University of **the Free State**

IMPACT

Report 2023

The Impact of
UFS Scholarship and Research on Society

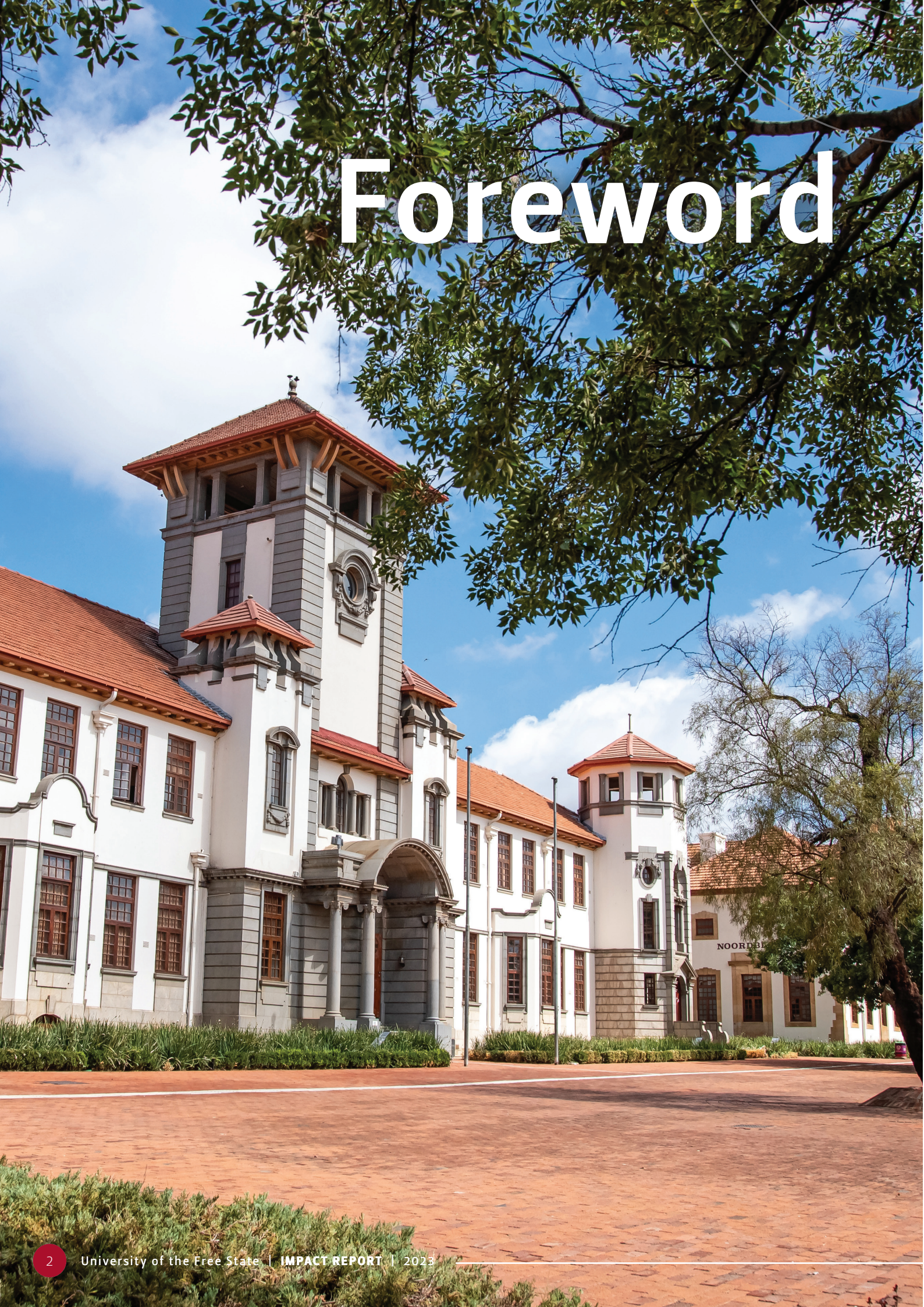
Inspiring excellence, transforming lives through quality, impact, and care.

VISION 130
Renew and Reimagine for 2034

UNIVERSITY OF THE **FREE STATE**
UNIVERSITEIT VAN DIE **VRYSTAAT**
YUNIVESITHI YA **FREISTATA**

Table of Contents

Foreword



Prof Francis Petersen

Vice-Chancellor and Principal

The last decade has seen increasing challenges to the higher education sector to remain competitive and to be relevant. How universities achieve their goals of boosting research, of making certain their graduates are competitive in a global market, and of ensuring they make a difference in a fast-changing global environment, has evolved significantly. The United Nations Agenda 2030 for Sustainable Development and its Sustainable Development Goals (SDGs) provide a strategic roadmap for universities, and indeed for the whole of society, on how to make a difference and be relevant in an ever-changing world. They are the world's call to action on the most pressing challenges and opportunities facing humanity. It is our responsibility as a university to respond with strategic intent and meaningful contributions and ensure that our graduates carry the baton forward.

In September 2022 the University Council adopted Vision 130, which states that the UFS intends to be acknowledged as a university that maximally impacts societal development. The UFS aspires to be a research-led, student-centred, and regionally engaged university that contributes to development and social justice by producing globally competitive graduates and knowledge. An engaged university of the future enjoys academic freedom and institutional autonomy, but is engaged with all its communities. We must be professionally attuned, but humanely informed, taking out global responsibilities seriously. Our commitment to this is reflected in the portfolio of the Deputy Vice-Chancellor for Institutional Change, Strategic Partnerships and Societal Impact, Dr Molapo Qhobela.

We are on a journey of visibility and impact. This commitment requires a purpose-driven focus on relevant and cutting edge research as well as the preparation of globally competitive graduates. This is steadfastly reflected in our research strategy as well as our teaching and learning strategy – the former placing increased emphasis on research that advances societal and knowledge impact, and the latter ensuring that our academic offerings and practices produce desirable and successful graduates.

The vision commits the University to using the UN SDGs as a primary lens for assessing such societal impact. Using the SDGs as the point of departure, this UFS Impact Report 2023 – the first in a series of biennial reports – showcases the impact of our scholarship and research on society in South Africa and beyond, for the period 2021/2022. There are many more stories to tell and successes to report; these cannot all be covered in a report of this nature, but the exemplars presented give a clear indication that the UFS is on track to deliver on its commitment to benefit the economy, society, culture, public policy, health, the environment, and quality of life.

Introduction

Prof Vasu Reddy

Deputy Vice-Chancellor: Research and Internationalisation

The process of compiling this report gave us the opportunity to reflect and take stock of where we are and where we could improve. This was done using UN Agenda 2030 as the primary lens, and connecting the Sustainable Development Goals (SDGs) to the African Union (AU) Agenda 2063 and our own institutional strategies. The primary focus in this report is on our research endeavours, but this in no way minimises the substantial contribution of the other important core functions of teaching, learning, and engaged scholarship, in which sustainability and impact are deeply embedded and which continuously strive to push the boundaries of excellence.

Complex problems faced by societies locally and globally require multi-, inter- and transdisciplinary inputs and teams. Globally, research is increasingly characterised by mutually beneficial research collaborations – across disciplines and faculties, and working with other national and international research groups and entities to produce new knowledge that is globally, continentally, and regionally relevant and impactful.

In response to this evolving research context, the University of the Free State's research goal is to increase its contribution to local, regional, and global knowledge, to address fundamental and strategically important developmental questions, and to make an economic, social and cultural impact at all levels. The UFS Research Strategy is aligned with the UFS vision. Resource allocation for research and innovation is focused on UFS areas of strength and distinctiveness, to transform the profile and increase the diversity of UFS researchers, and increase research impact, uptake and focus on the African Continent.

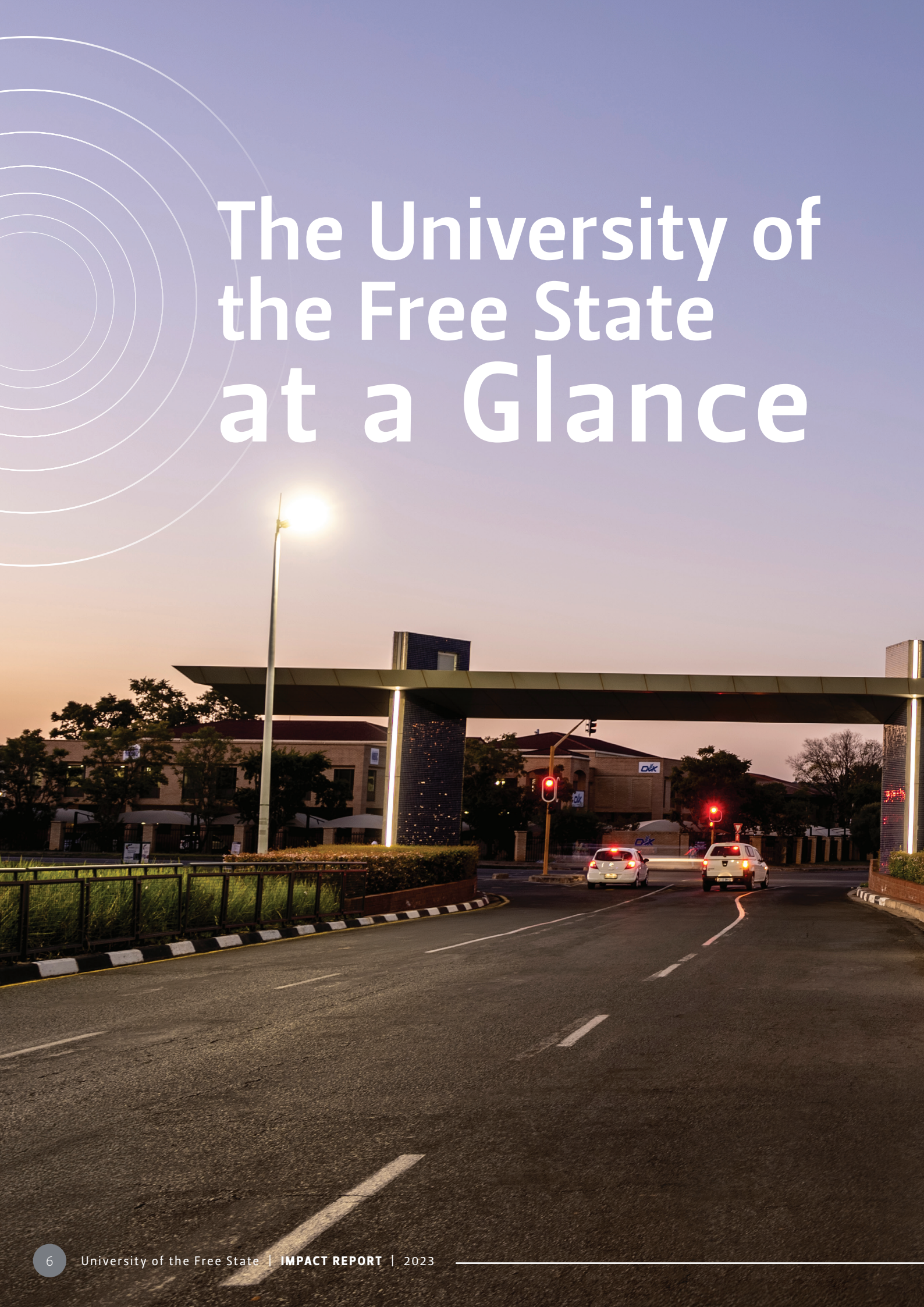
The Teaching and Learning Strategy is geared towards substantial transformation and realignment that are necessary to accommodate the changing realities and needs of a high performance 20th century African university, that is globally, nationally and continentally relevant.

Given the growing emphasis on stakeholder involvement, collaborations, and communities of practice, engaged scholarship has emerged strongly as a means and form of academic enquiry that is able to co-create impactful research and relevant curricula that address real-world problems.

The University places a strong emphasis on interdisciplinarity and encourages and supports scholars from different disciplines and communities to work together in a spirit of cooperation and integration, mobilising their respected, relevant knowledge to the benefit of communities and society.

Universities are institutions of tremendous influence that transcend geographical, social, and cultural boundaries. Their conceptual space is the global landscape of knowledge and ideas and they operate from a trusted place of knowledge and a position of intellectual abundance, proposing solutions and developing opportunities. It is thus expected of universities to make a substantial contribution to addressing complex problems, and shaping local and global agendas – in short, we need to be making a major impact on the realisation of the UN SDGs and the Aspirations of the AU Vision 2063. The work is never completed, but this report presents a glimpse of how the UFS is responding to these challenges, making an impact and being socially relevant.

The University of the Free State at a Glance




THEOLOGY AND RELIGION
NATURAL AND AGRICULTURAL SCIENCES
LAW
THE HUMANITIES
HEALTH SCIENCES
EDUCATION
IOUSE

*Vision 130 seeks to position the UFS as a globally recognised institution known for its **academic excellence**, **quality**, and **impact**.*

The University of the Free State (UFS) is a progressive university focused on transformation as a core strategy. Apart from being a university that excels in teaching, learning, and research, the UFS is committed to making a social impact on society.

Founded in 1904 in Bloemfontein, the UFS has become a multi-centred university with three campuses – Bloemfontein, Qwaqwa and South – with seven Faculties and a Business School. Quality teaching is delivered through 127 departments.

The UFS strives to be a research-led, student-centered and regionally-engaged university that contributes to development and social justice through the production of globally competitive graduates and knowledge. Looking ahead to 2034 when the University will celebrate 130 years of existence, Vision 130 seeks to position the UFS as a globally recognised institution known for its academic excellence, quality, and impact.

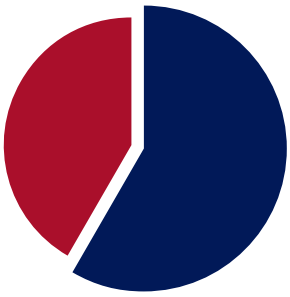
Institutional Profile (2022)

7 Faculties and **1** Business School

ECONOMIC AND MANAGEMENT SCIENCES | EDUCATION | HEALTH SCIENCES | LAW | NATURAL AND AGRICULTURAL SCIENCES | THE HUMANITIES | THEOLOGY AND RELIGION | BUSINESS SCHOOL

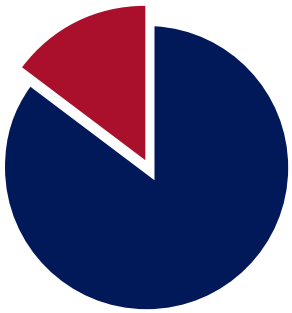
Permanent staff members:

- Female **865**
- Male **616**



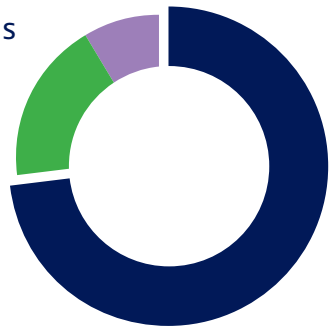
Students:

- Undergraduate **85,5%**
- Postgraduate **14,5%**



Students per campus:

- Bloemfontein Campus **73,3%**
- Qwaqwa Campus **18,2%**
- South Campus **8,5%**



University Ranking:

The World University ranking **801 – 1000**

9th among 15 South African universities featured

Quality Teaching and Learning for Globally Competitive Graduates

The UFS has seven faculties delivering top-quality programmes, driven by dedicated and highly qualified staff committed to making a real-world impact in their fields.

Total number of graduates
10 015

Permanent staff members with doctoral qualification
59%

Pass rate of Initial Test of Competence (ITC) of SA Institute of Chartered Accountants:
UFS
83,3%
National average
72,8%

Distinctions in ITC:
UFS:
2
of total of
29
distinctions from 2 946 candidates

163
Doctoral graduates

999
Honours graduates

554
Master's graduates

636
Postgraduate diploma graduates

7 663
Undergraduate graduates

Research Capacity and Capabilities

The UFS aspires to be a research-led institution, emphasising the parity between research, teaching, and learning for impact.

NRF-rated researchers
211

Postdoctoral research fellows
178

Increase in research output units from 2018 to 2022
38%

Research output units generated from publications
1 581,5

Research output units produced per academic
2,5

Research **focus areas**

Water and water quality | SDG 3,6
Health and well-being | SDG 3, 6, 9
New scientific and industrial challenges | SDG 9, 13,15
Social justice and the removal of inequalities | SDG 4, 5, 10, 16
Food security and land reform | SDG 2, 12, 13, 15
Local and regional socio-economic development | SDG 7, 8, 11, 12,13, 15

Premier Research Groups and Specialist Centres

Research Chairs

- SANRAL Research Chair in mathematics, natural sciences, and technology education
- SARChI Research Chair in city-region economies
- SARChI Research Chair in disease resistance and quality in field crops
- SARChI Research Chair in higher education and human development
- SARChI Research Chair in pathogenic yeasts
- SARChI Research Chair in solid state luminescent and advanced materials
- SARChI Research Chair in vector borne and zoonotic pathogens
- African Medicines Innovations and Technologies Development

Research Centres, Groups, and Units

- Afromontane Research Unit
- Centre for Development Support
- Centre for Environmental Management
- Centre for Gender and Africa Studies
- Centre for Global Change
- Centre for Health Systems Research and Development
- Centre for Mineral Biogeochemistry
- Centre for Teaching and Learning
- Free State Centre for Human Rights
- Institute for Groundwater Studies
- International Studies Group
- Mountain Bat Lab
- RWM Frater Cardiovascular Research Centre

Research Laboratories and Specialist Centres

- Biosafety Level 3 Laboratory
- Centre for Microscopy
- Clinical Simulation and Skills Unit
- Ecotoxicology Lab
- Johannes Stegmann and Centenary Art Galleries
- Merensky Group for Aerial Geological Image Classification (MAGIC) Lab
- New Generation Sequencing Unit
- Odeion School of Music
- Roodt Crystallographic Laboratory
- Sensory Laboratory
- South African Doping Control Laboratory
- South African National Control Laboratory for Biological Products

Regionally and internationally engaged

Formal high quality and productive collaborations with universities and institutions globally

70

International students

943

Research and Scholarship supporting Sustainable Development


Sci-Ed SCIENCE EDUCATION CENTRE

The concept of sustainable development can be interpreted in many different ways, but its origin can be traced back to 1987, to the definition included in the UN World Commission on Environment and Development report 'Our Common Future', and it is fitting to be reminded of it. Sustainable development was defined as "a development that meets the needs of the present without compromising the ability of future generations to meet their own needs". At its core it is an approach to development that looks to balance different, and often competing, needs against an awareness of the environmental, social and economic limitations we face as a society.

The research and scholarship undertaken by the University of the Free State responds to many of the national, continental and global aspirations, goals and challenges identified to advance global sustainable development. These are contained in the United Nations (UN) 2030 Agenda for Sustainable Development, the African Union's (AU) Agenda 2063, and the South African National Development Plan 2030 (NDP).

The 2030 Agenda for Sustainable Development, adopted by all UN Member States in 2015, provides a shared framework to work towards peace and prosperity for people and the planet. The Sustainable Development Goals (SDGs) are a universal call to action to preserve our planet and improve the lives of everyone, everywhere, in an inclusive and sustainable way, captured in the motto "No one left behind". They highlight the connections between the environmental, social and economic aspects of sustainable development. The 17 integrated SDGs, clustered within five P-based words – People, Planet, Prosperity, Peace, and Partnership – recognise that action in one area will affect the outcomes in others.

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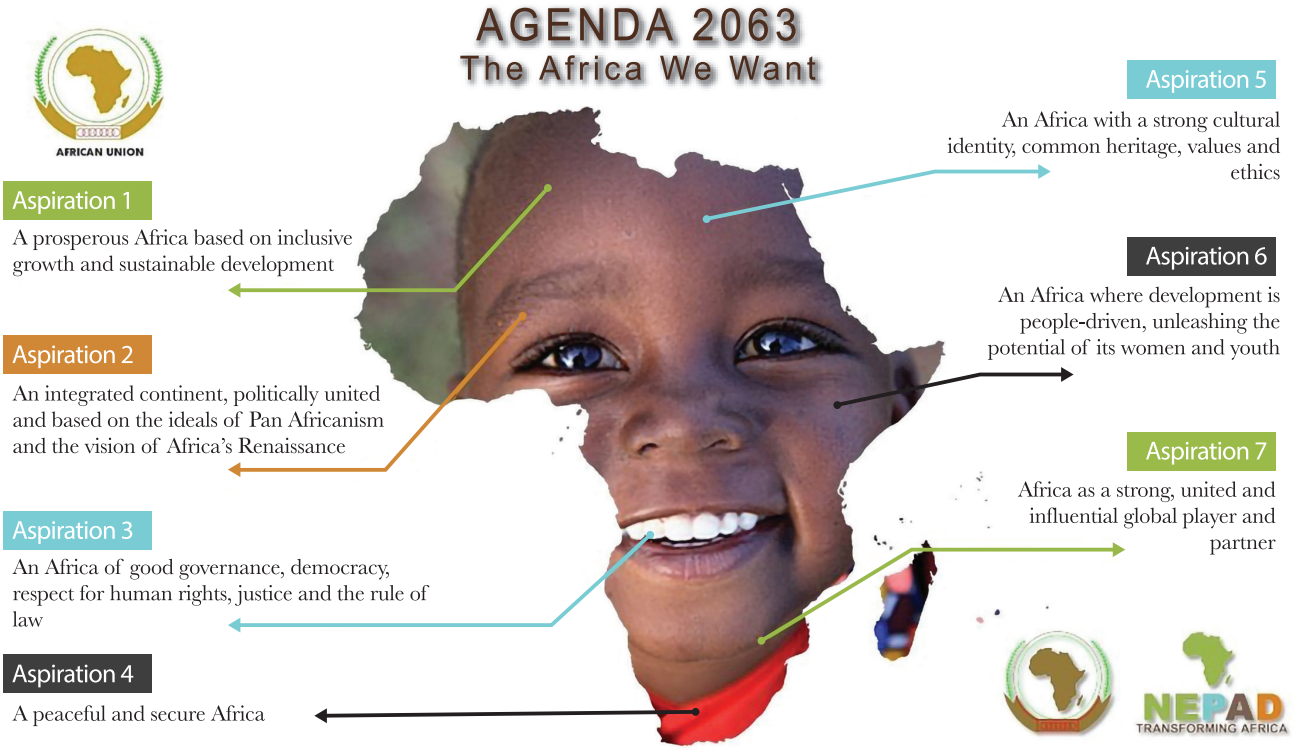
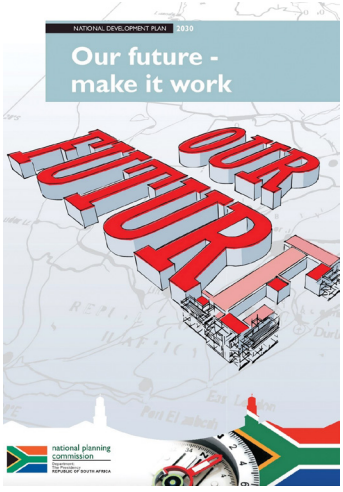
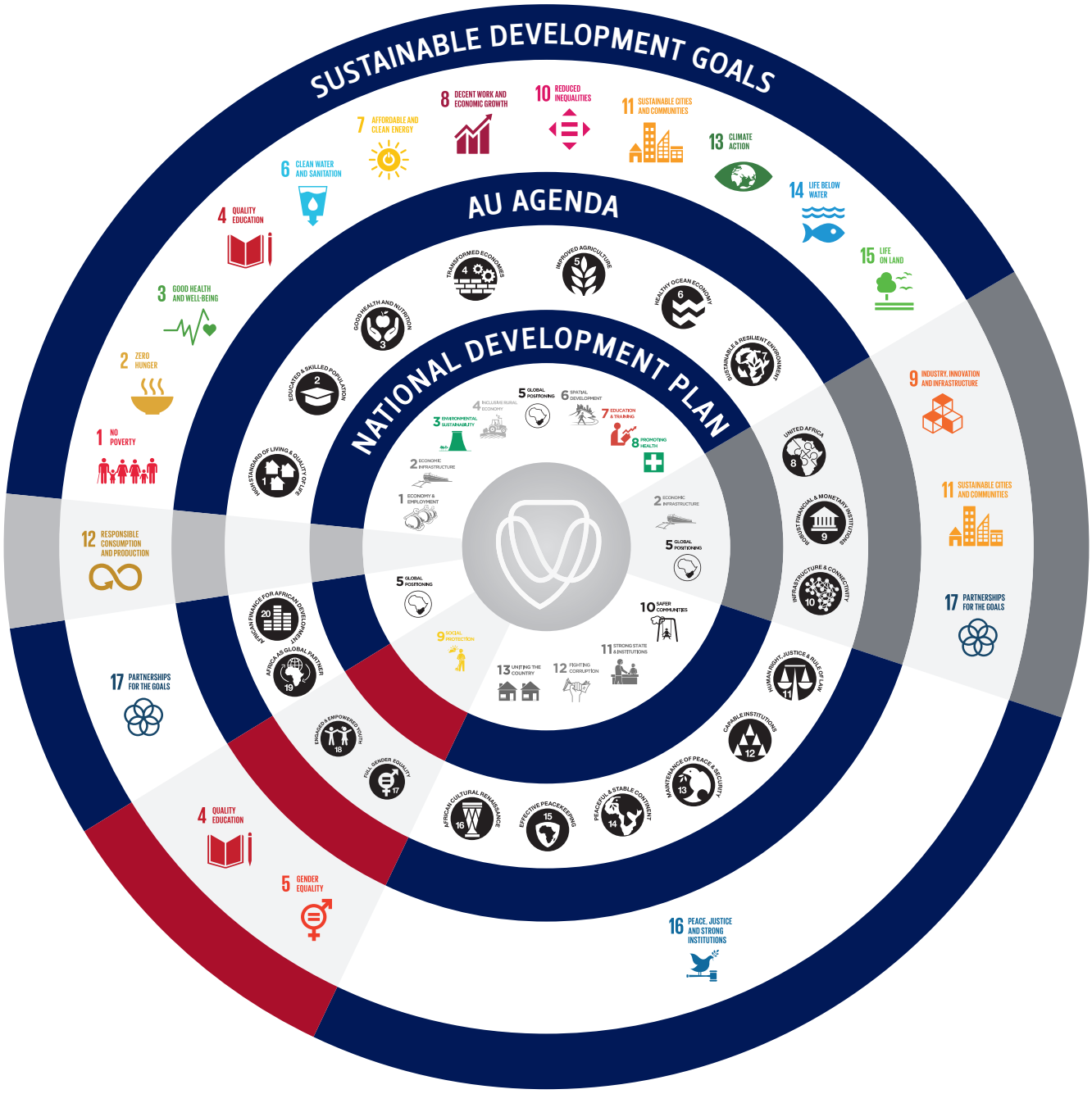


The AU Agenda 2063, signed in May 2013, provided a strategic framework for guiding Africa's development in the next 50 years, and aims to deliver on its goal for inclusive and sustainable development. Agenda 2063 presents a set of seven Aspirations with their own set of goals. These Aspirations speak to (1) a prosperous Africa based on inclusive growth and sustainable development; (2) an integrated continent, politically united and based on the ideals of Pan Africanism and the vision of Africa's Renaissance (3) an Africa of good governance, democracy, respect for human rights justice, and the rule of law; (4) a peaceful and secure Africa; (5) an Africa with a strong cultural identity, common heritage, values and ethics; (6) an Africa where development is people-driven, unleashing the potential of its women and youth; and (7) Africa as a strong, united and influential global player and partner.



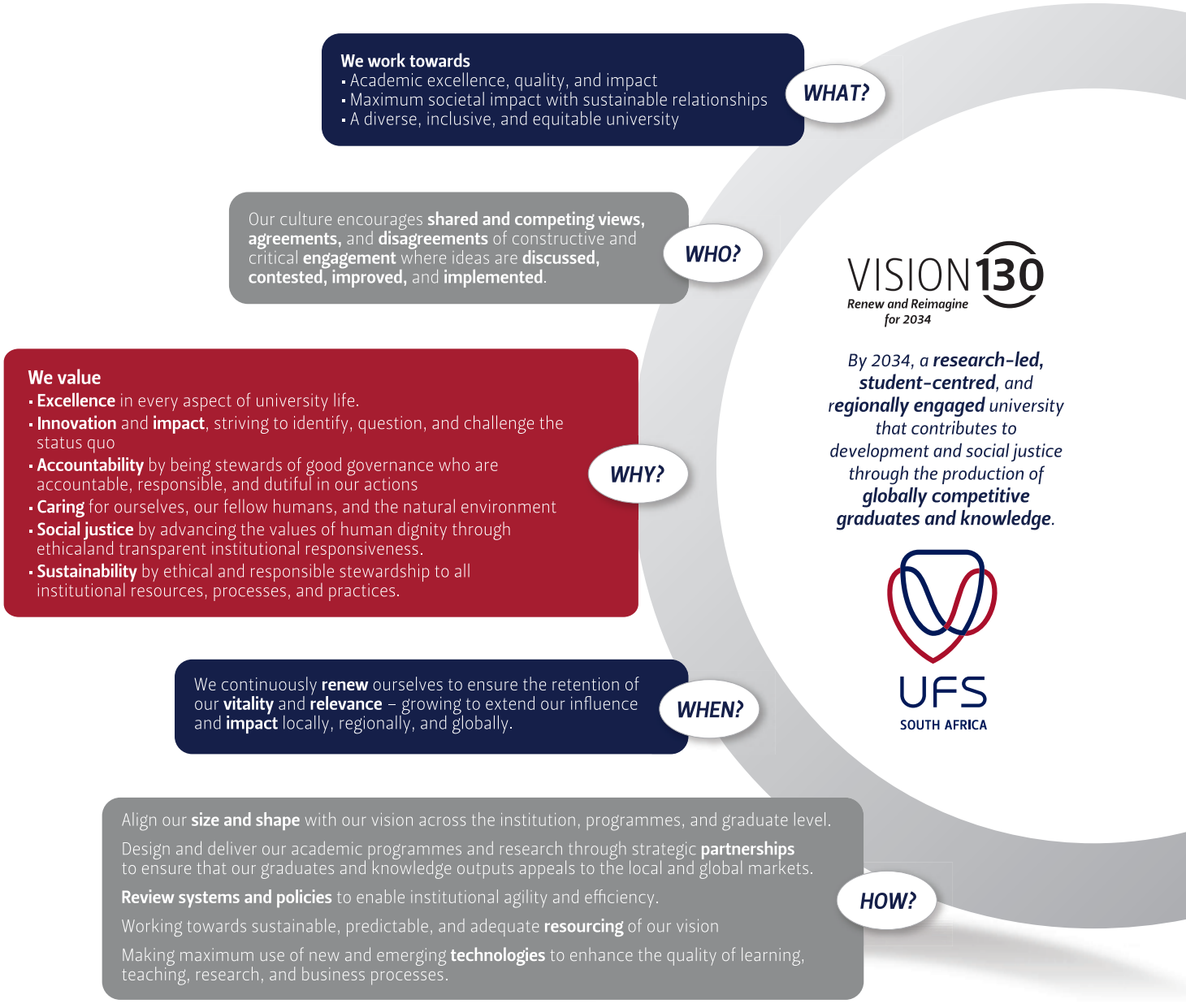
Closer to home, the South African NDP (Vision 2030) has similar goals and aspirations. It aims to eliminate poverty and reduce inequality by 2030, and sets out ambitious goals for poverty reduction, economic growth, economic transformation and job creation. Adopted by Cabinet in 2012, the plan states that "South Africa can realise these goals by drawing on the energies of its people, growing an inclusive economy, building capabilities, enhancing the capacity of the state, and promoting leadership and partnerships throughout society." It is structured around a number of priority outcomes: education, health, safety and security, economic growth and employment, skills development, infrastructure, rural development, human settlements, local government, environment, international relations, an affective public sector, social protection, nation building and social cohesion.

There is thus a high level of convergence between the call to action outlined in the UN Agenda 2030, the AU Agenda and 2063, and the South African NDP.



Higher education is clearly relevant to achieving these goals and in so doing contribute to the public good. Research should play a pivotal role in achieving these aims by providing stakeholders and policy-makers with the knowledge to meet these goals by producing a trustworthy base of knowledge and data, proposing innovative solutions, assessing progress made, and providing perspectives for the various plans. These important frameworks have in turn invigorated academic debate and production on sustainable development related issues.

The University of the Free State (UFS) has answered these calls and taken up the challenge. This is clearly expressed in Vision 130 – which sets out the University's strategic intent towards 2034 committing the University to be acknowledged as a university that impactfully supports societal development. Aspiring for maximum societal impact is thus a defining characteristic of the University, resonating deeply with the goals of the SDGs, the AU Agenda 2063 and the NDP.



'Regionally engaged' reflects the University's intent to ensure that its knowledge contributes to the development of the province, the country, and the African Continent, while 'research-led' emphasises the parity between research, teaching, and learning for impact. 'Globally competitive' refers to excellence and the intent to produce knowledge and graduates that make on impact on global and local platforms.

The following sections describe just some of the projects and initiatives currently active in the UFS which make a significant contribution to the SDGs.

Investing in People

People are at the core of the sustainable development goals. Building on the millennium development goals, the SDGs strive for a safer, healthier, and more prosperous world by 2030, within the bounds of planetary sustainability.

The 2030 Agenda for Sustainable Development thus states: "We are determined to end poverty and hunger, in all their forms and dimensions, and to ensure that all human beings can fulfil their potential in dignity and equality and in a healthy environment."

Ending poverty and hunger in all its forms and manifestations is not only a national or Continental challenge but must be tackled as a global challenge. Ending global hunger also encompasses the need for household and global food security and improved nutrition.

These are all necessary for the global health and well-being of people, especially those living in the global south, particularly Sub-Saharan Africa.

The University of the Free State is committed to assist with this goal by undertaking research that positively impacts people's lives. To achieve this, our researchers and academics undertake world-leading research to improve good health and well-being, improve food insecurity, and reduce and eradicate poverty hunger. In pursuit of one of the values of the University, of social justice, we also undertake research that advances equity and quality of educational outcomes.

The research of Profs Maryke Labuschagne, Steven Brown, Michael Pienaar, Melanie Walker and Linus Franke, are a few illustrative examples of the contribution of the UFS in supporting the attainment of these goals.

Nourishing the Continent

The world is still far from being without malnutrition with micronutrient deficiency affecting two billion people worldwide. Stunting in children and Vitamin A deficiency is a vast challenge globally and more so in Africa. With projections showing approximately 670 million people will still be facing hunger by 2030 which make up 8% of the world's population, Target 2.1 of SDG 2 aims "to end hunger and ensure access by all people, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round by 2030."

Target 2.2 aims to end all forms of malnutrition by 2030, including the internationally agreed targets on stunting and wasting in children under 5 years of age by 2025. This is aligned with the African Union ambitious Agenda 2063. One of the eight aspirations is to have a prosperous Africa based on inclusive growth and sustainable development. In this regard, the Africa of 2063 will be a continent without any form of food or nutrition insecurity and hunger. Measures will be adopted that lead to food sovereignty.

The research and scholarship into biofortification led by Prof Maryke Labuschagne, Professor of Plant Breeding in the Department of Plant Sciences and the NRF SARChI Research Chair in Diseases and Quality of Field Crops, is contributing to the realisation of these aspirations. Biofortification is achieved through the genetic improvement by conventional breeding of a crop by incorporating the appropriate genes to improve the nutritional value of the crop.

The research team led by Prof Labuschagne focuses on staple crops including maize, cassava, sweet potato, cowpea, and bananas, as these constitute the majority of crops consumed in Sub-Saharan Africa (SSA). Her research concentrates on plant breeding and incorporating genes for biofortification of vitamin A, essential amino acids, niacin, tryptophane, iron, and zinc. Zinc and iron deficiency, in particular, have a huge influence in the world, especially on children. The research not only focuses on addressing malnutrition in Africa, but also on enhancing food security by increasing food production, especially under the increasingly adverse climatic conditions that prevail on the Continent, and by improving the nutritional value of crops in a sustainable way.

According to a report from the African Union, almost half of African children under the age five years suffer from vitamin A deficiency, 60% suffer from anaemia, often caused by iron deficiency, and 25% are deficient in zinc. Micronutrient deficiency can lead to blindness, weakened immunity, stunted development, and other serious health problems affecting millions of women and children in Africa.

A study, 'Multinutrient Biofortification of Maize (*Zea mays* L.) in Africa: Current Status, Opportunities and Limitations', provides a synopsis of the health challenges associated with zinc, provitamin A, and tryptophan deficiencies and link these to vulnerable societies. It is also discusses the possibility of developing maize with multinutritional quality attributes, as well as with adaptation to stress conditions in SSA. The study suggested the development of maize with multinutritional attributes can be a sustainable and cost-effec-

tive strategy for addressing the problem of nutrient deficiencies in SSA. This can be done through stacking of genes determining nutritional factors, using conventional plant breeding, and not genetic engineering. Similar gene stacking for provitamin A and iron and zinc is done in other crops such as cassava and rice.

In another study 'Breeding of Vegetable Cowpea for Nutrition and Climate Resilience in Sub-Saharan Africa: Progress, Opportunities, and Challenges', the researchers looked at cowpea's potential to make a significant contribution to global food and nutritional security. It will be especially helpful as the world's population is increasingly leading to humanity facing a food and nutritional scarcity. In addition, it can be part of a sustainable food system, being a genetic resource for future crop improvement, contributing to resilience and improving agricultural sustainability under climate change conditions. In malnutrition prone regions of SSA, cowpea has become a strategic dryland legume crop for addressing food insecurity and malnutrition.

Cowpea, high in protein content and mineral, is indigenous to Africa and is widely grown by small-scale farmers. As part of Prof Labuschagne's research group, two PhD students – one in Ghana (working with the International Institute of Tropical Agriculture [IITA] in Nigeria) and one at the Agricultural Research Council (ARC) in Pretoria – are researching the genetic variability of cowpea and improving its nutritional value. A similar project was undertaken by a PhD student from Zambia on Bambara groundnut. In order to improve maize production and nutritional value, a PhD student from Eswatini looked at yield stability and iron and zinc variability in maize grown in this country.

Five PhD students are working on maize, looking at various aspects of the genetic improvement of maize to determine the genetic potential of newly released hybrids under adverse production conditions, compared to normal maize. Another PhD student from Zimbabwe is working on maize, which is high in provitamin A, zinc, and high essential amino acids, as a 'package' for farmers to grow.

Prof Maryke Labuschagne, PhD, is Professor of Plant Breeding in the Department of Plant Sciences and is also leading the NRF SARChI Chair in Diseases and Quality of Field Crops. She was the winner of the 2015 Continental Lifetime Achiever Award from Africa's Most Influential Women in Business and Government programme, in the category Education and Training. In January 2012, she received the African Union Kwame Nkrumah Award for Life and Earth Sciences on the Continent. She was named Grain Scientist of the Year for 2012 by Grain South Africa. Prof Labuschagne was elected as National Agriculturalist of South Africa for 2008 by the Agricultural Writers' Association of South Africa and was in 2008 also the winner of the National Science and Technology Forum award in the category for research capacity development. Prof Labuschagne has trained over 78 PhD and 74 MSc students from over 16 African countries. She and her students have authored 269 scientific papers in mainly ISI-listed journals. Her former students have released many new crop cultivars all over the African Continent, which has contributed to food security. Her own research interest is focused on the genetic improvement of the nutritional quality of staple crops in Africa.
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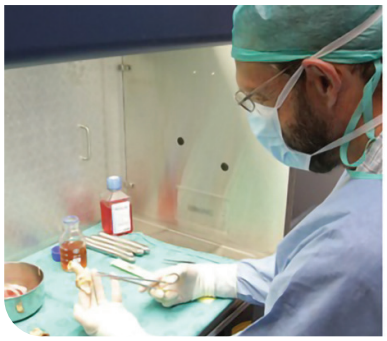
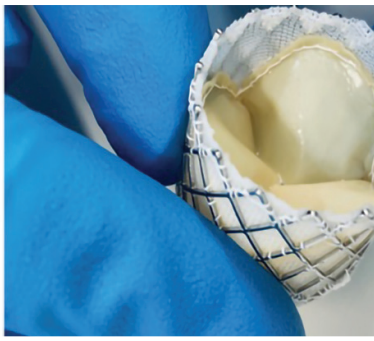
New Technologies **Help to Save Young Lives**





According to the United Nations Inter-Agency Group for Child Mortality Estimation (UN IGME), Report 2022, titled 'Levels and trends in child mortality', more than 5 million children globally, under the age of 5, including 2.3 million newborns, died in 2021. Along with this, 2.1 million children and youth aged 5 to 24 years – 43 per cent of whom are adolescents – also died during the same period. They may include congenital heart diseases which are the most common type of congenital defects, and account for more deaths in the first year of life than any other condition, excluding infectious etiologies.

This tragic and massive loss of life, according to the report, was mostly preventable with widespread and effective interventions such as improved care around the time of birth, vaccination, nutritional supplementation, and water and sanitation programmes. Every year more than 40 babies in the rural areas of South Africa may die as a result of an undiagnosed heart lesion, as some may assume they have respiratory problems when they actually have critical congenital heart disease – up to 85% of which is curable.

It is for this reason that paediatric heart specialists at the University of the Free State (UFS) Faculty of Health Sciences and the Universitas Academic Hospital have identified interventional and research epidemiology of cardiac diseases as their focus.

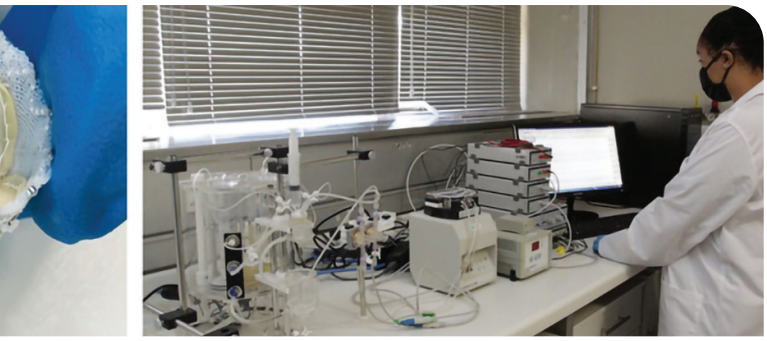
Prof Stephen Brown, Principal Specialist and Head of the Division of Paediatric Cardiology in the Department of Paediatrics and Child Health in the Faculty of Health Sciences, says children from poor and rural areas in central South Africa are dying of preventable Cyanotic Heart Disease (CHD), with the main contributor being the distance to regional hospitals.

The Robert WM Frater Cardiovascular Research Centre within the Department of Cardiothoracic Surgery in the UFS School of Clinical Medicine, conducts research on CHD amongst newborns with the intention to assist health authorities in central South Africa, and perhaps the rest of the Continent, to improve healthcare planning and services.

This research focuses on single ventricle physiologies – children who effectively have a single pumping chamber which means one of the chambers is underdeveloped or not developed at all, whereas normally a person has two pumping chambers. Children with this disease present with a blueish colour because the oxygenated and desaturated blood mixes, leading to the blue discoloration.

This retrospective study looked at over 20 years of cases from 1987 onwards. A total of 154 children with this disease were examined of whom 40 never received any form of therapy for the simple reason that many presented too late while others had severe birth asphyxia when they arrived at the hospital.

Treatment for CHD usually involves up to three operations before the child adequately recovers. The first operation is called palliation to ensure the control of the lung blood. That is usually in the first two to six weeks after birth. The second operation takes place between six months to a year of age and is called a bidirectional Glen – second-stage palliation. It also improves general condition and take some of the volume off the heart. The last operation, called the Fontan operation, takes place between six to seven years of age, after which they are deemed to be fully recovered.



The results from the study compare favourably with the rest of South Africa and Africa, but do not compare that well to high-income countries because of availability of resources. The study showed that the closer the patients are to the hospital, the greater their chances of being referred to a hospital with capacity and capabilities to treat congenital cardiac disease. This research has led to researchers embarking on outreach work with a donated mobile echocardiography apparatus. This facility has enabled paediatric heart specialists to consult between 170 and 250 patients per year.

Another important focus area of Prof Brown's research is an interventional component which includes research into Fontan conduits with collaborators from the Catholic University Leuven in Belgium. In the study 'Stent expansion of restrictive Fontan conduits to nominal diameter and beyond', the researchers aimed to evaluate the feasibility and safety of stent expansion of an Extracardiac Conduits (ECC) to the nominal dimension at the time of implant and, if possible, beyond nominal.

The study found that the diameter of the extracardiac conduit decreases over time in some Fontan-patients. The dimensions of ECC's can be safely and significantly increased to nominal, or even beyond, using stenting. It allows adjustment of ECC dimensions to compensate for adult somatic growth. It is evident that some ECC's may become smaller over the years with the diameter of the conduits at stent placement up to 30% smaller compared to nominal at the time of implantation.

With this work, the researchers they are testing out new technologies to try and treat patients without surgery in an effort to save and improve quality of life.

Prof Stephen Brown, D.M FCPaed (Cardio) DCH is a Principal Specialist and Head of the Division of Paediatric Cardiology in the Department of Paediatrics and Child Health in the Faculty of Health Sciences at the University of the Free State. He is also a paediatric cardiologist at the Universitas Academic Hospital. Prof Brown is a National Research Foundation (NRF) C-rated researcher and convener of the Health Sciences 2 Panel of the NRF. He is co-director of Clinical Research in the Robert Frater Cardiovascular Research Institute within the School of Clinical Medicine, and Section Editor for the *SA Heart Journal*. He is also a reviewer for national and international journals in the field of cardiology.
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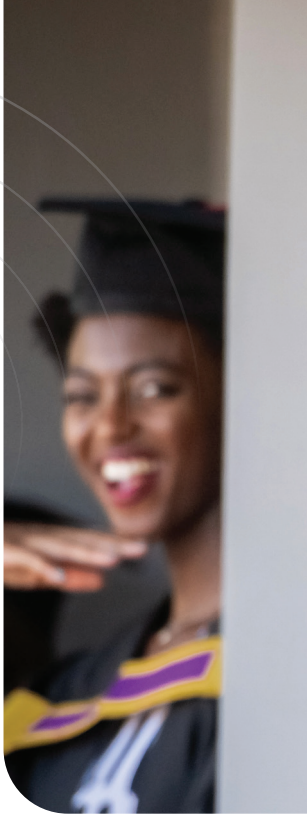

Quality Education **Changes Lives and Changes Communities**

SARCHI CHAIR IN HIGHER EDUCATION AND HUMAN DEVELOPMENT

RESEARCHING WELL-BEING, AGENCY AND STRUCTURES OF INEQUALITIES

Article 1.1 of the United Nations (UN) Declaration on the Right to Development states that "The right to development is an inalienable human right by virtue of which every human person and all peoples are entitled to participate in, contribute to, and enjoy economic, social, cultural and political development, in which all human rights and fundamental freedoms can be fully realized."

Contributing to this, the Higher Education and Human Development Research Group at the University of the Free State (UFS) led by Prof Melanie Walker, the SARChI Chair in Higher Education and Human Development, undertakes research and postgraduate education that contributes to human development.

This idea rests on a broad and plural conception of human well-being and conceptualises development as the promotion and advance of well-being. The UN Development Programme's (UNDP) definition of the core dimensions of human development includes empowerment, meaning the expansion of capabilities (ability to attain valued ends), expansion of valued functions (attained valued ends), and participation (sharing in specifying priorities), equity in distribution of basic capabilities, and security and sustainability of people's valued attainments and opportunities.

Prof Walker's group is concerned with advancing social justice and removing inequalities in and through higher education. The main focus of the research programme is therefore to interrogate the role of higher education in advancing or constraining human development. The researchers address questions about the kind of society we want, what is important in a democratic society,

and thus, what kind of higher education is valuable and relevant in the context of human and national development.

In one of her research publications titled 'Sustainable development goals and capability-based higher education outcomes' published by *Third World Quarterly*, Prof Walker addresses what kind of university education outcomes might contribute to the Sustainable Development Goals (SDGs), especially given claims that universities are or can be drivers of development and social change. To this end, she proposes a conceptualisation of higher education undergraduate outcomes aligned broadly with SDG 4 of 'quality' in education. In the paper Prof Walker sets out to make the case for a capabilitarian approach to university outcomes for quality and equitable higher education, rather than conceding this policy ground to neoliberal reductionist approaches.

The four-dimensional matrix and set of domains approach to outcomes seeks both to 'import' social justice development concerns grounded in the South African Constitution, with its emphasis on human rights, dignity, and equality, and to 'export' social justice back into society through a capabilities conceptualisation and more equitable outcomes across the diversity of students.

This framework, she argues, sharpens human development-facing learning outcomes and the notion of what quality and equality in higher education is or should be, and what for an individual a good higher education life ought to include, as well as fleshing out what a developmental university should develop, capabilities and functionings.

The role of higher education from a capabilitarian perspective would be to enable and expand the opportunities (capabilities) to achieve learning outcomes, reducing obstacles and expanding opportunities. The role of the individual agent (student) would be to mobilise their own agency and to make active choices as an important element of living a life of freedom.

Prof Walker and her team also look at the voices of students who made it to university and how

the diverse socio-economic and schooling backgrounds impact their development. With the research article titled 'Student decision-making about accessing university in South Africa' published in the journal *Compare: A Journal of Comparative and International Education,* she contributes a voice-based approach from young people who make it to university. To evaluate (more) justice, there is a need to know about their experiences and their capacity to act in the face of socially patterned conditions, to consider their day-to-day realities in making decisions about getting to university, and their aspirations.

The paper is essentially concerned with the 'accessibility' dimension of equitable higher education access and available options. Moreover, given the acknowledged importance of higher education to development policy in South Africa, inequalities of individual opportunities have real implications for development and the public good.

With this research, Prof Walker concluded that based on data from this project, university access in South African is uneven and not yet fair. On the one hand, there are students who experienced schools with high academic expectations, quality teaching, and information about higher education, including which degree programme to study, what to expect at university, having a ready-made group of friends to support them, and a family with sufficient income to support aspiration horizons. On the other, there is a group of participants who experience very little of these resources. What is clear from the student narratives is that circumstances make a difference and policy targets need to acknowledge this complexity, inconvenient though it may be for measurement.

The societal impact from the Higher Education and Human Development Research Group's work, lies in the body of knowledge they produce in a context where southern scholarship struggles to find recognition, place, and international standing – especially in the social sciences and in education. This body of knowledge is important.

Prof Melanie Walker is a full Professor and SARChI Chair in Higher Education and Human Development. She is a South African capabilitarian scholar whose research is informed by her own biography, the profound impact of struggling against apartheid in education and civic life, and hence enduring commitments to removing inequalities and injustices. Her research over the past two decades has been deeply informed by human development and the capability approach. She focuses on (higher) education, mostly in the Global South, and transversal research and practice challenges of decoloniality, methodology, inequalities, and justice. Prof Walker is an A1-rated education sciences scholar with the National Research Foundation (NRF), honorary professor at the Universities of Nottingham and Pretoria, and a fellow of the Academy of Science of South Africa (ASSAf). She was vice-president of the Human Development and Capability Association (HDCA) from 2014 to 2017, an editor of the *Journal of Human Development and Capabilities* (2007-2010), associate editor (2014-), and is the current President of the Human Development and Capability Association (HDCA) (2022-2024). She has been the recipient of numerous research grants in the UK, Europe, and South Africa, has delivered keynotes in South Africa, the UK, Europe, Australia, South Korea, and Taiwan, and is widely published – both books and journal articles. ORCID **ID 0000-0002-7859-6380**

The role of higher education from a capabilitarian perspective would be to enable and expand the opportunities (capabilities) to achieve learning outcomes, reducing obstacles and expanding opportunities.

Improving Food Security in Rural Communities

Extreme poverty and hunger are predominantly found in rural areas, with smallholder farmers and their families making up a very significant proportion of the poor and hungry, according to the United Nations' (UN) Department of Economic and Social Affairs. This problem is particularly acute in Sub-Saharan Africa (SSA) and urgent efforts and innovations are needed to address these challenges. Agriculture and rural development are poised to lead efforts in this regard.

Thus, eradicating poverty and hunger are integrally linked to boosting household food security and increased rural incomes. To assist with this, agricultural production must be sustainably intensified while acknowledging the multiple socio-economic roles that farms fulfil.

With the dual nature of farming in South Africa, smallholder farming activities exist next to large-scale, highly commercialised forms of agriculture that serve most of the formal markets. Small-scale farming is nevertheless essential to food security and income of millions of rural households in South Africa. It thus holds the potential to drive positive change in the country's economic state, elevating rural communities all while fostering regenerative and sustainable agricultural practices.

In these rural areas, communities rely on farming, including smallholder farming, to boost economic growth, eradicate poverty, and improve the quality of the livelihood of the people living in these areas, in particular the former "homelands" of Apartheid South Africa. With research into smallholder farms, Prof Linus Franke, investigates how this form of farming contributes to the eradication of hunger and poverty.

In one such study, 'Can small-scale farming systems serve as an economic engine in the former homelands of South Africa?', published in *Frontiers in Sustainable Food Systems*, Prof Franke found labour constraints, rather than land availability, as the main factor limiting increases in agricultural production among smallholders. Therefore, increasing the arable land of small-scale farmers alone is unlikely to stimulate production. Currently, small-scale farming does not serve as an engine for economic growth in communities of former homelands. However, sustainable intensification of farm production is a plausible pathway for the small number of households for whom farming forms an important part of their income. These households have the potential to engage in more commercial activities if farming and policies can be aligned. For those without this potential, small-scale farming remains a small but important contribution to household food security and farming is likely to remain an important supplementary livelihood opportunity for the majority of rural households.

In another study, 'Assessing the impact of climate change on crop production in southern Africa: A review', published in the *South African Journal of Plant and Soil*, Prof Franke provides a systematic review of studies assessing the impact of climate change on crop yields in southern Africa. The study reviewed twenty studies assessing the impact of climate change on future yields of crops, with the

results suggesting that potato, bambara groundnut and sugarcane have higher yield potential, while no consistent trends could be identified for maize and sorghum.

Elevated ambient carbon dioxide levels will have a major impact on crop biomass production and evapotranspiration in the future, with consequences for crop growth, water use, transpiration cooling, and other crop parameters. The results of the studies reviewed by the researcher on the impact of climate change on crop yields in southern Africa, point towards the uncertainties around future yield prediction. These are related to uncertainties in climate models predicting future weather conditions and uncertainties regarding the response of crops to higher temperatures and elevated CO2 levels. Especially the latter is technically difficult to test under realistic field conditions.

Though Prof Franke is of the opinion that it is not the role of academics to teach farmers how to farm, he is trying to improve farming by testing technologies on-farm and unraveling the interactions between field-level performance of technologies and biophysical and socio-economic constraints at farm level and beyond. He believes it is his role as a researcher and academic to test technologies to understand what kind of technologies work best in which areas and identify which farmers are most likely to adopt the technology. His research's impact lies in how it impacts the conversation, debates, and strong policy implications and recommendations around smallholder farmers.

Prof Angelinus Franke, PhD, is Professor and the Academic Department Head of Soil, Crop and Climate Sciences. He is also the Chair of a joint Agricultural Research Council (ARC)-UFS Research Chair on Climate Change and Agriculture. He is currently responsible for the implementation of projects on ecological resource use efficiencies of potato production in South Africa, the development of agronomic practices for hybrid potato, grazing management impacts on soil carbon dynamics of grasslands, and through PhD student projects, research on smallholder farming systems in South Africa, Namibia and Zimbabwe, and on sustainable sugarcane production in Eswatini and Mauritius.
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Artificial Intelligence Contributes to **Saving Fragile Lives**

According to the World Health Organisation (WHO), substantial global progress has been made in reducing childhood mortality since 1990. The total number of under-5 deaths worldwide has declined from 12.8 million in 1990 to 5 million in 2021. Since 1990, the global under-5 mortality rate has dropped by 59%, from 93 deaths per 1000 live births in 1990 to 38 in 2021.

Unfortunately, two regions, Sub-Saharan Africa (SSA) and southern Asia, accounted for more than 80% of the 5 million under-5 deaths in 2021. The under-5 mortality rate, being the probability of dying by age 5 per 1000 births, in SSA is 72 – being 9 times more likely than in Europe.

The leading causes of death in children under 5 years are preterm birth complications, birth asphyxia/trauma, pneumonia, diarrhoea, and malaria, all of which can be prevented or treated with access to affordable interventions in health and sanitation. Delays in identification, resuscitation, and referral have been identified as preventable causes of avoidable severity of illness and mortality in South African children. Research conducted by Prof Michael Pienaar and his collaborators in South Africa and the United Kingdom, aims to address this problem by using machine learning models. These models, which are used to predict a compound outcome of death prior to discharge from hospital and/or admission to the Paediatric Intensive Care Unit (PICU), were developed using artificial neural networks.

This research brings medical machine learning (MML) to South Africa. The idea of improving medicine with computation started with the advent of digital computers. In the branch of artificial intelligence (AI) called 'machine learning', computer software learns from experience and is used significantly in developing diagnosis, improving prognosis and patient monitoring. The results teach medical researchers and clinicians new ways of studying diseases, making medicines, and treating patients.

The development of artificial neural network models for paediatric critical illness in South Africa constitutes the first foray of MML in the country. The ultimate intention of the research is to build a machine learning system that can operate like a triage system for paediatric patients. This would enable clinicians, irrespective of their location, to potentially make early decisions with the accuracy of trained paediatricians, making informed diagnosis for treatment or referral.

The study found that ANN models are a feasible method for mortality prediction in lower- and middle-income countries (LMIC) but significant challenges exist. There is a need to conduct research directed toward the acquisition of large, complex data sets, the integration of documented clinical care into clinical research, and the promotion of the development of electronic health record systems.

Despite these limitations, the performance of the ANN models is an important proof of concept, demonstrating that ANN and other machine learning models can be developed in LMICs with efficient use of resources. This opens a wide range of research questions and informs the design and execution of clinical machine learning research in South Africa and LMICs.

Future research will focus on the implementation of the existing research through what is called a pragmatic clinical trial. Instead of having a strictly controlled or an experimental approach, which is the traditional approach in medicine, pragmatic clinical trials are much more interested in how an intervention works in the real-world practice.

The idea is to develop a mobile telephone application that will allow the clinician, irrespective of their location, to send patient data to a central computer that will use machine learning to provide a prognosis.

In contributing to reducing and preventing child mortality, the research flattens the skill pyramid in terms of making people with fairly basic training very powerful clinicians who can make very accurate decisions. It improves patient safety, reduces severity of illness, reduces the use of scarce resources – resulting in safer patients, less sick patients and ultimately, reducing child mortality. The big hope for this research is not see a preventable death again.

> *The development of artificial neural network models for paediatric critical illness in South Africa constitutes the first foray of MML in the country.*

Prof Michael A Pienaar, PhD, FCPaed (SA), Cert. Crit.Care (Paed, SA), Senior Lecturer/Med Specialist: Paediatrics and Child HealthFC Paed (SA) is an intensive care paediatrician. He is a Senior Lecturer in the Paediatric Critical Care Unit, Department of Paediatrics and Child Health at the University of the Free State. His clinical and academic career are in paediatric critical care and the prevention of paediatric mortality in low resource environments. He undertakes teaching and multi- and interdisciplinary research at undergraduate, postgraduate and postdoctoral levels. His research programme currently consists of postgraduate (six masters, three doctoral) and two postdoctoral fellows. **ORCID ID 0000-0001-6427-0278**

Protecting the Planet

The world is in the midst of a planetary crisis of climate change, biodiversity loss, and increased pollution and waste. The global economy is consuming ever more natural resources, and the world is not on track to meet the targets set by the UN Sustainable Development Goals (SDGs).

The planet is the only home for humanity, providing us with the essential means of sustaining life. The protection of the planet is often associated with protecting the environment; however, while there is an inextricable link between the two, the protection of the planet is fundamental to the sustainment of life.

Science and scientific research have become pivotal in finding solutions to this crisis, ranging from developing new technologies to changing policies and behaviour of societies.

Research undertaken at the University of the Free State (UFS) specifically focuses on responding to these and other challenges. Our researchers and academics undertake world-leading research in areas of biodiversity and ecosystem health, climate change, resource sustainability, and human health.

The research of Profs Patricks Voua Otomo, Ralph Clark, Paul Oberholzer and Dr Surina Esterhuyse are a few illustrative examples of how the UFS is addressing these challenges to attain the relevant SDGs.

As a good corporate citizen, the UFS has also committed to the ideals of the UN Global Compact by adopting a framework to advance Environmental, Governance and Sustainability. The work of the University Estate department, under the leadership of Nico Janse van Rensburg and Nicolaas Esterhuysen, illustrates this commitment.

Wastewater Sustains Lives and Livelihoods

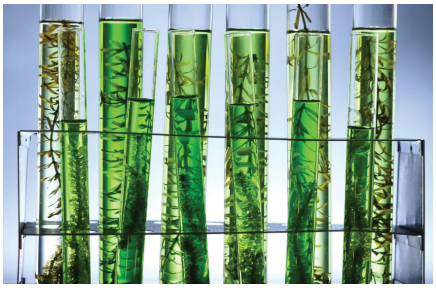
Water is the lifeblood of our planet, a crucial resource that sustains all forms of life and underpins human health, economic growth, and environmental sustainability. Yet, as the world grapples with escalating water scarcity, pollution, and the daunting challenges posed by climate change, the need for innovative solutions in water resource management has never been more urgent.

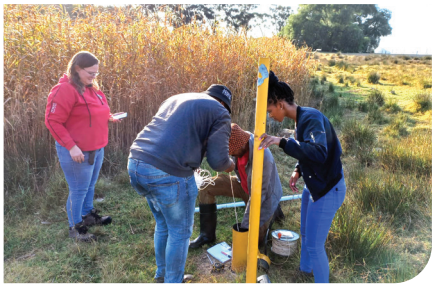
Using ecological engineering, a discipline that seeks not only to protect but also to regenerate and enhance natural ecosystems through the integration of human ingenuity and the inherent wisdom of nature, Prof Paul Oberholster, Director of the Centre for Environmental Management, undertakes impactful research at the nexus between science, sustainability, and ecological stewardship.

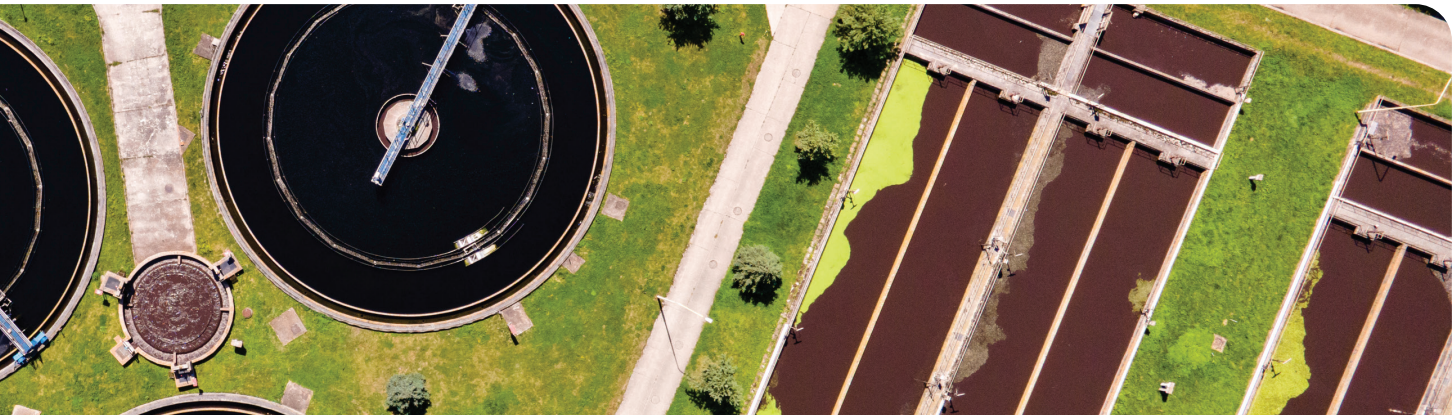
Prof Oberholster's involvement in groundbreaking projects across the Southern African Development Community (SADC) region illuminates his commitment to addressing pressing environmental challenges. In collaboration with the Council for Scientific and Industrial Research (CSIR) and local communities, he spearheads the 'Alternative low-cost solution to rural sewage wastewater treatment using phycoremediation'. This initiative aims to mitigate health risks associated with Wastewater Treatment Works (WWTWs) and foster poverty reduction through technological innovation. By enhancing the efficiency of pond-based WWTWs and implementing biotic cultures, the project safeguards community health and paves the way for sustainable waste management practices across the SADC region.

The aim of improving access to sanitation is included both in the United Nations Millennium Development Goals (MDGs) (2000–2015), the United Nations Sustainable Development Goals (SDGs) (2015–2030), the African Union's Agenda 2063 and South Africa's National Development Plan. Due to various problems, including technical, social, economic, and environmental challenges, insufficient Wastewater Treatment Plant (WWTP) capacity to cope with increasing wastewater loads due to an increase in population numbers, is a major problem in South Africa.

In the study 'Is Africa ready for natural base solutions to treat domestic wastewater as an alternative solution? A case study', Prof Oberholster







demonstrates how the successful implementation of the algae-based wastewater treatment pond system (WSP) could assist in improving WWTWs, especially in rural areas of South Africa and the rest of the Continent. The research found that the effective treatment of wastewater will improve the quality of water and increase the potential of downstream socio-economic activities, ultimately leading to the improvement of quality of life and reduce eutrophication. Such an approach brings significant opportunities for municipalities to address the backlogs in wastewater treatment, since it uses existing infrastructure with a more effective treatment process to address the risks of release of untreated to partially treated wastewater.

Phycoremediation, the use of micro- or macro algae for the removal or biotransformation of pollutants, including nutrients and toxic chemicals from different types of wastewaters or contaminated areas, is the answer to the ailing WWTW. This alternative method is gaining much attention. The technology is also eco-friendly and low cost, making it an attractive option for pollution control in developing countries.

To this end, Prof Oberholster is also involved in a study to demonstrate the feasibility of using an optimised phycoremediation system to treat domestic wastewater and reduce nutrients in waterbodies. The research study, 'A Comparative Study of Improvement of Phycoremediation Using a Consortium of Microalgae in Municipal Wastewater Treatment Pond Systems as an Alternative Solution to Africa's Sanitation Challenges', showed that improvement of phycoremediation through specific microalgae consortiums can play a major role in the removal of nutrients from domestic wastewater of WSP systems.

The implementation of phycoremediation in maturation treatment pond systems could also effectively minimise greenhouse effects, since the algae mass culturing in maturation ponds is a carbon-absorbing process, which can be used by municipalities in the carbon trading market and to provide a subsidy to reward their contributions to environmental protection.

The scope of Prof Oberholster's work extends beyond wastewater treatment. As the principal investigator for a project financed by the Global Environment Facility (GEF) through the African Development Bank and African Climate Technology Centre (ACTC), he explored the potential of phycoremediation as a climate adaptation strategy. This project, spanning Botswana, Malawi, and South Africa, demonstrated how effectively managing wastewater treatment plants could significantly reduce the proliferation of harmful nutrients and pathogens exacerbated by climate change.

Furthermore, Prof Oberholster's collaborative efforts with entities such as Sasol Group Technology, the Department of Forestry, Fisheries and Environment (DFFE), and international partners like the Geological Survey of Denmark and Greenland (GEUS), highlight his multidisciplinary approach to environmental challenges. From investigating pollutant pathways in defunct coal mines to contributing to disaster response efforts and advancing aquifer recharge technologies, his work is a beacon of innovation and resilience.

By working to improve water quality and reduce the prevalence of water-borne pathogens through projects like phyco-remediation, the impact of Prof Oberholster's research can be felt in reducing illnesses and mortality related to water pollution, thereby supporting efforts to ensure healthy lives and promote well-being for all. This research also directly contributes to improving water quality by reducing pollution, eliminating dumping, and minimising the release of hazardous chemicals and materials. His work on enhancing the operational efficiency of wastewater treatment works and developing guidelines for their implementation supports the goal of increasing water recycling and safe reuse globally.

Prof Oberholster also contributes to increasing the share of renewable energy in the global energy mix and improving energy efficiency, aligning with the goals for affordable and clean energy by using algae biomass for biofuel. In addition, his innovative approaches to wastewater treatment and ecosystem management contribute to building resilient infrastructure, promoting inclusive and sustainable industrialisation, and fostering innovation. His work on assessing and reducing health risks associated with water treatment facilities and his contributions to disaster response efforts, such as the Jagersfontein Tailings Dam disaster, align with the aim to mitigate the environmental impact of cities and improve urban resilience, while his work on the sustainable use and recycling of water resources and the exploration of algae biomass for biofuels and biofertilizers, supports the goal of achieving sustainable management and efficient use of natural resources.

Prof Paul Oberholster, PhD, is Dean of the Faculty of Natural and Agricultural Sciences and Director of the Centre for Environmental Management. He is also the Director of the Ecological Engineering Institute of Africa at the University of the Free State. His focus is on natural-based passive phycoremediation and phytoremediation treatment technology. He is a member of the Academy of Science of South Africa (ASSAf) in recognition of his academic achievements in South Africa and is currently rated among the top 2% in the world in the scientific category of engineering/technology, ecological engineering, and environmental engineering. **ORCID ID 0000-0001-5369-4497**

On Top of the Mountain

Aspiration One of Agenda 2063, Africa's vision and strategic framework is to deliver a prosperous future for the Continent and its people that is driven by inclusive and sustainable development. One of the goals under this aspiration is for the Continent to have an environmentally sustainable climate and resilient economies and communities. To achieve this, "measures need to be put in place to sustainably manage the Continent's rich biodiversity, forests, land, and waters and using mainly adaptive measures to address climate change risks".

To this end, the research team led by Prof V Ralph Clark, the founding Director of the Afromontane Research Unit (ARU) at the University of the Free State (UFS), has an important role to play. Their work contributes intellectually and practically to the sustainable development discourse of southern African mountains, with a particular focus on the Maloti-Drakensberg as a unique social-ecological system in southern Africa and the rest of the Continent.

As a mountain ecologist, Prof Clark's own research focuses on plant biodiversity, endemism, and the threats and risks to this biodiversity – including global change drivers, such as alien invasive plants species and land-use change, threatening the ecosystem goods and services provided by southern African mountains. He seeks to quantify the value that these poorly studied mountains contribute to the rich biodiversity of the region, the patterns and processes that drive this endemism, and enumerating and mitigating threats to it. He has also discovered 15 new plant species (many published in collaboration with or by local and international taxonomists), rediscovered many others only known from original collections, and considerably improved botanical and ecological knowledge of mountains in Angola, Eswatini, Lesotho, Mozambique, South Africa and Zimbabwe. His research has also incorporated the sustainable development of southern African mountains, given the pressures of land use change on biodiversity, and the trend towards transdisciplinary research in the global mountain research community.

Studying the ecology and biodiversity of mountains is important for many reasons. Globally, mountains are home for over 1 billion people and – according to the UN Food and Agricultural Organisation – nearly a third of such people live in developing countries such as South Africa. It goes without saying that we must look after our home. Mountains are a source of livelihood for millions of people. According to One Earth, mountains attract around 20% of global tourism, host nearly one-quarter of all terrestrial biodiversity, and are home to many of the foods consumed by humans. Climate change is also having a devastating impact on mountains. Most importantly, mountains are "water towers," providing 60-80% of all freshwater resources, the most precious resource of the planet.



The transboundary (Lesotho/South Africa) Maloti-Drakensberg is the largest and highest-elevation mountain system in southern Africa and provides a range of ecosystem services to the entire southern African region. If the alpine system collapses, it will have a detrimental impact on water availability both locally (such as immediate beneficiaries in the foothills) but as far afield as Gauteng, Durban, Upington, as well as in Namibia and Botswana – affecting more than 30 million people. With the research article 'Scrutinising Multidimensional Challenges in the Maloti-Drakensberg', published in *Sustainability,* Prof Clark and team identified research gaps affecting the Maloti-Drakensberg's future sustainability as a social-ecological system.

These gaps include the monitoring and mapping of ecosystem health and provision, in tandem with monitoring of changes in sociocultural well-being and the investigation of factors driving overstocking of rangeland. This includes the assessment of ecosystem carrying capacity in terms of livestock as well as tourist numbers, and mapping of areas of highest degradation and priority areas for sustainable development. In addition, quantitative analysis of the ecosystem is undertaken, including research into causality, trade-offs and interaction between degradation of multiple ecosystem services. The finding highlights the need for stronger multi- and interdisciplinarity research between scientific disciplines, particularly across social sciences, humanities, and natural sciences. Such inter- and multidisciplinary research is essential in an area where issues regarding ecosystem health, livelihoods, and politics/ administration are so obviously intertwined and there are no easy solutions to current challenges around e.g. communal rangeland over-use of the alpine zone.

Prof Clark and the ARU also undertake research into the impact of global change on montane and alpine vegetation in mountains, to establish why certain plants in mountains are rapidly expanding their ranges. This is a key question of the EU Biodiversa project 'RangeX', a multi-institutional research consortium on six continents under the Mountain Invasive Research Network (MIREN). The project seeks to better understand the processes and impacts of plants that are expanding their ranges following climate warming, and to use this knowledge to inform the development of policy regarding range-expanding plant species. This research is particularly important as woody alien invasive plants and range-expanding woody native plants can have major negative impacts on mountains and their human communities.

In another study, titled 'The Alien Plants that threaten South Africa's Mountain Ecosystems' in *Land's* Special Issue "*Mountains under Pressure*", the researchers suggest improved mountain-specific surveys to create a database which could be used to develop management strategies appropriate for each mountain range in South Africa. This study assessed the status of alien plants in South African mountains by determining sampling efforts, species compositions, and abundances across the six local mountain ranges at lower- to higher-elevations.

This research is significant because the six major mountain ranges in South Africa, which support critically important ecosystem services, including water production, biodiversity, and exceptional endemism (especially in the Cape Fold mountains and along the eastern Great Escarpment), are threatened by detrimental land uses, unsustainable use of natural resources, climate change, and invasive alien plants. Invasive alien plants, in particular, pose substantial and rapidly increasing problems in mountainous areas worldwide. However, little is known about the extent of plant invasions in the mountains of South Africa.

In a complementary study, titled 'Potential for Sustainable Mountain Farming: Challenges and Prospects for Sustainable Smallholder Farming in the Maloti–Drakensberg Mountains', the ARU team studied smallholder farming in the Maloti–Drakensberg that is impacted by unsustainable natural resource management. It was found that innovative and adaptive strategies that consider local and indigenous knowledge, mitigate soil degradation, and enhance water and rangeland conservation are needed to promote sustainable food production. They also suggest that a transboundary research effort that incorporates social and cultural nuances is needed, with results being of community benefit to develop agronomic solutions, inform policy, and revise legislation.

> *"It goes without saying that we must look after our home. Mountains are a source of livelihood for millions of people.*

Prof V Ralph Clark (Pri Sci Nat) is Director of the Afromontane Research Unit and an Associate Professor in the Department of Geography on the Qwaqwa Campus. He is C1-rated by the National Research Foundation and serves on the Board of Directors of the International Mountain Society, based at the University of Bern, Switzerland. He is also a Founding Trustee of the African Mountain Research Foundation, located in the United Kingdom. He served on the Scientific Steering Committee of the Global Mountain Biodiversity Assessment (GMBA, University of Bern), and the global network Mountain Invasion Research Network Steering Committee (MIREN). His research expertise focuses on improving our understanding of plant diversity and plants endemic to southern African mountains, and translating these into better biogeographic understanding for conservation and sustainable use outcomes – including areas in the southern Great Escarpment (Roggeveldberge to the Stormberg, South Africa), the Manica Highlands (Zimbabwe–Mozambique), the Qwaqwa Malotis (South Africa–Lesotho), the Malagasy Highlands, and the Angolan Highlands. Prof Clark has published numerous research papers, book chapters and graduated masters and doctoral students. Prof Clark was Chair of the Scientific Committee of the Grassland Society of Southern Africa (GSSA) and is a member of the international editorial board for the journal *Mountain Research and Development*. He has acted as guest editor for three mountain-focused special issues.
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Reclaiming the **Quality of Water**

One of the hallmarks of the Anthropocene has been, among others, the degradation of aquatic ecosystems due to pollution. In the Qwaqwa region, nested at the foot of the Maloti-Drakensberg Mountain range in the eastern Free State, the interplay between water scarcity and compromised natural water resources has been a reality for more than two decades. Most houses in the urban centre of Phuthaditjhaba are provided with potable water via the municipal water supply but this is not the case for informal settlements on the outskirts of the town and the rural villages higher up in the mountains. These remote communities must often rely on natural water resources of dubious quality. Moreover, access to the municipal water network does not always guarantee sustained access to water due to the prolonged interruptions in the water supply that are common occurrences in the region. The communities of the Qwaqwa region are, therefore, extremely vulnerable to water insecurity because of a combination of factors such as climate change, obsolete water infrastructure, ageing and underperforming wastewater treatment plants, and the widespread degradation of local river systems.

The degradation of river systems is not unique to the Qwaqwa region. It is a nationwide problem which has been linked primarily to our inability to properly treat wastewater. According to the 2022 Green Drop Report, out of the existing 850 wastewater systems across 90 municipalities, only 23 (or less than 3%) qualified for the Green Drop Certification. This underscores the depth and breadth of the wastewater treatment crisis in South Africa and its potential implications for human and environmental health.

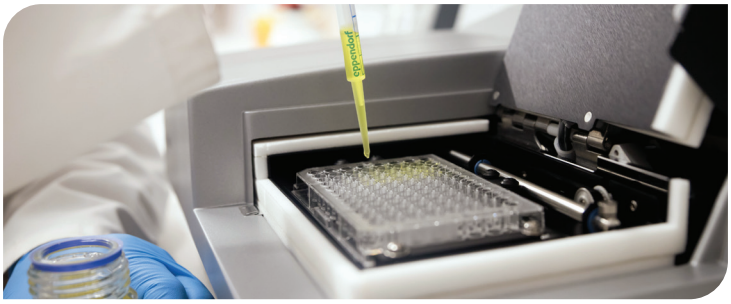
It is these challenges that inform Prof Patricks Voua Otomo's research, which focuses on the drivers of river pollution in the Qwaqwa region, ways to mitigate/remediate their effects, and the development of simple and quick methods to assess water quality.

Prof Voua Otomo's research has drawn attention to localised incidences of terrestrial and aquatic contamination linked to sewage sludge management by local wastewater treatment plants. Wastewater treatment plants, however, have been found to contribute only partially to river pollution in the region, as a significant amount of river pollutants emanates directly from the communities that, due to the lack of adequate refuse removal services and sanitation, often dispose of their household waste directly into the waterways. The pressure exerted by human settlements on the local rivers has further been evidenced by water analysis along the river courses showing unacceptable levels of pharmaceuticals such as biphenyl-4-ylacetic acid (an anti-inflammatory), efavirenz (an HIV medicine), and carbamazepine (an epilepsy medicine) These findings are currently in review for publication in *Frontiers in Water*.

To mitigate the deleterious effects of sewage sludge-induced pollution on terrestrial and aquatic ecosystems, Prof Voua Otomo has conducted research on the benefits of biochar amendment of sewage sludge as an alternative management strategy and shown that biochar amendment of the locally produced sludge before open-air storage could decrease toxic effects on terrestrial invertebrates such as oligochaetes.

To attempt to reclaim the quality of contaminated water, ongoing research in Prof Voua Otomo's laboratory involves the use of 'mycofiltration', being the use of fungal mycelia for the purpose of water filtration. This relatively untapped eco-friendly technology is attracting more attention, yet its real merits are only now being established and documented scientifically.

Together with Sanele Mnkandla, the PhD student working on the project, Prof Voua Otomo undertook a study on the optimisation and performance evaluation of fixed bed mycofilter prototypes,



which found that fixed bed mycofilter optimally removed food colour from aqueous solutions, in high bed height and flow rate, and low pH conditions.

Using freshwater snails, Prof Voua Otomo's research team have successfully shown that mycofiltration significantly reduces the toxicity of water samples contaminated with inorganic and organic toxicants. In this study, titled 'Mycofiltration of Aqueous Iron (III) and Imidacloprid Solutions, and the Effects of the Filtrates on Selected Biomarkers of the Freshwater Snail Helisoma duryi' published in *Archives of Environmental Contamination and Toxicology*, biomarker analysis showed that mycofiltration does improve water quality, evidenced by lowered catalase enzyme activities in H. duryi snails exposed to mycofiltered iron (III) or imidacloprid. In some instances, however, possible products formed due to interactions of the biosorbate and live mycelia may affect exposed organisms, as observed by the increased acetylcholinesterase activity in the snails exposed to mycofiltered iron (III) in this study. More tests using local wastewater effluents are currently being carried out and possible applications of this low-cost and eco-friendly technology are being explored.

Fungal species have also proved useful in the remediation of plastic pollution. Nozipho Kheswa, a research associate of Prof Voua Otomo, has successfully isolated more than a dozen strains of fungi that display varying levels of effectiveness for plastic degradation. The fungal strains were isolated from soils collected in selected landfills located in the eastern Free State. The preliminary results of this research are currently being prepared for publication.

Finally, through the study of both the escape behaviour of earthworms in semi-aquatic environments and the unique behaviours of mosquito larvae, Prof Voua Otomo has recently released two novel and affordable methods suitable for the quick assessment of water quality. These methods are simple enough to be used by both professionals and novices alike. Assisted by Nkabeleng Lechesa, an Honours student under his supervision, Prof Voua Otomo is seeking to validate a third method ahead of its publication.

Prof Patricks Voua Otomo, PhD, is the Associate Professor and subject head of Zoology and Entomology and Director of the Centre for Global Change (CGC) on the Qwaqwa Campus. He has served on the editorial board of the *Bulletin of Environmental Conta-mination and Toxicology* since 2013. He is a member of the Sub-committee on Water Security and Water Quality, a component of the Science Advisory Group on Emergencies (SAGE), under the auspices of the Academy of Science of South Africa. As a member of SAGE, in 2023 he contributed to writing a strategic advisory on wastewater management in South Africa, in the wake of the 2023 cholera outbreak. **ORCID ID 0000-0002-3384-5187**

Groundwater – A Precious **Natural Resource**

Due to the current and prolonged energy crisis in South Africa, the requirement for new energy sources has gained momentum with the government considering unconventional oil and gas (UOG) development in the Karoo. However, as with other countries, South Africa is experiencing increased water stress due to the effects of climate change and high-water demand for human and economic needs. This has led to greater reliance on available groundwater. It is thus important that this vital resource is protected by developing appropriate measures informed by science.

UOG extraction, often involving hydraulic fracturing, is extremely water-intensive and comes with significant risk to the environment, specifically as it can contaminate both surface water and groundwater during spillages and during the fracking process itself.

The research led by Dr Surina Esterhuyse, a researcher at the Centre for Environmental Management, focuses on understanding the UOG extraction technology and its environmental and socio-economic effects. This research is used to develop appropriate measures to protect groundwater. Some of the measures include assessing vulnerability, determining impacts, developing monitoring protocols, and the development of regulations. The research has provided advice to governments and regulatory bodies on how to effectively monitor and manage these technologies, and how to regulate the extraction activities, both in South Africa and internationally.

Dr Esterhuyse has extensively researched the environmental impacts of UOG extraction, with over 60 scientific papers, books, book chapters, and research reports on this topic, some of which are being used by regulatory agencies. In commissioned work for the Water Research Commission (WRC), she and her team helped determine the possible biophysical and socio-economic impacts of UOG extraction. During this research they also developed an interactive fracking vulnerability map (https://fracking.webmaps.africa/) and a monitoring protocol for UOG extraction within the South African context. This study recommended a Strategic Environmental Assessment (SEA) for shale gas development in the Karoo.

The SEA, on which she was a contributing author, undertook a scientifically independent regional-scale environmental scientific assessment of shale gas development in South Africa. This formed an evidence base for South African regulators on which to base policy decisions regarding shale gas development. In the book chapter 'Effects of Hydrocarbon Extraction on Freshwaters' in the *Encyclopedia of Inland Waters*, published by Elsevier, Dr Esterhuyse explains the interlinked regional-scale effects of hydrocarbon extraction on inland water resources. The chapter recommends sustainable management approaches for governments who consider UOG extraction.

More recently, Dr Esterhuyse and her collaborators also assessed the impact of UOG extraction in the Okavango. They found that extraction could pose a serious risk to groundwater resources, and they recommend prohibiting oil exploration and production until further studies can determine the impacts of hydrocarbon extraction with greater certainty. Based on their study, UNESCO proposed that the Okavango World Heritage site be expanded to include the whole Okavango watershed across Angola, Namibia, and Botswana.

An important aspect of protecting groundwater resources is understanding the baseline quality of the water resources and ensuring monitoring of these water resources during UOG extraction. Research on the capacity and capability of regulatory authorities in South Africa to monitor groundwater resources during UOG extraction, recommends that South Africa develop a specialised UOG extraction monitoring laboratory to cater for analytical needs during UOG extraction. Such capacity could also address the analytical requirements for the rest of the African Continent during UOG extraction.

Apart from vulnerability and impact assessments and monitoring protocols for UOG extraction, another very important tool to protect water resources involves regulations. Her research study titled 'Developing and enforcing fracking regulations to protect groundwater resources', published in the *Nature* journal *NPJ Clean Water*, offers crucial insights into how to protect groundwater resources during UOG extraction, using regulations. This study recommends specific UOG extraction regulations to protect groundwater resources, which are not only relevant to South Africa, but also to other countries that extract UOG resources. In addition, Dr Esterhuyse, reviewed, classified, and systematically tested the many different regulations that are currently applied internationally, to assess their usefulness in protecting groundwater resources.

As a potential means of enhancing citizen science, Dr Esterhuyse's research is also exploring the possibility of introducing a mobile application to monitor UOG activities to aid in the enforcement of groundwater protection regulations. Such an application would allow citizens to report pollution and other incidents that may affect the environment, to ensure timeous action to mitigate negative environmental effects.

Dr Surina Esterhuyse, PhD, is a researcher at the Centre for Environmental Management, University of the Free State. She specialises on minimising the environmental impact of unconventional oil and gas extraction on specifically groundwater resources. Her research interest lies in the area of water resources management and protection during unconventional oil and gas extraction. Currently, her research focuses on the regulation of fracking to protect groundwater resources and she is part of the project team developing a regional groundwater monitoring network for the Karoo.
ORCID ID 0000-0001-7675-443X

Green is **our Colour**

The mission of the University of the Free Sate (UFS) is to generate and impart new knowledge that impactfully supports societal development. In this context, and as a responsible citizen in South Africa, a country grappling with profound societal, environmental, and governance challenges, the UFS recognises its duty to lead by example. As such, the UFS embraces environmental, social and governance (ESG) principles and practices and commits to integrating these throughout its operations, including its education, research, and engagement endeavours.

This commitment will contribute to the UFS not only being a sustainable organisation, but also facilitate the sustainable development of our country and society. This is consistent with the UFS' values of excellence, innovation and impact, accountability, care, social justice, and sustainability. Regarding sustainability, we commit to ethical and responsible stewardship of all institutional resources, processes, and practices to ensure operational, financial, environmental, and societal sustainability.

According to the World Green Building Council (WorldGBC), a local-regional-global action network, "buildings are currently responsible for 39% of global energy-related carbon emissions: 28% from operational emissions, from energy needed to heat, cool and power them, and the remaining 11% from materials and construction." The WorldGBC claims "that towards the middle of the century as the world's population approaches 10 billion, the global building stock is expected to double in size." It also claims that by 2050, "Africa will be home to 1.1 billion more people than it is today – nearly 75% of the world's projected population growth of 1.5 billion more people."

Therefore, the built environment sector, especially the sustainable built environment, has a critical role to play to protect the environment by reducing greenhouse gas emissions. At the UFS, the University Estates department, in doing its small part, aims to align its building projects with the SDGs in terms of clean energy, innovative infrastructure, and responsible consumption. One of the department's main goals is to achieve energy efficiency and green building principles in every new building project and in upgrading of buildings taking place on the University's three campuses.

One prime example of such a building is the Modular Lecture Building on the Bloemfontein Campus, which incorporated various energy-saving measures, including building orientation to optimise exposure to sunlight in spaces where it matters, seasonal sun control, double glazing and louvres for energy conservation, rainwater harvesting and storage on the roof of the building, trees, and water-wise landscaping. The building received a National Merit Award from the South African Institute of Architects (SAIA).

Through guidelines for pursuing sustainability in its built environment, the UFS has given meticulous consideration when new buildings and structures are planned and is also measuring and tracking energy consumption in all its existing buildings. Furthermore, the institution has adopted technical guidelines for building design and development, following the rating systems and tools developed by the Green Building Council of South Africa (GBCSA), which are used for the certification of sustainability performance in the built environment. These guidelines, which apply to indoor environmental quality, energy, materials, land use ecology, emissions, innovation, and water, among others, form part of the measures used when new buildings are developed.

The UFS shows it commitment to sustainable development and societal impact by undertaking projects that promote green energy solutions, energy-saving measures, and save precious water sources.

As a flagship project for renewable energy, the UFS installed solar plants across its three campuses, thus promoting sustainable, clean energy solutions while also responding to problems associated with ongoing national load-shedding. The microgrid installation on the Qwaqwa Campus in the eastern Free State is one of the biggest solar-diesel hybrid systems in South Africa, enabling the Campus to fully function despite excessive power interruptions in the region. Since the first solar plant was commissioned in 2017, the institution has saved up to

R43,28 million which will increase substantially with the commissioning of two large new ground-mounted solar plants on the Bloemfontein Campus.

The UFS' efforts with energy-saving measures have yielded positive results as the energy consumption has decreased by 14,5% since 2017, even though the gross surface area of the University has grown by 8,8% and despite an increase in buildings, residences, and student numbers. At the end of 2022, solar energy contributed 11% of the University's total electricity consumption. The University's carbon emissions have also decreased from 0.115 CO2/m2 in 2013 to 0.088 CO2/m2 in 2022 – making it a frontrunner in low carbon emissions among South African higher education institutions. This is mainly due to the implementation of energy-efficient strategies and solar generation, effectively minimising energy consumption.

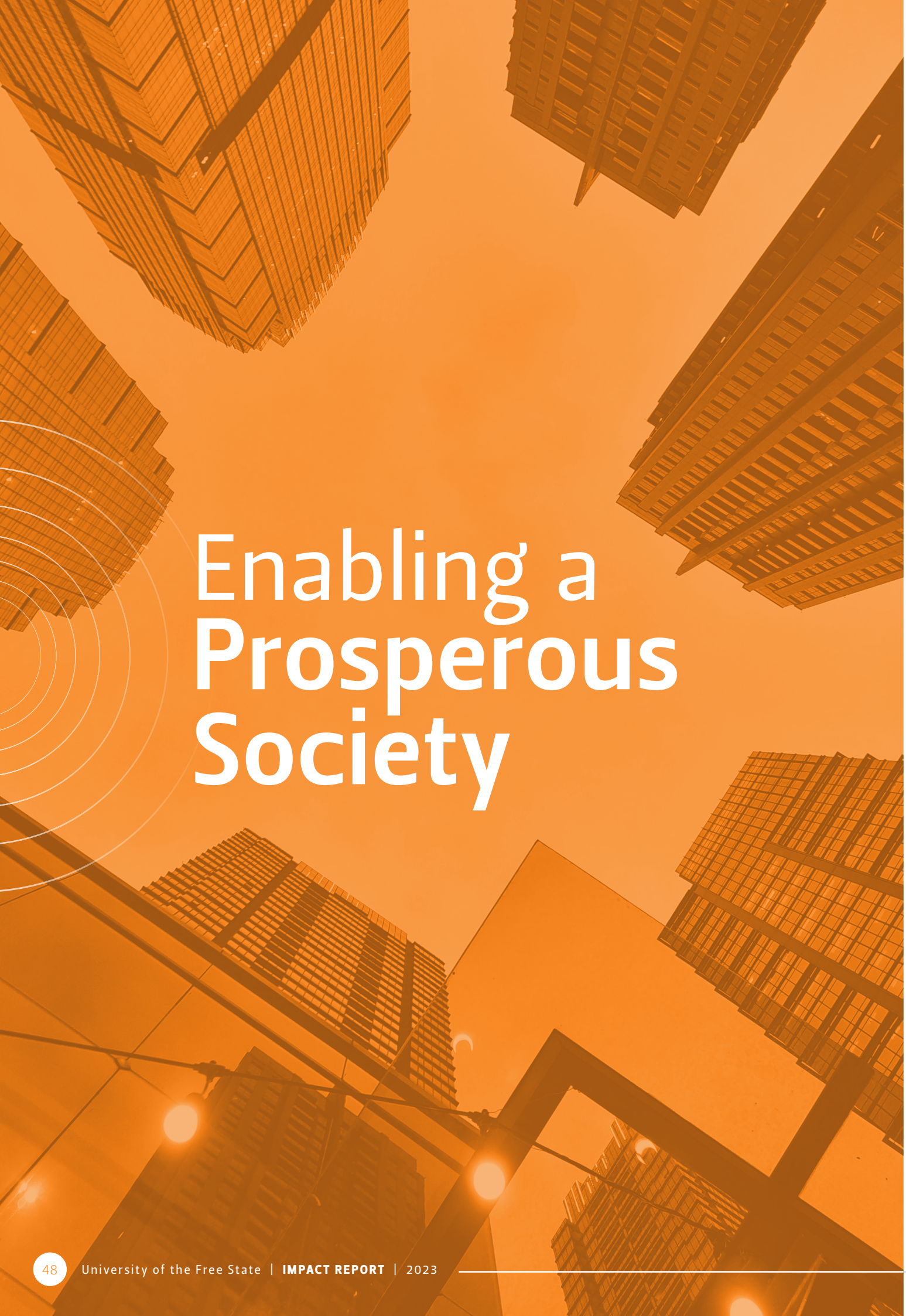
Replacing the old hot water systems in student residences with heat pump clusters, enabled consolidation of the hot water systems and further contributed to the UFS' energy efficiency efforts. The institution is also saving energy by using energy efficient lighting, changing to LED lights in buildings, streetlights, and sport lights. In addition, lights in common areas and in buildings are connected to a motion sensor, while area lights are on day night sensors. All old air conditioning systems are being replaced with energy efficient systems.

Another focus area for the University is waterwise landscaping in which greywater initiatives have been introduced to reduce the municipal water consumption. This is done by replacing large expanses of lawn with hard elements and paving, as well as waterwise indigenous plants, including a range of hardy succulents which can adapt to continuous local drought conditions and sporadic water restrictions.

Rainwater harvesting systems have also been introduced at all residences and academic buildings. Other water-saving initiatives include greywater systems installed at residences, waterless urinals in administrative and academic buildings, water restrainers, pressure control systems (reducing the volume of water), and push-button systems instead of taps in all bathrooms.

Nico Janse van Rensburg, Senior Director: University Estates.

Nicolaas Esterhuysen, Director: University Estates Engineering Services.



Enabling a **Prosperous Society**

8 DECENT WORK AND ECONOMIC GROWTH

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

10 REDUCED INEQUALITIES

11 SUSTAINABLE CITIES AND COMMUNITIES

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

During the past half century, more people have become economically prosperous than in the history of the world. While this is a laudable achievement, it has resulted in some negative consequences, such as increased inequality and associated challenges of increased urbanisation. Similarly, this prosperity has also required increased extraction and use of natural resources with a detrimental impact on the environment and the planet.

With the aim to "ensure that all human beings can enjoy prosperous and fulfilling lives and that economic, social, and technological progress occurs in harmony with nature", the Sustainable Development Goals (SDGs) promote sustainable and inclusive economic growth. However, inequality remains one of the biggest issues of our time. Despite global efforts to reduce inequality in income and opportunities, progress is stalled by deep-rooted systemic inequalities. However, it has been shown that it is possible for economic growth that occurs in harmony with nature, without increased extraction.

Given the urgency of the challenges we are facing, we need to follow these examples and make progress at a faster pace. If we can achieve SDG 8 (Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all), SDG 9 (Build resilient infrastructure, promote inclusive and sustainable industrialisation and foster innovation), SDG 10 (Reduce inequalities within and among countries), SDG 11 (Make cities and human settlements inclusive, safe, resilient, and sustainable), and SDG 12 (Ensure sustainable consumption and production patterns), a sustainable and prosperous world for all would be possible.

There are many examples of work being done at the University of the Free State that address these goals. The research of Profs Lochner Marais, Ivan Turok, and Brownhilder Neneh are a few examples that reflect the contribution being made by the University.

Life **After Mining**

The mining industry has been the bedrock of the South African economy for over a century. In 2023, mining contributed R202 billion to South Africa's GDP. As an extractive industry with finite resources, mines ultimately must be closed. However, the National Development Plan 2030 has identified the need to not only eradicate poverty, but to also reduce inequality and provide decent work and prosperity through inclusive and sustainable economic growth.

Universities are rightly expected to contribute to the attainment of this vision. In this regard, the University of the Free State (UFS) has prioritised and invested in undertaking research into mining and mine closures, the socio-economic impact of renewable energy, local economic development practice, and spatial planning in secondary and mining cities. This research not only considers how these events influence the prosperity of people and economic growth, but also looks to provide evidence for understanding and proposing solutions to the problem.

The Centre for Development Support (CDS), under the leadership of Prof Lochner Marais, is a research unit within the Faculty of Economic and Management Sciences which aims to promote sustainable human development in the broader South African society through its research projects. However, most research takes place in multi-disciplinary teams with staff of other departments.

Since transitioning to democracy in the mid-1990s, South Africa has taken considerable steps to improve its citizen's well-being. The progress, however, has stagnated in the last decade and, according to the World Bank, the percentage of the population living below the upper-middle-income country poverty line fell from 68% to 56% between 2005 and 2010 but has since trended slightly upwards, to 57% in 2015, and is projected to have reached 60% in 2020.

South Africa's high and increasing unemployment rate will be exacerbated with the closing of various mines in the coming years. This, according to the research by Prof Marais and the CDS, will not only impact the jobs of thousands of people, but it will also lead to social disruption and higher crime levels.

In one of their numerous research publications, 'Mine closure, social disruption, and crime in South Africa', the researchers found that the small cities where mining is declining have been experiencing the highest crime rates (expressed as a crime per 100 000 of the population) for most of the main and subcategories of crime (including murder). For half of these crime categories, the rates in these towns are generally higher than in the large metropolitan cities. This finding stands in contrast to global research that posits that large cities have higher crime levels than small cities. The results also show that the small cities where mining is growing have lower crime levels than cities where mining is in decline (also in contrast to international literature on the topic).

The evidence from this study shows that mining decline contributes to social disruption which has been happening in South Africa's gold mining industry, where local organisations and institutions are not strong. The researchers believe their paper reveals only the tip of the iceberg and that more research will add to their discoveries and help in understanding these patterns.

The CDS has also conducted research into the effect of mine closures on housing in these towns and cities. In their recent book titled *The Social Impacts of Mine Closure in South Africa – Housing Policy and Place Attachment*, Prof Marais and colleagues investigated the relationship between mining, mine closure, and housing policy in post-apartheid South Africa. Mine closures present a major challenge to the mining industry and governments and the book argues that the dependencies created by the mining industry and mine housing policies while a mine is operational cause serious societal problems when it closes. Assets that have been created in good times, now have little value. A further edited collection (with

Matebesi and Nel) *Local Responses to Mine Closure in South Africa: Dependencies and Social Disruption*, provides multiple case studies of post-mining communities and their responses to mine closure.

To demonstrate this, the book applies the concepts of place attachment, asset-based development, and social disruption. In South Africa, the mining industry and the government have created comprehensive housing programmes linked to home ownership to promote place attachment, stability, and wealth among mine workers. These programmes do not consider the disruption that mine closure might bring, and the book challenges the blind application, during boom periods, of policies which create long-term dependencies that are difficult to manage when a mine closes.

In researching mine closure, Prof Marais and the CDS researchers also studied the impact of these events on woman, as reported in their recent publication 'Women and mine closure: A case study of policy in South Africa' published by *Resources Policy*. Using literature on how mining affects women and the history of discrimination against black women in South Africa, they examined South African policy on women in mining and how mine closure affects them. The paper contributes towards a more nuanced understanding of the social aspects of mine closure and recommend a more comprehensive policy focus on the local and regional social consequences of mine closure for women.

Though mine closure is a huge challenge for a town, municipality, as well as the country at large, Prof Marais believes mine closure could create new economic opportunities if the focus is in the first place on managing closure and decline. For example, land rehabilitation or leveling the land to the original state, provides a platform for new economic activity. The poor state of mine closure in South Africa hampers the development of new economic opportunities.

The research done by Prof Marais and the CDS contributes to both academia and society, across and within disciplines, and is of benefit to individuals, organisations, and nations.

Prof Lochner Marais, PhD, is a Professor of Development Studies at the Centre for Development Support at the University of the Free State. He is also an honorary professor at the Sustainable Minerals Institute (University of Queensland, Australia) and since 2014 he has been the Executive Editor of the journal of Cambridge University Press: *Research Directions: Mine Closure and Transitions*. He serves on the editorial board *of Habitat International* and the advisory boards for *Housing Studies*, *International Journal of Housing Policy and Housing and the Built Environment*. His research interests include housing policy, small cities and towns (mining and renewable towns and cities), and public health focusing on children. In addition to concentrating on these themes separately, he focuses on integrating them. Marais has authored, co-authored, and compiled over 250 research reports, including 180 refereed articles in peer-reviewed journals or books.
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Cities at the Heart of a Prosperous and Inclusive Society

The pace of urbanisation in Africa is faster than elsewhere in the world. Many African cities are growing at 5% per annum or more, which means they are doubling in size every 14 years. Surging population growth presents opportunities for social and economic progress, but it also creates formidable challenges for the provision of housing, public services, food security and employment.

The outcome of rapid urbanisation in Africa is not a foregone conclusion. Much depends on the ability of decision-makers to anticipate and respond to the needs of cities for additional land, investment in infrastructure, and governance capabilities. Prof Ivan Turok's Research Chair in City-Region Economies is intended to strengthen understanding of the drivers and dynamics of urban growth. Reliable knowledge and information about cities is crucial for forward planning and policy action by governments and other stakeholders.

The Chair is funded by the National Research Foundation (NRF) and the SA Cities Network. It is hosted in the Department of Economics and Finance and the Centre for Development Support. The central purpose is to advance public awareness of the role that cities can play in creating a more prosperous and inclusive society. The core idea is that cities are platforms for social and economic progress because they enable learning and foster creativity. Cities also make people and firms more productive and successful through improved access to all kinds of resources, opportunities and infrastructure.

Greater understanding of the potential of cities is vital in South Africa because of widespread doubts about urbanisation. Many politicians and officials fear that cities are increasingly overwhelmed by the influx of unskilled and unemployed migrants from rural areas and other countries. Big cities are also widely perceived to be congested, conflict-ridden and ungovernable.

The Chair's research explores multiple ways in which cities contribute to economic success and social upliftment. It aims to strengthen the evidence base in order to improve policy and practice – for government, civil society, and the private sector. The Chair is building a team of researchers and postgraduates who collaborate with their counterparts in other institutions at home and abroad to influence local, regional, and global urban agendas and outcomes.

A major achievement has been the Spatial Economic Activity Data: South Africa (SEAD-SA) initiative. The impetus stems from the complete absence of reliable information about the changing location of jobs and investment in the country.

Up-to-date economic data at neighborhood and city levels will stimulate public debate and make the government more accountable for its track record in growing the economy and overcoming the divisive spatial legacy of apartheid. For the first time ever, comprehensive information is available on where jobs are concentrated, which industries and locations are creating new jobs, and which sectors and places are shedding them. SEAD-SA has been created by extracting administrative

data from tax returns and other sources. It is the culmination of a long-term collaboration between University of the Free State (UFS) researchers, led by Dr Justin Visagie, the National Treasury, the SA Revenue Service, Statistics SA, and UNU-WIDER.

The data have already begun to inform city-level planning and policymaking. The statistics are available in a user-friendly data portal (see www.spatialtaxdata.org.za). This is aimed at government officials, investors, businesses, researchers, and the general public. The portal and its various dashboards and interactive charts make it simple to explore and download data on various dimensions of local employment growth and decline, industry diagnostics, and business performance.

The data reveal important insights into what is special about the economy of every city. Understanding the distinctive assets, infrastructure and institutions of each municipality allows for a more devolved approach to industrial and economic policy, which builds on the strengths of every metro. For example, Johannesburg is a financial stronghold whereas eThekwini is a manufacturing and logistics hub. The SEAD-SA information has also been used to analyse the uneven impact of the Covid-19 pandemic on different places and people.

Another important achievement has been to alter housing policy in South Africa's largest cities and townships. Through many years of policy engagement, UFS researchers, Dr Andreas Scheba and Prof Turok, have contributed to a more positive stance towards backyard or small-scale rental housing. Organisations that were once ambivalent, because of the informal and non-compliant character of this housing, are coming to recognise the opportunities to provide decent affordable accommodation as well as to create jobs and stimulate local economies.

Many beneficiaries of government-subsidised (RDP) houses have partnered with enterprising micro-developers to invest millions of Rands in constructing higher-quality rental flats on their plots. Most developers do not apply for planning approval or building permits because the onerous nature of these official regulations more than doubles the cost of a block of rental units. Until recently, the government shunned this phenomenon and refused support, thereby contributing to its unauthorised character. Rapid densification of these neighbourhoods has also put pressure on the infrastructure and community facilities.

Turok and Scheba have documented the progression from makeshift structures towards solid brick and mortar units. They have argued for a more positive and developmental approach from government that works with informality rather than against it. Through evidence-based research and partnerships with other organisations, they have helped to shift public perceptions of the sector. Their influence stems from long-standing policy involvement, reputable research, and the power of external collaboration. They have also helped to organise a National Symposium on Small-Scale Rental Housing (planned for 2023), involving delegates from diverse public sector and civil society organisations.

Scheba and Turok have also begun to extend their research on informal rental housing into the wider southern Africa region. Their team involves early-career researchers, Dr Abraham Matamanda from the UFS Department of Geography, and academics from the Universities of Botswana, Lesotho, and Zimbabwe. By studying informal rental housing in Gaborone, Harare, and Maseru, they will address a significant knowledge and policy gap, and strengthen the UFS' agenda of regionalisation and internationalisation.

> *"Understanding the distinctive assets, infrastructure and institutions of each municipality allows for a more devolved approach to industrial and economic policy, which builds on the strengths of every metro.*

Prof Ivan Turok, PhD, holds the NRF Research Chair in City-Region Economies in the Department of Economics and Finance and the Centre for Development Support at the University of the Free State. He has authored more than 160 peer-reviewed publications and 11 books/monographs and is one of the most highly cited social scientists in SA. He holds an NRF B1-rating and is the former Editor-in-Chief of the international journal, Regional Studies. He is also a Distinguished Research Fellow at the Human Sciences Research Council and was Chairman of the Durban City Planning Commission. He was formerly Professor of Urban Economic Development at the University of Glasgow, a Mellon Fellow at the University of Cape Town and Professor of Urban and Regional Planning at the University of Strathclyde. He is an occasional adviser to the United Nations, OECD, African Development Bank and UNECA. His recent books include Transitions in Regional Economic Development (2018, Routledge), Value Chains in Sub-Saharan Africa (2019, Springer), and Restoring the Core: Central City Decline and Transformation in the South (2021, Elsevier). He was a finalist for the NSTF Lifetime Achievement Award in 2021. **ORCID ID 0000-0001-5520-2492**

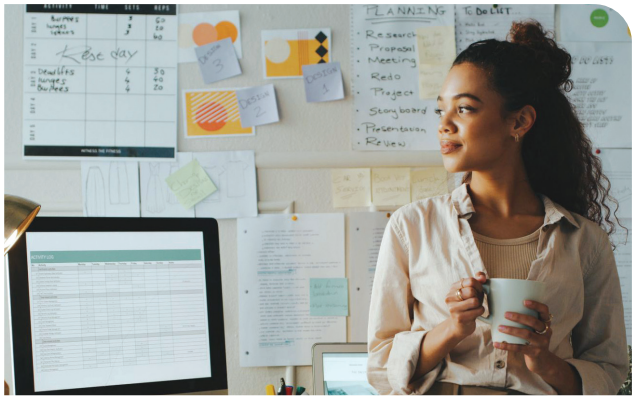
Women and Youth are the Future of Entrepreneurship

With the global unemployment crisis, underemployment, poverty, and the limited capacity of both public and private sectors to absorb all employable people, it has become imperative to explore alternative career paths beyond traditional full-time employment. Thus, many governments are promoting entrepreneurship as an optimal solution to the triple challenge of unemployment, underemployment, and poverty reduction.

In South Africa, the government established the National Development Plan (NDP) with the objective to reduce the unemployment rate from 24.9% in 2012 to 14% by 2020 and to 6% by 2030. One of the ways to achieve the NDP's objectives is by fostering entrepreneurship, as the success of small businesses is one of the core mechanisms through which the NDP objective can be realised. In this regard, Prof Neneh has dedicated her research towards finding solutions to foster the development of entrepreneurial competencies and behaviours vital for success, with a special emphasis on youth and women entrepreneurship.

A particular focus is to understand why some young people choose entrepreneurship relative to employment. Additionally, she provides insights on the mechanisms to close the gap between entrepreneurial intention and entrepreneurial behaviour by identifying the boundary conditions that hinder aspiring youth entrepreneurs from launching businesses.

In the area of women's entrepreneurship, she specifically explores strategies to empower women entrepreneurs to flourish despite persistent challenges. It is estimated that over 54.3% of the workforce in South Africa are women and given the gender-related challenges that women face, they need to work harder than their male counterparts to advance their careers. Most working



women spend over 40 hours per week on their jobs, and they still have to shoulder most of the household responsibilities. This places substantial pressure on meeting the demands of these roles. As such, the problem with existing approaches to fostering entrepreneurship have been the categorisation of both men and women into the same entrepreneurial venture group, without considering the idiosyncratic needs and challenges of women entrepreneurs.

Prof Neneh's research has focused on providing insights on the work-family interface and its impact on the performance and growth intentions of women entrepreneurs. This will enable an understanding of the circumstances that enable women entrepreneurs to excel in their businesses, maintain work-life balance, and enhance life satisfaction despite experiencing work-family conflict.

An important element of Prof Neneh's research is also to understand how various configurations of family support influence the performance of women-owned businesses and what type of resources women need and have at their disposal to alleviate work-family conflict or support their business operations.

Her research methodology uses phenomenology, quasi-experimental methods, 2-wave studies, and diary studies to understand different entrepreneurial phenomena or test the effectiveness of an intervention.

In one of her numerous research papers, titled 'Work-family conflict and life satisfaction: Do work-family segmentation and family support make a difference?' published in the proceedings of the Fourteenth International Business Conference in 2021, she discussed the configurations of the different dimensions of work-family conflict (WFC) and concluded that women can achieve life satisfaction when experiencing some, but not all, the dimensions of WFC at a given point in time, since the experience of work-life conflict among working women seems unavoidable. The study recommended that women experiencing time-based conflict need to seek adequate family support, while those experiencing strain and or behaviour-based conflict need to adopt a segmentation strategy.

In this regard, female entrepreneurs should realistically identify how much time they are willing to dedicate to their business and other daily responsibilities and identify which support structures they have at their disposal that they can rely on to manage their work and family demands. Her research also recommends that women entrepreneurs ought to participate in peer support groups within the same industry. This would provide them with information and tools to solve or cope with the stressors they encounter in their daily lives as female entrepreneurs. These findings are reported in her 2022 papers titled 'Family support and business performance of South African technology Entrepreneurs', published in the *International*

Journal of Entrepreneurial Behaviour & Research and 'Why Peer Support Matters: Entrepreneurial Stressors, Emotional Exhaustion, and Growth Intentions of Women Entrepreneurs' published in the *Entrepreneurship Research Journal.*

Prof Neneh has utilised her research findings to inform teaching and training materials, especially for teaching entrepreneurship. She has demonstrated how entrepreneurship goes beyond the classroom to develop and empower the future generation of entrepreneurs. Her 2022 paper titled 'Entrepreneurial passion and entrepreneurial intention: the role of social support and entrepreneurial self-efficacy', published in *Studies in Higher Education,* emphasises the need for entrepreneurship educators to include role models or real entrepreneurial stories that students can relate to as a means of developing entrepreneurial passion through their courses. In a previous paper titled 'From entrepreneurial intentions to behaviour: The role of anticipated regret and proactive personality', published in the *Journal of Vocational Behavior*, she advocates for entrepreneurship educators to use self-reflections of entrepreneurs to stimulate attributes that will help students translate their intentions into action. In her latest publication, titled 'Transitioning from entrepreneurial intention to actual behaviour: The role of commitment and locus of control' published in the *International Journal of Management Education*, she outlines the need to ensure that the teaching of entrepreneurship is accompanied by approaches to enhance entrepreneurial alertness and certain personality traits such as, commitment and internal locus of control.

Prof Brownhilder Neneh is a Full Professor and currently serves as the Vice-Dean of Research, Engagement and Internationalisation at the Faculty of Economic and Management Sciences at the University of the Free State. She is an NRF-rated researcher. She was a visiting scholar at the University of North Carolina in 2022. She is also the recipient of funding for the Erasmus mobility programme at the Fulda University of Applied Sciences in, Germany in January 2023. Prof Neneh has published 59 publications and two book chapters, co-edited one book, and graduated 17 masters and four doctoral students. She won the Teaching and Learning Award in 2018 and the Best Senior Researcher Award in 2019 in the Faculty of Economic and Management Sciences. She was a 2019 Winner of the Emerald Literati Award for Highly Commended paper published in the African Journal of Economics and Management Studies. She was the winner of the 2022 Research in Learning and Teaching: Advanced category at the University and was named the Best Senior Researcher in 2023 in the Faculty of Economic and Management Sciences. In 2023, she was cited 9th among academics at the University of the Free State in the Stanford-Elsevier Ranking of Top 2% Most-cited Researchers worldwide. This ranking is widely considered to be one of the best and most comprehensive measures of a researcher's scientific impact.
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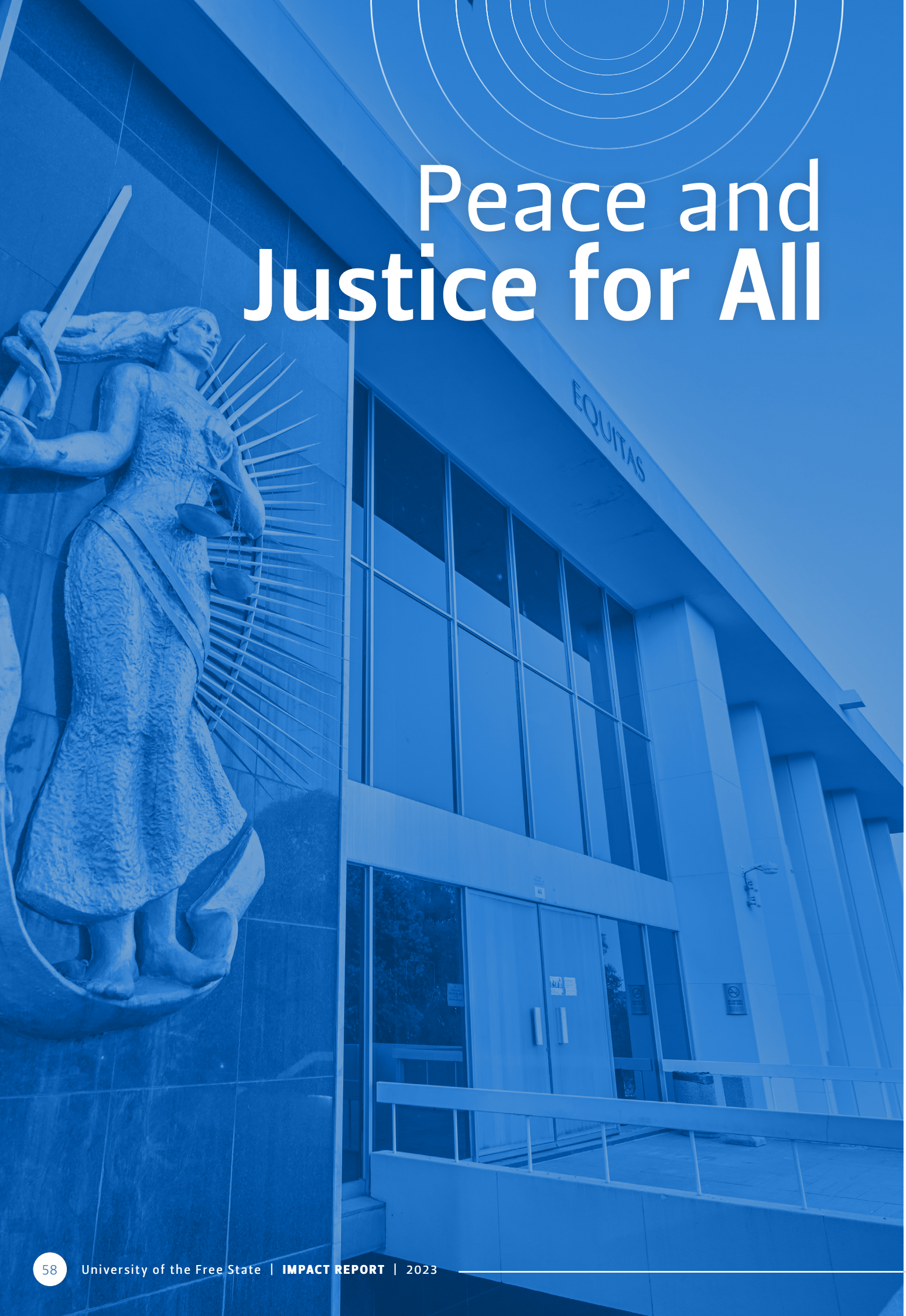
Peace and Justice for All



The pursuit of peace is at the core of the UN's mission and part of the 2030 Agenda for Sustainable Development, with SDG 16 aiming to "Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels." The importance of SDG 16 in achieving all the SDGs, cannot be over-emphasised. Sustainable development will remain elusive until there is peace, stability, and human rights or effective governance that is based on the rule of law. The world is increasingly divided. Some regions enjoy sustained levels of peace, security, and prosperity, while others fall into seemingly endless cycles of conflict and violence. Every minute, nearly 20 people are displaced as a result of conflict or persecution, 10 million have been deemed stateless as a result of having been denied a nationality and related rights, 603 million women live in countries where domestic violence is not considered a crime, and human trafficking remains largely undetected. In 2022, ongoing and new violent conflicts around the world accounted for a 50% increase in conflict-related civilian deaths. High levels of armed violence and insecurity have a destructive impact on a country's development, while sexual violence, crime, exploitation, and torture are prevalent where there is conflict or no rule of law.

Peace, justice, and strong institutions provide the foundation for a stable and prosperous society. Strong institutions are essential for ensuring that peace and justice are maintained and upheld. This includes a robust system of government, an independent judiciary, and a strong civil society. Governments, civil society and communities need to work together to find lasting solutions to conflict and insecurity, while the international research community can strengthen peacebuilding efforts through rigorous research on conflict and peace.

The research of Prof Danie Brand and Drs Eben Coetzee and Gerard Kamga are a few illustrative examples of the contribution of the University of the Free State in supporting the attainment of the outcome targets of SDG 16.

16 PEACE, JUSTICE AND STRONG INSTITUTIONS

Having a Home is a Human Right

Human rights and transformation are the two linchpins of the work and research of the Free State Centre for Human Rights (FSCHR) within the Faculty of Law. The Centre explores the relationship between human rights and transformation from a critical and interdisciplinary perspective. It has a particular focus on those human rights that relate to poverty (impoverishment), to democracy, and to identity. It explores the ways in which human rights may be used to achieve transformation concerning poverty, democracy, and identity. In addition to undertaking research, giving legal advice, and engaging in human rights-related litigation, the Centre also provides postgraduate teaching and supervision to the doctoral level, and hosts postdoctoral fellows. In 2021, the University concluded a Memorandum of Understanding with the Free State office of the South African Human Rights Commission (SAHRC), which confirmed the existing relationship between the FSCHR and the SAHRC. The three entities agreed to collaborate, in particular, concerning human rights impact litigation.

As both a lawyer, who has and continues to litigate on behalf of people to vindicate their constitutional rights, and an academic, who thinks and writes about these rights, Prof Danie Brand, Professor at and Director of the FSCHR, draws a strong link between his practical work as a lawyer and his research. In his academic and his practical work Prof Brand is interested in exploring the multifaceted (and often ambivalent) relationship between law and human rights on the one hand, and poverty/impoverishment on the other. He is particularly interested in the ways in which the law and human rights may be used to enhance democracy and leverage accountability and political capacity for impoverished people in this context. Although in the past he also worked on rights to have access to other basic resources, such as food and water, most recently he has focused on access to land and housing.

Section 25 of the Bill of Rights, while protecting existing landholding against arbitrary deprivation or expropriation, proclaims the rights of everyone to have equitable access to land – and of those who had lost land in the past due to discriminatory laws or practices, to have their land, or their rights in land, restored. Section 26, in turn, proclaims the right of everyone, through reasonable state measures, to have access to adequate housing, and to be protected against arbitrary eviction from their homes.

Despite these lofty constitutional ambitions, South Africa continues to suffer a land and housing crisis. During her recent remarks during the State of the Nation Address debate in Parliament, the Minister of Human Settlements, Mmamoloko Kubayi, said "The housing backlog is huge and the pace of provision of new houses can be greatly improved." Many South Africans who have access to land and housing are also precarious in their occupation and use of that land and their homes; they do not enjoy security of tenure and are constantly vulnerable to removal or incursion from others.

> *They should also enjoy the protection that all of us enjoy against eviction from what they experience as their homes, despite that theirs is an unusual conception of a home.*

In a recent book chapter titled 'Street-based people and the right not to lose one's home', Prof Brand and colleague Prof Isolde de Villiers focus on this problem of insecure tenure, in particular as it concerns street-based people (who we usually, but inaccurately called 'homeless' people), i.e. people who do not live in any traditional understanding of home, but on the streets. They focus on the constitutional prohibition of arbitrary eviction from one's home, which they describe as, in fact, the right not to lose one's home. They note that this right and the protection against interference in one's home that it provides, applies only to occupation of a 'home'. They criticise recent judgments that have tended to interpret the notion of 'home' narrowly, to refer only to the traditional understanding of a home as a permanent structure with four walls and roof. Instead, they say, 'home' should quite literally be understood to mean wherever the heart is. In this way they advocate that application of the right not to lose one's home arbitrarily, should be extended also to street-based people, who sleep under bridges or overpasses, on traffic islands, or on pavements. They should also enjoy the protection that all of us enjoy against eviction from what they experience as their homes, despite that theirs is an unusual conception of a home.

In a more recent study (to be published), Prof Brand considers the ongoing debate about how to address the land question in South Africa. He is concerned about the debate's exclusive focus on redress of past injustice, on giving back the land. Although, so he emphasises, real and substantial redress is crucial, indeed indispensable, on its own it is not enough. We must give back the land, but we must also think about how we will live together concerning land once it has been given back.

For that, we need to rethink and reimagine our most basic understandings of property and ownership, that we inherited from apartheid.

To illustrate this concern, Prof Brand considers the two most prominent proposals that emerged from the land debate: "expropriation without compensation" and "state custodianship" of land. Both these measures are focused on enabling the giving back of land. However, Prof Brand suggests that in the process, despite their ostensible radicality, neither break fundamentally with apartheid land law.

Prof Brand describes apartheid land law as built on a basic understanding that land should always be under the absolute and exclusive power of someone or something. For white South Africans, this was a private property owner, who, simply by virtue of being owner, could exclude everyone else from land regardless of context or broader considerations of justice and fairness. For black South Africans, this was the State, who held their land for them 'in trust', with the consequent power of absolute control over access, occupation and use.

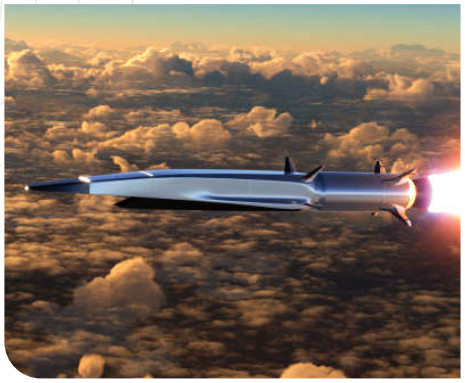
The proposal for 'expropriation without compensation' seeks to enable the taking of land for nil compensation from some to give it back to others.

But what is taken and given back remains apartheid's notion of ownership, with the absolute power to exclude and to visit injustice on others, that this notion entailed. 'State custodianship of land' in turn affords apartheid's absolute, exclusive power over land to the state. Ironically, in terms of this proposal, the state would be placed in almost exactly the same position of absolute power concerning land, vis-à-vis everyone in South Africa that it occupied vis-à-vis black South Africans under apartheid, with the same capacity to visit injustice concerning land on everyone, that it possessed under apartheid.

Prof Brand concludes that, in addition to enabling the giving back of land, our efforts at addressing the land question should also engage the future, by thinking how we can live together concerning land, differently from and better than we did under apartheid. He proposes the 'democratisation' of property law – rethinking our property law as, instead of a system of rights, each enabling mutual exclusion, a system of regulation, through which overlapping and intertwined interests and rights concerning land may be mediated, with mutual accommodation the goal. To illustrate this, he uses recent examples from mining law and eviction law, where resolution of disputes concerning access to and use of land were resolved through negotiation, mediation and engagement.

Prof Danie Brand holds the degrees BLC LLB (UP), LLM (Emory) and LLD (Stellenbosch). He has for the past 25 years worked as an academic, in the fields of constitutional law and theory and administrative law. At the same time, since 2013, he has practiced as an advocate in human rights-related cases. He has acted as judge of the High Court several times, most recently in Pretoria and Johannesburg. **ORCID ID 0000-0001-5161-6700**

Nuclear Weapons – The world's best 'peacekeeping' weapons?



According to the United Nations, ongoing and new violent conflicts around the world, are making it difficult to achieve global peace and security and the promotion and attainment of peaceful and inclusive societies for sustainable development. Currently, a record 100 million people have been forcibly displaced worldwide – more than double the number a decade ago. In Africa, according to the Africa Center for Strategic Studies, the most recent figures indicate that 25 million people are displaced, which is a 500 percent increase from 2005. Here conflict and repressive governance are the two main drivers of displacement.

On the African Continent, currently 13 countries are facing armed conflict, which account for almost 90 percent of the 25 million people displaced. This is counter to the aspirations of the African Union's (AU) Agenda 2063, of "Silencing the Guns in Africa" by 2023, which is deemed a necessary condition for Africa's development and prosperity.

To make sense and improve our understanding of these issues, Dr Eben Coetzee, Senior Lecturer in the Department of Political Studies and Governance at the University of the Free State (UFS), undertakes research that focuses on issues of war and peace, international relations theory, nuclear weapons, and nuclear terrorism. His research is global with a focus on East Asia, the United States of America, Europe, and the African Continent.

War, as with many other societal vices, has a peculiar and perpetual way of finding its way back to the centre of international political life. War also takes many forms, with the scourge of international war constituting but one of many. Other forms, notably civil wars and terrorism, likewise continue to heap relentless suffering and devastation on nation states, societies, and individuals. In the main, the quest for (international) peace could be characterised as a dismal failure. According to Dr Coetzee, this is unfortunately incorrect as "war – and preparations for it – never really left us".

In the chapter 'The prospects for nuclear and radiological terrorism in Africa', published in the book titled *The future of war in Africa,* Dr Coetzee dispels the fears of terrorists detonating a nuclear or radiological device by mapping the principal fears informing nuclear alarmism in Africa, as well as the obstacles confronting would-be terrorists contemplating detonating a nuclear or radiological device. He argues that while the threat levels for nuclear and radiological terrorism differ, both threats are manageable and hardly cause for alarm.

In the article 'Hypersonic weapons and the future of nuclear deterrence', published in the *South African Journal of Military Studies*, Dr Coetzee, also argues that hypersonic weapons with their increased speed, agility and range, coupled with their invulnerability to missile defence, do not pose unprecedented challenges to African militaries. The hype of the deleterious effects of hypersonic weapons, he concludes, are just hyperbole. This is because all nation states have historically experienced and accepted that it is almost impossible to construct a leak-proof defence, a problem that is only compounded by the development of hypersonic weapons.

Moreover, the increased speed, agility, and range of hypersonic weapons do not provide additional military capability to those states wielding them. Additionally, advanced militaries can, with relative ease, strike sensitive or time-critical targets with weapons other than hypersonic weapons.

In attempting to explain the intractableness of war in international politics, Dr Coetzee focuses on the continued relevance of the work of structural realist Kenneth Waltz's understanding and explaining of international politics. Through his research, he identifies structural realism, a theory of international politics, as an extremely useful point of departure. It shows, at the most basic level, *why* wars recur and why we should be pessimistic about any claims about and models for world peace. In this regard, while some forms of government undoubtedly hold much more promise for peace and prosperity at the domestic level, there is little evidence that warrants a view that any particular form of government – any idea of *the* good society, whether liberal democracy, socialism, or communism – would eliminate the scourge of international war.

There is, however, one unit-level change that has greatly affected the recurrence of war – to wit, nuclear weapons. Nuclear weapons certainly are no panacea, but they have dramatically reduced the incidence of war between those that possess them. Although skirmishes have occurred, it is highly salient to note that no major war has occurred between possessors of nuclear weapons. While nuclear weapons do not reduce incentives to compete and while preparations for war continue, these weapons have introduced peace, or, at the very least, the absence of war, at the centre of international politics – a feat unprecedented in the world prior to the bomb. Although a controversial position, nuclear weapons could be the world's best and only 'peacekeeping' weapons.

While these weapons provide a possible reliable source of "peace" between their possessors, their presence does not obviate all forms of security competition. Similarly, it is not advocated that nation states should pursue acquiring nuclear weapons, especially if their security situation does not require it.

Dr Eben Coetzee, PhD, is a Senior Lecturer in the Department of Political Studies and Governance at the University of the Free State. His PhD focused on the continued relevance of structural realist Kenneth Waltz to understanding and explaining international politics. He has delivered several international and national papers dealing specifically with nuclear weapons/nuclear deterrence, the democratic peace proposition, structural realism, and the idea of theory in international relations. His research interests include nuclear proliferation, nuclear deterrence, nuclear terrorism, structural realist theory, the nature of theory, and the history and philosophy of science.
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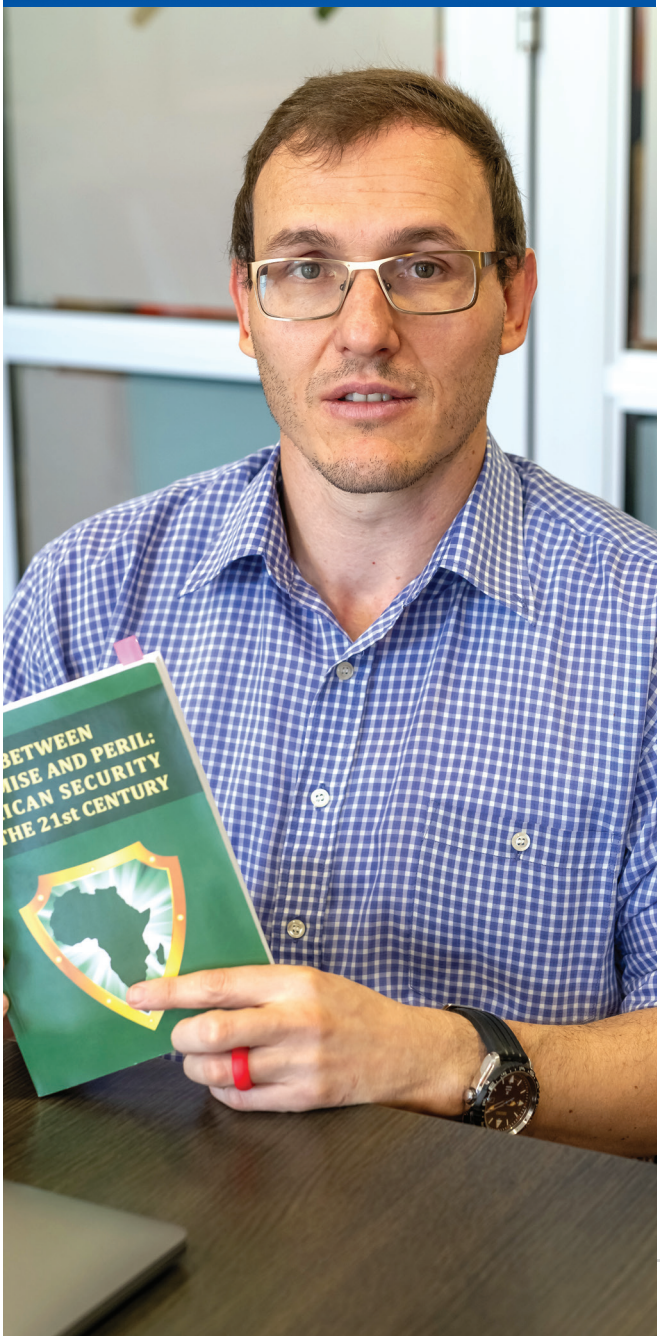


When Is the Law a **Friend or Foe?**

Illicit trade, which encompasses a wide spectrum of illegal activities including smuggling of goods, counterfeiting, money laundering, trafficking of humans and wildlife, and tax evasion, not only hinders the progress of achieving Goal 16 of the United Nations (UN) Sustainable Development Goals (SDGs), but it also holds back progress and development of countries. The aim of this goal is to significantly reduce illicit financial and arms flows, strengthen the recovery and return of stolen assets and combat all forms of organised crime, and substantially reduce corruption and bribery in all their forms.

Currently citizens face challenges in accessing justice, basic services, and/or legal guarantees and are generally underrepresented due to ineffective institutions. Moreover, structural injustices, inequalities, and emerging human rights challenges are putting peaceful and inclusive societies further out of reach. To meet the goals and objectives of SDG16, action is needed to restore trust and to strengthen the capacity of institutions to secure justice for all and facilitate transitions to drive sustainable development.

South Africa was recently placed on the Financial Action Task Force's (FATF) grey list because it does not have sufficient mechanisms in place to monitor and combat money laundering and terrorist financing activities. This comes after the country was considered to have too many weaknesses in its legal framework (being deemed to be inadequately compliant with 20 of FATF's recommendations) in all 11 effectiveness immediate outcomes, according to the National Treasury. South Africa was subsequently put under a one-year observation period in October 2021, giving the country time to address 67 Recommended Actions. The country made significant progress during the observation period, passing two major Amendment Acts in 2022, and strengthening its institutions, and reduced the 67 Recommended Actions to eight strategic deficiencies.

Dr Gerard Kamga, Senior Lecturer and programme director of research and postgraduate studies in the Faculty of Law and coordinator of research and postgraduate division at the Free State Centre for Human Rights, through his research, scrutinises what is wrong in society, to propose long-term and sustainable solutions that can make a difference.

The violence generated by the current political system as Dr Kamga portrays in his research, intersects with the existing global, regional, and local systems of governance, laws, and policies as well as their effects on the human condition, social justice, human rights, and the rule of law. If the rules of the game are not followed, if the social contract is overlooked, this can derail the community's project, the shared future of humanity, and the destiny of millions of individuals.

The core of his research revolves around the premise that we have overestimated the power of law in regulating life. The state of deliquescence

of society is sufficient proof that the law may not be enough to bring about all the solutions. More importantly, such law appears to have occasionally become a tool of social oppression, as exemplified by the series of papers dedicated to antiterror legislation and the state of exception through which a parallel sphere of law is being instituted.

In his contribution dedicated to 'The nexus between illicit financial flows and the recent downgrade of South Africa's ratings by credit rating agencies' in the book, *Illicit Financial Flows from South Africa: Decolonial Perspectives on Political Economy and Corruption*, Dr Kamga analyses South Africa's downgrade in March and April 2020 by three international rating agencies, namely Moody's, Fitch Ratings, and Standard and Poor's (S&P). The three major rating agencies respectively downgraded the country to full junk status, to "BB" from "BB+" with the outlook being negative, and to "BB–" with the outlook being stable.

This occurred during the coronavirus pandemic resulting in drastic consequences at the socio-economic level. The three rating agencies put forward corruption and weak state structures to justify their move to downgrade South Africa, but omitted to mention the proliferation of illicit financial flows that contribute to drain a staggering sum of money out of the country to the profit of multinational corporations and other obscure individual networks and complex chains of command. The analysis further questions the opportunity to downgrade a country amid a global health emergency that had brought the global economy to a standstill.

At the heart of this chapter lies the idea that if corruption, inefficient state institutions, poor governance, political and policy vacuum, and deep structural problems contributed to the current socio-economic downfall of South Africa, illicit financial flows appear to be one of the key drivers of this debacle.

Another pressing societal problem is violence against women. In the book *Democratic Governance, Law, and Development in Africa*, Dr Kamga's chapter reflects on the standard of due diligence that can be used as a remedy to curb violence against women. There have been many global and national initiatives directed at tackling this scourge. Yet most of these initiatives, that include among others, legislation and drastic penalties, remain ineffective, with initiatives generally designed to be implemented after the perpetration of the offences. In the chapter 'Violence Against Women and the Quest for a Sustainable Solution in Africa: Reflections on Rediscovery of the Due Diligence Standard' he makes his key argument that very few initiatives to curb violence against women actually contain a preventative character and are instead of a "curative" nature. In so doing, he then reviewed the standard of due diligence that emerged from the case of Velasquez Rodriguez v. Honduras that places four obligations on states, including the obligation to prevent, to investigate, to sanction, and to compensate whenever there are allegations of human rights violations.

Through his research and writings dedicated to the state of exception, antiterror laws, and then violence, Dr Kamga is concerned with advancing knowledge and public understanding of the place of norms to build and consolidate a prosperous society. As a society, he argues, we must strive to experience and understand the nature of law. His purpose in his work is therefore to expose the double edge of law that can be both a tool of social protection and a device through which our society can transition or return to a totalitarian state where the concept of human will lose its meaning. This was portrayed in various articles, two of which being titled 'Toward new international standards on emergencies: extreme emergencies and the new negation of fundamental rights' published by *South African Yearbook of International Law and* 'Killing two birds with one stone: insights into the recent counterterrorism legislation in Cameroon' published in *VRÜ Verfassung und Recht in Übersee.*

Another key issue is that of development and the right to development on the African Continent. Many individuals are often not treated with dignity because they live in poverty, lack of

education, healthcare, housing, and infrastructure, while those in power live a comfortable life apparently oblivious to the plight of others. The Continent has been recording substantial economic growth for the past several years, but this has not been felt by its people and this signals an issue regarding the fair distribution of resources. The impact of this on human rights in general and the right to development, is axiomatic. With regard to the recognition of the right to development as a human right at the global level, Dr Kamga's research and many other similar projects have contributed to debunk this argument.

It was relevant to change this perception in a context of decolonisation, where former colonial empires aspired or continue to aspire to absolve themselves from the damages they have caused and continue to perpetrate through neo-colonialism and unorthodox practices, such as illicit financial flows, economic and monetary domination through which the Continent's resources have been plundered. One of Dr Kamga's articles dedicated to this problem is titled 'Empty currency and the mechanics of underdevelopment within the Franc Zone' available in the *Journal of Juridical Science*. His research in this field, therefore, contributes to shed light on such practices that are inconsistent with human rights, ethics, and the rule of law.

> *The core of his research revolves around the premise that we have overestimated the power of law in regulating life.*

Dr Gerard Emmanuel Kamdem Kamga, LLD is Senior Lecturer and programme director of research and postgraduate studies in the Faculty of Law at the University of the Free State and coordinator of research and postgraduate division at the Free State Centre for Human Rights. He has a multidisciplinary background including in Law, Human Rights, Critical Theory, Gender Analysis and Violence. He holds a doctoral degree in Laws from the University of Pretoria. His current projects essentially revolve around the problem of the exception and the mechanics of violence and question the existing global, regional and local systems of governance and policies as well as their effects on the human condition, social justice, human rights and the rule of law. He is the author of various publications in these areas. **ORCID ID 0000-0002-8828-1323**

Delivery through **Partnerships**

One of the primary ways in which the higher education sector has responded to the challenge of "making a difference" has been through mutually beneficial partnerships and networks with other academic institutions, industry, government entities, and civil society. Partnerships can strengthen academic programmes, enhance innovation and creativity in research, create new solutions to solve problems, improve relevance and usefulness of research, facilitate greater trust with communities, and change society for the better. While partnerships are not a new phenomenon in higher education, they now need to be much deeper than universities have been accustomed to in the past.

By bringing together scientists and non-scientists from diverse backgrounds, countries, cultures, and disciplines and perspectives, these partnerships can create new avenues for research and encourage the development of new ideas, as they enable the pooling of resources and technology.

These principles are echoed in the 2030 Agenda and the Sustainable Development Goals (SDGs), which are based on an intertwined healthy environment, a thriving society, and a prosperous business environment. They thus purposely state that there is an essential need for collaboration across societal sectors to solve problems and deliver long-lasting impact. Without synergies the SDGs remain out of reach. The SDGs thus call for a new collaborative way of working. The 2030 Agenda encourages multi-stakeholder partnerships, defined as: "... ongoing collaborative relationship between or among organisations from different stakeholder types aligning their interests around a common vision, combining their complementary resources and competencies and sharing risk, to maximise value creation towards the Sustainable Development Goals and deliver benefit to each of the parties".

The University of the Free State has a range of partnerships that meet this description. Some have been mentioned or alluded to in the previous chapters (e.g. the work of Profs Labuschagne, Brown, Pienaar, Oberholster, Brand, and Turok, among others). The UFS values its partners highly, and those reported below are just some additional examples of the excellent institutions we partner with and who support our partnerships. The partnerships involve two or more organisations working together, typically with external funding. The University provides added value in playing a role as "honest broker" – facilitating the bringing together of different types of partners (public sector organisations, NGOs, industry and private companies, and other academic institutions), around a common and mutual objective. Each partner brings their own unique strengths and resources to the table, demonstrating not only the value of partnerships but also the impact they have on the University and beyond.

17 PARTNERSHIPS FOR THE GOALS

University of Antwerp

BRITISH COUNCIL

science & innovation
Department: Science and Innovation
REPUBLIC OF SOUTH AFRICA

ETH zürich

European Commission

HM FOUNDATION

iREN
Mountain Invasion Research Network

NRF National Research Foundation

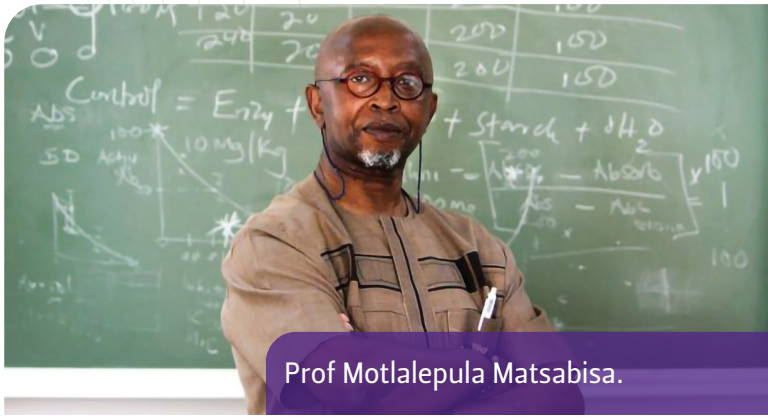
Sida

technology innovation AGENCY
Innovating Tomorrow Together

World Health Organization

UPPSALA UNIVERSITET

Impactful **Partnerships**


Prof Motlalepula Matsabisa.

In a partnership focused on SDG 3 (Good health and well-being), the South African **Department of Science and Innovation (DSI)** partnered with the Department of Pharmacology at the University of the Free State (UFS) to establish an African Traditional Medicine and Natural Products cGMP accredited herbal medicines Production and Commercialisation Facility. The DSI's Technology Innovation Programme aims to enable research and development in strategic and emerging focus areas (including, inter alia, indigenous knowledge systems) intellectual property management, technology transfer and technology commercialisation. The Facility was set up through the UFS African Medicines Innovations and Technologies Development (AMITD), an Indigenous Knowledge Systems (IKS) **Technology Innovation Agency (TIA)** platform, under the leadership of Prof Motlalepula Matsabisa. TIA is a DSI entity which promotes the development and exploitation of discoveries, inventions, and innovations to improve the quality of life for all South Africans by bridging the innovation chasm between research and commercialisation. In bridging the innovation chasm, TIA is an active funder, connector, facilitator and enabler. This partnership recognises the UFS as the national leader in the pharmacology of herbal medicines and IKS and will establish the laboratories and manufacturing facilities as a Centre of Excellence for the South African government, the World Health Organisation (WHO) and the African Union (AU) Commission for Social Development. The AMITD and IKS is now approved as part of the newly established BRICS Natural Medicines Institute. The facility and laboratories conduct research and development for proper drug discovery, drug development and product development, producing intellectual property of a range of medicinal products and services to commercialisation. The work of the Department of Pharmacology is strengthened by collaborative initiatives with institutions in China, South Korea, India, Germany, Brazil and others. The partnership also contributes to SDG 8 (Decent work and economic growth), SDG 9 (Industry, innovation and infrastructure), and SDG 17 (Partnerships for the goals). The scientific outputs have received certification and recognition for their contribution to the SDGs.

The Centre for Global Change (CGC) (formerly known as the Risk and Vulnerability Science Centre [RVSC]), is a flagship initiative under the **Global Change Research Plan (GCRP) established by the Department of Science and Innovation (DSI) through the National Research Foundation (NRF).** Under the leadership of Prof Patricks Voua Otomo, the CGC plays a crucial role in sustainable global change. It houses researchers across various disciplines, including natural and social scientists who conduct research and community engagement projects, shedding light on the unique challenges faced by the communities in the Thabo

Prof Patricks Voua Otomo.

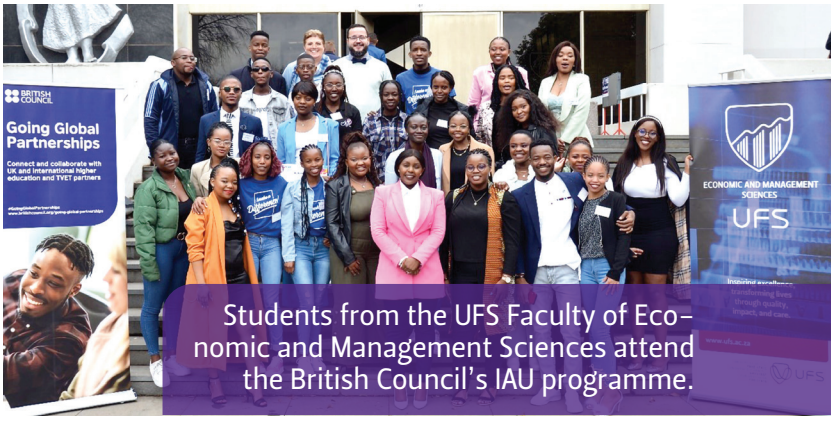
Dr Nadine Lake.

Mofutsanyane District Municipality and beyond. Striving to operate within a transdisciplinary research framework, the CGC aims to bridge the gap between science and society, within the framework of the water-energy-social issues nexus. Some of the multi-disciplinary challenges being addressed by the Centre also include waste minimisation methods and technologies, planning for sustainable urban development, water security, resilience and capacity, and social learning for sustainability, adaptation, innovation, and resilience. The Centre has the potential to develop into a sustainability sciences hub. This partnership addresses several interlinked SDGs – such as SDG 3 (Good health and well-being), SDG 6 (Clean water and sanitation), SDG 11 (Sustainable cities and communities), and SDG 15 (Life on land).

The ideals of SDG 5 (Gender equality) are at the heart of the project titled 'Gender Mainstreaming: Developing competencies in Higher Education for Gender Equality, Peace-Building and Gender Sensitive Research', which has been supported by the **Swedish International Development Agency (Sida)** since 2018. Sida is a government agency working to create better living conditions for people living in poverty and under oppression. Their work is focused on thematic areas that are of particular importance for combating poverty around the world, such as democracy, gender equality, climate and peaceful societies. Sida supports research in and by low-income countries to reduce poverty and build sustainable societies. This collaborative project involves researchers from the University of the Free State (led by Dr Nadine Lake from the Centre for Gender and Africa Studies), the Centre for Gender Research at Uppsala University in Sweden, and the University of Eduardo Mondlane in Mozambique. Gender mainstreaming is a key strategy in achieving the goal of gender equality. The primary objective of this five-year project is to create an enabling environment for gender-sensitive research in different knowledge domains, building towards a research-led university, with a primary focus on the University of Eduardo Mondlane.

> *"...these partnerships can create new avenues for research and encourage the development of new ideas, as they enable the pooling of resources and technology.*

Delegates attending the iKudu Leadership Summit in Siena, Italy in June 2022.



Students from the UFS Faculty of Economic and Management Sciences attend the British Council's IAU programme.

One of the projects in which they are playing a critical leadership role is the iKudu Project – co-funded through the **European Union's (EU's) Erasmus+** programme – to develop about a South African concept of Internationalisation of the Curriculum (IoC), which integrates Collaborative Online International Learning (COIL) virtual exchanges. The consortium includes ten partner institutions – the UFS coordinated the project (under the leadership of Prof Lynette Jacobs, and previously Dr Cornelius Hagenmeier), University of Antwerp (co-coordinator), University of Siena, Coventry University, The Hague University of Applied Sciences, Amsterdam University of Applied Sciences, Central University of Technology, Durban University of Technology, University of Limpopo, and University of Venda. Underlying the formation of this consortium is the long-standing partnership between the UFS and the **University of Antwerp**. Since its inception in November 2019, the iKudu project has contributed to developing the participating institutions as leaders in IoC, curriculum transformation, and COIL in South Africa and Europe. Curriculum decolonisation and internationalisation is understood as a central aspect of curriculum renewal. This partnership clearly addressed SDG 4 (Quality education), and will continue beyond the project time line in a formalised network.

The **British Council's Innovation for African Universities (IAU) Programme** is a learning and collaboration platform which brings together higher education institutions in the United Kingdom and Sub-Saharan Africa to engage, interact and learn from one another, with the aim of developing mutually beneficial partnerships that strengthen the capacity and capability of higher education systems in both locations, to provide meaningful contributions as key players within the entrepreneurship ecosystems.

The Supporting Youth Social Entrepreneurship (SYSE) project is part of the IAU programme, and includes 24 projects (in Ghana, Kenya, Nigeria, and South Africa) funded through the IAU programme. An exploration of the barriers of – and opportunities for – current and latent social entrepreneurs, with an emphasis on the youth, and the role of higher education institutions. Barriers and opportunities are investigated and shared to develop a roadmap that will better support youth social entrepreneurship and the growth of social enterprise to deliver sustainable jobs and address wicked challenges of the focus countries, and wider sub-Saharan Africa. The SYSE project is being delivered by the UFS Centre for Development Support, working with Challenges Ghana and Scotland's Glasgow Caledonian University. The project leader at the


Prof Martin Nyaga.

"As part of its vision, the UFS aspires to be an internationally engaged university that produces globally competitive graduates and knowledge.

UFS is Prof Deidré van Rooyen, at the Centre for Development Support. The project trained 50 students on aspects of social entrepreneurship, and groups of five were matched with 10 NGOs. In this way the knowledge they gained was transferred to community projects. The project contributes to SDG 4 (Quality education) as well as SDG 8 (Decent work and economic growth).

Contributing to SDG 3 (Good health and well-being) is the partnership between the **World Health Organisation (WHO)** and the UFS which resulted in the University being designated as a WHO Collaborating Centre (WHO-CC). An institution is designated as a WHO-CC by the WHO Director-General and endorsed by the host country's Minister of Health to form part of an international collaborative network, to carry out activities in support of the WHO programmes at the country, intercountry, regional, interregional and global levels. In line with the WHO policy and strategy of technical cooperation, a WHO-CC also participates in the strengthening of country resources, in terms of information, services, research and training, in support of national health development. The WHO-CCs an essential and cost-effective cooperation mechanism, which enables the WHO to fulfil its mandated activities and to harness resources far exceeding its own. WHO gains access to top centres worldwide and the institutional capacity to ensure the scientific validity of global health work. Through these global networks, the WHO is able exercise leadership in shaping the international health agenda. Designation as a WHO-CC provides institutions with enhanced visibility and recognition by national authorities, calling public attention to the health issues on which they work. It opens up improved opportunities for exchange information and technical cooperation with other institutions, in particular at international level. The WHO-CC based within the UFS-Next Generation Sequencing Unit (UFS-NGS) directed by Prof Martin Nyaga, will be part of the Vaccine Preventable Disease (VPD) Surveillance and Pathogens Genomics Cluster until September 2024. Upon request by the WHO, the UFS-based WHO-CC implements agreed work assignments on genome sequencing of pathogenic organisms causing VPD, including rotavirus and SARS-2 strains collected as part of the routine VPD surveillance using NGS technology and analysis of the generated datasets sing bioinformatics tools. As part of the agreement, the UFS WHO-CC, inter alia, conducts molecular characterisation of specimens collected during outbreak and public health emergencies, provides technical guidance to SHO on strategies to improve laboratory molecular diagnostics, molecular typing and NGS of rotavirus diarrheal strains and

Maloti-Drakensberg Mountains.

Dr Martin Clark.

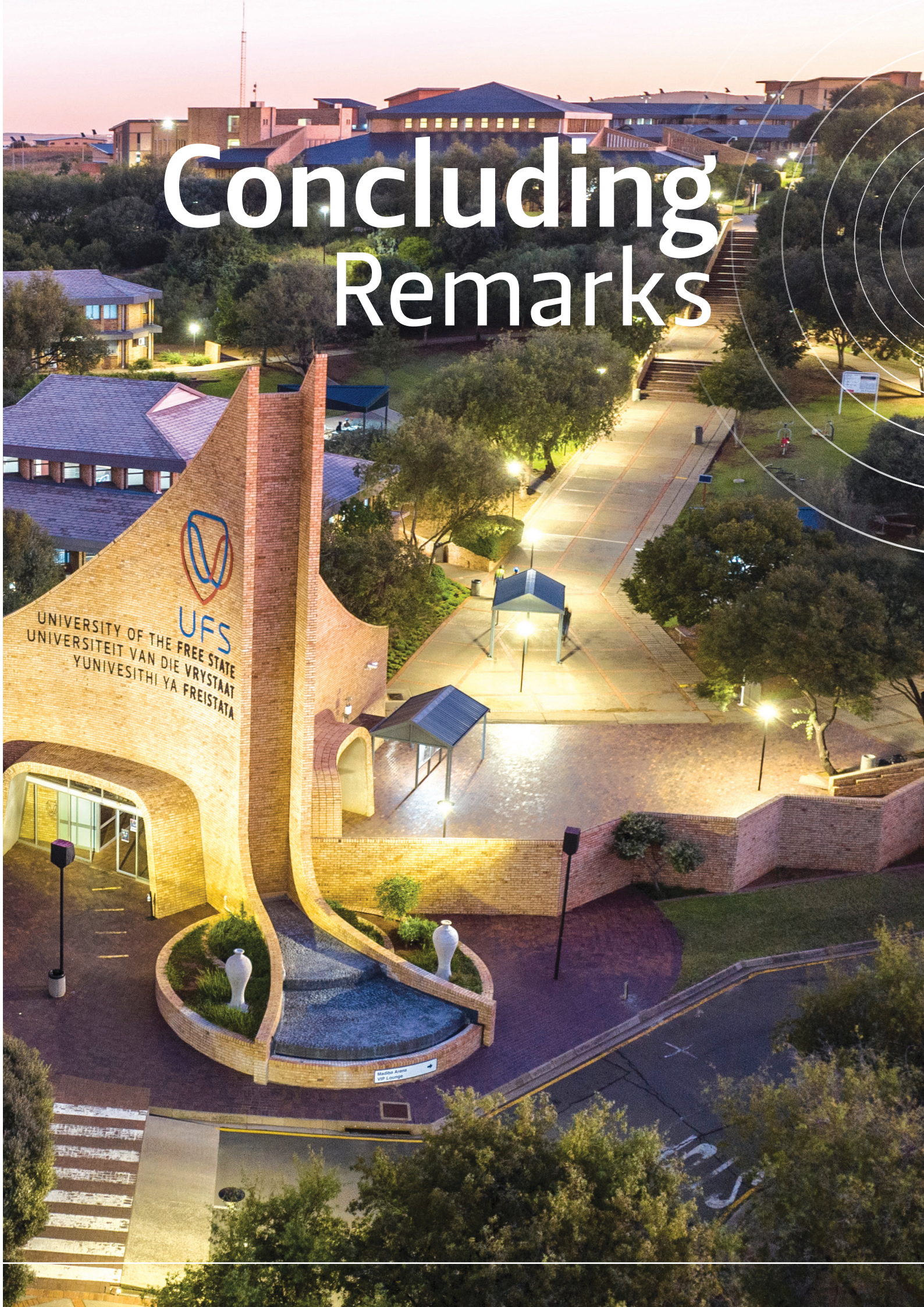
other enteropathogens, and conducts validation of tools and new molecular diagnostics for the detection and characterisation of unusual or rare VPD strains.

The Afromontane Research Unit (ARU) Is contributing to an international study of non-native plant invasions in mountains through the RangeX project – a multi-institutional research consortium under the **Mountain Invasion Research Network (MIREN)**, coordinated by **ETH Zürich**. MIREN aims to understand the effects of global change on species distributions and biodiversity in mountainous areas. ETH Zürich regularly features in international rankings as one of the best universities in the world, and when the rankings are differentiated by specialist area, it is in the first twelve for Science and Engineering. The project is supported by the highly prestigious **Biodiversa+** programme, which forms part of the EU Biodiversity Strategy 2030. The South African component of the project, underway in the Witsieshoek area of the Maloti-Drakensberg, is led by Prof Ralph Clark, Director of the ARU, with Prof Sandy Steenhuisen as co-principal investigator of the South African team. The project is exploring the effects of global change, biological invasions, as well as climate and land-use changes in high mountainous areas of southern Africa – thus contributing to SDG 13 (Climate action) and SDG 15 (Life on land). The project places the spotlight on the rich biodiversity of the area and how data could contribute to the overall priorities of the government in terms of biodiversity. Other RangeX partners are in Germany, Norway, Sweden, Denmark, Australia, Argentina, India, China, Chile, and France, with research locations in the Swiss Alps, Himalayas, Andes, Australian Alps, and Scandes.

A significant agreement between the UFS Department of Geology and the **Hans Merensky Legacy Foundation** was launched in 2020, concerning a five-year project titled 'Merensky Group for Airborne Geological Image Classification (MAGIC)'. The main objective of the Hans Merensky Foundation is to promote and assist in the development of the resources of South Africa and neighbouring territories – particularly such natural resources as soil, water, flora, and fauna – and to promote the health and welfare of the inhabitants; more specifically, through research, experimentation, and demonstration and through the correlation and application of scientific knowledge.

Under the leadership of Dr Martin Clark, the overarching aim of the MAGIC project is to perform focused research on the development of remote sensing technologies using unmanned aerial vehicles (UAVs) and satellites for application in the mineral and groundwater exploration industries in South Africa and beyond – thus contributing to primarily SDG 9 (Industry, innovation and infrastructure). Specific focus areas include the exploration of potentially mineralised areas, as well as regional groundwater exploration and management strategies utilising remote sensing technologies.

Concluding Remarks



Concluding Remarks

In this report we have attempted to illustrate the University of the Free State's alignment with and commitment to the Sustainable Development Goals (SDGs) and the contribution our research is making to address societal issues and challenges. It is part of our aim to play our part in meeting the SDGs.

Sustainability-related reporting in South African higher education institutions is relatively new and a developing 'genre', as we wrestle with how to meaningfully measure performance and progress. There are undoubtedly many ways in which this could be done. This is the first report of its kind from the University of the Free State and we are continuing to learn how best to present the information in a way that will contribute to knowledge and the implementation thereof.

We chose to present the report primarily by highlighting specific research endeavours through the lens of the SDGs, categorising them to tell the story of how they are making a difference and having a positive impact. This report is one step towards being able to clearly measure progress and performance across the SDGs. We will continue to work towards increasing the relevance of our research and scholarship, to make a lasting positive impact in our province, country, region, continent, and the world.

Acknowledgements

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