowledge led to Honours and Master's degrees in Criminology. She said that completing her PhD, which was the catalyst for her career in Higher Education, was a milestone. She is passionate about research, teaching, and mentoring younger academics and has used the grants she secured over the past decade to empower students and colleagues and ignite their passion for research.

Meanwhile, the BRICS bloc of developing nations recently agreed to admit Saudi Arabia, Iran, Ethiopia, Egypt, Argentina and the United Arab Emirates in a move aimed at accelerating its push to reshuffle a world order it sees as outdated. □

# LEGAL LEGEND A STREET LAW AND CLINICAL LEGAL EDUCATION INSTITUTION

WORDS BY GREG DARDAGAN

**Professor David McQuoid-Mason introduced Street Law - a human rights education programme - to thousands of high school pupils, university students, awaiting-trial prisoners and other members of the community in the mid-1980s, during one of the most repressive periods in South Africa, when states of emergency were declared on a regular basis and thousands of political activists were detained.**



**PROFESSOR DAVID MCQUOID-MASON SHAKES HANDS WITH THE LATE BRITISH MONARCH, QUEEN ELIZABETH II AT ST JAMES' PALACE IN LONDON.**

**V**eteran UKZN academic, Professor David McQuoid-Mason has been dubbed 'the Father of Street Law in South Africa' and 'the Father of Clinical Legal Education in Africa' and in many other parts of the world, having visited more than 132 countries to train and educate in these fields as well as assist with drafting legal aid legislation.

McQuoid-Mason has taught Law for 52 years from his base at UKZN where he is a Senior Research Associate, Acting Director of the Centre for Socio-Legal Studies, part-time LL.M and LL.B lecturer and a supervisor of Master of Laws and PhD students.

He established the first Law Clinic at the then University of Natal (now UKZN) in 1973, and the first Street Law legal literacy programme in South Africa in 1986 while engaging in various

other pursuits, including being a male model on a yacht in Turkey.

Would the 79-year-old legal eagle do it all over again given the chance? "Most definitely! I have been very blessed to have had the experience and the freedom to do it."

McQuoid-Mason was raised and attended school in Bulawayo in the then Rhodesia, going on to win a bursary to attend the University of Natal where he graduated with a B Comm in 1964 and an LL.B in Pietermaritzburg in 1966. Then it was time for adventure as he travelled the world hitch-hiking and having fun, including modelling on a yacht that cruised the Aegean Sea! On his return, he took up a teaching post at the University of Natal where he obtained his PhD in 1978. He was also awarded an LL.M from London University in 1979.

Setting up the Law Clinic to confront apartheid injustices in 1973 led to him working with members of the then banned African National Congress (ANC) and the Mass Democratic Movement. Before and after he became Dean of Law in Durban, he was an activist, working with like-minded people and committing himself to the struggle for democracy.

In the mid-1980s during one of the most repressive periods in South Africa, when states of emergency were declared on a regular basis and thousands of political activists were detained, McQuoid-Mason introduced a human rights education programme called Street Law to thousands of high school pupils, university students, awaiting-trial prisoners and other members of the community.

He managed this by ensuring that the programme was presented in an ostensibly neutral manner and that it was supported by influential members of the legal fraternity and educational departments.

He devised several other strategies to teach human rights to both opponents of the apartheid regime and the security forces, particularly during public protests and professional meetings, in a manner that conformed with the legal constraints of the time. The lesson learned was that provided creative methods are used, human rights can be taught in the most hostile of environments.

Said McQuoid-Mason: "In essence, Street Law is a programme designed to train Law students and others such as school teachers and community leaders to make lay people, primarily secondary school children, aware of their legal rights and where to obtain legal assistance. It helps people to understand how the law works, how it can protect them, what kinds of legal problems they should be aware of, and how they can resolve these problems. Street Law not only makes people aware of how the legal system can safeguard them, but also encourages them to think about the type of legal structure they would like in the future."





The first Street Law programme was established at the Georgetown University Law Centre in Washington DC in 1972 by a group of Law students who suggested that colleagues be trained to visit high schools to teach school children about the law. One of the students was Professor Ed O'Brien, who later became the Executive Director of the American Street Law Programme. Since then, the programme has spread throughout the United States and into more than 45 other countries.

McQuoid-Mason recalled: "In 1984, I met Professor O'Brien in the United States and invited him to South Africa in August the following year. It was not the most auspicious time as his visit coincided with the declaration of the first of a number of states of emergency by the apartheid authorities in terms of the Public Safety Act.

"Together with a non-racial teacher's association, I convened South Africa's first Street Law workshop at the Ecumenical Centre in Durban, to which we had invited a group of Black and White school teachers and secondary school pupils. Each teacher was asked to bring three pupils from their school.

"The dynamics of the workshop were very revealing because it was one of the few

occasions when Black and White school children interacted as equals. At the end of the workshop, the broad outline of a curriculum was drawn up."

He and O'Brien persuaded the Association of Law Societies and the Attorneys' Fidelity Fund to support Street Law, and by the end of the 1980s, programmes had spread in one form or another to 17 of the 21 Law schools in South Africa.

McQuoid-Mason has published more than 300 articles in law and medical journals, authored or co-authored 24 books and manuals, and contributed more than 70 chapters to books.

He has delivered more than 155 papers at national conferences and more than 220 internationally. He serves on the boards of several local and international human rights and cultural bodies, as well as the editorial boards of local and international legal, ethical and medical journals. He has received numerous accolades in South Africa and internationally.

"It has been a happy and fruitful time for me," said McQuoid-Mason. "I feel very humbled by the experience because I had the honour of being Dean of Law at UKZN for 13 years from 1983 to 1996 during turbulent times - from the

decline of apartheid to the advent of democracy. I was lucky in that the University was always very supportive of what I, as an activist Dean, and the students, did during the struggle for democracy."

Retirement is definitely not on his agenda! He is currently producing the second edition of his book, *Basic Trial Advocacy* written with a colleague at Christchurch University in New Zealand and is collaborating with colleagues at Monash University in Melbourne, Australia, and a young academic at the University of the Witwatersrand to write a chapter on Clinical Legal Education and Street Law in South Africa.

He has also been approached to assist Malawi with a strategic plan for its Legal Aid Bureau, and to run a Street Law workshop for the National Law School University in Delhi, India. In between, he is compiling his memoir.

McQuoid-Mason is married to Fiona Kirkwood, an internationally-recognised artist who has exhibited in more than 24 countries and specialises in art works and installations on social issues such as human rights, HIV and AIDS, climate change, wild life conservation, and COVID-19 using fibre and fabric. □

# PRESERVING MEMORIES AND HERITAGE THROUGH ROCK ENGRAVINGS RESEARCH

WORDS BY BAWINILE NGCOBO

**A research project based at UKZN's Centre for Communication, Media and Society is shining the spotlight on pre-industrial rock engravings and their relevance as heritage sites that have the potential for greater tourism and thus, job creation.**

**T**he year 2019 saw Professor Lauren Dyll, UKZN Centre for Communication, Media and Society (CCMS) Associate Professor; Dr Mary Lange, CCMS research affiliate; and Ms Nongcebo Ngcobo, CCMS master's student, head to Mashishing, Mpumalanga, to conduct a preliminary field trip for a historical collaborative research project on cross-cultural rock engraving traditions.

The ongoing multi-party research project aptly named "Marking Memories" sought to operationalise Indigenous Knowledge Systems in a diverse contemporary South African society by the inclusion of diverse African languages and comparisons of past and present rock engravings.

The project is based at CCMS and is led by Dyll, while Lange co-ordinates it on behalf of ARROWSA. Partially funded by the National Heritage Council, the project includes community leaders and families linked to the Boomplaats Rock Engraving Site, Mpumalanga; teachers and museum staff from Mashishing; as well as institutions and communities such as San traditional healers and crafters from the Kalahari.

Marking Memories was originally conceptualised and initiated by Emeritus Professor Roger Fisher from the University of Pretoria's Architecture Department, and builds on the Biesje Poort Rock Art Project which focused on the recording of previously undocumented rock engravings as well as the recording of the research teams' (including Kalahari representatives) stories inspired by the rock art site.

Said Dyll, "This project is a collaborative participatory project that includes multidisciplinary academics, practitioners, local peoples, organic intellectuals, and professionals (including educators, translators); bringing together diverse voices in the interpretation of South African heritage. Action and the particularity of place and people's experiences is this project's focus as it operationalises varying forms of knowledge and African languages in the readings of Bakoni rock engravings across time and cultures in Mashishing. It therefore fosters an atmosphere of sharing, across both cultural and temporal divides. Initially, the project objectives were to record oral interpretations



**PROFESSOR LAUREN DYLL, DR MARY LANGE, AND NONGCEBO NGCOBO ON THE FIELD.**

of the rock engravings and skills transference to on recording methods of engraved rock. However, as the project progressed, these outputs were enhanced in both scholarly and practical terms, for broader/public dissemination of the knowledge gained in the project."

Due to COVID-19 restrictions, Marking Memories was adapted to an online project. The project was initially envisaged as a short-term project (2019-2021) with the potential to become an ongoing project as more specialists, individuals and communities share their perceptions of South Africa's rock/engraving national heritage. The lack of computer equipment, online connectivity, bureaucracy and misalignment of reporting mechanisms between ARROWSA and the University are additional challenges that the team would have to overcome.

Said Lange, "COVID-19 changed the nature of the project to remote image driven that allowed further inclusion. Due to the pandemic, the team had to re-imagine the nature of the research and adapted to an image-driven electronic encounter by the participating groups with the selected artefacts. What has been discovered is that there are ways that projects, initially conceptualised as on-site fieldwork, can be adapted for further inclusion and diversity through the use of online engagement. This project has evolved into a hybrid research space. The digital virtual aspect became a

significant part of the project to continue with the inclusion of the initial team members and allowed further diversity and inclusivity by welcoming more participants from other areas in South Africa. This was a valuable outcome as more people could be included."

The research project has not been without success. While the project's initial objectives were the recording of oral interpretations of the rock engravings and skills transference, the project is currently writing a proposal for a book to be co-authored by the entire team as well as the design of an educational booklet for Grades 4 to 6 to bridge the local heritage knowledge gap (including engraving tradition) within the school curriculum.

"The educational booklet builds ARROWSA's multiple intelligence and critical diversity literacy approach by appealing to more than the written literary and mathematical intelligences but provides exercises that allow learners with other strengths such as spatial and musical intelligences also to shine. Particularly innovative is the inclusion of phrases and greetings in Nama, a Khoe-San language, as well as other indigenous languages. It also includes original illustrations, just one example of how the project has created short term employment for artists and translators. The team's discussions with JP Celliers and a tour of the museum and surrounding heritage sites identified the role that a new tourist brochure and a documentary video could play in the dissemination of the project's research, especially if these outputs engaged a diverse team and included the voices of indigenous people," added Lange.

Dyll – who, as an academic, is driven by the "exchange of knowledge, connecting to others, facilitating skills and the inclusion of students for 'learning outside' the classroom, as well as the protection and lively debate of heritage, including intangible heritage" – said the project's allocated funding of R120 000 belies the scope of research that has been achieved; thanking funders and team members for their patience, perseverance and willingness to share knowledge. "The Lydenburg Museum and the Mashishing community team have exceeded all expectations," she said. □



# UKZN HI-TECH AGRICULTURE AND TRADITIONAL MEDICINE CENTRE PROMOTES ENTREPRENEURSHIP

WORDS BY COLLEEN DARDAGAN

**Young agri-entrepreneurs and traditional medicine practitioners looking to get ahead in their chosen careers are set for a major boost with UKZN accelerating its drive to support their education.**

**U**KZN has accelerated its drive to support education for young agri-entrepreneurs and traditional medicine practitioners looking to get ahead in their chosen careers.

The UKZN Agriculture and Traditional Medicine Centre for Entrepreneurship Rapid Incubator (CFERI) set up to promote enterprise development among young people is not only a first for the University; it aims to commercialise the production of medicinal crops and services that benefit young farmers and traditional healers.

The Centre offers young people temporary, exclusive and affordable access to a small farm fitted out with the necessary infrastructure to improve their farming and business capabilities in a material setting.

The agriculture site is linked to the UKZN Agriculture campus in Pietermaritzburg, while the traditional medicine stream is housed on the Howard College campus, where the youngsters will have access to a laboratory facility and business support centre.

Professor Tafadzwanashe Mabhaudhi, an Honorary Associate Professor and Head of the Centre for Transformative Agricultural and Food Systems (CTAFS) in the School of Agricultural, Earth and Environment Sciences, said this is an invaluable opportunity for young aspiring farmers to practice and learn basic skills in a low-risk environment. "It gives them both the practical experience and the knowledge they need to make informed business decisions. When the youngsters move out independently and set up their own businesses, they will have a better chance of succeeding as agri-entrepreneurs."

The Traditional Medicine Centre's core focus is the development of crops used in traditional remedies while at the same time providing training and development in technology, best business practice and technical guidance. The training is linked to the safe use of traditional medicine and the propagation and production of the plants used in various therapies.

Mabhaudhi said the priority is to support and assist young practitioners and entrepreneurs to commercialise their services, while also producing farmers skilled in growing and harvesting the various crops used by traditional

healers. The programme is unique in terms of including all the services, products and support required for agriculture and traditional medicine ventures.

Funded and supported by the Small Enterprise Development Agency (SEDA), the Centre is co-led by Mabhaudhi and Professor Nceba Gqaleni who heads up the Traditional Medicine Laboratory on the Howard College campus.

Mabhaudhi said that while the programme comprises two learning streams (agriculture and traditional medicine), the model allows for seamless interchange and interaction among students.

The course will start with 10 successful applicants for each separate stream of learning.

Mabhaudhi said the programme's contribution to environmental protection, economic upliftment, and growth will be wide-ranging.

"The accelerator provides a leg-up for student start-ups and previously disadvantaged young farmers. Once they have signed up for the course and been accepted, they will have the ideal opportunity to benefit from the nurturing and supportive environment during their enterprises' early and developmental stages."

The agriculture component of the programme includes field crop production, integrated organic agriculture, farm design and business management, bio fencing, permaculture methodologies, soil ecology and nutrition, agricultural technology and mechanisation, weed management, organic manures, composting and fertiliser, zero waste farming, as well as land, soil, water and irrigation management. The traditional medicine component includes short courses on traditional medicine and producing safe traditional medicines, indigenous knowledge, certification and standards, occupational health and safety, and the regulatory framework for marketing medicines.

The programme's scope includes reduced barriers to entry via access to equipment, meeting facilities and on-site business and technical assistance without overhead and operating costs during the critical formative years; networking and mentoring through the provision of sources of capital, partners, suppliers and investors; as well as credibility and profile in

the marketplace. The success of these businesses will have overarching socio-economic benefits for neighbouring communities such as new employment opportunities, particularly in township and rural areas. In the long term, this programme aims to create a progressive, forward-thinking society able to encourage and support sustainable living while at the same time harnessing the power of technology to improve society.

"Entrepreneurs are vital to the success of the South African economy, particularly in the agriculture sector. Developing economies in rural and township settings lies at the heart of this programme, while at the same time providing employment opportunities, especially for women and the youth, and therefore increased tax revenue for the country," Mabhaudhi said. □



**PROFESSORS NCEBA GQALENI (ABOVE) AND TAFADZWANASHE MABHAUDHI.**



# A PEEK INTO THE FASCINATING WORLD OF CHEMICAL ECOLOGY

WORDS BY LEE RONDGANGER

**One of the key challenges facing pollinators today is the loss of natural habitats. While the study of chemical ecology may not have a direct impact on the conservation of pollinators, it can inform efforts to manipulate flower volatiles in agriculture to both attract desirable pollinators and repel undesirable ones.**

**T**he world of pollination is a complex web of interactions between plants and pollinators.

It involves the transfer of pollen from the male reproductive organs of flowers to the female reproductive organs, which results in fertilisation and the production of seeds. However, what may appear as a simple process to the naked eye is a complex dance that involves various factors, including chemical signals.

Professor Steven Johnson, the Director of UKZN's Centre for Functional Biodiversity and a National Research Foundation (NRF) A-rated researcher, is at the helm of this fascinating research into chemical ecology on the African continent.

Johnson has been with UKZN since 1997 with his research focus on pollination biology, evolution, plant speciation, insect-plant relationships, invasive species, chemical ecology and floral mimicry.

He held the Department of Science and Technology (DST)-NRF South African Research Chairs Initiative (SARCHI) chair in Evolutionary Biology from 2007 to 2021 and has been an associate editor of several international journals, including *Proceedings of the Royal Society B: Biological Sciences* and *Biological Journal of the Linnean Society*. He is the author of *Orchids of South Africa: A Field Guide* (2015), the first complete field guide to local orchids to be published in over 30 years, as well as *Floral Mimicry* (2016), an academic book on the evolution of flowers that deceive pollinators through mimicry.

When he is not out in the field - at one of his three research sites spread across KwaZulu-Natal - Johnson can be found at his world-class lab at the University, mentoring PhD students and assisting colleagues from Africa and around the world who visit UKZN to use the lab.

The chemical ecology of pollination systems is the study of the interactions between plants and their pollinators through the use



**PROFESSOR STEVEN JOHNSON.**

of chemical signals. These include the floral odours, nectar, and pigments that plants produce to attract pollinators. The signals are essential for pollinators to locate and identify flowers which they use as food sources, while plants rely on pollinators for reproduction. Therefore, chemical signals are a critical aspect of the pollination process.

In addition, when animals interact with plants, it is usually because they want to eat their

leaves or fruit, or consume nectar or pollen Johnson explained.

"Plants have developed ways to defend themselves against animals by producing bitter-tasting chemicals that prevent animals from feeding on them. However, in some cases, animals play a useful role in plant reproduction, such as pollinators or seed dispersers. In these cases, plants need to be attractive to animals





and use advertising strategies involving visual or scent cues or a combination of both," he said.

Johnson added that chemical ecology is a relatively recent field that took off in the late 1950s with the discovery that insects use chemical signals to find their mates.

"The development of gas chromatography linked with mass spectrometry in the 1960s and 70s allowed scientists to analyse very small quantities of chemicals in plants and insects and study their chemical structures. This breakthrough made it possible to identify specific chemical volatiles that plants use to communicate with insects."

One of the key challenges facing pollinators today is the loss of natural habitats. While the study of chemical ecology may not have a direct impact on the conservation of pollinators, it can inform efforts to manipulate flower volatiles in agriculture to both attract desirable pollinators and repel undesirable ones. For example, selective breeding or hybridisation can change the volatile composition of crops, affecting the attraction of bees.

'Volatile' is an important term in chemical ecology research. A volatile is a chemical that can volatilise or become airborne. Johnson explained that when we smell something, we're smelling small chemicals that are swirling around in the air. Thousands of non-volatile

chemical compounds that don't become airborne are also found in plants and animals. They perform important functions, but don't influence smell. Researchers focus on volatile compounds because they are key signals of communication.

Chemical ecology research may sound complex, but it has a real-world impact on protecting crops from pest insects.

Johnson also has a fascination with the use of smell in pollination systems and his research focuses on unusual pollinators such as beetles, flies, rodents, and fruit bats. He said that his typical day in the field involves collecting scent compounds from flowers, trapping insects, and analysing pollen to determine if they are pollinators.

He added that his research is critical in understanding the origins of new plant species, the importance of deception in the natural world, and in protecting agricultural crops.

Johnson works closely with his colleague, Dr Adam Shuttleworth who is an expert on using electrophysiological methods to determine which volatiles can be detected by insects' antennae. Their students and postdoctoral researchers work with the citrus and sugarcane industries to identify volatiles from fruits or insects that can be manipulated to prevent crop damage.

"Essentially, they find ways to trap or deter pests using particular volatiles or mate attraction techniques," he explained.

But how does this benefit the general public?

"Understanding chemical ecology helps us appreciate the natural world beyond just its visual components," said Johnson.

"There's a whole world of communication happening with thousands of different volatiles controlling the behaviour of plants and animals. By studying these volatiles, we can better understand how they find food and mates, for example. This knowledge helps us protect crops and preserve biodiversity."

Johnson believes that UKZN's Centre for Functional Biodiversity Lab and its research into chemical ecology has an important role to play not just in South Africa, but the world: "This is a completely new avenue of research. What we're doing is establishing a kind of a chemical ecology group."

"I think that it's important not just for the University, but for South Africa and even Africa because it's probably the strongest chemical ecology group of any university on the continent in terms of the available equipment and expertise," he said. □

# DRONES AT THE FOREFRONT OF SMALLHOLDER FARMING SOLUTIONS

WORDS BY COLLEEN DARDAGAN

**Artificial intelligence and the increased use of technology to improve food production in order to meet the growing needs of an overpopulated world and mitigate against the impact of climate change in agriculture are under the spotlight at the University.**

**U**nmanned aerial vehicles (UAVs) are becoming an indispensable tool the world over for improved agricultural practices and at UKZN, this technology is the key in studies looking to improve food security among smallholder farmers.

Artificial intelligence and the increased use of technology to improve food production in order to meet the growing needs of an overpopulated world and mitigate against the impact of climate change in agriculture are under the spotlight at the University.

Critical research funded by South Africa's Water Research Commission is underway to investigate:

- The use of drone technology to monitor the state of crops to improve water use productivity with precision agriculture and improved irrigation scheduling – Dr Mbulisa Sibanda;
- Unmanned aerial vehicle high-throughput phenotyping of neglected and underutilised crop species (NUS) for improved water use and productivity in smallholder farms – Dr Mbulisa Sibanda;
- Leveraging the Google Earth engine to analyse very-high spatial resolution UAV data to guide and inform precision agriculture on smallholder farms – Dr Shaedon Gokool; and
- Assessing the utility of drone technology in monitoring water availability and quality in irrigation canals and dams to improve crop water productivity and enhancing precision agriculture on smallholder farms – Ms Tsitsi Bangira.

The drones used in the research projects are Matrice 300 drones by DJI (Da-Jiang Innovations headquartered in China) integrated with a multispectral MicaSense Altum camera which captures data across six spectral bands.

Agrometeorology lecturer, Professor Alistair Clulow, who is involved in the interdisciplinary studies, said the research primarily focuses on smallholder farmers with fields of between 0.5 and one hectare. The UAVs are primarily used for crop monitoring to potentially guide



**PROFESSOR ALISTAIR CLULOW.**

and inform precision agriculture applications to assist smallholder farmers to improve the efficacy of their crop management and boost their yields for better household food security," he said.

Crops under investigation include staples such as maize, sweet potato and *amadumbe* (popularly known around the world as taro root or colocasia esculenta. The starchy root vegetable is a staple in many households in South Africa). Clulow said the postgraduate students working on the research projects are engaged in specific studies using drone flights and processing imagery to come up with practical and applicable conclusions. The solutions or outcomes are then assessed for their value and contribution to the practical and sustainable production of food and crops by smallholders. "The work the students do forms the basis of their MSc and PhD qualifications. Our aim is to get a better idea of the value the drones have to offer smallholder farmers, how the technology can be used to improve production and how the often-limited resources available to such communities can be optimised." Clulow added that the studies also focus on setting

suitable indicators or benchmarks to describe crop health and crop variability. The use of drones could assist in assessing crop health and incidences of disease or pest infestations, allowing for rapid interventions. "They centre on low-income, smallholder farmers where the economic risk of agricultural ventures is higher than average. It is in these communities that poor crop production or failure is felt the most because they don't have the resources to mitigate against diseases or to boost yields through irrigation systems. Unlike commercial farmers, they are usually unable to afford insurance to cover crop failures or damage such as during the unprecedented flooding experienced in KwaZulu-Natal in early 2022. Smallholder farmers typically have very little support," Clulow said.

Drones are increasingly taking centre stage in both the media and in modern or smart agriculture. They are seen as a useful tool to detect canopy and crop health, among several other things.

However, Clulow warns there are limitations, including fixed wing versus quadcopters. Camera quality and processing software is also continuously improving. Furthermore, the cost of the equipment and expertise required to operate, process and synthesise the information from the imagery is well beyond the means of smallholder farmers.

"The only way for these farmers to benefit from the technology is if they combine their efforts to employ service providers to produce imagery at specific intervals to provide early warning of potential crop health issues."

Clulow said that one of the projects under the auspices of the University is past the half-way mark while others are still in their infancy.

"We are really grateful to the Water Research Commission which has provided most of the support for our work thus far. However, I believe that there is a need for broader collaboration on drone research as South Africa needs as many interested parties as possible. I would like to see much more collaboration between government departments, research groups, the private sector and academic institutions." □



# UKZN-TANZANIA RESEARCH PROJECT DELIVERS STRIGA-RESISTANT SORGHUM

WORDS BY COLLEEN DARDAGAN

**The Striga parasitic weed is one of the major biotic constraints limiting the production and productivity of cereal crops on the African continent. Researchers at UKZN and in Tanzania have bred candidate Striga-resistant sorghum lines, providing excellent control of key Striga species in sorghum.**

A mutually beneficial partnership and landmark study between South African and Tanzanian academics have added a critical element to the management of Striga infestations in sorghum in resource-poor communities on the African continent.

Spanning seven years, a study by UKZN and the Tanzania Agriculture Research Institute (TARI) has resulted in two new Striga-resistant sorghum varieties significant for improved food security in Africa.

Striga, a parasitic weed, is one of the major biotic constraints limiting the production and productivity of cereal crops on the African continent. These include maize, sorghum, pearl millet, finger millet and rice. Yield losses of between 30% and 90% are regularly reported in Africa's resource-poor and rural communities.

While sorghum is increasingly topping the menu as a superfood and 'powerhouse grain' among the world's vegan and health-conscious elite, the nutrient-rich grain has featured as a staple among some of Africa's poorest people for centuries.

Developing strategies to improve crop yields has never been more urgent as experts predict that climate change will have a dire impact on food security, particularly in the continent's semi-arid regions.

Deputy Director of UKZN's African Centre for Crop Improvement (ACCI), Professor Hussein Shimelis said the two new sorghum varieties were released in January 2021 and approved and registered through the Tanzania Official Seed Certification (TOSCI) agency. Seed propagation is the next crucial step following the certification agency's regulations for commercialisation.

"Tanzanian farmers are keen on using the seeds of these two new varieties which will now undergo trials in South Africa and neighbouring Southern African Development Community (SADC) countries in phase two of the study," Shimelis said.

The Striga-resistant varieties are used together with a biological control agent called Fusarium



PROFESSOR HUSSEIN SHIMELIS.

oxysporum F.sp strigae or FOS. "Over the years, several control methods were recommended to reduce the Striga infestations such as resistant varieties, bio-control agents, cultural practices, and chemical control methods. However, the cost of some of these was beyond the means of smallholder farmers," he said.

Furthermore, research has shown that the parasitic weed requires a toolbox of effective and durable antidotes. "No single option has proven effective to stop the spread of Striga. Farmers have also consistently resisted using previously released sorghum varieties capable of increasing yield as they lacked preferred traits such as tall stems," said Shimelis.

He added that the best option for successful control is an integrated Striga management (ISM) approach. "The use of FOS is a critical component of the ISM. It has been confirmed as an eradication method, particularly when used with resistant crop varieties which have the expressed traits the farmers prefer. However, FOS is yet to be registered and commercialised in South Africa or Tanzania."

The partnership with the Tanzanian research institute began in 2013 when Dr Emmanuel Mrema accepted a place to study for his PhD at UKZN's ACCI in the School of Agricultural Earth and Environmental Sciences. Mrema's studies

were funded by the Alliance for a Green Revolution in Africa (AGRA). His thesis was titled: *Integrated Striga Management in Sorghum through Resistance Breeding and Biocontrol in the semi-arid regions of Tanzania*.

In his report, Mrema noted that research and strategies to develop an ISM system through the development of resistant varieties together with the use of FOS was based on the reality that sorghum is the "staple crop of millions of households" on the African continent.

PhD student, Dr Rebeka Gebretsadik from Ethiopia, and South African MSc student, Athenkosi Makebe, worked with Mrema on the research.

"In the first year of their studies, the students carried out rural evaluations in Tanzania, Ethiopia, Uganda, South Africa, Kenya and Zimbabwe. They interviewed hundreds of farmers to establish the abiotic and biotic factors affecting their crops. The impact of Striga on crop losses was discussed in-depth. The picture that emerged showed that infestation was on the increase, particularly in the drier regions of the continent and disproportionately where sorghum was traditionally grown. Furthermore, the discussions revealed that Striga was worse where soil fertility was poor, or no fertiliser was applied to the fields. Further contributors included cereal mono-cropping, the production of susceptible varieties and a lack of adequate agricultural land to allow for inter-cropping or longer fallow or rest periods between harvests," Shimelis said.

The new Striga-resistant lines have been shared with students across the countries to enable the transfer of candidate genes into locally adapted and farmer-preferred sorghum varieties. "This reduced breeding costs, saved time and meant less duplication, which speaks volumes for the benefits of partnerships and teamwork between academics and universities on the African continent as they search for solutions to Africa-specific problems to ensure that the billions of people who live on this continent have the necessary tools to provide food for themselves in the face of the challenges racing towards them due to climate change and global warming," said Shimelis. □

# HARNESSING INNOVATION TO CREATE JOBS, IMPROVE FOOD SECURITY AND MITIGATE CLIMATE CHANGE

WORDS BY GREG DARDAGAN

**SHAPE – which will see UKZN focus on investigating agricultural entrepreneurship among the youth in South Africa using a social innovation development strategy – seeks to develop a systemic action learning and action research postgraduate curriculum that will reduce unemployment, improve food security and soften the impact of climate change.**

**U**KZN is one of 23 international universities involved in a wide-ranging systematic action learning and research programme to advance entrepreneurial development and research partnerships between Higher Education Institutions in Africa and the United Kingdom (UK).

The Innovation for African Universities (IAU) programme - designed and funded by the British Council - is implemented by the Centre of Excellence (CoE), a partnership between the Council, University of London, University of Nairobi, and Change School UK.

UKZN's priority is to investigate agricultural entrepreneurship among the youth in South Africa using a social innovation development strategy known as Shifting Hope and Activating Potential Entrepreneurship (SHAPE) founded by Dr Thea van der Westhuizen, Academic Leader in the School of Management, Information Technology and Governance (SMIG) at the University and lead of the current project.

SHAPE was a winner at the Innovative Youth Incubator Awards at the 6th international Conference on Innovation and Entrepreneurship in Washington DC, United States, in 2018.

Also awarded the National Research Foundation's Best Youth Development Organisation in KwaZulu-Natal in 2014, SHAPE seeks to develop a systemic action learning and action research (SALAR) postgraduate curriculum that will reduce unemployment, improve food security and soften the impact of climate change.

The cyclical year-long research project run in partnership with Swansea University in the UK, Council for Scientific and Industrial Research in South Africa, University of the Cape Coast in Ghana, and the Liv Agriculture – Liv Village in Verulam, KwaZulu-Natal, reached its final stages towards the end of 2022 to be presented by van der Westhuizen and her team to the British Council during this year.

Van der Westhuizen identified the four objectives of the current SHAPE project as (1) establishing a formal research entity at UKZN; (2) conducting a series of workshops aimed at



**DR THEA VAN DER WESTHUIZEN.**

upskilling agricultural management concepts; (3) developing a curriculum that will qualify for a Postgraduate Diploma in Agriculture and Entrepreneurship; and (4) the publication of the research.

The project involves three of UKZN's four Colleges (Law and Management Studies; Humanities; and Agriculture, Engineering and Science), with collaboration from academics in the Schools of MITG, Agricultural, Earth



and Environmental Sciences, and Education. In terms of challenges, van der Westhuizen said the initial stage of forming relationships and figuring out how to connect the dots had taken the longest.

Prior to coming to UKZN, she founded and managed several hospitality and education ventures in the Western Cape before relocating to the United Arab Emirates where she was involved in similar projects for more than 10 years.

She joined UKZN as a lecturer in 2013 and obtained her PhD in Leadership. Her research interests include Leadership, Management, Psychology, and Education. She has also authored or co-authored several books.

An authority in the field of entrepreneurship development, van der Westhuizen was appointed the first national chairperson of the Entrepreneurship Development in Higher Education (EDHE) Community of Practice (CoP) for Entrepreneurship in Academia. The CoP represents researchers and academics who support entrepreneurship development through teaching, learning and research across disciplines.

"I started to participate in projects through EDHE with the British Council that built on the concept of SALAR," she said. "A nationwide entrepreneurial eco-system baseline study was completed in South Africa, Kenya, Nigeria, and Ghana which led to the British Council's IAU programme to advance entrepreneurial development and research partnerships between Higher Education Institutions in Africa and the UK."

When the IAU called for projects, she used the concepts and strategies she had developed with her team at UKZN, upscaling from a micro-project to an international one. UKZN was invited to present its project to an International Association of Higher Administration Conference this year through a paper: "Stop Teaching and Start Inspiring" by van der Westhuizen.

"The achievement for me as an individual is that we came up with novel and original findings 10 years ago. We piloted and tested them and the project grew into a much larger concept. Thus, there are two significant achievements, one commercial where we were awarded the project by the British Council, and the other scholarly where thoughts, models and frameworks we created were regarded highly enough to be significantly funded on a large scale. I believe I have produced innovative concepts and impactful research over the past 10 years... it is a living theory."

Born in Potchefstroom, van der Westhuizen grew up with parents who were academics. However, she said, "I always wanted to be a business person! My time in the Middle East completely changed my thinking towards education and I used the experience and knowledge gained as I ventured into academia in South Africa."



When she decided to return to South Africa she chose Durban as her new home and began her academic career at UKZN, "enjoying the sunshine and great sporting opportunities".

- SHAPE is funded by the National Research Foundation of South Africa (Thuthuka Grant Number: 122002).
- For further information, go to <https://shapentrepreneurs.com> 





# AUDACIOUS CELLULAR AGRICULTURE MEETS GLOBAL AWARD CHALLENGE

WORDS BY COLLEEN DARDAGAN

**With a sharp decrease in available arable land on which to produce food coupled with a growing global population, traditional meat production may need help to keep pace. Cell-cultivated meat could be a more sustainable way to meet this demand and ensure sustained and ethical supply to meat.**



PROFESSOR CAROLA NIESLER AND DR CELIA SNYMAN.

**A**frica's only semi-finalist in the XPRIZE Feed the Next Billion competition are advancing their meat production methodologies using cellular agriculture to address the continent's growing food security threat.

In a collaboration between some of South Africa's finest scientific minds at UKZN and the Tshwane University of Technology, the development of cellular agriculture tools to generate meat-related products has made great strides.

What began as a bid to support conservation by storing cells cultured from various wildlife species has evolved to become an integral part of a movement towards food security on the African continent while at the same time

addressing some of the ethical issues linked to industrial farming.

Dr Paul Bartels, CEO of the Mogale Meat Co, which is headquartered at the Hartbeespoort Dam outside Pretoria, first had the idea of storing cells cultured from various wildlife to support conservation using cellular agriculture. His aim was to make cell-based meat accessible 'to all'.

But it was the global 'future-positive' movement XPRIZE that provided the impetus for what is now a unique partnership.

Bartels contacted laboratories with expertise in plant-based products for food such as Professor Thierry Regnier and Dr Belinda Meiring

of the Department of Biotechnology and Food Technology at the Tshwane University of Technology as well as labs with expertise in cell culture to support cell-mass production such as the one on UKZN's Pietermaritzburg campus in the School of Life Sciences under the leadership of Professor Carola Niesler and Dr Celia Snyman.

What followed was a not-for-profit consortium named MeatOurFuture (<https://meatourfuture.org>) a public-private partnership between the Mogale Meat Co, UKZN and the Tshwane University of Technology.

The XPRIZE is a global competition that promotes the development of 'audacious and achievable' ideas using collaborations that





harness the genius of everyday individuals to solve problems for the benefit of humanity across a range of issues, from food security to climate change and space travel, to name but a few. In 2022, MeatOurFuture was announced as the only African semi-finalist in the US\$15 million (R272 million) XPRIZE Feed the Next Billion competition.

“When the XPRIZE Feed the Next Billion competition on food security was launched it provided an ideal opportunity to bring together experts from different institutions that supported Dr Bartels’ vision,” Niesler said.

The multi-year competition incentivised the participating teams to produce chicken breast or fish fillet alternatives to replicate or outperform conventional chicken and fish in terms of environmental sustainability, animal welfare, affordability, nutrition, and taste and texture.

Furthermore, the solutions should provide a more environmentally friendly, sustainable path to meet demand for meat products while advancing food systems (improve product design, nutritional value, production and supply chain) and animal welfare (counteract the increase in the number of animals kept in areas that are not growing correspondingly and the related health concerns).

The competition was developed in response to the release of XPRIZE’s Future of Food Impact

Roadmap, an in-depth analysis of global food system challenges that identified 12 radical breakthroughs which could establish a more food secure and environmentally sustainable world by 2050. The critical impact zone that XPRIZE Feed the Next Billion competition addresses is the need for alternative proteins at-scale. Although the MeatOurFuture team did not reach to the finals of the XPRIZE, the journey since 2021 has paved the way for the collaborators to make substantial progress in their quest to produce nutritional products that meet the stated criteria.


Niesler said that given global population growth coupled with a sharp decrease in available arable land on which to produce food, particularly on the African continent, scientists worldwide are under pressure to come up with viable and accessible solutions. Africa’s population is expected to exceed four billion by the end of this century, significantly increasing the need for adequate and viable food production.

“Increased demand for animal meat products will need to be addressed through alternative approaches, such as cellular agriculture. Keeping more and more animals in ever shrinking spaces is unsustainable and unethical.

The benefit of our collaboration and research is that it works towards providing a local solution to food production without putting additional

strain on current agricultural resources. It also offers the opportunity to train scientists, engineers, entrepreneurs etc. in the globally growing area of cellular agriculture, while giving consumers a more viable choice of what they might like to eat based on how that food is produced or on its nutritional value.”

In response to being announced as semi-finalists in the XPRIZE Feed the Next Billion competition in 2022, Niesler said the group worked hard to improve the yield of primary cultured chicken cells, including fat and muscle stem cells as well as supporting cells. “Ultimately, we want to propagate these cells effectively with minimal use of media and to generate cell lines that are immortal so that the least number of animals is used to generate the initial cell mass. We are also keen to provide postgraduate training and education in the field of cellular agriculture through a range of collaborative links.”

So, where to from here now that the XPRIZE road has come to an end? For the team, this opportunity was critical and provided the springboard for future endeavours that are currently being planned. “Our learning curve was steep, but invaluable. We are now ideally positioned to achieve the initial vision. Watch this space!” 

# UKZN SPEARHEADS REINTRODUCTION OF NEGLECTED TRADITIONAL CROPS

WORDS BY COLLEEN DARDAGAN

**A landmark project that has already trained hundreds of farmers is actively promoting the production and commercialisation of underutilised indigenous and traditional crops.**



PROFESSOR TAFADZWA MABHAUDHI.

**B**ringing traditional crops once grown by people in deep rural areas back into the mainstream is critical for household food security and offers unique agri-business opportunities for young people in South Africa's remote districts.

Age-old farming methods combined with contemporary technology are at the heart of a UKZN programme to boost the production, productivity and utilisation of traditional crops in KwaZulu-Natal's rural districts.

Worldwide, and particularly in developing countries, scientists and researchers are calling for a return to indigenous knowledge for crop production to secure a food supply and reduce

industrial mono-crop production's destructive impact on the environment.

UKZN's Centre for Transformative Agricultural and Food Systems has established a landmark programme to boost the production and commercialisation of indigenous and traditional crops such as amaranthus, *amadumbe*, bambara groundnuts and sweet potatoes.

The programme has already trained and equipped 500 smallholder farmers from five different districts in KwaZulu-Natal: uGu, uMgungundlovu, Harry Gwala, uThukela, and eThekweni.

Honorary Research Professor Tafadzwa Mabhaudhi, who heads up the programme,

said it is designed to harness indigenous knowledge and the power of technology to promote innovation linked to crop production, particularly organic farming and the harvesting of seed.

"Rural people are considered the most vulnerable to economic hardships such as climate change, social unrest, high food prices, rolling power outages and unemployment. Indeed, at the household level, most rural communities in South Africa are considered food insecure," Mabhaudhi said.

The Department of Science and Innovation-backed programme is directly linked to creating agribusiness operations using



cooperative models, which would allow for improved access to markets due to economies of scale.

“The farmers are trained on the agriculture value-chain in its entirety which we are optimistic will allow for improved sustainability of product supply. Cooperatives also boost buying power which can lead to a notable reduction in input or operational costs,” he said.

Mabhaudhi added that as the global agrifood system is unsustainable and has failed to equitably meet the global population’s basic food needs despite advancing technology, indigenous and traditionally grown crops have great potential to improve household food and financial security, especially in marginal areas.

“Food security and household financial security depend on developing more resilient agricultural practices among smallholder farmers. Research has shown that indigenous crops are naturally adapted to extreme environmental conditions such as poor soils and low levels of water stress. They can be grown successfully in

various climatic conditions with very few inputs such as fertiliser,” said Mabhaudhi.

However, the use of traditional crops has dwindled over the years, and their successful production has been largely neglected. “Traditional legumes such as bambara groundnuts and cowpeas are consistently reported as ideal for low-input agricultural systems. They grow well in marginal areas, which are often synonymous with South Africa’s smallholder rural landscape,” he added.

A further important goal is to meet the needs of young people in these landscapes in order to curb their exponential movement to urban centres.


“The primary goal of most of today’s youngsters is to make money and, coupled with the desire to innovate, this is one of the main reasons you will find young people participating in the rural economy.

“Our young people want exciting activities like making fried sweet potato chips or cowpea peanut butter. They want to take rural

agriculture to the next level, graduate as well as own and run agri-enterprises that meet unique market niches and demands; and this is why the UKZN programme is so fit for purpose.”

Mabhaudhi noted that in the past, resources and research were generally focused on commercial agriculture and the production of a few exotic cereal crops such as maize, wheat and rice with markets to support them. “This led to a decline in the production of traditional crops. The green revolution has done the rural smallholder economy no favours.

It promotes monocropping and commercial farmers as the fundamental role players in the food system.

“Our programme is about bringing back the relationship and history between traditionally grown sustainable crops and people. It’s about debunking the stigma linked to these foods and rolling back the scarcity of agronomic information on how to grow them sustainably while at the same time, securing rural people’s economic and social wellbeing.” 



# ROCKET RESEARCH PROGRAMME LAUNCHES INTO NEW ORBIT

WORDS BY LEE RONDGANGER

**Over the past 13 years, Aerospace Systems Research graduates have become sought-after by industry and have gone on to work for major South African entities such as the Denel Group, Armscor, Aerosud, Naval Africa Design, and Milkor.**



**PROFESSORS MICHAEL BROOKS (LEFT) AND JEAN PITOT.**

**U**KZN's rocket research programme propelled to new heights this year when it changed from a research group to an institute.

The UKZN Aerospace Systems Research Group (ASReG) became the UKZN Aerospace Systems Research Institute (ASRI) - a move that will accelerate the programme's technology development work.

The Aerospace programme within the discipline of Mechanical Engineering was established in 2009 by Professors Jean Pitot and Michael Brooks. While Pitot served as the

head of the research group, Brooks now serves as the leader of the new institute. "We are really excited about this new institute," said Pitot. "It will enable us to accelerate our technology development work, which is central to what we do. As that development work unfolds, we will enhance our ability to train and upskill postgraduate students in areas of aerospace engineering and mechanical engineering."

The Institute will also participate in outreach programmes to stimulate interest in science, technology, engineering, and mathematics (STEM) among the wider community, especially high school learners.

Pitot said that high schools will be invited to visit the test range where they will see the rockets and take part in lectures.

While the ASRI will continue to focus on designing, developing, and testing aerospace propulsion and flight systems, by becoming an institute, it will be able to focus on research and external research on behalf of corporate clients in addition to academic outputs.

And they have the reputation to back it up.



Over the past 13 years, Aerospace Systems Research graduates have become sought-after by industry and have gone on to work for major South African entities such as the Denel Group, Armscor, Aerosud, Naval Africa Design, and Milkor. Two graduates have been awarded PhDs by prestigious international universities, and two have been head-hunted by a leading European rocket company.

One of the aims of the Institute is to continue to build a talent pool of South African engineers for aerospace.

Other notable achievements include establishing a new African altitude record for hybrid rockets at 17.97km, which is the third-highest altitude achieved globally by a university-based team. The ASRI aims to break that record this year.

The group also developed and tested the most powerful university-built liquid rocket engine on the African continent in November 2021, which was the second most powerful university-built liquid engine globally, with a nominal thrust of 18kN (1.8 tons). In addition, it designed and constructed static test facilities for hybrid and liquid (cryogenic) rocket engines.

Explaining why becoming an institute is a good move, Brooks said it will be a bigger, more self-sufficient entity.

“Unlike a research group, which often relies on postgraduate students, the Institute is primarily staffed by personnel who are employed to conduct contract research. The ASRI will have a staff complement of research engineers, who will continue to do the work of the group, but do it in a more focused manner. So instead of being entirely focused on academic outputs, like graduate degrees, and so on, it will focus not only on research, but contract research.

“It will also focus a little bit more externally on the broader field of aerospace engineering for the country. It will continue the research group’s focus on building capacity within the University, but will also focus a little bit more on the broader South African and even African levels of aerospace,” he said.

The new Institute will focus on three programmes. The first is the Phoenix hybrid rocket programme, which is designed to create sub-orbital rockets with a scientific purpose.

The programme will also serve as a training ground for students to learn how to design and test rockets, providing an opportunity to learn about various rocket components, such as airframes and pressurised tanks. Although the Phoenix programme also allows for a small amount of scientific research, it is primarily a suborbital programme.

This year, two new Phoenix hybrid test rockets were successfully launched by a team of Mechanical Engineering students. The Phoenix-1D, carrying experimental sensors and



**THE PHOENIX 1D ROCKET PRIOR TO LAUNCH.**

cameras as part of the mission, was launched at the Denel Overberg Test Range in Arniston, Western Cape. The higher-altitude rocket was launched out over the Indian Ocean, unrecovered, and tracked by radar from lift-off to ocean impact.

The second programme, the Sapphire programme, is an orbital programme with its main focus on developing an indigenous satellite launch capability for South Africa. The goal is to create a Small Satellite Launch Vehicle, which is currently referred to as the CLV (Commercial Launch Vehicle).

Designing and creating a rocket capable of launching satellites into orbit requires a significant amount of energy; the rockets used for the Sapphire programme will thus be much larger than those used for the Phoenix programme. The rocket engine used for the CLV

is called the Sapphire engine, and is a liquid propellant rocket engine that uses kerosene and liquid oxygen. The ASRI is currently focusing on developing the Sapphire engine as a critical step in creating a rocket capable of launching satellites.

The ASRI’s third focus is commercialisation of the technologies it develops.

The UKZN Aerospace Systems Research programme is one of the largest aerospace research groups in South Africa and the only specialist rocket propulsion group in academia on the African continent. The group is supported by the Department of Science and Innovation and has generated in excess of R45 million in third-stream income over the past four years, according to Brooks. □

# PUTTING AFRICA ON THE MAP AS A GLOBAL QUANTUM TECHNOLOGY HUB

WORDS BY GREG DARDAGAN

## Dr Yaseera Ismail is developing quantum optical tools for the advancement of free-space long-range secure quantum communication.

**U**KZN's Dr Yaseera Ismail is clearly not your average human being because quantum technology is her world, her night and day!

Since graduating with a PhD, she has been developing optical systems for free-space and fibre-based quantum communication.

"Quantum technology is next generation computing, and the world is racing to establish the first universal quantum computer. China has set up the longest quantum network, which is more than 2 000km long," said Ismail.

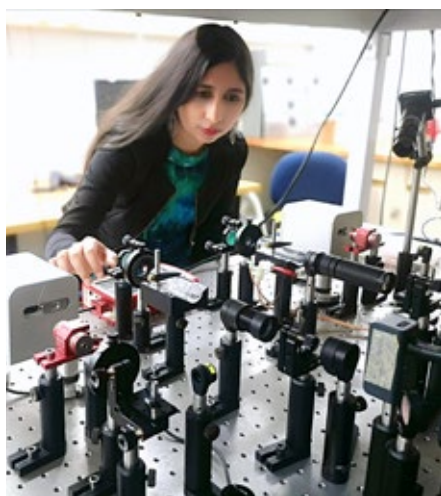
"Such technologies involve high-powered security and the protection of sensitive information, and this is where quantum technology plays a vital role."

The Quantum Satellite and Fibre Communication (QuSAF) technology being developed by Ismail and her physicist colleagues at UKZN aims to transmit secure keys using a satellite-based quantum distribution network to maintain the security of information.

"QuSAF will act as a catalyst for science, technology and big data business opportunities, jobs and innovation," she said. "It has the potential to put Africa on the map as a world quantum technology hub. Our goal is to set up the Satellite Ground Station in Kwa-Zulu-Natal in association with partners in other BRICS countries."

She added that QuSAF aligns with the African continent's goal to establish satellite-enabled technology, which would provide high-tech security for various sectors, including government, health care, energy, finance and research.

Chatsworth born, bred and schooled, Ismail completed all her higher education studies through to a doctoral degree in Physics at UKZN. After her PhD in 2015, she remained at the Quantum Research division as a post-doctoral researcher and was appointed a lecturer in the School of Chemistry and Physics in 2017 before becoming a senior lecturer in 2021. "I am now the lead experimentalist in quantum technology within the Quantum Research Group.



**DR YASEERA ISMAIL**

My research lab is the only experimental quantum physics lab at UKZN," she said.

Ismail started her research career in classical optics at the Council for Scientific and Industrial Research (CSIR) National Laser Centre, and during studies for her doctorate, joined the Quantum Research Group headed by Professor Francesco Petruccione where they were working on experimental activities in quantum communication in the fibre regime. "I wanted to work on free-space optics, so for my PhD, I developed entanglement sources for free-space quantum communication. More recently, I have been developing optical systems for free-space and fibre-based quantum communication."

The focus of quantum communication is the protection of information, especially data that needs to be kept secure in the long term. This project will act as a catalyst as postgraduate students and technicians will have to be trained to maintain the systems.

"QuSAF aims to develop a quantum network in South Africa which includes satellite and fibre-base communication. Quantum networks are of interest due to their potential to secure information," said Ismail.

"QuSAF requires the development of a ground station to link with a satellite carrying

a quantum payload which is all specialised technology. Developing the first link could lead to numerous other links across South Africa, resulting in the progression of infrastructure into Africa."

As with any communication, a transmitter and a receiver are essential. The ground station, which serves as the receiver to detect quantum signals, will link with existing satellites with a quantum payload that is launched by collaborators to generate a secure key through the process of quantum key distribution by sending encoded single-photons from the satellite to the ground station.

Said Ismail: "The long-term goal for quantum communication technology is to develop a quantum network consisting of optical fibre and satellite links. Quantum communications infrastructure could network individual quantum computers or sensors to further enhance performance and develop what is known as a quantum internet."

QuSAF is an ongoing project to develop a quantum network in South Africa which requires specialised infrastructure to be embedded into existing classical systems to offer an extra layer of security for the transfer of information.

Ismail says the QuSAF project is the first Quantum Satellite link in Africa. "In 2010, when the Quantum Research Group at UKZN implemented the first fibre-based quantum link embedded in the city of Durban, the project received global attention. Satellite-based quantum communication will be a stepping stone in the right direction towards a quantum network in South Africa."

Her plans include attracting the funds required to develop the ground station in South Africa through research infrastructure grants or external investment and further into the future to increase the possible quantum link by incorporating a fibre-based quantum link to the satellite link to develop a quantum network.

Ismail has a long list of accolades and awards for her work and serves on numerous international committees, some of which she chairs. □



# POWER LINE INSPECTION ROBOT SPARKS INTEREST IN JAPAN

WORDS BY COLLEEN DARDAGAN

**In South Africa and around the world, electrical utilities are required to inspect power lines and their immediate environment to ensure safe and reliable operation of the electrical network. Such inspections are costly and may be prone to human error.**



**MR TREVOR LORIMER (RIGHT) AND MR TADASHI MANO WITH TWO PROTOTYPES OF THE CABLE LINE INSPECTION ROBOT.**

**D**escribed as “cutting-edge technology” by a Japanese power company, a Power Line Inspection Robot (PLIR) with unique capabilities is ready for roll-out at UKZN.

Off-the-shelf hardware teamed with a robot carrying artificial intelligence (AI) developed at the University and backed by Eskom has the muscle to keep the lights on for longer by upping the ante on power line maintenance.

Current methods to inspect electricity transmission assets require inspectors to travel by helicopter, truck or on foot and use special cameras to examine and maintain the vast volume of cabling that spans the length and breadth of most countries. Inspectors are sometimes required to ascend the pylons to view areas of specific interest. This methodology is not only time consuming and expensive but can expose personnel to considerable risk.

In a bid to mitigate against these factors, Dr Trevor Lorimer from UKZN's School of

Engineering and former UKZN Professor, Edward Boje, developed an inspection robot with on-board machine-learning capabilities that is able to seamlessly check overhead line conductors and hardware. More specifically, the robot provides increased inspection detail and close-up views as well as in-contact measurements of the hardware under review. It can evaluate the conductors and hardware from otherwise impossible viewpoints or angles and in difficult-to-reach areas. The technology was developed in collaboration with Eskom and is patented in South Africa, Germany, France, the United Kingdom, the United States and Canada.

Lorimer, who started work on the PLIR as a project for his master's degree, has delivered a pre-production prototype robot to Japan's Tokyo Electric Power Company. “In South Africa it might eventually be used to carry out niche inspections that are difficult, dangerous or too expensive.” While there are other “noteworthy” designs on the market, Lorimer said the

unique proposition of the UKZN invention is its weight and simple manufacturing. “It is very easy to install and remove and has a very small number of moving parts. This robot is about 10kg compared with others on the market that are closer to 100kg.”

The first three models are mainly made of aluminium and the pre-production version is made of carbon fibre due to its favourable strength-to-weight ratio. However, it is its ability to manoeuvre while on the conductor that makes the robot's design so exciting. “We like to think of our robot as a vehicle that moves inspection sensors along power lines. When it gets to an obstacle, like line hardware or a tower, it can climb past before moving on to the next expanse of cable. So, it rolls along the lines on wheels but when it comes to a pylon, it has arm-like links that make it possible to reach around the obstacle and grasp the line beyond it,” Lorimer quipped.

The latest design has a machine-learning or AI optimised on-board computer, which together with cameras, is able to identify the line and different kinds of hardware, a communications module – to send video and receive commands from a remote laptop – and custom-built electronics to drive the actuators. “The actuator driver electronic boards were developed at the University, but the other modules are off-the-shelf hardware. “The development phase included four physical models to take the concept from laboratory to proof of concept and a pre-production version over a period of five years. The PLIR has been tested and demonstrated on power lines in Cape Town, Durban and other parts of Kwa-Zulu-Natal, and in New Zealand.

Licensing and commercialisation of the technology is planned under the auspices of Power Line Robotics, a company in which the University will hold shares. Lorimer said the most exciting aspect of the development is combining multiple engineering disciplines in an interesting and potentially useful way to produce a tool able to provide the important service of electricity transmission. □

# SMART SOLUTIONS TO SOUTH AFRICA'S ENERGY CRISIS

WORDS BY COLLEEN DARDAGAN

**UKZN electrical and electronic engineers have developed an energy-efficiency solution to process data on real-time energy consumption, where the information is used by an energy management system to automate energy-saving methods.**

**A**s South Africa's President Cyril Ramaphosa declared the country's ongoing power shortage a State of Disaster in his State of the Nation Address earlier this year, it was announced that UKZN's electrical and electronic engineers have devised a 'smart' plug that reduces electricity consumption in both the home and the office by up to 30% through effective collection of data in real-time.

Better known as a 'smart metering plug', the device has the potential to provide an income stream for the University and opportunities for employment and skills development among students.

As an energy meter system, the plug is easily integrated into any electricity supply scheme such as photovoltaic (PV) inverters with the capability of providing immediate energy-use data to consumers. Engineering lecturer, Dr Farzad Ghayoor, who headed up the project, said the development of the plug was in direct response to South Africa's electricity crisis.

"Recent studies by the Private Sector Energy Efficiency programme (PSEE) have shown that using an energy management system - whether in a home or a business - can reduce utility and operating costs by up to 15%," he said.

Ghayoor added that the features of such a system must include control of heating, ventilation and air conditioning (HVAC) systems, geysers, lighting and other electrical appliances. "More specifically, using an automated system to adjust the thermostat on a geyser or air conditioner, or when the lights switch on or off based on daylight, occupancy, or usage patterns, can contribute to overall energy saving of up to 30%. An automated system can also shut down office equipment during non-working hours which saves even more electricity," he said.

Ghayoor observed that, given that economic growth and the country's sustainable development are dependent on the quality, efficiency and price of energy, solutions such as the 'smart metering plug' are essential. "The frequency



and length of disruption during load shedding is evidence of the severity of the shortage of electricity supply capacity. Since 2007, South Africans have experienced unrelenting power outages while demand for power has grown by up to 17%. "The 'smart metering plug' is simply plugged into a wall plug and the metering switches are positioned between an appliance and its power source. The device collects data on electricity consumed and transmits it via energy management software to the consumer in real time. "This gives the consumer the power to manage their electricity use in a responsive and more effective way," said Ghayoor. The system can be used in residential and commercial applications with services such as energy management solutions, assessment of power quality and integration of renewable energy sources.

Ghayoor said the development of the first-level prototype was concluded and tested with certification from the South African Bureau of Standards (SABS), the next step in the process towards commercialisation. "The plug requires SANS164 certification from the SABS. This is the

South African National Standard for plugs and socket outlets for household and commercial purposes. We are not sure how long the certification process will take as depending on our chosen target market, it might be two different processes because the plug can be used as part of a closed smart management system, or sold by retailers as a stand-alone plug," he said.

He added that the novelties of the plug are being explored to determine what could be patented to protect its development and design in the interests of the University.

"The device could bring revenue to UKZN while at the same time enabling skills development through student training and employment. It can offer in-house technical assistance in different fields such as power system design, energy management, electronic design, the Internet of Things (IoT), cloud computing and application development for smart devices, to name but a few. There are of course other spin-offs for the University and for aligned research groups," he said. □



# UKZN INVERTER TO POWER SOLAR FOR LOWER-INCOME EARNERS

WORDS BY COLLEEN DARDAGAN

**Electrical engineers at UKZN have exploited recent advances in power electronics to develop an affordable grid-connectable single-phase inverter for use in homes and small-scale electric power applications such as small businesses.**

The development of an inverter for more affordable solar power specifically aimed at bridging the gap between the haves and have-nots is on the cards at UKZN.

While South Africa's high and middle-income earners are more likely to secure financing for solar power to mitigate against the country's power crisis, lower-income households and small businesses could find themselves out in the cold.

Electrical engineers at UKZN have exploited recent advances in power electronics to develop an affordable grid-connectable single-phase inverter for use in homes and small-scale electric power applications such as small businesses. The inverter addresses the total electricity needs of an average residential household in a suburban or rural area with an alpha-prototype being developed and tested.

Put simply, an inverter is an electrical appliance able to transmit the correct voltage of solar powered energy through the conversion of direct current (DC) to alternating current (AC) for domestic, commercial and industrial use.

John Agee, Professor of Control Systems Engineering and leader of the Smart Grid Research Programme at UKZN, said the idea was first mooted in the early 2000s.

"The notion for this development goes back to an earlier time in Botswana where the need for a more affordable solar power supply to rural and lower income-households and businesses was first identified. In 2009, the South African National Research Foundation provided a grant of R500 000 to support hybrid renewable energy research at UKZN in collaboration with the University of Constantine 1 in north-eastern Algeria," Agee said.

The funding was used to research and develop low-cost solar tracking systems together with some initial exploration into the design of low-cost inverters.

As most inverters and batteries used to store solar power are imported, the costs are prohibitive, particularly for lower-income households and small businesses. Agee said



the research conducted by the Programme aims to address this issue.

"In the conceptual design stages, the rating of the inverter was selected in line with average suburban household power consumption in the eThekweni Metro in 2017. We then adapted the design to enable it to meet the power ratings typical in a middle-income home and for small business such as restaurants, fast-food outlets and medium-sized grocery stores or spaza shops."

Durban-based ARTSolar – a solar panel manufacturing company in the Pinetown industrial node that specialises in the manufacture of crystalline panels – provided guidance on how to meet the needs of low-income homes. Agee said the development was made possible by a grant from the Technology Innovation Agency (TIA) and crucial support from UKZN InQubate's Technology Transfer Office. InQubate is the University's innovation hub which connects the Institution's innovators and their discoveries to the public and industry or commercial interests. More succinctly, InQubate transforms research into solutions by connecting academic experts and industry to collaborate in addressing socio-economic challenges through innovation.

Agee said the initial development of the inverter relied on supervised undergraduate projects to test and verify the various concepts. "Then we worked with a master's student to produce the first pilot unit."

As InQubate is looking to secure the Intellectual Property (IP) rights to some of the inverter's components, Agee said details on how it works are still under wraps.

But, he added that the huge gap in the South African market for inverters between 1kV and 5kV capacity for use in low-cost housing projects were key drivers of the innovation.

"The commercialisation and roll-out of the inverter will be handled by UKZN InQubate," Agee said. □

# HARNESSING SOLAR ENERGY

WORDS BY SLINDILE KHANYILE

**In a bid to ease socio-economic suffering amplified by energy shortages across the globe, UKZN academics have created an innovative and flexible technology that can be applied on any surface or material to harness solar power.**

**A**s the world battles global warming and energy shortages, UKZN Chemistry professors have developed and patented flexible thin film nanotechnology to harness solar energy.

Professors Bice Martincigh and Vincent Nyamori said this development would not only be useful in solar energy innovation, but could also be applied in the advancement of sensors; fabrication of transistors and saturable absorbers, especially in medical lasers; as well as communication devices such as mobile phones and radio-frequency transmitters. It can thus be applied to numerous electronic industries.

"Many countries, including South Africa, still use coal-based energy sources, which is not sustainable and has negative environmental consequences. Silicon is currently the material of choice to fabricate solar cells; however, it has its limitations. Firstly, it is rarely found in nature in pure form. Hence, a tremendous amount of energy is required to purify it and its manufacturing process leads to the unfavourable emission of greenhouse gases. Secondly, silicon is rigid and relatively heavy, and thus, not very conducive to all surfaces. Lastly, silicon is not cheap; it is a non-renewable resource, has an end-of-life disposal problem, and power conversion efficiency has not advanced much in recent years. Our novel crystalline nanocellulose technology is flexible, biodegradable, based on renewable feedstocks in the region, and has superior conductivity properties," said Nyamori.

The UKZN team has a strong, longstanding collaboration with SPECIFIC at Swansea University (United Kingdom). Martincigh said they began working together in 2009. "In 2013, we ran a schools' outreach programme called 'Catching the Light with the Rainbow Nation' in Mafikeng and Durban to promote the use of solar energy for different purposes. In 2015, a post-doctoral study investigated the lifetime of a normal battery with solar cells," said Martincigh.

The SPECIFIC Innovation and Knowledge Centre is an academic and industrial consortium



**PROFESSORS BICE MARTINCIGH (RIGHT) AND VINCENT NYAMORI.**

**THE IMAGE SHOWS MARTINCIGH MORE.**

led by Swansea University, with strategic partners Akzo Nobel, NSG Pilkington, Tata Steel and Cardiff University. It is funded by the Engineering and Physical Sciences Research Council, Innovate UK and the European Regional Development Fund through the Welsh Government. SPECIFIC has the equipment and expertise to fabricate and test flexible and roll-to-roll electronics, including flexible photovoltaic panels.

"SPECIFIC promotes 'Active Buildings' that can generate, store and release their own heat and electricity from solar energy. Essentially, your home is your powerhouse," added Martincigh. Several countries have recently faced energy shortages, with South Africa being severely affected.

"Energy drives the economy of many countries, and unfortunately, many are still using fossil fuels, with negative consequences such as global warming/climate change. There are other alternatives such as wind and geothermal energy, hydropower and ocean power, but solar energy is the best suited for Africa as the continent is blessed with plenty of solar radiation for solar cells.

"Our solar cells are flexible and can be applied on any surface or material, including garments,

curtains, roofs and windows. The efficiency of solar cells is currently low, but there is room for improvement, and importantly, they are sustainable since the material is derived from renewable resources that do not damage our environment," said Nyamori.

Martincigh attended the former University of Natal, where she obtained her BSc(Hons) and PhD. A professor in Physical Chemistry at UKZN, she served as President of the South African Chemical Institute (SACI) from 2015 to 2017. She is a recipient of the University's Distinguished Teachers' Award and the SACI Merck medal. She has been elected as a Fellow of SACI, RSC, IUPAC, and the Royal Society of South Africa, and as a member of the Academy of Science of South Africa.


Her research encompasses applying physical chemistry principles to solve problems related to health or the environment. She has investigated the photochemical behaviour of the absorbers used in sunscreen and cosmetic preparations to prevent skin reddening and the application of nanomaterials in wastewater remediation, either through adsorption or photocatalysis. She is also involved in projects investigating environmental contamination caused by PAHs (polycyclic aromatic hydrocarbons), PCBs (polychlorinated biphenyls) and flame-retardant chemicals.

Nyamori is a professor in the School of Chemistry and Physics at UKZN, the coordinator of the University's Nanotechnology Platform and a former President of the SACI. He is a Fellow of the South African Chemical Institute (FSACI) and of the Royal Society of Chemistry (FRSC) and South Africa's Representative at the Federation of Commonwealth Chemical Sciences Societies.

Nyamori is also an Associate Editor for the *RSC Sustainability* journal published by the Royal Society of Chemistry (United Kingdom). His research interests include green and sustainable chemistry, nanotechnology and materials science. □



# GENDER-BASED VIOLENCE **STAND UP, SPEAK UP**



**Gender-based violence (GBV)** includes any overt or subtle act or threat of harassment, intimidation or violence - whether persistent or isolated - directed against any person on the basis of their gender, sex, sexual orientation or gender identity, that results in or is likely to result in physical, sexual or psychological harm or suffering, or impairment of a person's dignity. Harassment and violence may constitute a single act or a pattern of repeated acts.

## **REPORT GBV!**

### **RMS CONTROL ROOM CONTACT NUMBERS**

**HOWARD COLLEGE CAMPUS: 031 260 2540/42**

**PIETERMARITZBURG CAMPUS: 031 260 5211/6215**

**WESTVILLE CAMPUS: 031 260 7133/7265**

**MEDICAL SCHOOL: 031 260 2540/42**



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