UNIVERSITY OF THE FREE STATE

IMPACT Report 2025

The Impact of UFS Scholarship and Research on Society

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

UNIVERSITY OF THE
FREE STATE
UNIVERSITEIT VAN DIE
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YUNIVESITHI YA
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Foreword

Prof Hester C. Klopper

Vice-Chancellor and Principal

We are living in a time of momentous changes for higher education, a period in which the future is not a pre-given but is being reimagined and co-created. There is no universal blueprint for universities to navigate the turbulence of global change. Instead, there is a profound responsibility: to lead boldly, to innovate purposefully, and to shape futures that are just, sustainable, and deeply human.

At the University of the Free State, walking with purpose is more than just a metaphor; it is our call to action. It is the embodiment of a scholarly vision that reaches beyond borders and disciplines towards a world where research defines possibilities and where creativity accelerates global progress. Our commitment as a university located in the central heartland of South Africa is not only to excellence in research, teaching, and engagement, but also to responsible societal futures where research and innovation work in tandem to serve humanity and safeguard the planet.

We are building a university that is future-ready and globally connected, a hub of transdisciplinary scholarship tackling the critical challenges of our time – climate change, inequality and poverty, technological disruption, planetary health, and social transformation. Through a human-centred AI-enhanced research impact, collaborative networks, and evidence-driven research strategies, we are positioning the UFS at the forefront of shaping the knowledge economy, moulded by integrated development agendas such as the Sustainable Development Goals, Agenda 2063, and the National Development Plan.

This report is more than just a record of achievements; it is, in fact, a testament to our visionary ambition – to create ecosystems where ideas flourish. Innovation thrives, and graduates emerge as ethical leaders and changemakers. Every milestone reflects a shared purpose: to generate knowledge that matters, to inspire transformation on all fronts, and to lead with integrity in a world that demands courage and creativity.

As we look to the future, we reaffirm that progress is not measured solely by outputs, but by the impact of ideas and the integrity of our journey.

Together, we walk with purpose, guided by values, energised by compassion and innovation, and united in shaping a future that is sustainable and profoundly aspirational. ■

Introduction

Prof Vasu Reddy

Deputy Vice-Chancellor: Research, Innovation, and Postgraduate Studies

The University of the Free State is shaping a future-ready institution – responsive, inclusive, and anchored in research that transforms lives. Our achievements reaffirm a steadfast commitment to advancing knowledge, driving innovation, and fostering societal progress. At the heart of this mission is scholarship that is locally relevant yet globally resonant.

In 2024, the university community once again demonstrated the power of research to address the pressing challenges of our time. Our scholars continue to reimagine possibilities through bold ideas, interdisciplinary collaboration, and innovation that touches lives. Through our research programmes, postgraduate studies, and partnerships, we aim not only to generate data, but also to provide direction – to co-create solutions that respond to issues such as climate change, inequality, health, and social justice. Our work reflects a clear purpose: universities must take the lead in shaping a sustainable and equitable future.

Our institutional vision aligns with national and global imperatives – the United Nation's Sustainable Development Goals, the African Union's Agenda 2063, and South Africa's National Development Plan – embodied in our Vision 130 strategy. These frameworks guide our moral and strategic compass, enabling us to focus our collective energies on innovation that empowers people, protects the planet, and builds prosperous, caring, and socially just societies. Within this ecosystem, Africa is positioned not as a periphery, but as a knowledge hub that influences global discourse through contextually grounded research.

The stories in this report celebrate a vibrant research community – staff and students whose creativity and dedication make the university a beacon of intellectual engagement.

Together, we are nurturing a generation of researchers who are courageous, innovative, and committed to shaping a future defined by knowledge, inclusivity, and transformation. It is clear that, at the University of the Free State, research is not an end in itself – it is in fact, a catalyst for creative and transformative impact. ■

The University of the Free State **at a glance**

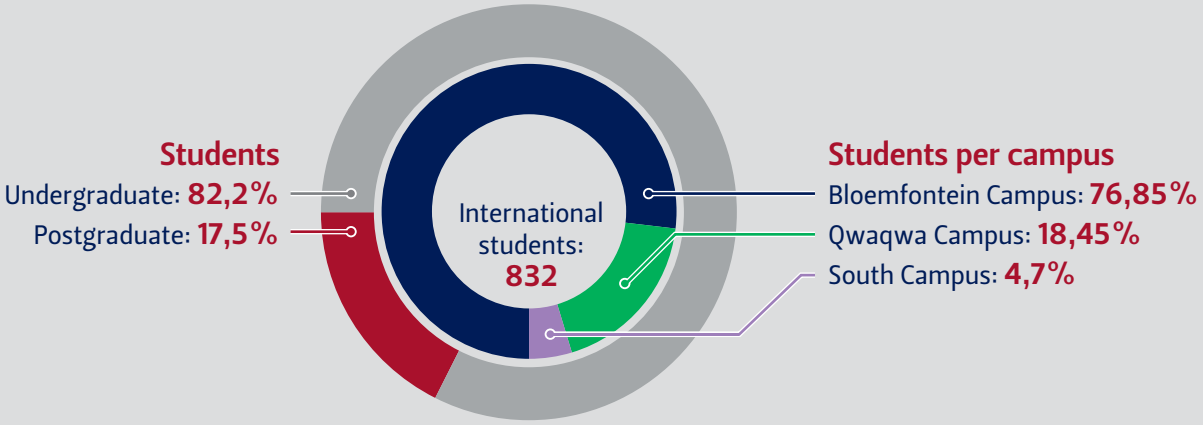
Institutional profile

Quality teaching and learning for globally competitive graduates

The University of the Free State (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.

Seven faculties | One business school

- Economic and Management Sciences
- Education
- Health Sciences
- Faculty of Law
- Natural and Agricultural Sciences
- The Humanities
- Theology and Religion
- UFS Business School



Staff

Women		Men
1 894	Permanent staff members	1 253
485	Research and instructional staff	429

Total research and instructional staff: 914

Graduate output and professional excellence

Total number of graduates:
9 237

Pass rate of Initial Test of Competence (ITC) of SA Institute of Chartered Accountants at the UFS:
86 %

2024 graduates

159 doctoral graduates

1 110 honours graduates

650 master's graduates

865 postgraduate diploma graduates

6 453 undergraduate graduates

University rankings

The World University Rankings:
1 000–1 200

14 **9th** among South African universities

Research capacity and capabilities

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

59 % permanent staff members with doctoral qualification

234 NRF-rated researchers

199 postdoctoral research fellows

18 % Increase in research output units from 2020 to 2024

1 516,6 research output units generated from publications

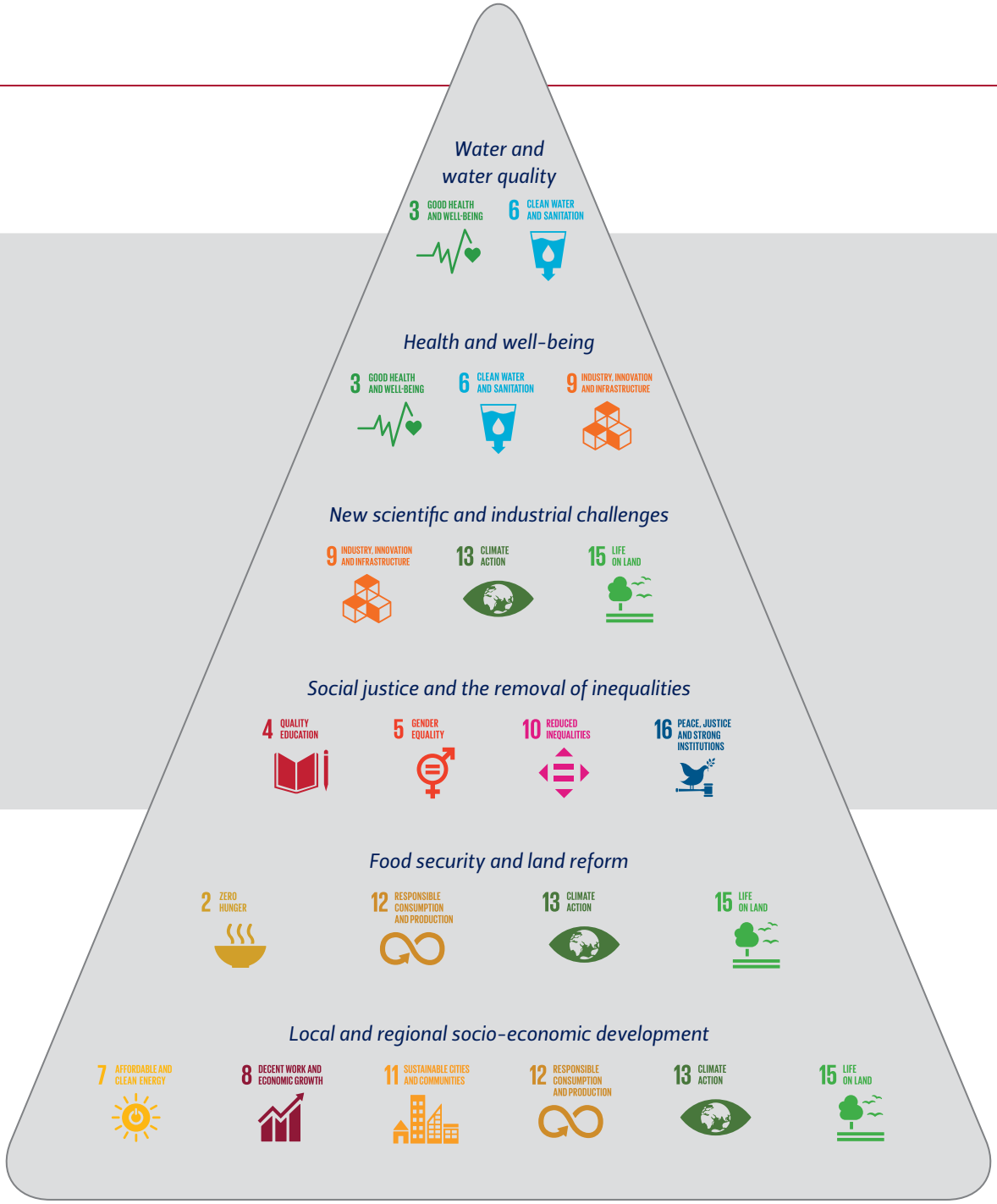
1,71 research output units produced per academic:

Global engagement and international presence

Formal, high-quality and productive collaborations with universities and institutions globally:
70

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

- African Medicines Innovations and Technologies Development
- 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

Research centres, groups and units

- Afromontane Research Unit
- Cactus Pear Research
- Centre for Business Dynamics (UFS Business School, Executive Education Unit)
- Centre for Development Support (CDS)
- Centre for Environmental Management (CEM)
- Centre for Gender and Africa Studies (CGAS)
- Centre for Global Change (CGC)
- Centre for Health Systems Research & Development (CHSR&D)
- Centre for Sustainable Agriculture
- Centre for Sustainable Agriculture, Rural Development and Extension (CENSARDE) / Centre for Sustainable Agriculture
- Department of Pharmacology – African Medicines Innovations and Technologies Development (AMITD) Platform
- Digital Scholarship Centre (DSC)
- Empowerment (ULFE)
- Free State Centre for Human Rights (FSCHR)
- Free State Indigenous Knowledge Systems Documentation Centre (IKSDC)
- Free State Indigenous Knowledge Systems Documentation Centre (IKSDC)
- Interdisciplinary Centre for Digital Futures (ICDF)
- Teaching Practice Unit (Faculty of Education)
- Unit for Institutional Change and Social Justice
- Unit for Language Facilitation and

Research laboratories and specialist centres

- Biosafety Level 3 Laboratory
- Centre for Microscopy
- Clinical Simulation and Skills Unit
- Ecotoxicology Laboratory
- Johannes Stegmann and Centenary Art Galleries
- Merensky Group for Aerial Geological Image Classification (MAGIC) Laboratory
- 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 (SANCLBP)
- UFS Law Clinic

Research chairs established in 2024 in collaboration between Agricultural Research Council (ARC), Department of Agriculture (DoA) and the University of the Free State (UFS)

- Agriculture Risk Financing
- Breeding of Climate-Resilient Vegetables and Grains
- Climate Change Impacts and Mitigation in Agriculture
- Communication for Innovation
- Impact Assessment of Climate-Smart Interventions
- Innovative Agro-Processing for Climate-Smart Food Systems
- Sustainable Livestock Production

Research and scholarship

supporting sustainable development

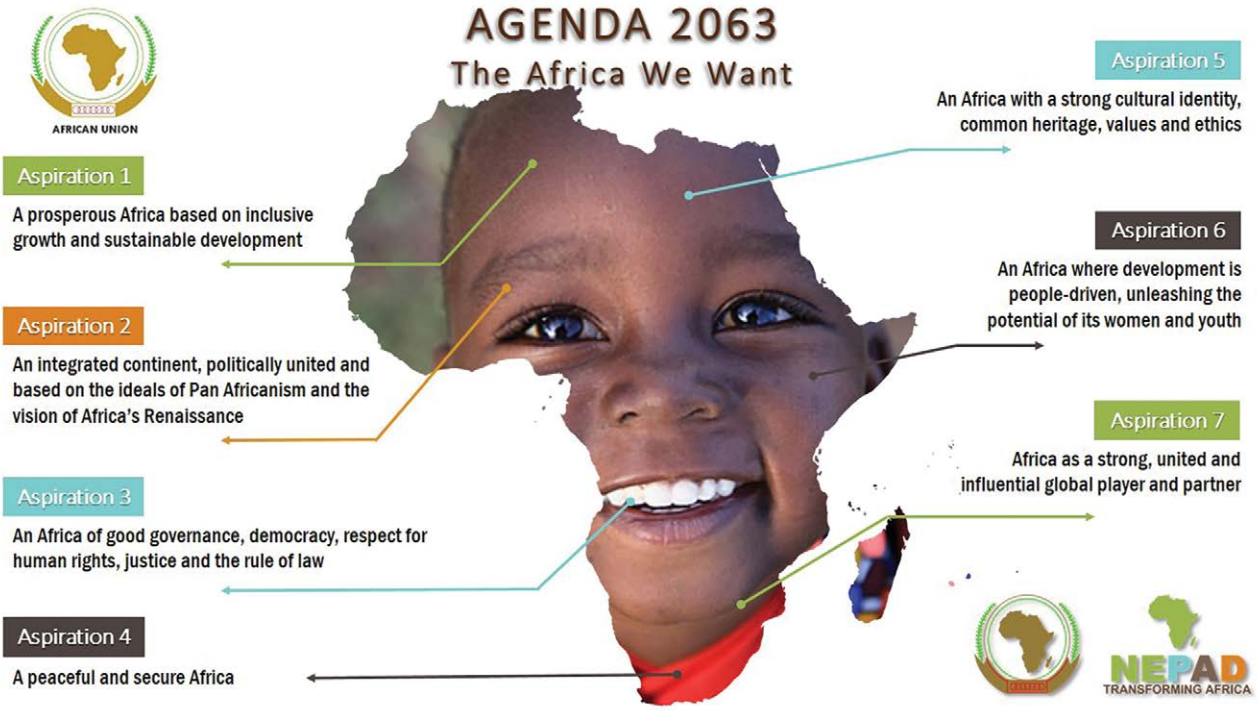
The concept of sustainable development can be interpreted in many different ways, but its origin can be traced back to 1987, to the definition included in the UN World Commission on Environment and Development report 'Our Common Future', and it is fitting to be reminded of it. Sustainable development 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).

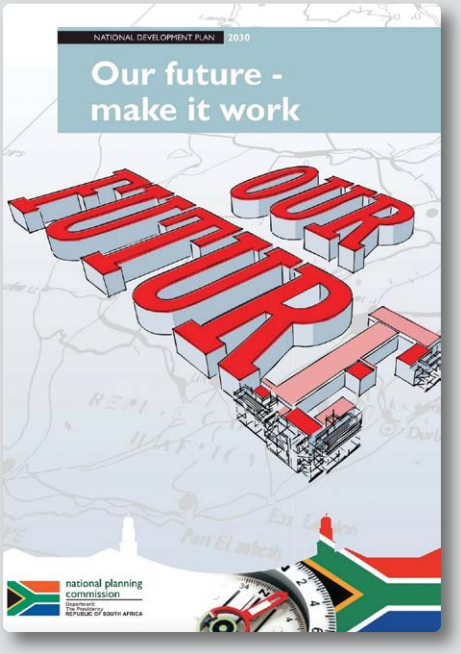
The 2030 Agenda for Sustainable Development, adopted by all UN member states in 2015, provides a shared framework to work towards peace and prosperity for people and the planet. The Sustainable Development Goals (SDGs) are a universal call to action to preserve our planet and improve the lives of everyone, 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 four P-based words – People, Planet, Prosperity, and Peace – recognise that action in one area will affect the outcomes in others.

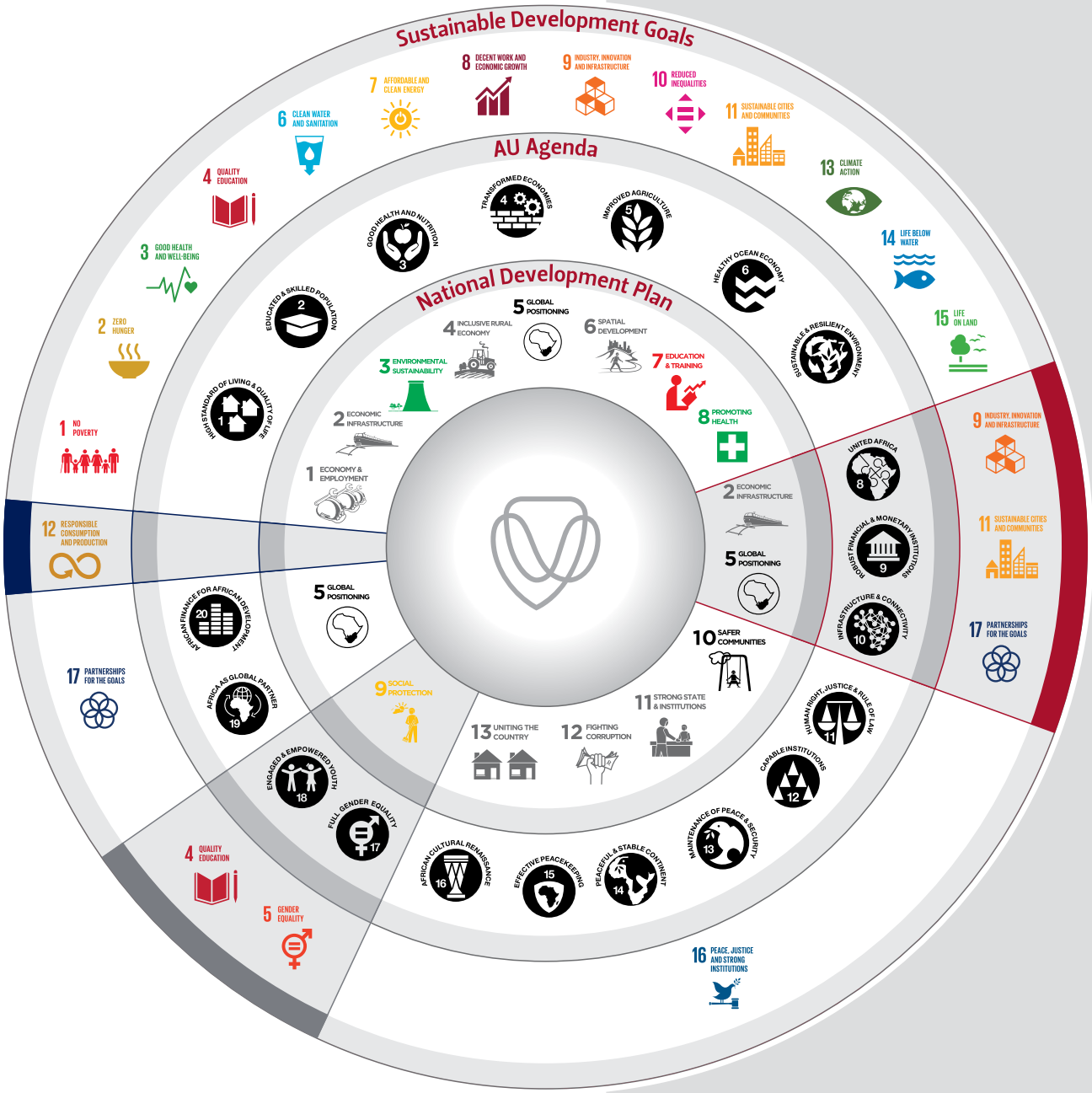


The AU Agenda 2063, signed in May 2013, provided a strategic framework for guiding Africa's development in the next 50 years, and aims to deliver on its goal for inclusive and sustainable development. Agenda 2063 presents a set of seven aspirations with their own set of goals. These aspirations speak 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, AU Agenda 2063, and the South African NDP.



Higher education is clearly relevant to achieving these goals and in so doing contributes to the public good. Research should play a pivotal role in achieving these aims by providing stakeholders and policymakers 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, in turn, have invigorated academic debate and production on issues related to sustainable development.

The University of the Free State 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 at the UFS and that make a significant contribution to the SDGs.

Peace, justice, **and rule of law**

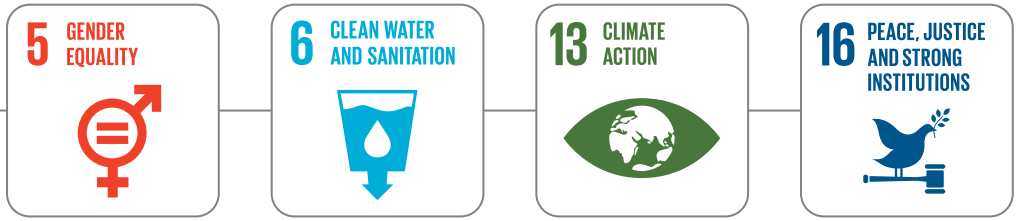
The United Nations 2030 Agenda for Sustainable Development highlights the critical role of peace, security, and the protection of human rights as conditions for sustainable development and prosperous societies.

SDG 16 aims to "promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions". Globally, geopolitical conflicts are increasing and becoming more violent, contributing to high levels of instability, displacement, and civilian deaths. The underdevelopment of the African Continent despite advances in science, technology, and human capital is often attributed to the continuous historical conflicts, lack of security, and human rights violations that characterise many countries on the continent. The complex intersections of geopolitical conflicts and human rights violations require urgent transformation of approaches to peace, justice, and the rule of law. The integration of perspectives from international relations, conflict resolution, and justice frameworks provide a deep understanding of how historical peace and stability can be maintained by addressing material harm, reparative justice and systemic inequalities, especially in impoverished nations.

Strong institutions are essential for ensuring that peace and justice are maintained and upheld. Collectively, robust governance systems, an independent judiciary and an active civil society can find lasting solutions to conflict and insecurity. The international research community contributes to peace and justice through rigorous research on transformative justice, conflict, and peace.

The research of Profs Hussein Solomon and Catherine Namakula represent significant contributions by the university to the attainment of SDG 16.

Related SDG



Ingredients for a secure and peaceful Africa

Peace and security are a necessary precondition for the economic and social development of any society and nation. It is in this context that the African Union (AU) called for a peaceful and secure Africa – a key aspiration of Agenda 2063. This was further emphasised in the theme of 'Silencing the Guns by 2020', which underlines the necessity of making the continent's mechanisms for conflict prevention, management, and resolution operational at all levels.

Despite the progress made towards resolving some conflicts, silencing the guns on the continent has been elusive and as a result, the 14th Extra-Ordinary Session of the AU Assembly, held on 6 December 2020, in Johannesburg, South Africa, extended the timeline to 2030. With an estimated 18 900 fatalities linked to 'militant Islamist' violence in Africa in 2024 – according to the Africa Center for Strategic Studies – and more then 3 400 terror attacks on the continent resulting in more than 13 900 fatalities as recorded by the AU Counter-Terrorism Centre, the 2030 deadline is again at risk of not being achieved.

Fatalities and violent events linked to 'militant Islamist' groups in Africa sustained near record pace, with the Sahel and Somalia accounting for 79% of related deaths. At a United Nations (UN) Security Council meeting focused on strengthening counter-terrorism on the continent, convened by Algeria, the Council President for January, Amina J Mohammed, Deputy Secretary-General of the UN and Chair of the UN Sustainable Development Group, emphasised that terrorism is the most significant threat to peace, security, and sustainable development across Africa today. She presented sobering statistics outlining its devastating toll, indicating that "sub-Saharan Africa now accounts for nearly 59% of all terrorism-related deaths globally".

With Africa being considered as the epicentre of global terrorism, based on the number of terror attacks, their severity and lethality, it is both necessary and imperative that political and other solutions are informed by research and scholarship. It is this context that informs the research undertaken by Prof Hussein Solomon – Senior Professor in the Centre for Gender and Africa Studies at the University of the Free State – on the understanding of any and all international non-state actors that perpetrate terror on the African continent. His work focuses on issues of radicalisation that examines the process of recruitment, and this involves the psychological condition of individual recruits – their motives for recruitment, and the reason to kill and die for the cause of the group.

The research also includes the understanding of radical ideological and religious fundamentalism and why these ideas have not been challenged by mainstream theologians. The context in which this radicalisation takes place is

Prof Hussein Solomon is Senior Professor at the Centre for Gender and Africa Studies, within the UFS Faculty of the Humanities. Until 2022, he was Academic Head of Department in the Department of Political Studies and Governance at the university. His research interests include conflict and conflict resolution in Africa; South African foreign policy; international relations theory; religious fundamentalism and population movements within the developing world. His publications have appeared in South Africa, Nigeria, the US, the UK, Switzerland, The Russian Federation, Greece, The Netherlands, Norway, Denmark, Egypt, Ethiopia, Israel, Lebanon, India, Bangladesh, Spain and Japan. He is a member of the Academy of Science of South Africa (ASSAf), and a member of the International Political Science Association, the Canadian Political Science Association and the South African Association of Political Science. Until February 2021, he was also convenor of the National Research Foundation's (NRF) Philosophy and Political Science subject specialist rating group. Prof Solomon currently holds a B3 ranking from the NRF.

Academic profile: See Google citation index

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also examined in his research, which may include issues of political alienation, economic underdevelopment, or even the impact of climate change. The latter is evident in the Sahel, where there is increased conflict caused by the scarcity of arable land as a result of desertification. Terror groups in the region exploit such tensions and add their pernicious ideology to the mix.

Prof Solomon has published more than 340 books, book chapters and peer reviewed scholarly papers on this and related topics. In the chapter 'Getting counter-insurgency right in Africa', published in the book *Between Promise and Peril: African Security in the 21st Century*, Moscow: Institute for African Studies of the RAS, ISBN 978-5-91298-293-4, Prof Solomon identified seven ingredients of a successful counter-insurgency operation. These include recruiting the right people with the appropriate level of skills and integrity into the security services, preventing the penetration of the security apparatus by insurgents, subversives and their sympathisers, and actively looking after the well-being of the state security forces, especially rank-and-file troops. Similarly, armed forces need to use proportional rather than excessive force in their operations and especially respect the human rights of the civilian population. It is equally important to constantly upgrade the skills and education levels of the armed forces so that their military doctrine, strategy and tactics are superior to those of the non-state actors.

Universities as institutions of society are expected to produce knowledge and skills for the benefit of such societies. Developing countries on the continent, including South Africa, require these institutions to research, understand, critique and propose solutions to intractable problems.

Research has also highlighted the need to ensure that counter-intelligence operations are intelligence-driven. Lastly, while the immediate focus of the state would be on degrading the insurgents' military capabilities, it is imperative that real grievances of the affected population are addressed, including the social and economic development of regions.

Prof Solomon's current research focus is on two regions on the continent – Southern Africa, in particular northern Mozambique – and the Sahel region, specifically northern Nigeria. The focus of the research in these regions is on elucidating and understanding the reasons for the longstanding failure of the respective counterterrorism initiatives. In the case of Mozambique, it is particularly stark, since both Rwanda and the Southern African Development Community (SADC) were involved in the counter-insurgency campaign against the non-state actors, but the terror threat has grown, with signs that it is spreading beyond the Cabo Delgado into other provinces. In the case of northern Nigeria, despite the deployment of 40 000 troops, the insurgency has grown in strength. Despite the support of the neighbouring countries and the broader international community, this insurgency has expanded to neighbouring states. Understanding why this is so and what can be done is the core of current and future research.

Universities as institutions of society are expected to produce knowledge and skills for the benefit of such societies. Developing countries on the continent, including South Africa, require these institutions to research, understand, critique and propose solutions to intractable problems.

Prof Solomon's research is thus policy-oriented. Each research paper advises the reader what the challenges are for counter-terrorism, and what could be done to ameliorate the threat posed. Consequently, over the course of three decades focused on counter-terrorism, he had the opportunity to advise, lecture and train members of the armed forces of several countries as well as the broader intelligence community, the AU, the North Atlantic Treaty Organisation and the UN. In addition, he has been involved with several local and international NGOs involved in counterterrorism initiatives, peace and conflict resolution efforts and attempts to bolster deradicalisation efforts. Prof Solomon is also an officer in the South African Air Force Reserves. He has been ranked among the top 100 terrorism experts in the world by ScholarGPS with a ranking of #93. ■

Related SDG

16 PEACE, JUSTICE AND STRONG INSTITUTIONS

Reparative justice: Africa's pursuit of wholeness

The interface between justice for Africa and reparation is deduced from the continent's stagnation despite global advancements in technology, science, and human capital development. Since 1963, the Organisation of African Unity (OAU) and its successor, the African Union (AU), have supported initiatives to advance justice for historical crimes and the payment of reparations to Africans, as well as the restitution of cultural artefacts and heritage pillaged during the periods of colonisation and enslavement. These sensitive subjects were addressed at the 2001 World Conference against Racism, Racial Discrimination, Xenophobia and Related Intolerance held in Durban, South Africa, which culminated in the adoption of the Durban Declaration and Programme of Action. The declaration acknowledged the appalling tragedies of racism, racial discrimination, xenophobia, and related intolerance, including slavery and the transatlantic slave trade. It emphasised the need for victims of these human rights violations to have access to justice, legal assistance, and effective protection and remedies. The conference also urged states to reinforce protection against racism, racial discrimination, xenophobia, and related intolerance by ensuring that all persons have access to effective and adequate remedies and enjoy the right to seek – from competent national tribunals and other national institutions – just and adequate reparation and satisfaction for any damage because of such discrimination.

The University of the Free State Africa Reparations Hub (UFSARH), under the leadership of Prof Catherine Namakula, an Associate Professor in the UFS Department of Public Law, is conducting evidence-based transdisciplinary research on reparatory justice for Africa, addressing the legacies of the past, including four centuries of enslavement, colonialism, apartheid, and contemporary forms of extortion. In so doing, the UFSARH is contributing to both the UN's Sustainable Development Goal (SDG) 16, which focuses on peaceful and inclusive societies and access to justice, as well as the AU's Agenda 2063, which emphasises justice and development for Africans. The AU raised the profile of this subject by *Peace, justice and rule* of law declaring 'Justice for Africans and People of African Descent through Reparation' as the theme of the year 2025 and as the theme of the decade (2025–2034). This UFSARH research is filling the gap for African thought leadership and intellectual support for pursuits of reparatory justice – including those by Libya against Italy through the Treaty of Friendship, Partnership and Cooperation of 2008; the Nama and Herero of Namibia against Germany for colonial genocide, which culminated in the Namibia-Germany Reconciliation Agreement of 2021; the Khulumani Support Group of South Africa against US companies for their contribution to repression mechanisms during apartheid; the Mau Mau veterans of Kenya against the United Kingdom for colonial violence, which led to

Prof Catherine Namakula is a trial and reparatory justice scholar, an Associate Professor of Law, and African states member of the Working Group of Experts on People of African Descent of the Human Rights Council, having served as its chairperson in 2021–2022. She is also convenor of the Africa Reparations Hub and a professor of human rights law and criminal justice with the Global Humanistic University (Curaçao). She authored resolution 543 on Africa's Reparation Agenda and the Human Rights of Africans in the Diaspora and People of African Descent Worldwide, which was adopted by the African Commission on Human and Peoples Rights in 2022. Her work on the effective promotion of the Declaration on the Rights of Persons Belonging to National or Ethnic, Religious and Linguistic Minorities, is cited with approval by the UN General Assembly in Res A/70/212 of 30 July 2015, the High Court of Kenya, and endorsed by leading scholars and practitioners. She facilitates trainings of national judiciaries on fair trial and has delivered lectures on contemporary issues of international law. She has previously been awarded scholarships by the Alistair Berkeley Memorial Trust (2010), the Max Planck Institute for Comparative Public Law and International Law (2010) and the Max Planck Institute for Foreign and International Criminal Law (2011). Prof Namakula has supervised two master's and two PhD students and currently, three PhD students are under her supervision.

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the settlement agreement of 2013; the Africa diaspora's quest for restitution of cultural property; and the Caribbean Community against former colonial powers.

In the research article titled, 'The Rugged Trajectory of Africa's Reparations Agenda: From Aspiration to Claim and Action' published in the *South African Yearbook of International Law* (DOI: 10.25159/2521-2583/15034), Prof Namakula concludes that Africa must advance its claim for reparation in a manner that is authoritative and effective, including by way of a legal claim, high-level political strategy, and the development of a continent-wide social movement for reparations. "History shows that political approaches complement legal approaches effectively in advancing reparatory justice agendas. Pursuing reparations should be conceived as a multi-faceted, transgenerational role that is backed by principles, sustainable institutions, high-level diplomatic endeavours and scholarly work. The ad hoc individualised endeavours for reparation to Africa need to be substituted by structured, institutionalised and consistent mechanisms that translate efforts into a resilient movement," she writes.

In an article published in the *African Yearbook on International Humanitarian Law* titled, 'Reparations without reparation: A critique of the Germany–Namibia Accord on colonial genocide' (DOI: 10.47348/AYIH/2021/a2), Prof Namakula

Reparations must meet both procedural and substantive requirements: they must be proportional, appropriate, prompt, and adequate, and they must culminate from a process that ensures the meaningful participation of victims and judicious regard for all relevant factors and circumstances.

argues that reparation is meant for effect – to make amends. The offer of €1,1 billion in a June 2021 agreement by the Federal Republic of Germany to the Republic of Namibia for the genocide committed during the colonial-era occupation encourages debate about the categorisation and effect of the payment in the fields of human rights and international criminal justice. The genocide was characterised by the loss of lives of thousands of people among the Nama and Herero people of Namibia between 1904 and 1908. In a pioneering analysis, this article reiterates the principles of reparation in international criminal jurisprudence as a yardstick for this significant gesture of remorse. Reparations must meet both procedural and substantive requirements: they must be proportional, appropriate, prompt, and adequate, and they must culminate from a process that ensures the meaningful participation of victims and judicious regard for all relevant factors and circumstances. Reparations for the sake of it, without the remedial effect, make a mockery of justice.

The hub curates resources and consolidates a continental resource database for Africa's reparations, comprising evidence of violations, scholarship reflecting African perspectives on the subject, jurisprudence on reparation, and the progression of political developments. Such a resource base, embodying an extensive array of materials on reparation, would aid research and scholarship towards the progression of the African claim. The UFSARH is also leading a book project on developing the guiding principles of Africa's reparations. This book would be a pioneering compendium of principles on Africa's reparations, which would support the development of continental principles at a diplomatic level. A standard is required for emerging reparatory justice endeavours meant for Africans and people of African descent. Reparations per se are legitimised by meeting the expectations of beneficiaries; this makes the African voice critical in articulating what reparation means for the continent. Scholars are analysing six critical questions: i) What harm was occasioned to Africa by enslavement, colonialism, and contemporary forms of extortion?; ii) What are the procedural and substantive guarantees of reparatory justice?; iii) Can the crimes of enslavement and colonialism be time barred?; iv) What are the determinants of a reparatory effect?; v) How is jurisdiction over crimes of enslavement and colonial aggressions established?; vi) What is the corporate responsibility for enslavement and colonialism?

The UFSARH initiated, led, and hosted a collaborative colloquium among law schools on the continent, including the University of the Western Cape's African Centre for Transnational Criminal Justice, the Faculty of Law at the University of Ilorin, Nigeria, Strathmore Law School, and the Africa Judges and Jurists Forum. It was held in May 2025 with a focus on mainstreaming reparatory justice in legal education in Africa. This successful dialogue centred on the colonial underpinnings and traits of law curricula and legal practice on the continent. A 10-point agenda for reparatory justice in legal education in Africa was adopted. The future research of the hub would demystify each agenda item and popularise the ideals of the initiative, including instigating the African conscience in legal education; advancing justice-centred pedagogy; modelling legal education around community-based justice systems; promoting African agency over knowledge production; promoting understanding of the structural roots and facilitators of injustice; promoting sensitivity to the digital divide and encouraging digital reparation in the use of AI and other technologies; and encouraging a comparative conceptual understanding of reparatory justice, racial justice, spatial justice, digital justice, environmental justice, and economic justice.

The UFSARH team comprises a multinational pool of academics and postgraduate researchers from Botswana, the Democratic Republic of Congo, Uganda, Zimbabwe, South Africa, Lesotho, and Nigeria. ■

Investing **in people**

People are at the heart of the Sustainable Development Goals. The SDGs strive for a safer, healthier, and more prosperous world by 2030 – while rigorously respecting the limits of our planet.

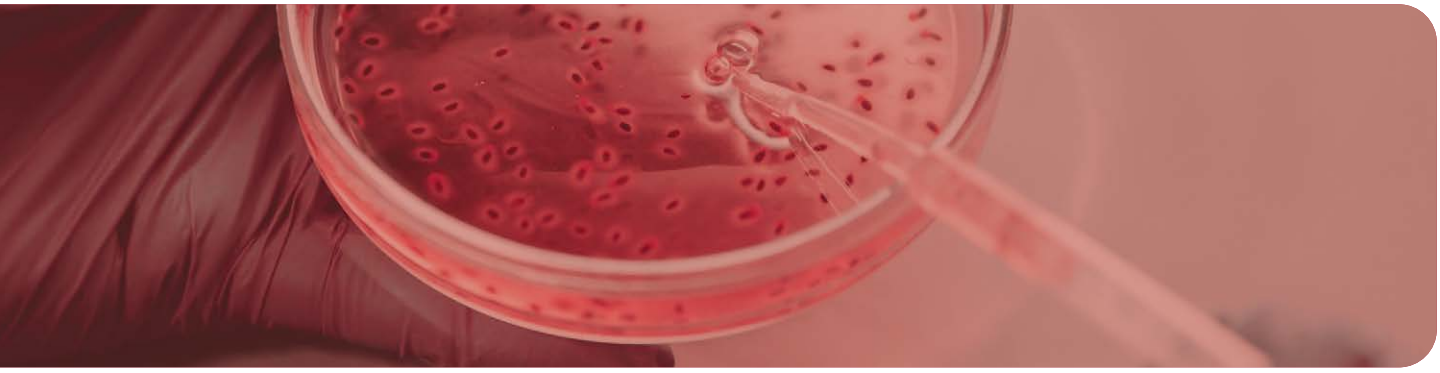
The eradication of poverty is central to the objectives of the UN's 2030 Agenda for Sustainable Development. Eliminating poverty and hunger is not a challenge confined to any one nation or continent – it is a shared global imperative. Guaranteeing global food security and improved nutrition at both household and planetary levels is essential to eliminating hunger.

Addressing these critical issues is vital for the health and well-being of people worldwide, especially those in the Global South, and more urgently, in sub-Saharan Africa. Human, animal and environmental health intersect; therefore, it is imperative that research addresses planetary health and social equity to ensure a sustainable and healthy future for all life on Earth.

The University of the Free State stands firmly committed to this global mission. Through transformative research, our scholars lead pioneering efforts that directly improve lives – championing better health, tackling food insecurity, and relentlessly working to eradicate poverty and hunger. Upholding our core value of social justice, we also drive innovative research that promotes equity and elevates the quality of education across communities.

The research of Profs Martin Nyaga, Felicity Burt, Motlalepula Matsabisa, Liezl Lues, Loyiso Jita, and Maria Tsakeni serves as exemplars of the university's contribution to cutting-edge advancement to improve the lives of people.

Related SDG



Next generation sequencing – A vital tool for better health

Health experts and the World Health Organisation (WHO) agree that the world was not prepared, and is perhaps still not prepared, for the outbreak of the coronavirus (COVID-19) pandemic. Along with this, the risk of new health emergencies also continues to increase. In an effort to better prepare and respond to future health emergencies, Dr Tedros A Ghebreyesus, WHO Director-General, proposed a technical document titled, *Strengthening the global architecture for health emergency prevention, preparedness, response and resilience (HEPR)*. This paper provides a two-part summary of the initiatives that are now underway to strengthen the global HEPR architecture.

The WHO developed the Global genomic surveillance strategy for pathogens with pandemic and epidemic potential, *2022–2032*. The strategy provides a high-level unifying framework to leverage existing capacities, address barriers, and strengthen the use of genomic surveillance in the detection, monitoring, and response to public health threats.

According to the strategy, the continuous detection, monitoring and assessment of existing and emerging pathogens has become a global priority. The strategy builds on the lessons of the past, including the COVID-19 pandemic, while thinking ahead to safeguard the health and well-being of human populations. It provides a unifying vision for strengthening and using genomic surveillance capacities in local to global pandemic and epidemic preparedness and response. Countries are at the heart of the strategy. The strategy builds on existing strengths and encourages partnerships to ensure that genomics is part of our 21st Century surveillance toolbox for a post-COVID world.

Prof Martin Nyaga, Head of the University of the Free State–Next Generation Sequencing (UFS-NGS) Unit and Professor of Virology, undertakes research that primarily revolves around pathogen genomics, leveraging cutting-edge next-generation sequencing (NGS) technologies for comprehensive pathogen surveillance and characterisation, which plays a key role in this strategy. His research involves delving deep into the genetic makeup of various pathogens, particularly viruses of significant public health concern, to understand their evolution, transmission dynamics, and resistance patterns. His team focuses on the entire spectrum of the genomic process, from meticulous sample preparation to library construction, sequencing and data analysis.

The core of their exhilaration stems from the unparalleled resolution and speed that NGS brings to the investigation of viral pathogens. Traditional methods often provide only a snapshot, but genomics allows for the observation of viruses in unprecedented detail, almost in real time. This includes identifying novel viral strains, tracing the origin and spread of outbreaks, and even predicting potential mutations that

Prof Martin M Nyaga is a full professor and the Head of the UFS-NGS, and the unit's principal researcher. His academic affiliation is to the Division of Medical Virology within the Faculty of Health Sciences. His research interests utilise genomics surveillance on vaccine-preventable diseases (VPD), particularly pre- and post-vaccination enteric virus surveillance at whole genome level for the WHO African Rotavirus Surveillance Network (ARSN) and the Africa CDC Pathogen Genomics Initiative (PGI) VPD focus group, with the aim of providing technical guidance and support to develop a continental VPD road map and implementation strategy for the PGI. Prof Nyaga is currently investigating the long-term effects of the introduction of the monovalent Rotarix vaccine in five African countries (Cameroon, Ghana, Malawi, Kenya, and South Africa) through the African Enteric Viruses Genome Initiative (AEVGI). One of the key goals of the AEVGI is to leverage a genomics and bioinformatics approach to complement the routine work done by the ARSN. He is also the team lead for studies on metagenomics of gut and respiratory virome in the UFS-NGS Unit. The aim of these studies is to establish the role played by the gut and respiratory virome in young children over time to effect normal and metabolic disorders that may influence a child's healthy growth or impact medical conditions such as obesity later in life. Prof Nyaga is an NRF B3-rated researcher and a recipient of the Calestous Juma Science Leadership Fellowship. His research initiatives are funded by the Gates Foundation, the WHO, the South African Medical Research Council, the Distributed Platform in Omics (DIPLOMICS), the Poliomyelitis Research Foundation, the National Research Foundation (NRF), and the Rostropovich-Vishnevskaya Foundation. He has supervised and graduated 24 master's and doctoral students, mentored seven postdoctoral fellows and several interns. Prof Nyaga belongs to four scientific societies and/or academies.

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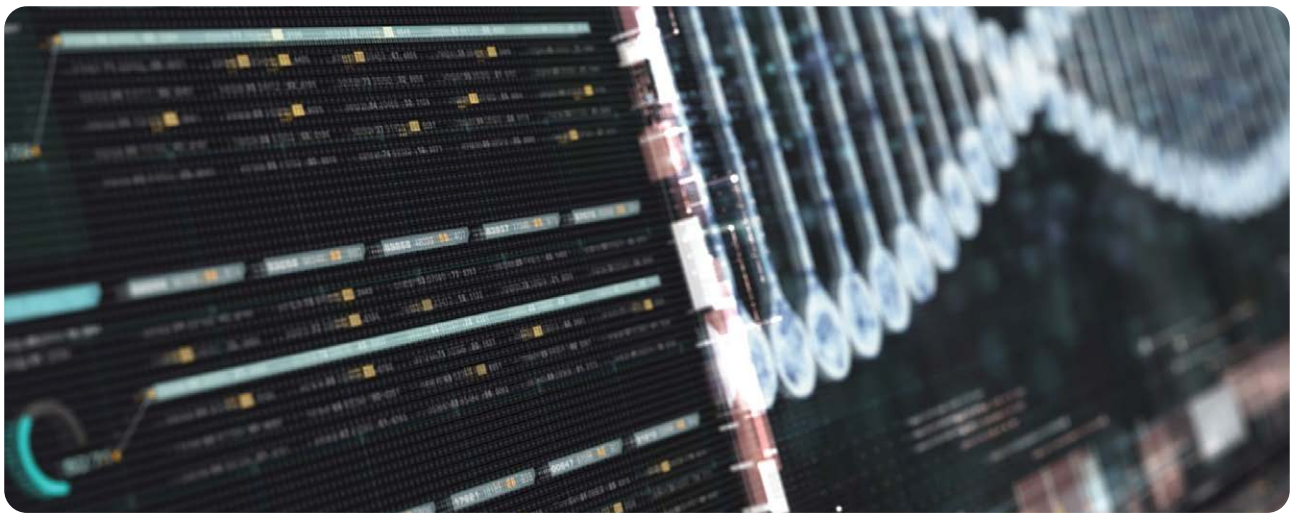
could impact vaccine efficacy or drug resistance. For example, Prof Nyaga and the team's work is crucial in monitoring vaccine-preventable diseases (VPDs), aligning with his role as Director of the WHO Collaborating Centre for VPD Surveillance and Pathogen Genomics. The ability to rapidly sequence and analyse viral genomes means they can provide critical data to public health authorities much faster than ever before, enabling swifter and more targeted interventions.

Globally, Group A rotaviruses (RVA) represent the most common cause of paediatric gastroenteritis in children under the age of five. There has been an increase in global detection and reported cases of acute gastroenteritis mostly caused by RVA genotypes G1P[8], G2[4], G3[8], G9[8] and G12[8] strains, with more severe disease reported particularly in Africa. In the research article, 'Genomic Analysis of Rwandan G9P[8] Rotavirus Strains Pre- and Post-RotaTeq® Vaccine Reveals Significant Distinct Sub-Clustering in a Post-Vaccination Cohort' published in *Viruses*, Prof Nyaga and colleagues assess changes in the evolution of the genomic makeup of the G9P[8] strains that were circulating in Rwanda during the



pre- and post-RotaTeq® vaccination periods, as part of the WHO CC disease surveillance at whole genome level in Africa. The researchers' findings indicate that the Rwandan G9P[8] strains revealed a distinct sub-clustering pattern among post-vaccination 2015 study strains circulating in Rwanda, with changes at neutralisation epitopes, which may play a role in neutralisation escape mutants from the vaccine candidate in use in Rwanda for these strains. This emphasised the need for continuous whole-genome surveillance to better understand the evolution and epidemiology of the G9P[8] strains post-vaccination, and to further assess the vaccine's impact on circulating rotavirus strains in Rwanda.

What makes this field so profoundly exciting is its direct relevance to global health security. In an era of increasing interconnectedness and emergent infectious diseases, understanding the genetic blueprint of pathogens is not merely academic; it is foundational to defence. Every genomic sequence they generate contributes to a larger global knowledge base, allowing for a collective, informed response to viral threats. This dynamic interplay between cutting-edge technology and immediate public health imperative is what drives our research forward with passion and purpose.

The impact of pathogen genomics research on society is profound and multifaceted, extending from localised public health interventions to global health strategies. Primarily, the UFS-NGS's work provides the foundational intelligence needed for robust public-health decision-making. By rapidly identifying and characterising circulating viral strains, we equip health authorities with the data necessary to implement targeted control measures, allocate resources effectively, and communicate accurate information to the public during outbreaks. This early warning capability is critical for preventing widespread transmission and minimising morbidity and mortality. For instance, the African Enteric Viruses Genome Initiative (AEVGI), which Prof Nyaga co-founded, improves rotavirus vaccine efficacy across five African countries, potentially saving numerous lives. During the COVID-19 pandemic, their work with the Network for Genomics Surveillance in South Africa (NGS-SA) provided critical data for policy and vaccine rollouts, demonstrating immediate benefits.

Beyond immediate public health crises, the UFS-NGS Unit's research contributes to strengthening health care infrastructure and capacity building, particularly within South Africa and the broader African continent. They are not just generating data; they are building expertise, training the next generation of scientists, and establishing state-of-the-art diagnostic and surveillance capabilities that will serve our communities for decades to come. The technical proficiency and ability to follow complex protocols with precision, exemplified by the team, are direct outcomes of this commitment to capacity development.

Ultimately, the societal impact of their research can be seen in enhanced public safety and improved quality of life. By reducing the burden of infectious diseases, they free up health care resources, reduce economic disruption, and foster healthier, more resilient communities. Their work empowers policymakers, clinicians, and individuals with the knowledge to make informed choices, moving us closer to a future where pandemics are better controlled, and preventable diseases become a relic of the past.

Prof Nyaga plans to strategically align advancing the UFS-NGS capabilities in pathogen genomics and amplifying their societal impact. The immediate horizon involves expanding their research into a broader spectrum of pathogens, including those associated with neglected tropical diseases, and exploring host-pathogen interactions at a genomic level. A significant pillar of their future planning is the integration of advanced computational and artificial intelligence (AI) methodologies for genomic data analysis. While the current work of the UFS-NGS emphasises experimental design and data capturing, the sheer volume and complexity of NGS data demands sophisticated bioinformatics pipelines and machine learning algorithms. The unit aims to develop predictive models for viral evolution and transmission, allowing for even more proactive public health interventions. This will involve investing in high-performance computing infrastructure and recruiting specialised bioinformatics expertise.■

Related SDG

Catching and detecting deadly viruses

In recent years, outbreaks of arthropod-transmitted viruses (arboviruses) and zoonotic viruses (viruses that jump from animals to humans) have increased, with significant public and veterinary health implications. Diverse factors, including climate change and various anthrogenic factors, will drive the emergence and re-emergence of viruses. Climate change influences the survival and abundance of mosquitoes and ticks, and facilitates the geographic spread of these vectors, while changes in land use, travel and trade, and population growth increase potential for exposure. In addition, evolution of viruses can facilitate spread and adaptation to new vectors. The potential for spread and expansion of endemic regions highlights the importance of improved surveillance, diagnostics and raised awareness.

Surveillance is the cornerstone of preparedness for epidemics, or pandemics. The research of Prof Felicity Burt, NRF Research Chair in Vector-Borne and Zoonotic Pathogens in the Division of Virology within the Faculty of Health Sciences at the University of the Free State, uses a One Health approach for surveillance of vectors, people and livestock to identify currently circulating viruses and their interaction with different hosts in nature. The research also involves community engagement among rural farmers.

Prof Burt's research primarily aims to determine the prevalence and distribution of known and novel arboviruses circulating in the country. Her view is that improved and regular surveillance is key and essential to pandemic preparedness. To achieve this goal, Prof Burt, an expert in arbovirology, has developed multiple assays to detect and identify viruses circulating in our region (Southern Africa), and to investigate their medical or veterinary impact. Her research group engages with communities to understand their knowledge and awareness of zoonotic diseases to which they are at risk of exposure due to their occupational activities and their practices to avoid infection.

Surveillance of mosquitoes was routinely undertaken during the 1970s and 1980s, confirming the presence of various arboviruses with public health implications in the country. However, although numerous viruses had been detected historically, the current situation and the prevalence 50 years on, was largely unknown. In her research article entitled, 'Arbovirus surveillance detects mosquito-borne viruses in central South Africa' published in *Virology* in 2025, Prof Burt and colleagues confirmed the presence of West Nile, Sindbis and Middelburg viruses in mosquitoes collected in the Free State and identified local circulation of Bagaza, Bunyamwera, Germiston and Witwatersrand viruses. Similarly, in her article titled, 'Identification of arboviruses in mosquito populations in Kwazulu-Natal, South Africa and the first record of Wyeomyia mitchelli in the Old World'

Prof Felicity Burt is a Professor in the Division of Virology and holds a joint appointment with the National Health Laboratory Service and the UFS. She also holds the NRF SARChI Chair in Vector-Borne and Zoonotic Pathogens Research and is an internationally recognised expert in the field of viral haemorrhagic fevers (VHF) and arboviruses. Prof Burt started her virology career at the Special Pathogens Unit at the National Institute for Communicable Diseases in Johannesburg (1988–2006) participating in the diagnosis and investigation of outbreaks of VHF and arboviruses. These included outbreaks of CCHFV, a tick-borne zoonosis endemic in South Africa; filovirus outbreaks in other regions of Africa (Ebola DRC 1995, SA 1996, Uganda 2000, Marburg DRC 1999) and a Rift Valley fever virus outbreak in Saudi Arabia in 2000. Prof Burt has in excess of 100 publications in international peer-reviewed scientific journals and a Google Scholar h-index of 45. Her research includes establishing a metagenomics platform for virus discovery and improving molecular and serological tools for the diagnosis and detection of known and novel vector-borne pathogens; genetically characterising novel pathogens and determining genetic relationships between novel and existing vector-borne and zoonotic pathogens; to investigating host immune responses (innate and adaptive) against selected pathogens of medical significance in South Africa (e.g. CCHFV), and to understanding immune correlates of protection that contribute to the development of novel treatment and vaccines and establish a drug discovery programme for arboviral/zoonotic viruses. Prof Burt was responsible for the establishment of a Biosafety Level 3 facility for zoonotic pathogens at the UFS. She has previously handled select agents of arboviral and zoonotic origin within the confines of a maximum security laboratory (Biosafety Level 4 laboratory) situated at the National Institute for Communicable Diseases in Johannesburg, South Africa. Prof Burt has served as a member of two international panels for the WHO-led prioritisation of diseases of epidemic and pandemic threat reviewed for viruses from the *Bunyaviridae* family and the *Togaviridae* family. She is a member of the Advisory Council of the International Society of Crimean-Congo Haemorrhagic Fever and the Chair of the CCHFV Africa Advisory Committee. She has also served as a member of the International Scientific Advisory Board for Southern African Centre for Infectious Disease Surveillance (SACIDS) and is currently a member of the international advisory boards for the *Lancet, Infectious Diseases* journals.

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published in *PLoS Neglected Tropical Diseases* in 2025, the circulation of Sindbis, Witwatersrand and Bunyamwera viruses was confirmed in KwaZulu-Natal. These viruses have potential to cause outbreaks of disease in humans and/or domestic livestock, especially following heavy rainfall facilitating increased mosquito populations.

Developing methods for virus discovery is also an important aspect of the research. Using a novel metagenomics-based technique for virus discovery, Prof Burt's laboratory has been able to detect a tick-borne virus not previously known to occur in South Africa. The significance of this virus globally is currently under investigation, and we will continue to determine its prevalence and significance in South Africa.

To ensure that the world is better prepared for future diseases and pandemics, the World Health Organisation (WHO) created an initiative called the Preparedness and Resilience for Emerging Threats (PRET). It is an innovative approach to improving disease pandemic preparedness. It recognises that the same systems, capacities, knowledge, and tools can be leveraged and applied for groups of pathogens based on their mode of transmission. Together with the African Union

Commission and Africa Centers for Disease Control released the Zoonotic Disease, Prevention and Strategy (2025–2029). This One Health Approach highlights the importance and global concern regarding potential for significant outbreaks and pandemics.

The United Nations Sustainable Development (UN SDG) Goal 3 aims to achieve good health and well-being for all by 2030. However, there are still many challenges, including ending the epidemics of AIDS, tuberculosis, malaria and combating hepatitis, water-borne, and other communicable diseases.

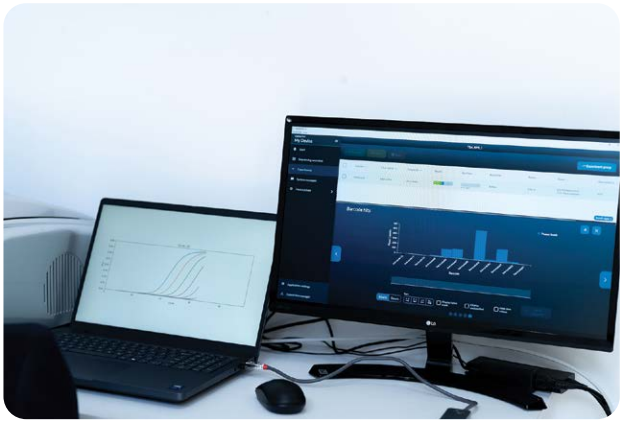
The distribution and awareness of arboviral diseases in many African countries is also an unknown phenomenon. There is currently limited genomic data for informing emergence, diagnostics, vaccine development, virus evolution, pathogenicity, or host interactions. In this regard, Prof Burt's research and application of cost-effective genomic sequencing will play a key role in identifying the spread and transmission of viral lineages, and provide key information for the development of diagnostic tools, vaccines and countermeasures to mitigate disease.

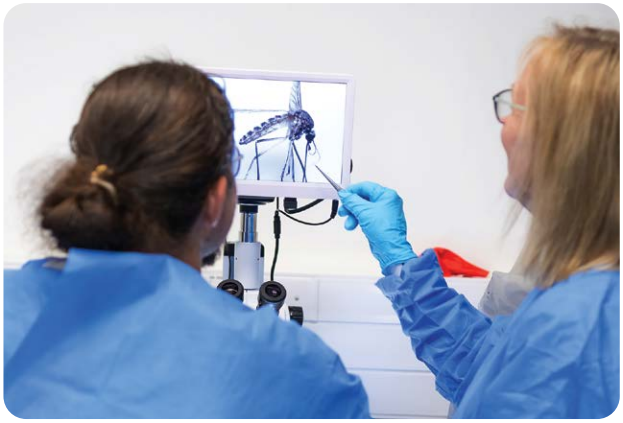
The researchers have made significant contributions towards the global knowledge on CCHFV, a tick-transmitted zoonosis with a 30% fatality rate in South Africa. They have published complete genome sequences for African isolates that are currently limited on public databases, as well as confirming that natural genome reassortant strains are circulating.

Human, animal, and vector surveillance contributes towards early warning of emergence, or spread, or spillover events, that could result in disease outbreaks. In this regard, Prof Burt's research uses a One Health approach to investigate and monitor emerging and re-emerging arboviruses using cost-effective technologies that could be applicable for low-resource settings.

The research programme will also consider the potential impact on public health in the context of climate change, as this has a direct impact on the dispersal of arthropod vectors and the subsequent spread and emergence of disease. The targeted pathogens in the research programme include viruses prioritised by the WHO for research due to the lack of treatment and/or vaccines and the potential to cause significant outbreaks that could be precipitated by climate change. Understanding how these pathogens cause disease is key to future therapeutics and vaccines.

To date, Prof Burt has graduated 28 BMedSc (honours) students, 23 MMedSc students and 11 PhD students. Eight postdoctoral fellows have been mentored. She is currently supervising five MMedSc, and six PhD students and mentoring one postdoctoral fellow. Five former students completed their entire postgraduate education with the research group, from honours to PhD.





The team is working closely to collect and identify mosquitoes and ticks. Students who have never had the experience of visiting a national game park have participated in field trips to the Kruger National Park and Mokala National Park. The team shared their knowledge during community engagements and arranged visits to schools to educate learners on the risk of zoonotic disease and how to take care of their pets. Rabies is a significant threat in the Free State, with children being infected by stray dogs. Knowing the risks and what to do could save lives. ■

Related SDG

Traditional medicine: Ancient wisdom meets modern science

For thousands of years, people have relied on traditional medicine to heal and stay healthy. Ancient knowledge in traditional medicine and herbal remedies has shaped how people care for their bodies and minds. Some of today's most important medicines – such as aspirin (for pain and inflammation) and artemisinin (for treating malaria) – have their roots in traditional healing practices.

Currently, the role and importance of traditional medicine is entering a new era, blending age-old wisdom with cutting-edge science to offer more personalised and holistic health care. According to the World Health Organisation (WHO), approximately 90% of people in most developing countries report using some form of traditional medicine in health care. In this regard, the WHO has called for more research evidence and clear guidelines of usage to enhance the safe, effective use and increased accessibility for all. To this end, the WHO launched the Global Traditional Medicine Centre (GTMC) in 2022, with support from the government of India to meet this global need. The WHO GTMC is focused on supporting scientific research into traditional medicine, encouraging knowledge-sharing across cultures, protecting biodiversity, and building global partnerships that connect ancient practices with modern health solutions. By bringing together tradition and innovation, the GTMC is helping to unlock the full potential of traditional medicine – for the health of people and the planet. The vision of the WHO's new Traditional Medicines Strategy 2025–2034 is for a world in which there is universal access to safe, effective and people-centred traditional complementary and integrative medicine for the health and well-being of all. The goal of the new strategy is to advance the contribution of evidence-based traditional complementary and integrative medicine to the highest attainable standard of health and well-being. It has four strategic objectives, namely strengthening the evidence base for traditional complementary and integrative medicine, supporting the provision of safe, effective traditional medicines through appropriate regulatory mechanisms, integrating safe and effective traditional medicines into health systems and optimising the cross-sector value of traditional medicines, and empowering communities.

Prof Motlalepula Matsabisa is a Professor of Pharmacology and a global expert in African traditional medicine and Head of the African Medicines Innovations and Technology Development Platform (AMITD) at the University of the Free State. His research not only aligns with the goals and purpose of the WHO and the WHO GTMC, but also contributes to the Sustainable Development Goals (SDGs), particularly Good Health and Well-being by providing accessible, affordable, and culturally appropriate health care, especially in rural areas. This research focuses on the discovery and development of new drugs and medicines based on traditional and herbal African medicines. It entails looking at the safety, efficacy and quality of traditional medicines for select but important priority diseases such as diabetes, hypertension, cancer, malaria and Alzheimer's. AMITD, an institutional and national research platform, also

Prof Motlalepula Matsabisa holds a PhD in Pharmacology specialising in pharmacology and pharmacology of traditional medicines, in drug discovery and development, the formulation research of traditional medicinal products to proprietary finished final products. His research encompasses all value chains of new drug research, basic science research, discovery, development, molecular and mechanistic pharmacology research, pharmaceutical research to clinical trials. The focus of his research is on discovery and development of new drugs and medicines based on traditional and herbal African medicines. The research entails looking at the safety, efficacy and quality of traditional medicines for select diseases such as diabetes, hypertension, cancer, malaria and neurodegenerative diseases such as Alzheimer's. The research entails working fairly and meaningfully with communities on their use of herbal medicines for self-medication and self-treatment on certain diseases and in their research, conduct controlled scientific research to confirm or dispute the anecdotal claims made about these traditional medicines. The research is to inform the public on the potential benefits and risks of the use and consumption of traditional medicines and the economic potential of indigenous knowledge systems (IKS) for health. Prof Matsabisa is a member of the World Health Organisation (WHO) Strategic and Technical Advisory Group (the 'AG') on Traditional, Complementary and Integrative Medicine and previously served on the WHO Global Centre for Traditional Medicine Editorial Board/Evidence Task Force. He is the co-chair of the WHO Second Traditional Medicines Global Summit. He also holds the position of chairperson of the WHO Regional Expert Advisory Committee on Traditional Medicines for COVID-19, a committee which the WHO is now repurposing to look into broader aspects of traditional medicines. Prof Matsabisa is a member of the International League Against Epilepsy and serves in the Ministerial Advisory Committee on traditional medicines for the National Department of Health for South Africa. He is also a member of the Complementary Medicines Committee for the SAHPRA. He is currently also a visiting professor of Pharmacology to the Busitema University in Uganda.

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undertakes the product and policy development, training and teaching on pharmacology and indigenous knowledge-based medicines. The ultimate aim is to pursue both knowledge and societal impact.

AMITD has advanced the scientific development and commercialisation of indigenous knowledge by transforming traditional plants such as *Croton gratissimus, Myrothamnus flabellifolius, Lippia scaberrima, Lippia javanica, Buddleja saligna, and Phyla dulcis* into branded indigenous infusion teas and iced teas. Through the establishment of modern post-harvest and tea-processing facilities in the rural communities of Krwakrwa, Ntshatshongo, Mokgola and Lekubu, AMITD has transferred technical skills, established organised local cooperatives, and helped register community-owned businesses into SMMEs. This initiative has generated 40 direct jobs and more than 100 sustainable community-based employment opportunities, and numerous indirect jobs through partner projects. The commercialisation of AMITD's teas is now contributing to the formal economy, demonstrating how indigenous medicinal plants can drive innovation, enterprise, and inclusive growth.

Prof Matsabisa's research on PHELA, an herbal product made from four medicinal plants, set the benchmark in methodology and in policy development on traditional medicines, using randomised, multicentre controlled clinical trials. The AMITD platform, together with FARMOVS, conducted the first South African Health Products Regulatory Authority (SAHPRA)-approved multicentre controlled clinical trial of a plant-based product on mild to moderate COVID-19 patients. The main purpose of the study titled, *A multi-centre, open label, randomised, parallel group, controlled study to provide reliable evidence on the efficacy of the African traditional medicines, PHELA, in combination with SOC, as a candidate therapy for mild to moderate COVID-19*

in non-hospitalised patients was to confirm the product as a treatment for mild to moderate COVID-19.

Traditionally, PHELA had been used for a disease called muyaga, but was recently scientifically tested and found effective as an immune modulator, thus benefiting persons with a compromised immune system. The study found that PHELA in vitro inhibited the growth of SARS-CoV-2 and SARS-CoV infection and MERS-CoV with the implication for further development for the infection control of these viruses. PHELA could potentially be developed as a standalone or adjunctive therapy for COVID-19 with the standard of care.

The second study titled, *A multi-centre, Double-Blind, Randomised, Parallel Group, Controlled Study to Provide Reliable Evidence of the Efficacy of the African Traditional Herbal Medicine, PHELA, as an Adjunct Therapy in Adult Patients with Long term Effects of COVID-19 who Develop First-episode non drug Resistant Pulmonary Tuberculosis* was to conclude that PHELA could have positive effects on post-COVID-19 patients presenting with tuberculosis (TB). PHELA has been formulated as an easy-to-use hard gelatine capsule and it has now been formulated as an ionic gelation throat spray for those patients who may have difficulty swallowing.

The AMITD's research on local high-THC cannabis landraces has significantly influenced the medical cannabis sector in South Africa and the region, and has shaped government perspectives on cannabis research, its decriminalisation, and associated policy development. The platform's studies contributed to setting approved THC levels in complementary medicines and helped shift community perceptions of cannabis – from a narcotic to a valuable medicinal plant. The team also developed a chitosan hydrogel for slow-release anti-inflammatory treatment, further showcasing the therapeutic potential of cannabis. Research published globally on medicinal cannabis shows that the local landraces of cannabis have potency on a number of diseases that include cancer, diabetes and Alzheimer's and appeared better-acting than other global varieties.

AMITD leads several international research collaborations with counterparts from Cameroon, Ghana, Uganda, Ethiopia, China, Germany, India, Lesotho, Chile and Brazil, all focused on high-impact innovation. AMITD research has a global perspective and impact. The discovery of novel non-symmetrical sesquiterpene molecules with antiprotozoal effects from the traditional medicinal plant, *Dicoma anomala*, has positioned our work for impact regionally on research in malaria. The molecules have received global, regional and national patents granted in the following countries: South Africa Patent No 2007/004160; China Patent No 935480 ZL200580043591; USA, Patent No S 8,586,112 B2; Nigeria Application No NG/C/2007/04160; Tunisia Application No 19881; Madagascar Application No PCT/IB2005/003265; ARIPO Application No AP2256; and a PCT/IB2005/003268; and applications in Brazilian Patent Application No P105170752; Egyptian Application No PCT 454/2007; Indian Application No F21187 and OAPI Application No F21179. South Africa is not a malaria endemic country but AMITD contributes to the regional disease burden.

With regard to policy and regulatory contributions, nationally, AMITD heads a multidisciplinary team of lawyers, medical doctors, pharmacists, researchers, and traditional health practitioners under DSTI and SAHPRA. This group is developing a regulatory framework for traditional medicines, contributing to the drafting of a new Health Products Bill to replace the outdated Medicines Act (Act 101 of 1961). Through this work, AMITD continues to shape national policy by recommending the separate regulation of African traditional medicines and proposing the creation of a new Category E for such products as a transitional measure. The AMITD has also partnered with the African Union Commission, the WHO Africa Region and recently hosted the G20 Research Innovations Working Group (RIWG) and the G20 Bioeconomy Group.

International contributions of AMITD are around working with the WHO in strategy and technical assistance for traditional complementary and integrative guidance. AMITD's impact is also global. It is undertaking a global project for the WHO in all six regions, working in a total of 194 countries to develop an Intellectual Property Framework for Protection, Regulation, and Innovation of Traditional Medicine that would safeguard Knowledge, Rights, and Commercialisation Pathways in an inclusive manner with communities.

AMITD has established strong collaborations with the pharmaceutical industry through several research agreements and projects. Notably, AMITD partnered with Tiger Brands to reformulate peppermint gripe water and improve the stability of Umuthi Wenyoni, successfully reintroducing both products to the market. The platform is also working with Tiger Brands on its Peaceful Sleep product range. In addition, AMITD is collaborating with AfriPharm and SHEQ Consulting to achieve SAHPRA and South African National Accreditation System accreditation, respectively, for its laboratories.

The teaching and training programmes developed by AMITD in the pharmacology of medicinal plants grew from humble beginnings with just three staff members and four honours students, to a team of 25 staff, 20 postgraduate students, and 20 postdoctoral fellows. Its graduates are now among the most sought-after professionals, widely employed across government and the private sector. ■

Related SDG

Leading with accountability in VUCA environments

The contemporary global landscape is increasingly marked by democratic backsliding, implying an intentional, incremental erosion of core democratic institutions and norms and denotes the process of removing constraints on accountability for democratically elected leaders. Signs of this backsliding are evident in both established and emerging democracies, underscoring the precariousness of the sustainability of democratic principles worldwide.

Reflecting these adverse trends, the Economist Intelligence Unit reports that the average global Democracy Index score declined from 5.44 in 2022 to 5.17 out of 10 in 2024, the lowest score since the index started in 2006, signalling a measurable weakening of democratic resilience.

One of the main drivers of decline in 2024 was the functioning of the government, of which the lack of public sector leadership accountability has undermined public confidence. Among emerging middle-income countries, citizen dissatisfaction with democratic governance is notably high: 66% in Chile, 71% in South Africa, 77% in Colombia, 89% in Peru, and 58% in Sri Lanka. This widespread discontent reflects a generally low level of public trust in national leaders, political parties, and the overall functioning of democracy.

Public sector leadership accountability represents a pivotal challenge for contemporary democracies. Deficits in this area weaken the performance of democratic institutions and fuel democratic backsliding. Rectifying these accountability gaps and meeting citizens' expectations is therefore indispensable for sustained social and economic development. Public sector leadership accountability can be understood as the duty of individuals and organisations, such as oversight bodies, public administrators, and elected officials, to report transparently on their actions and to assume responsibility for the consequences of those actions.

The United Nations Sustainable Development Goals (SDGs) underscore the centrality of effective and accountable public leadership in achieving sustainable global development. Indeed, the persistence of the challenges addressed by the SDGs, such as poverty, inequality, environmental degradation, and weak institutions, can be interpreted as symptomatic of deficiencies in public leadership at global and national levels. In this context, the SDGs not only serve as developmental targets but also as normative frameworks aimed at strengthening democratic institutions and promoting accountable leadership.

Specifically, SDG 11 seeks to promote inclusive, safe, resilient, and sustainable cities and communities, while SDG 16 focuses on the promotion of peace, justice, and strong institutions. These goals collectively support the African Union's Agenda 2063, which underscores the significance of

Prof Liezel Lues is a renowned scholar in Public Administration and Management at the UFS. Her career spans notable roles in human resource development with the Free State Office of the Premier and the National Department of Water Affairs. She served as deputy and chairperson of the Association of Southern African Departments of Public Administration and Management (ASSADPAM); a former Vice-President representing Africa on the International Associations of Schools and Institutes of Administration (IASIA) and serves on the Steering Committee of the International Commission on the Accreditation of Public Administration and Training Programmes. She was appointed as the president of IASIA. Prof Lues also contributes to the Board of Management of IASIA and the Steering Committee of the International Commission on the Accreditation of Public Administration and Training Programmes (ICAPA-SC). Her extensive publication record and editorial board memberships, combined with her NRF rating and multiple senior researcher faculty awards, underscore her significant impact in the field. Prof Lues teaches both undergraduate and postgraduate courses focusing on human resource management, public sector management, and leadership.

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good governance, democracy, and respect for human rights as foundational pillars for sustainable development across the continent.

Prof Liezel Lues, whose research includes Public Sector Management Transitions, in particular the role of leadership accountability, aims to better understand public sector leaders, but also their role in leading their countries through modern-day crises and volatile, uncertain, complex, and ambiguous (VUCA) environments.

Public sector leaders within the South African context are constitutionally mandated to adhere to principles of professionalism, ethical conduct, and accountability, as enshrined in Chapter 10 of the Constitution of the Republic of South Africa. These constitutional imperatives are further echoed in national and international policy frameworks. The National Development Plan (NDP) 2030 articulates a vision of "an efficient, effective and development-oriented public service", emphasising the need for a capable state to drive development. Similarly, the NDP 2030 vision aligns international development priorities with the pursuit of accountable and effective governance within the South African public sector.

Since 2020, public leaders across the globe have been confronted with a series of unprecedented and multifaceted challenges, including the COVID-19 pandemic, the Russian invasion of Ukraine, the second Trump administration and the continuing Israel-Palestine conflict, to mention a few. These challenges have generated profound socio-economic and political repercussions. In addition, protracted crises such as the civil war in Syria, systemic gender oppression in Afghanistan, Venezuela's deepening economic collapse, and the conflict in Sudan, further exemplify the volatility and complexity of the current global landscape. These developments underscore the urgent need for transformative public leadership and heightened accountability, which have significantly reshaped the expectations, responsibilities, and conduct of public leaders. The evolving global economy appears to demand innovative leadership paradigms and adaptive approaches, increasingly rendering traditional leadership models and conventional practices obsolete.

Similar issues are evident in South Africa, with rising crime, corruption, inequality, health care failures, and infrastructure decline and recent aid cuts. Trust in public leadership is low, and overall trust in government institutions, such as the police, records 22%. This distrust is tied to leadership incompetence, contributing to high unemployment (32,9% in Q1 of 2025), extreme inequality (the highest globally in 2025), and service disruptions such as electricity and water shortages, which sparked violent protests and looting in July 2021. South African democracy relies heavily on public sector leaders to address national and international challenges, such as achieving the goals of the NDP, SDGs, managing international relations, and responding to credit

rating downgrades, while being rated a flawed democracy by the Economic Intelligence Unit (2022).

Amid this VUCA environment, South Africa's public sector leaders, more than ever, must navigate unprecedented socio-political challenges. In the research article titled, 'Exploring Public management accountability toward human resources current issues and new developments', as part of the Working Group VI: Public sector leadership and governance of the International Institute of Administrative Sciences (IIAS), Prof Lues found that public management accountability requires informed public officials (the accountable actor), responsive administrative processes and procedures (the nature of the conduct), the implementation of strategies and application of approaches to the benefit of the public (the accountable forum), and consequences for the non-performance or actions (the nature of the obligation) of public officials. The importance of public accountability and public administration is to warrant that the conduct of public officials is to the benefit of the public good.

Traditionally, a public leader is expected to craft a sustainable vision alongside strategies for achieving that vision, 'doing the things right' (efficiency) and 'doing the right things' (effectiveness). Public sector leadership accountability and public accountability, and public accountability in particular, should (commas) matter to everyone because at the most fundamental level, accountability is a cornerstone of any functioning democracy. Without it, the alternative is impunity.

The framers of the South African Constitution recognised its centrality by embedding accountability within the founding provisions and making it an integral part of the democratic project. Beyond its democratic significance, public sector leadership accountability delivers tangible benefits for society, including strengthening good corporate governance; enhancing the management of public finances; lowering the costs of investigating misconduct and misappropriation of funds; and enabling optimal performance and the improved delivery of quality services to citizens.

Although South Africa has made progress towards achieving the goals of SDG 16, the country is still perceived as a dangerous place, with many people believing that crime is increasing and many crimes go unreported. Trust in key institutions has also declined over the years. In the research paper titled, 'How can public sector leadership advance peace, justice and strong institutions in a VUCA environment?', as part of the Working Group VI: Public sector leadership and governance of IIAS, Prof Lues concluded that South African leaders need to address the structural and systemic flaws of the economy and society with strength of leadership, boldness, visionary thinking and innovative planning. The paper identified several factors to be considered by South African leaders in advancing peace, namely safety and security, trade and industry, job creation and technology. Each of these factors could be seen as a potential risk towards maintaining peace in the country.

Prof Lues' analysis of South Africa's public sector leadership since the advent of democracy reveals a recurring pattern of governance within a VUCA environment. The trend suggests that South Africa has not transitioned out of VUCA environments but has rather moved from one to the next, with some leaders exacerbating rather than resolving systemic challenges. High-profile scandals such as state capture, the 'Gangster State' allegations, the 'Phala-Phala' report, and diplomatic controversies further highlight instances where leadership actions have amplified rather than mitigated national instability. ■

Related SDG

Instructional leadership: Quality teaching for a prosperous society

The quality of education depends on the quality and commitment of teachers. They are the cornerstone of sustainable transformation in any educational system and play a crucial role in preparing well-educated, future-proofed learners. As such, the achievement of the objectives of the UN Sustainable Development Goals and the attainment of the aspirations of the African Union's (AU) Agenda 2063 rely on the dedicated efforts of teachers who need to be well-trained, professionalised and empowered.

In this regard, one of the aims of SDG 4 and Agenda 2063 is to substantially increase the supply of qualified teachers, especially in science, technology and innovation, to enable the development of Africa's human and social capital. The Transforming Education Summit (TES), a key initiative of the United Nations Secretary-General's Our Common Agenda launched in September 2021, reiterated the crucial role of teachers as drivers of educational reform. However, the input of teachers is rarely requested, and they are not involved in either decision-making or policy development.

These issues have occupied the research and scholarship of Prof Loyiso C Jita, Dean of the Faculty of Education and SANRAL Chair in Science, Mathematics and Technology Education at the University of the Free State, over the years. To this end, Prof Jita has focused on instructional leadership, teacher development, how teachers teach, how they learn to teach better, and how leadership structures can support this process as well as curriculum reform. His work sits at the intersection of policy and practice, bringing together his training in education policy and his early experience as a policy researcher. This has led to his participation in the development of many of the new provincial government white papers on education in South Africa in the mid-1990s.

Prof Jita's scholarship brings together instructional leadership, curriculum studies, teacher education, science, mathematics and technology education, drawing on grounded empirical evidence to inform reforms in teaching, teacher training, school leadership, and the integration of digital pedagogies in both resourced and resource-constrained settings. Across his academic career, Prof Jita has produced a sustained and wide-ranging body of research focused on the core challenges facing science, mathematics and technology education in the Global South. His scholarship has consistently interrogated how teachers learn, lead, and adapt to changing curricular, policy, and classroom contexts.

In one of his numerous research articles, 'Perceptions and practices of principals: examining instructional leadership for curriculum reform', published in *Frontiers in Education*, Prof Jita's findings indicate that while principals perceive themselves as actively engaged in instructional leadership, particularly through principal instructional management

Prof Loyiso C Jita is one of South Africa's most influential scholars in the field of instructional leadership, curriculum studies, science, mathematics, and technology education. Over a career spanning more than two decades and counting, he has built a legacy defined by scholarly rigour, institutional leadership, and developmental impact. His research and scholarship has made lasting contributions to teacher education, instructional leadership, curriculum transformation, and education policy, both nationally and across the African continent. As the inaugural holder of the SANRAL Chair in Science, Mathematics and Technology Education at the UFS since 2014, he has led one of the most active and productive research groups in the country, nurturing new talent and advancing teacher education and policy-research in rural and urban contexts alike. He has produced more than 40 PhDs in the SANRAL Chair between 2014 and 2024, and 10 postdoctoral fellows, with the research team producing more than 88 journal articles in that period. Prof Jita has supervised 46 doctoral students and 22 master's students to successful completion, while currently continuing to supervise a cohort of doctoral and master's candidates across the university and beyond. Prof Jita previously served as Director of the School of Education at the University of South Africa (2009 to 2011), and Director of the Joint Centre for Science, Mathematics and Technology Education (2002 to 2005) at the University of Pretoria. Prof Jita has served on numerous university councils and national committees, including the Council of Umalusi, South Africa's national body for quality assurance in education, and currently chairs its Assessment Standards Committee that is responsible for quality assuring the national matriculation examination results.

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dimensions in defining school missions, managing instructional programmes, and fostering positive school climate – gaps exist between their self-perceptions and enacted practices. Thematic analysis shows that principals influence the establishment of school goals, facilitate instructional collaboration, and reinforce positive behaviours among teachers and learners. However, inconsistencies emerge in data-driven decision-making and direct instructional oversight. This study exposes the need for structured training, clearer role expectations, and sustained support to enhance principals' leadership effectiveness.

Three of his most influential publications, each with more than 300 citations, were developed with Prof Jim Spillane of Northwestern University in the US, which conceptualised and helped to foreground the notion of distributed instructional leadership in schools. 'Managing in the middle: school leaders and the enactment of the accountability policy', with more than 600 citations and published in *Sage Journals*, is one of the ground-breaking pieces on distributed and instructional leadership work worldwide. The article brought to the fore the notion of how school leaders were active agents of policymaking and policy-interpretation, who make sense of and mediate top-down policies from their districts and/or states for the teachers in the schools. More importantly, the paper argued that such mediation would always be situated in the leaders' professional biographies, school histories and their roles as intermediaries between the policymakers and the classroom teachers.

The impact of that work was far-reaching, as no longer could policymakers assume that policy could and would simply be implemented from the top-to-bottom as intended by the developers.

The impact of that work was far-reaching, as no longer could policymakers assume that policy could and would simply be implemented from the top-to-bottom as intended by the developers. Sense-making and mediation have now become key concepts in thinking about education policy implementation, curriculum transformation, school leadership for improved learning, teacher professional development, teacher education, digital and ICT integration in schools, among others.

Similarly, the article 'Leading instruction: the distribution of leadership for instruction', which was published in *Taylor & Francis Online*, helped to bring to the foreground the idea that school improvement and learning improvements may only be achieved and/or harnessed by recognising and marshalling the varied contributions of multiple leaders – formal and informal – within the school contexts. While recognising the important role of the principal in a school, this work suggested that it takes more than the principal to achieve sustainable improvements in teaching and learning within a school context.

It is this idea on the important role of formal and informal school leaders in improving teaching and learning that Prof Jita successfully piloted with the Mpumalanga Department of Education in the establishment of what came to be known as 'cluster leaders' – a group of teachers who would lead their colleagues on making curriculum transformations, guide the implementation of the new curriculum and collectively work on improving teaching and learning across schools within a particular district. The concept of 'teacher clusters' and/or 'cluster leaders' was transformative and was embraced and later adopted by all provincial departments of education in South Africa.

Prof Jita often publishes with his postgraduate students and postdoctoral fellows. The research published with ML Mokhele titled, 'When teacher clusters work: selected experiences of South African teachers with the cluster approach to professional development', published in the *South African Journal of Education*, and with TC Ndlalane on 'Teacher clusters in South Africa: opportunities and constraints for teacher development and change', published in *Perspectives in Education*, explored the benefits (and possible constraints) of collaborative forms of professional development, linking it to the structures and contexts for instructional leadership in schools.

The impact of this work can be seen in the fact that all provincial departments of education in South Africa have since established these collaborative structures of teacher professional development. Prof Jita continues to explore and puzzle over the nature and influence of various subject-specific leadership configurations and professional development on school and classroom change in African contexts. With a specific focus on how these configurations contribute to improving the teaching and learning of science, mathematics and technology in schools, and breaking the digital divide between the resource-rich and the under-resourced contexts in the Global South, Prof Jita's research has also focused on curriculum policy and implementation issues in African contexts with science and mathematics as the content and context. These contributions have over time informed education policy in South Africa and influenced practices in other sub-Saharan African countries, including Botswana, Lesotho, Zimbabwe, Ghana, Nigeria, among others. ■

Related SDG

Preparing STEM teachers for the 21st Century

The 21st Century is characterised by several changes that warrant frequent innovations in science, technology, engineering, and mathematics (STEM) subjects' curricula. STEM education is one of the national strategic goals in South Africa, the National Strategy for Mathematics, Science, and Technology Education (2019–2030), which aims to equip young people with the necessary mathematics, science, and technology future-proof knowledge and competencies to be functional in the rapidly evolving world. STEM education is viewed by governments and world bodies such as the United Nations as a strategy to develop innovative talent in citizens to meet the economic development, environmental and social well-being needs of the 21st Century.

In fact, STEM education is so important that one of the world's biggest and fastest-growing social media platforms, TikTok, introduced a dedicated STEM tab in 2023. According to the Global Digital Report, 15,5% of active social media users between the ages of 16–24 say TikTok is their favourite social platform. In a blogpost announcing the STEM feed, the social media platform, the fifth most-popular social network by active users, currently boasting more than 955 million active users worldwide, wrote it is "a new viewing experience that will give our community a dedicated space to explore a wide range of inspiring, entertaining, and enriching videos related to science, technology, engineering, and math." STEM-related hashtags received more than 110 billion views shortly after it was announced. Whether encouraging aspiring scientists to work out experiments in comments sections or helping a new programmer learn to code, the STEM feed provides a space for co-learning, inspiration, and enrichment.

Besides being aligned to national strategies for development, STEM education also aligns with the content and nature of most Sustainable Development Goals (SDGs), which include Good Health and Well-being; Clean Water and Sanitation; Affordable and Clean Energy; Decent Work and Economic Growth; Sustainable Cities and Communities; Responsible Consumption and Production; Climate Change; Life Below Water; Life on Land; and Quality Education.

One of the aims of SDG 4 is to substantially increase the supply of qualified teachers, including through international cooperation for teacher training in developing countries, especially least developed countries and small island developing states, by 2030. It is also aligned to a major aspiration of the African Union's Agenda 2026 of realising a prosperous Africa based on inclusive growth and sustainable development. This aspiration requires well-educated citizens and skills revolutions underpinned by science, technology and innovation developing Africa's human and social capital.

Prof Maria Tsakeni is an Associate Professor and the Head of the Department of Mathematics, Natural Sciences and Technology. As an NRF C-rated researcher, her research focuses on exploring the development and implementation of innovative curricula and instructional strategies in STEM classrooms. Her work primarily focuses on the preparation of pre-service teachers and in-service teachers to adapt to ever-changing classroom environments by embracing change in order to implement the innovations in the classrooms. Her research is further influenced by global shifts in curriculum innovations, including education for sustainable development, indigenous knowledge systems and developments in educational technologies, including the development of digitalised curricula and integration of cutting-edge technologies that include the use of AI to support teaching and learning. Her practice aims to develop STEM classroom practitioners who are adept and have the agility to work in 21st Century environments. Prof Tsakeni has supervised to completion, seven PhD, five MEd and about 20 BEd honours and PGDip research projects. She is currently supervising nine PhD students, one MEd and two BEd honours and PGDIP students.

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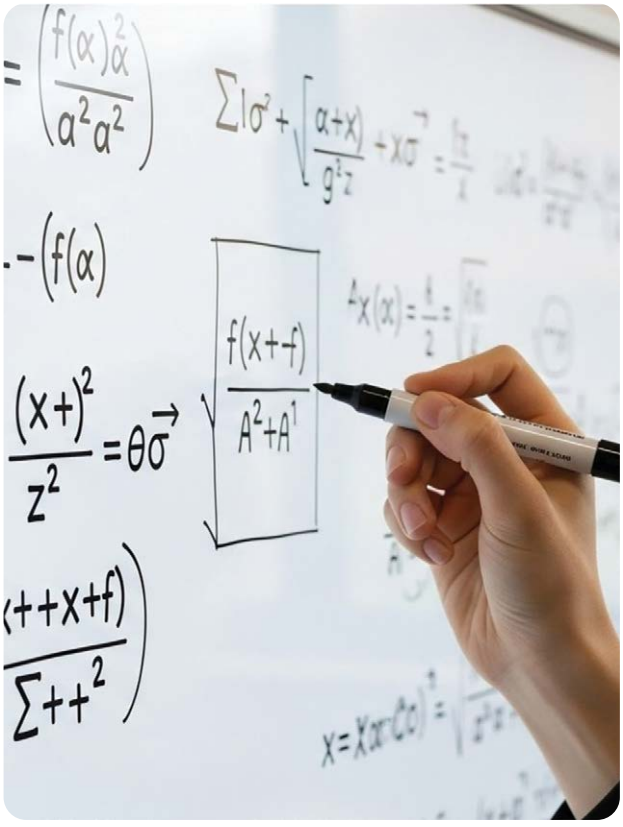

To ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including through education for sustainable development and sustainable lifestyles, among others, there is a need to start with how pre-service and in-service teachers are trained and educated to implement the curriculum innovations.

As the curricula transform, teacher training programmes have to keep up with or anticipate the imminent innovations. Accordingly, Prof Maria Tsakeni, an Associate Professor and the Head of the Department of Mathematics, Natural Sciences and Technology Education,at the University of the Free State is focused on understanding teaching and learning in the wake of technological advancements and curriculum innovations driven by developmental needs and changes in society. The broader goal of her research is premised on the need to explore how pre-service and in-service teachers develop the necessary pedagogical content knowledge to implement the curriculum innovations responsive to 21st Century environments, the STEM education agenda, Education for Sustainable Development (ESD), Indigenous Knowledge Systems (IKS), and innovative instructional strategies for the development of 21st Century skills such as enquiry-based learning and the use of educational technologies that are pervasive in South African higher education and are increasingly becoming ubiquitous in schools and society at large.

In the study 'Exploring Design Principles for STEAM Learning Activities Development by Science and Technology Teachers', Prof Tsakeni explored the design principles of science, technology, engineering, arts, and mathematics (STEAM) learning activities developed by science and technology teachers for classroom practice. The findings of the study showcase the design principles to include design thinking, finding solutions for learning problems, creativity, and innovation applied to instructional design. The study recommends the use of design thinking pedagogies in developing teacher knowledge on STEAM classroom practice.

The implementation of the innovations in classrooms has implications for multiple-deprived classroom environments and is thereby directly linked to the realisation of SDG 4 on Quality Education. Multiple-deprived environments are characterised by a number of unmet social needs. Teacher training is one of the ways of making sure that learners are adequately prepared in 21st Century skills in STEM classrooms, hence the calls to develop STEM teachers in the curriculum innovations implementation. Pre-service teachers should be prepared to integrate 21st Century skills such as computational thinking in their future classrooms and different subject areas. Similarly, UNECE (2011) emphasises the need for pre-service teachers to develop the competencies necessary for the implementation of education for sustainable development in ways that holistically address the sustainable development challenges.

With the study 'Preservice Primary Teachers' Perceptions of STEM-Based Teaching in Natural Sciences and Technology Classrooms', Prof Tsakeni recommends that pre-service teachers be taught to link STEM activities with the development of specific STEM skills. This study explored the perceptions of pre-service teachers of STEM-based teaching in natural sciences and technology classrooms. The teaching of natural sciences and technology in primary schools presents an opportunity to use innovative approaches to teach STEM-based activities. The subject presents opportunities for learners to experience STEM-based instructional approaches in their early school years; therefore, it is essential that pre-service primary school teachers are adequately prepared for the task.

Aligning to the UFS' vision of being a research-based university, the research conducted is based on the scholarship of teaching and learning. Prof Tsakeni is a recipient of a First Award in the Category of Research in Teaching and Learning Advanced in 2022 at the university. The training and preparation of teachers is conducted through a digitalised curriculum that integrates current drives on classroom technologies, integration of the curriculum innovations of the STEM education imperatives, Education for Sustainable Development, and Indigenous Knowledge Systems.

The teaching and learning impact goes beyond the borders of South Africa because Prof Tsakeni also led the development and teaching of 10 Short Learning Programmes (SLPs) to more than 200 Lesotho Mathematics and Science teachers in 2024. The SLPs were based on curricula that include content knowledge, teaching methods, use of technologies in the classroom, curriculum development for teacher professional development in the use of technologies, and instructional leadership in the implementation of digitalised school curricula. ■

Protecting **the planet**

The Anthropocene marks an era in which human activity fundamentally transforms the Earth's ecosystems and climate. People are at the core of this change, driving both environmental degradation and the potential for restoration. Addressing the challenges of the Anthropocene requires strengthening of human agency in sustainable development efforts, including SDGs 6, 7, 13, 14 and 16 that focus on Clean Water and Energy, Biodiversity on Land and in Water, as well as Climate Action.

Innovative, interdisciplinary research at the University of the Free State includes perspectives on human behaviour, since this is crucial in the achievement of sustainable solutions. The university is actively involved in institutional research and community projects that address environmental sustainability, resource management, and the development of resilient systems for a sustainable future. It also focuses on understanding and mitigating the impacts of climate change, ensuring food and water security, and promoting responsible resource utilisation. Our researchers explore nature-based solutions, understanding environmental and cultural interfaces, and integrating traditional ecological knowledge systems.

The research of Profs Helene Strauss, Jeanet Conradie, Puseletso Mofokeng and Sandy-Lynn Steenhuisen exemplify the contributions of the UFS to innovative and advanced technological research to mitigate the effects of climate change, ensuring food and water security, and promoting responsible resource utilisation.

Related SDG

Clean air: Symbiosis of plants and humans

To breathe is to draw vitality from our atmospheric interdependence with others. This vitality derives first and foremost from the photosynthesising capacities of plants. Without plants, our planetary atmospheres would have remained hostile to human life. It is this foundational debt to plants that informs the current research of Prof Helene Strauss from the Department of English at the University of the Free State.

The World Health Organisation estimates that 99% of people on Earth currently breathe unsafe air, resulting in as many as seven million premature deaths a year. A core premise of Prof Strauss' research is that dirty air is a direct result of colonial modernity's disregard for the carbon-sequestering labour of plants. She asserts that the unchecked scale and speed at which fossil fuel capitalism releases carbon captured in deep time into the Earth's atmosphere, not to mention the rampant destruction of vegetal life to meet contemporary consumer demand, require that we attend anew to the life-giving symbiosis linking plant and human breath.

Working alongside scholars in the decolonial eco-humanities, Prof Strauss considers specifically how literary and other creative cultural texts imagine conditions for the flourishing of multi-species breath. She identifies in the work of artists, creative writers, filmmakers, and environmental activists, particularly generative pathways towards repairing the foundational kinship relationship between human and more-than-human forms of living and breathing.

As the recent recipient of fellowships from the Stellenbosch Institute of Advanced Studies as well as the Institute for Cultural Inquiry in Berlin, Germany, in support of this research, Prof Strauss is particularly well-placed to delve into these vital concerns for our times.

The depletion of forests, together with the alarming rate of species extinction, not only put achieving Sustainable Development Goal 15 at risk, but more importantly, it jeopardises the delicate balance of ecosystems. This goal seeks to protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and biodiversity loss.

The topic of breath has preoccupied scholars of decolonial justice for many years. Prof Strauss' research in this field grows in part from her award-winning book *Wayward Feeling: Audiovisual Culture and Aesthetic Activism in Post-Rainbow South Africa* ISBN 978-1-4875-4058-6, University of Toronto Press, in which the breath started to materialise as a central site of analysis. In this book, the search for breathable atmospheres emerged particularly in relation to South African histories of resource extraction, racial

Prof Helene Strauss is a professor in the Department of English, which she chaired from 2012-2019. Her research and teaching interests span topics such as Southern African, African and African diasporic literature and audio-visual culture, feminist and queer aesthetic activisms, protest cultures, materialisms old and new, mining, documentary film, and embodied pedagogy. Her publications include the book *Wayward Feeling: Audio-visual Culture and Aesthetic Activism in Post-Rainbow South Africa* (University of Toronto Press); co-edited special issues of the journals *Studies in Social Justice, Interventions: International Journal of Postcolonial Studies*, and *Critical Arts: South-North Cultural and Media Studies*; and a book titled *Contemporary African Mediations of Affect and Access*, co-edited with Jessie Forsyth and Sarah Olutola (Routledge). Prof Strauss further has a wealth of experience as postgraduate supervisor of a wide range of topics, including several recent projects in the Environmental Humanities. She has supervised or examined well over 40 MA, PhD students, and postdoctoral fellows at McMaster University in Canada and the UFS respectively. Most of these students have obtained distinctions and awards, and many have subsequently taken up tenure-track faculty positions at universities around the globe. Alongside these students, who each comes from histories of colonisation and extractive violence from their own unique vantage points, Prof Strauss has been building an archive of critical cultural enquiry invested in enhancing rather than depleting the life-giving capacities of the air we breathe.

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capitalism and violent patriarchy. The breath here indexed both the aesthetics and materiality of injustice as a socially embedded mode of embodied experience.

Atmospheric injustice is at the root also of an accelerating climate crisis, additionally compelling scholars to take a closer look at extractive capitalism's historically harmful relationship with air and lungs. In South Africa, mineworkers have long paid for the extraction of diamonds, gold and other mineral resources with their pulmonary health. Hazardous dust has been a debilitating threat to these workers long before recent airborne emergencies such as the COVID-19 pandemic started to constrain breath. Several of Prof Strauss's recent publications, including a chapter in the book *Ruptured Commons* (edited by the Canadian scholars Veronica Austen and Anna Guttman), have charted the experiential histories of South African mining through this harrowing legacy of respiratory risk.

Polluted air has also emerged as a key site of social struggle for communities, for instance, in the Mpumalanga Highveld area, where citizens have long been breathing air that far exceeds the limits for particulate pollution stipulated by South Africa's own National Ambient Air Quality Standards set under the National Air Quality Act. The 2022 outcome in the landmark #DeadlyAir case set an important precedent in this struggle, as it was the first to hold the South African government to account for breaching the constitutional rights of citizens to healthy air.

Prof Strauss' research explicitly links the struggle over clean air to capitalism's continuing destruction of vegetal life. Alongside scholars of black, indigenous and feminist social and ecological relations, she insists that we must attend to the central link between plant respiration and human breath, and to the importance of heeding the lessons taught by plants as the original engineers of our planetary atmosphere.

Thinking and breathing with plants bring together a complex set of intersections and scholarly fields. Most prominent among these is the growing body of work in the environmental and energy humanities associated with the so-called atmospheric and vegetal turns. Prof Strauss enters these fields specifically through the prism of the phytosphere, a term that she expands from its traditional usage by plant scientists to include the terrain where plant chemistry sustains human and more-than-human breath.

The atmospheric relationship between plants and human breathing is thoroughly immersive and, ideally, mutually regenerative. The mass production of plastic and other forms of waste as the disavowed bedrock of extractive capitalism

has, however, severely compromised the atmosphere's biogeochemical cycles of repair. Building on recent as well as older African, indigenous and decolonial insight into what cultural theorist Hsuan Hsu calls the "material and spiritual qualities of air", Prof Strauss seeks to analyse and amplify the work of creative cultural workers – including novelists, artists, filmmakers, and poets – who have drawn our attention to the regenerative capacities of plants. These capacities include the work that plants do to (re)oxygenate the atmosphere, to extract harmful particulate matter from air, to regulate temperature and water cycles, and to remediate damaged soil.

To this end, she is currently writing a book titled *Phytospheric Justice*, which brings together imaginative archives across a range of global sites that offer plant-oriented alternatives to fossil fuel capitalism's chokehold on the Earth's atmosphere. The book draws momentum from a recent explosion of popular interest in so-called plant sentience and vegetal intelligence. Much of this work has traced plant communication via the mycorrhizal networks connecting the popularly termed 'wood-wide web'. While these networks are a central part of the complex ecosystem contributing to the health of the biosphere, Prof Strauss has been paying attention more closely to the exchange of air-borne chemicals made possible by plants, and to the remedial capacities of vegetal life as far as polluted air is concerned.

One of the most consequential insights to develop from this research is that petro-capitalist modernity has made both humans and plants companions in colonial histories of harm. Far from reading plants as straightforward saviours in the fight for risk-free air, in other words, Prof Strauss insists that we consider the complex set of biopolitical relationships that made plants key protagonists in histories of both colonial violence and decolonial repair.

What she refers to as 'decolonial and feminist phytospherics' emerge particularly through her analysis of literary and other creative audio-visual cultural production alongside several past and present environmental justice movements, including the South African #LivingLimpopo Campaign, the Green Belt Movement and Green Generation Initiative in Kenya, the Africa-wide Great Green Wall Initiative, the Chipko Movement in India, as well as continued indigenous activisms against the tar sands in Canada, widely considered to be the most destructive fossil fuel operation in the world.

As a cultural theorist whose work has spanned the terrains of literary studies, film theory, aesthetics and activism, Prof Strauss is concerned especially with writers and artists who imagine worlds beyond petrochemical pollution and deforestation, and who make these imaginaries available to activism and human understanding beyond the often-inaccessible registers of climate science.

This research has also become a touchstone for Prof Strauss work in the classroom, where she has spent many years developing methods of embodied pedagogy aimed at curbing the crisis of attention currently plaguing digitally distracted students the world over. In an honours course titled 'Reading, Breathing, and Sensing with Plants' on offer in the Department of English since the start of 2025, for instance, as well as in a third-year seminar on the literary links between psychic and environmental health, she makes somatic-sensorial activities designed to forge partnerships between people and plants a central component of the learning process.

Given the centrality of vegetal life to these courses, they have offered fertile ground for bringing the growing international field of decolonial embodied pedagogy to life in the local South African classroom through the prism of phytochemical interdependence. She conceives of the work of multi-species breathing in these courses in part as exercises in *unlearning*, aimed at helping students release some of the pressures deposited in their bodies by the pursuit of higher education in a context of extreme material hardship and food insecurity, not to mention the daily stresses that come, for many, as first-generation students.

These pedagogical innovations grow in part from Prof Strauss' continued involvement with several international research networks. Most recently, she drew inspiration for rethinking dominant approaches to pedagogy in South African higher education from her membership in the international 'Reworlding Research Collective', a group of academics, artists, and activists in Canada, Brazil, and South Africa who have sought to challenge forms of humanistic enquiry historically complicit with extractive and ecocidal systems of domination. One of the offshoots of this work has been a Special Issue of the journal *Studies in Social Justice* on the topic of *Reckoning, Repairing, Reworlding* that she co-edited, and for which she co-authored three essays.■

Related SDG

Bananas – a power fruit in purifying water

Bananas! A versatile, tasty and accessible power fruit, packed with vitamins and good for blood sugar, digestive health, the heart and excellent in purifying water. Prof Jeanet Conradie, Research Fellow in the Department of Chemistry at the University of the Free State, and her team are researching the use of banana peel, among other natural materials, as absorbents for water purification.

The main aim of the UN Sustainable Development Goals (SDGs) Goal 6 is to ensure the availability and sustainable management of water and sanitation for all. The drastic reduction of pollution of freshwater is a prerequisite to achieve this goal. Accessible, clean and safe drinking water is critical for health, societal development and for all life. Approximately 70% of the Earth is covered by water, with the oceans holding about 97% of this water, and 3% as terrestrial freshwater. Most of this freshwater is locked in glaciers and groundwater.

Human health and development are particularly dependent on accessibility and availability of clean freshwater. This precious resource is under severe pressure from all corners, including overuse, climate change and industrial pollution. According to the United Nations Environment Programme (UNEP), approximately 1,9 billion people live in potentially severely water-scarce areas and by 2050, this figure could increase to 3 billion people. A major concern of the UNEP is that many freshwater sources are drying up or becoming more polluted, thus threatening the lives and livelihoods of communities, potentially deepening poverty in societies.

According to the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), a possible major cause of freshwater pollution could be attributed to the fact that up to 400 million tons of heavy metals, solvents, toxic sludge and other industrial wastes are released annually into the world's waters. These pollutants also include heavy metals, radioactive substances, dyes, pesticides, pharmaceuticals, chiral chemicals as well as oil contaminants.

In this context, Prof Conradie focuses on water purification and environmental remediation. In collaboration with research teams in Cameroon and Nigeria, Prof Conradie is involved in projects that explore the use of natural materials – such as poplar leaves, banana peels, and coconut shells – as absorbents for water purification. Her research group performs in-depth material chemical characterisation using techniques such as Brunauer–Emmett–Teller (BET), Thermogravimetric Analysis (TGA), Scanning Electron Microscopy with Energy Dispersive X-ray Spectroscopy (SEM-EDX), Powder X-ray Diffraction (PXRD), Fourier Transform Infrared Spectroscopy (FTIR), thereby enabling

Prof Jeanet Conradie is an Emeritus Professor and Research Fellow in the UFS Department of Chemistry. Her research focus is the synergy between experimental and computational chemistry in understanding structure and reactivity of transition metal complexes. Her specific interest is computational chemistry in understanding the structure and reactivity of transition metal complexes. Her research group focuses on the synthesis, characterisation, computational chemistry, electrochemistry and kinetics of ligands, transition metal complexes, transition states and reaction intermediates for application in drugs, dye-sensitised solar cells (DSSC), and catalysis. A high-performance computer (HPC) is used to study the behaviour of atoms and molecules in the real world. Prof Conradie has consistently been recognised among the World's Top 2% of Scientists by Stanford University, the latest being in 2024. This ranking, compiled in partnership with Elsevier using data from Scopus, highlights researchers making significant contributions in their respective fields who are world class. Prof Conradie currently holds a C1 ranking from the National Research Foundation (NRF) and is a member of the Academy of Science of South Africa (ASSAf). Prof Conradie supervised 28 postgraduate students that led to 19 MSc and nine PhD graduates.

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better understanding of the properties of these compounds and subsequent publication of the research in leading scientific journals. Additionally, her group is developing novel ligands specifically designed to extract heavy metals from contaminated water, further contributing to solutions for environmental sustainability.

The overarching aim of Prof Conradie's research is to contribute meaningfully to scientific advancement with real-world applications — specifically in the areas of sustainable energy, clean water, and improved medical treatments. She maintains active collaborations with research groups at local, national, and especially international levels to sustain momentum in these diverse fields.

Prof Conradie's research has yielded over than 460 publications in high-impact international journals on this and related topics. In one of her articles: 'Banana peel as a biosorbent for the decontamination of water pollutants. A review', published in *Environmental Chemistry Letters* 18, 1085–1112 (2020), the research looked at the viability of natural banana peel for water decontamination, in order to help advance its commercialisation. Banana peel has received particular interest as a viable biosorbent and alternative to the more expensive and complicated removal techniques, such as filtration, solvent extraction, coagulation, sedimentation, membrane separation, evaporation, reverse osmosis, electrocoagulation, advanced oxidation, skimming, chelation, reduction, photo-catalysis, dispersion, use of solidifiers, nanofiltration and irradiation, to name a few.

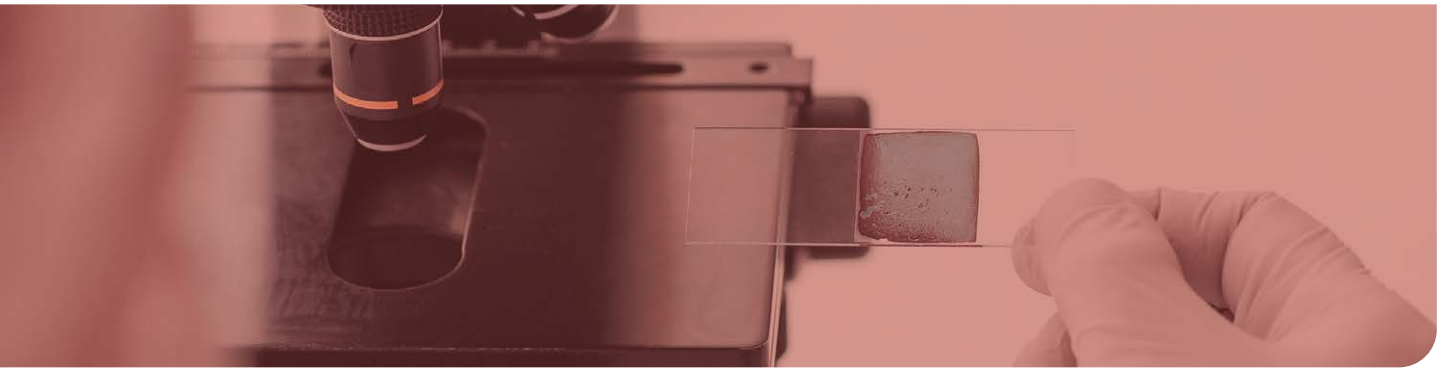
Other biosorbents such as cassava waste, rice husk, potato peel, corn cob, maize leaf, microbial biomass, cocoa pod, groundnut husk, sugarcane bagasse, orange peel, oil palm waste, and coconut husk have been tested. However, banana peel waste is of particular interest because it is widely grown, and the peel waste is readily available.

While the research showed the efficacy of banana peel as an effective biosorbent, the potential for commercial application is limited due to cost and the requirement of skilled personnel and equipment.

Prof Conradie's other research focuses on cleaner and sustainable energy. Prof Conradie's group conducts extensive experimental and theoretical research on the electrochemical and photophysical properties of both novel and known molecules such as various transition metal complexes of b-diketones, polypyridines and hydroxy-benzophenones. She has also collaborated with the Ghosh Laboratory at the University of Tromsø (UiT) in Norway for more than 25 years. This partnership focuses on the study of porphyrin analogues with applications in cancer therapy, diagnostics, and renewable energy. These projects combine experimental and theoretical approaches to understand molecular properties at a fundamental level, enhancing both the scientific knowledge base and its practical applications. The collaboration also extends to partners in the US and India, fostering global scientific exchange.

Looking ahead, Prof Conradie plans to continue her research – primarily in computational chemistry. ■

Related SDG



Plastic pollution crisis – the quest for clean water

A global concern in the modern era is the widespread pollution of the environment and water bodies from plastic waste and heavy metals. This mounting threat to human and planetary health is exacerbated by the 19–23 million tonnes of plastic leaking every year into the world's oceans, rivers, and lakes, according to the United Nations (UN) Environment Programme (UNEP).

Water is at the core of sustainable development and plays an indispensable role in human well-being and prosperity as well as ecological and environmental health. However, in recent decades overexploitation, pollution, growing populations, increasing consumption and climate change have led to severe water stress in locales across the world. This puts in jeopardy the achievement of the majority of the United Nations Sustainable Development Goals.

According to the World Wildlife Fund (WWF), 2,7 billion people face water shortages for at least one month each year. It is anticipated that almost half the world's population will face severe water scarcity by 2030 if no urgent action is taken. The WWF estimates that over the past 120 years, two-thirds of all natural wetlands have been destroyed, and the population of freshwater animals has also declined by

Prof Julia Puseletso Mofokeng is a polymer scientist in the UFS Department of Chemistry. She currently holds a Y2 rating by the National Research Foundation and serves on the editorial board of an open access journal *(International Science and Technology Journal – ISTJ)*. She is an external examiner of dissertations/theses for different institutions in South Africa (Vaal University of Technology, University of Johannesburg, Nelson Mandela University, University of South Africa, to name a few). Prof Mofokeng is a reviewer for different journals, including *Journal of Applied Polymer Science, Materials Sciences and Applications*, and *Journal of Agricultural Chemistry* and Environment. To date, Prof Mofokeng has published 18 peer-reviewed quartile one and two (Q1 and Q2) journal articles and one book chapter, graduated 10 bachelor honours, seven master's students and one doctoral student. She is currently supervising and co-supervising two honours, two master's and four doctoral students. Prof Mofokeng has established collaborations both nationally and internationally, with institutions in Gauteng, Serbia and Libya. She is co-supervising one master's and one doctoral student, with UJ in Gauteng, and the Libyan Advanced Center for Chemical Analysis in Libya, respectively, as the main supervisor. Prof Mofokeng's research focuses on improving water purification systems and biodiversity through the development of fully biodegradable polymers and/or composites. She is based on the UFS Qwaqwa Campus.

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more than three-quarters since 1970, with one third of all freshwater species facing extinction.

Most of the planet's water is the sea, with approximately 3% of the world's water being fresh water. Most of this water is locked up in ice or underground aquifers. When it comes to surface water, only about 0,3% of freshwater is found in lakes, rivers, and swamps, according to *National Geographic*.

This scarce resource is under severe pressure from agricultural, industrial and human-generated pollution such as nitrates, faecal matter, plastic and heavy metals. Plastic and heavy metal pollution have a profound impact on the environment, biodiversity and human well-being. Heavy metals such as copper, cadmium, zinc, aluminium, mercury, and lead are major metal pollutants in both drinking and wastewater. Lead stands out as one of the most toxic heavy metals to both plants and animals.

A gradual accumulation of lead in the human body over time leads to severe health issues, including damage to the liver, brain, kidneys, and reproductive system. Children are particularly vulnerable to the neurotoxic effects of lead, according to the World Health Organisation (WHO), which states that lead exposure causes a significant burden of disease: it is estimated that lead exposure accounts for 0,9 million deaths per year (IHME, 2020) and 30% of the global burden of developmental intellectual disability of unknown origin (WHO, 2019). The WHO has identified lead as one of 10 chemicals of major public health concern needing action by member states.

Children are ingesting lead from different sources, including contaminated water, food and toys (paints). These heavy metals cause diseases such as anaemia, nervous system disorders, hypertension, renal (kidney) damage, abdominal pain, constipation, and others, ultimately resulting in developmental disorders and increased mortality rates over a prolonged period. There are a few reasons why children are more vulnerable to heavy metals, including lead: (i) higher intake per body weight; they drink more water relative to their size, (ii) immature detox systems; liver and kidneys are still developing, (iii) developing brain; more sensitive to neurotoxins such as lead and mercury, and lastly (iv) longer life ahead; increased risk of developing long-term chronic diseases [1–4].

Through engagement with industry, her research improves the environmental sustainability and water purification processes. This is important for water-scarce countries, especially in rural localities which often rely on raw river or groundwater.

Tackling the problem particularly of lead pollution in water bodies through the use of biodegradable polymer composites filled with lead-adsorbing materials emerges as a viable solution to some of these problems.

It is in this context that the research undertaken by Prof Julia Puseletso Mofokeng, Associate Professor and researcher in the Department of Chemistry at the University of the Free State, seeks to improve water purification systems through the development of fully biodegradable polymer composites or nanocomposites adsorbents/membranes. The goal is to contribute to the reduction of water and environmental pollution from natural causes, petroleum-based plastics used in disposable products, and industrial waste.

Through engagement with industry, her research improves the environmental sustainability and water purification processes. This is important for water-scarce countries, especially in rural localities which often rely on raw river or groundwater.

Prof Mofokeng prepares and characterises fully biodegradable polymers, their blends and composites/nanocomposites, by incorporating carbonaceous materials, natural fibres and inorganic nanofillers, to enhance the thermal, thermomechanical, mechanical, and barrier properties of these materials. The research is aimed at providing sustainable alternatives to conventional petroleum-based plastics/polymers for short shelf-life/disposable applications. This approach targets applications

in packaging, water purification, disposable medical devices, and automotive interiors. The current focus is water purification, where she and her research group use GO and its composites, synthesised from expandable graphite (EG), and transition metal phosphates, masked with completely biodegradable polymers such as polylactic acid (PLA), Poly(3-Hydroxybutyrate-co-3-hydroxyvalerate) (PHBV), and poly(ε-caprolactone) (PCL) as adsorbents for the removal of heavy metal ions (lead, copper, chromium, mercury) in water. These biopolymers or biodegradable polymers are derived from renewable resources such as vegetable oils and starches, aiming to replace petroleum-based plastics in disposable product applications. They can therefore be easily disposed of after use without harming the environment. A few of her published research articles on the topic are referenced at the end.

Several adsorbents have been explored to eliminate lead ions from water, including zeolites, activated carbon, and alumina, ordered mesoporous carbon, and silica gel. However, most of them are either costly to formulate or dispose of after use, thereby limiting their effectiveness. Recently, graphene oxide (GO) has emerged as a promising adsorbent for lead ions in water. Current research demonstrates GO's high efficiency in removing lead ions. This effectiveness is attributed to the abundant oxygen-containing functional groups within its structure, enabling lead ion removal through both chemical and physical mechanisms.

In one of her recent studies, 'Preparation of poly(lactic acid) (PLA)/poly(3-hydroxybutyrate-co-3-hydroxyvalerate) (PHBV)/graphene oxide (GO) polymeric composites for the selective removal of lead ions (Pb(II)) in water', published in the journal *Polymer Composites*, the researchers intended to formulate GO-filled PLA/PHBV blends and assess their water intake, as well as Pb(II) ion adsorbing capabilities for different contact times and pH media. The findings of this work could set a path for developing effective and environmentally friendly materials to be used industrially in removing lead ions from water by membrane filtration/batch adsorption processes and help alleviate lead poisoning. In this research, all the prepared samples showed the capability to adsorb lead ions from water, but the highest adsorption was observed at the lower GO content, and the optimal sample was the one with equal parts of the polymers, since leaching/degradation did not happen. Prof Mofokeng and her PhD student, Lebohang Seromo, are working on featuring transition metal phosphates into GO, which they expect to result in increased oxygen-containing groups on GO, thereby improving its metal ions adsorption capacity/efficiency further.

The research on biodegradable polymer composites/nano-composites is envisioned as a transformative force in addressing the global water and plastic pollution crisis. It will also influence policymakers to enforce strict laws governing the production and retail industries to use biopolymers or biodegradable polymers in disposable packaging materials. ■

Related SDG

Magic in the mountains: The world of plant-animal interactions

Pollination is the process of transferring pollen from the male part of a flower to the female part, being a crucial step for plant reproduction that leads to the formation of seeds and fruit. This process enables plants to reproduce, providing food security and supporting ecosystems by forming the base of the food web, purifying water, and cycling carbon. Pollinators are the animals that transfer the pollen between plants and are thus essential for food security and environmental health.

Unfortunately, pollinator populations are experiencing significant declines due to a range of environmental and anthropogenic stressors that make it harder for them to survive and do their important work. Habitat degradation and fragmentation reduce the availability of foraging resources and nesting sites, disrupting essential ecological processes. Additional threats such as pollution, the widespread use of pesticides, the spread of invasive alien pests and plants, shifts in land use, and the impacts of climate change have all been linked to declines in both the abundance and diversity of pollinators, particularly among insect species.

In a collaborative study with scientists from the University of KwaZulu-Natal, Prof Sandy-Lynn Steenhuisen, Subject Head and Associate Professor in the Department of Plant Sciences on the University of the Free State Qwaqwa Campus – a pollination ecologist – and her colleagues made a major discovery with the first record of a lizard pollination system in continental Africa. This phenomenon is only well-known in oceanic island ecosystems where pollinator communities are limited to those who could get to the islands. Mountains represent similar systems, as so-called 'sky islands' and pollinator communities are heavily influenced by harsh montane climates up elevation gradients.

One of the United Nations (UN) Sustainable Development Goals (SDG 15) is to conserve mountain ecosystems, including their biodiversity, to enhance their capacity to provide benefits that are essential for sustainable development.

Mountains are extremely important for the health and well-being of the environment. The Rio+20 Conference outcome document, The Future We Want, highlights the importance of mountain regions for sustainable development. Mountains provide water for a large part of the world's population and are home to many indigenous peoples and local communities. *The Future We Want* points out that mountain ecosystems are fragile and easily harmed by problems such as climate change, deforestation, land use changes, land degradation, natural disasters, and the marginalisation of mountain communities. Because of this, it encourages countries to work together, involve all important groups, and share their knowledge. It also calls for long-term, holistic plans that include special policies for mountain areas – such as poverty-reduction programmes – especially in developing countries.

Prof Sandy-Lynn Steenhuisen is an Associate Professor and Subject Head in the Department of Plant Sciences, UFS Qwaqwa Campus, and affiliated Research Champion of the Afromontane Research Unit. She is an evolutionary ecologist specialising in the pollination and reproductive ecology of native and invasive alien plant species in South Africa. Her primary passion is investigating shifts in pollination systems and associated floral traits in endemic flora, especially between bird, beetle, and mammal pollination systems in South Africa's flagship genus, *Protea*. Prof Steenhuisen holds a C2 rating from the National Research Foundation, is an alumnus of the first cohort of the DHET Future Professors' Programme, an NSTF nominee, was a Claude Leon Foundation fellow and an NRF Research Career Advancement fellow. She has graduated 14 master's and four doctoral students. Prof Steenhuisen has an extensive network of collaborators, ranging nationally from the Centre for Biological Control at Rhodes University, the Centre for Invasion Biology at Stellenbosch University, the South African Environmental Observation Network (SAEON, BirdLife South Africa, the South African Biodiversity Institute (SANBI), various South African universities and the SARChI Research Chairs in Ecosystem Health and Biodiversity, and Evolutionary Biology at the University of KwaZulu-Natal. Her research group is primarily focusing on determining factors contributing to the spread of invasive alien plant species in sensitive high-elevation grasslands in South Africa. This research is essential to understanding how these species may be impacting our natural biodiversity and farmlands and will contribute to integrated management regimes.

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Prof Steenhuisen leads the Qwaqwa Plant-Animal Interactions Research (Q-PAIR) group whose research goals are founded on three thematics areas – pollination ecology, invasive species impacts and management, and the monitoring and conservation of natural biodiversity. The group specialises its research on mountain ecosystems.

The vision of the Q-PAIR group is for a Southern Africa where plants and animals thrive together in healthy, diverse mountain ecosystems. Their mission is thus to advance collaborative ecological research on plant-animal interactions, to understand the impacts of climate change and invasive species on mountain ecosystems and develop creative response strategies. The Maloti-Drakensberg Mountains of Qwaqwa provide a unique laboratory for such multi- and trans-disciplinary research.

In one of her many collaborative research articles titled, 'The role of plant–pollinator interactions in structuring nectar microbial communities', published in the *Journal of Ecology*, Prof Steenhuisen and colleagues from the University of Seville in Spain explore the importance of plant-pollinator interactions in the assembly of the nectar microbiome and

study the role of plant geographic location and pollinator system as a determinant of microbial community composition. The results showed that plant-pollinator interactions played a crucial role in shaping nectar microbial communities. Plants visited by different pollinator guilds supported significantly different yeast and bacterial communities. The pollinator guild also contributed to the maintenance of beta diversity and phylogenetic microbial segregation. With long-time collaborator from Cornell University, Prof Robert Raguso, and emerging researcher Dr Nora Mitchell from the University of Wisconsin-Eau Claire in the US, they are now moving into how the often-invisible communities of microbes have played a role in the evolution of the great diversity of proteas we enjoy today. A whole world of plant-animal interactions is still waiting to be uncovered and these discoveries continue to enrich our academic lives.

The Q-PAIR group is part of the Afromontane Research Unit (ARU) on the UFS Qwaqwa Campus. A key objective of the ARU is to contribute intellectually and practically to the sustainable development discourse of the Maloti-Drakensberg as a unique social-ecological system. The ARU has a well-developed network of scientists that focuses of addressing 'wicked' problems in montane ecosystems. One of those is the increasing loss of diverse Afromontane grasslands to encroaching woody plants, both invasive and native. From an interactions point of view, many of these plants are in the family Rosaceae and produce red-orange berries at times when grasslands are meant to be dormant.

The presence of these fleshy-fruited plants in these ecosystems is changing not only the plant communities that they smother, but the animal communities as frugivores expand their ranges to take advantage of this novel food source. This research gap allowed the creation of the Northern Temperate Weeds group, led by UFS affiliates from the Centre for Biological Control at Rhodes University, Prof Grant Martin and Dr Kim Canavan.

In addition to undertaking groundbreaking research on the 'wicked' problems in montane ecosystems, the Q-PAIR group and the ARU train the next generation of ecological scientists who research and learn how to manage invasive wattles with facilitated spread of gall-forming wasps and seed-eating weevils, and reintroduce eland as biocontrol agents, as part of larger community-informed and stakeholder-involved research aims.

Prof Steenhuisen is also part of the ARU's international project, RangeX, led by Prof Ralph Clark, ARU Director, and Dr Jake Alexander from ETH Zurich, Switzerland. This multi-disciplinary global project investigated the impacts of range-expanding plant species under global warming conditions. Prof Steenhuisen and her postdoctoral fellow Dr Stephanie Payne tracked weather conditions and pollinator interactions with alpine plant species in warming chambers using camera traps and machine-learning techniques. This collaboration also led to the creation of the highest research station in Southern Africa on top of the Amphitheatre in the Maloti-Drakensberg in partnership with the ARU, Transfrontier Parks Destinations, and Witsieshoek Mountain Lodge.

In the study, 'The invasive grass genus Nassella in South Africa: A synthesis', published in the *South African Journal of Botany*, Prof Steenhuisen's doctoral student, Dr Anthony Mapaura (now an ARU postdoctoral fellow) highlighted the invasive nature, ecology and major impacts that *Nassella* invasions cause in terms of biodiversity, soil productivity, and the economy, based on literature. *Nassella* is a grass genus with about 116 species that occurs predominantly in South America, with *Nassella trichotoma* and a couple of other species being naturalised in South Africa.

These grasses are harmful to livestock, with dense invasions leading to huge losses and costs to the animal husbandry industry and tourism, and severe impacts on biodiversity, especially in the mountain grassland regions of South Africa. Globally, mountain areas are very important and contribute immensely to biodiversity and cannot afford the threat from these invasive species. These mountains are home to many endemic, range-restricted and threatened species, and the continued expansion of these invasive grass species will likely contribute to their decline. The need to understand the status of these species in South Africa and to institute control measures is important and urgent. ■

Enabling
a prosperous society

Significant progress has been made globally to increase the prosperity of nations. A prosperous society hinges on our collective commitment to the Sustainable Development Goals (SDGs) designed to address the world's most urgent challenges.

By prioritising sustainable development, communities can unlock opportunities for innovation, eradicate poverty, safeguard the planet, and build resilient communities that thrive across generations. Increased prosperity is characterised by significant increases in economic output, largely driven by technological progress, productivity gains, and capital accumulation. However, it often leads to overconsumption of natural resources and environmental degradation and contributes to climate change, while industrialisation and urbanisation can exacerbate social inequalities, with benefits of growth unevenly distributed across populations.

The SDGs aim to promote inclusive economic growth and sustainable development to ensure "that all human beings can enjoy a prosperous and fulfilling life and that economic, social and technological progress occurs in harmony with nature". This paves the way for a world where every individual has the chance to live with dignity, security, and with hope for current and future generations. Access to good quality education is critical for ensuring prosperity and quality of life because it equips individuals with essential skills, knowledge, and competencies needed to participate fully in the economy and society. Education enhances critical thinking, problem-solving abilities, and technical expertise, all of which improve productivity and innovation at both individual and national levels.

The research of Dr Arno van Niekerk and Profs Francois Strydom and Rajab Matamanda are illustrative examples of the contribution of the University of the Free State to progress with the attainment of higher levels of prosperity and progress in harmony with nature.

Related SDG

Ubuntu: The basis for an inclusive economy

Is it possible to align economic progress with social equity and ecological parity? This is the key question pursued by economic sustainability. As demonstrated by the United Nations Sustainable Development Goals (SDGs), it is more than a question; it has become an existential necessity for planetary health in the 21st Century. The aim of SDG 8 is to "promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all". This is one of the key enablers of "ending poverty in all forms everywhere" (SDG 1) with target aim "to ensure that all men and women, in particular the poor and vulnerable, have equal rights to economic resources, as well as access to basic services, ownership and control over land and other forms of property, inheritance, natural resources, appropriate new technology and financial services, including microfinance".

Since rapid technological advancement is changing modern society, it is vital that economic sustainability becomes the *driver of innovation*. Prof Arno J van Niekerk, Senior Lecturer in the Department of Economics and Finance at the University of the Free State, believes the answer for "sustained, inclusive and sustainable economic growth" and the new sustainable growth narrative can be found in Africa. It is called Ubuntu.

Ubuntu is a unique African concept and philosophy, emphasising humanity, compassion, interconnectedness, and shared progress. The expression "I am because we are" epitomises this idea. It means that a person's humanity is shaped by their relationships with others – valuing community, mutual care, respect, and dignity.

Ubuntu encourages cooperation over competition and highlights the importance of belonging and collective well-being. In short, Ubuntu is about being human through others. Prof Van Niekerk believes that this is what economics and the basis of any national economy should be. However, the current economic systems have resulted in increased inequality, poverty, centralisation of economic power, overconsumption, unsustainable debt and weakening public services, to name a few. The fundamental question is: Why?

According to Prof Van Niekerk, this is because something is missing: Ubuntu. Technological progress and economic prosperity that has been experienced by some, has excelled without humaneness at its core. Ubuntu is the much-needed balancing factor. The time has come to *rethink* the current economic systems in the context of Ubuntu to establish the right balance and synergy between economic prosperity and technological advancement for planetary sustainability.

The concept of Ubuntu and Africa answering the global economy questions is the drive behind Prof Van Niekerk's research, teaching and engaged scholarship. Economists have a responsibility to help steer the economy to a healthy place in a holistic sense, not just to help ensure economic growth. Ubuntu brings accountability and productive inclusion, which are the missing ingredients in today's economy.

Prof Arno J Van Niekerk holds a PhD in Economics and is a Senior Lecturer at the Faculty of Economic and Management Sciences at the UFS. His research focuses on inclusive economies, globalisation, international economics, and financial markets, He has more than 20 years of experience in researching various aspects of the economy, both at local and international level, at the IMF and the World Bank in Washington D.C., in the US. He is also a visiting professor at the University of Salzburg, Austria. He often speaks on radio and television about new economic thinking and the latest developments, as well as having published numerous articles in peer-reviewed journals.

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In his latest book, *The Inclusive Economy: Criteria, Principles and Ubuntu* (Publisher ISBN 2022), Prof Van Niekerk states that while Ubuntu is in strong contrast to the Western individualist mindset, where competition, personal success and independence (self-reliance) are primary motivations for progress, Ubuntu, on the other hand, focuses on sharing (and optimising) available resources with the aim of benefiting all. The Western individualist mindset, while inherently not wrong, unfortunately forms the basis of today's predominant but vulnerable economic system and is largely the reason for the inequality crisis. When profit becomes a collective objective, as is the case with Ubuntu economics, the focus is on collective expansion, not hoarding (winner takes it all). Africa's Ubuntu mindset lends itself to building a more circular economy to reduce wastage, optimising efficiency and having greener, inclusive growth.

Ubuntu economics is a form of relationship-based economics. Prof Van Niekerk explains that this new economy system relates strongly to social capitalism. The latter envisions a communal-type society where seeking advantage for the group/community ranks equal to personal benefit, but without the latter being the main or end goal. Collective well-being is the main goal. Importantly, this does not mean that utilitarian neoclassical economics and Ubuntu are mutually exclusive. Instead, Ubuntu incorporates individualism and utilitarianism. The value of Ubuntu is that it not so much represents new goals for the economy but opens up an alternative road for communities to reach the goals of economic prosperity and sustainable development as a collective. This also reflects the difference between Ubuntu economics and social capitalism in that the former is a community-based, relational model rooted in African communal values, while the latter is a state-regulated market economy that aims to make capitalism more socially responsible. Ubuntu redefines what it means to thrive; social capitalism reforms how markets serve society.

Prof Van Niekerk's future plans are to involve more of his students and colleagues in the projects to help transform communities. Municipalities have already contacted his department, so they are putting a team together – after having applied for funding – to work with them and do research. They are partnering with universities in Austria and Germany, as well as with the private sector, to enhance their capacity and impact. These transformative partnerships enable them to work on new models and methods to help shape an inclusive economy – all based on Ubuntu principles. ■

Related SDG

Building universities for the future

Building universities for the future is a multifaceted process. It necessitates a continuous interrogation of assumptions about the role of universities in society, as well as critical, evidence-based reflection on their own processes and practices. Through its commitment to student success and quality teaching and learning, the Centre for Teaching and Learning (CTL) at the University of the Free State is supporting the university in not only transforming the lives of its students but also contributing to a more just, equitable, and responsible societal future for all.

Prof Francois Strydom, Senior Director in CTL, believes that student success in the South African context is a social justice imperative. University education and qualifications are tools and enablers of social mobility for greater equality and is one of the most powerful ways to change the economic prospects of students, their families, and communities.

This aligns with South Africa's National Development Plan (NDP), a long-term strategic plan that serves as the roadmap for securing the future of South Africans. The NDP views education as a key driver for achieving the country's goals of eliminating poverty and reducing inequality. It emphasises a quality education system that spans from early childhood to tertiary education, which focuses on building human capabilities and providing equal opportunities, particularly for those previously marginalised in society.

The NDP aims to align educational and skills development with the needs of the economy in highly competitive and increasingly globalised markets.

The aspiration of the NDP is for South Africa to have more than 10 million university graduates with a minimum of a bachelor's degree by 2030 – a 300% increase from 2001. The majority of these new graduates need to be in the critical skills categories, such as engineering, actuarial science, medicine, financial management, and chartered accountancy. Higher education, as stated by the NDP, is thus the major driver of realising this vision as a major contributor to social and economic development.

Since the formation of CTL in 2012, its mission has been scholarship-driven innovation that promotes excellence in learning and teaching for student access with success. In this regard, the driving force behind CTL's work has always been the pursuit of social justice. As an academic support service, CTL has a rare hybrid design that combines academic staff development with student success interventions. External reviewers have commended CTL for the excellence with which it delivers on its mission.

As a scholar in the multidisciplinary field of higher education, Prof Strydom's leadership has focused on innovation driven by the latest research on how to build higher education environments in which academics and students can thrive and realise their potential. Co-creation and collaboration are integral to CTL's foundational philosophy, which is reflected in its continued engagement and responsiveness to the needs of academics and students.

Universities are complex organisations that have evolved but retained their basic raison *d'être* for centuries. They comprise

Prof Francois Strydom is the Senior Director of the Centre for Teaching and Learning (CTL). He has been the project leader of the South African Surveys of Student Engagement (SASSE) since 2007. The SASSE project, sponsored by the Kresge Foundation, has been used by 20 public higher education institutions across Southern Africa. The SASSE has influenced national quality assurance policy and practices, and is a key component of the Siyaphumelela (We succeed) network, which focuses on improving student success in higher education through the use of data analytics. His research interests include student engagement and success, enhancing the quality of teaching and learning, and implementing evidence-based change in higher education and promoting employability.

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talented individuals who require critical engagement and rigorous research to participate in change and innovation. In light of the complex challenges that face higher education, data, evidence, and research are vital to be agile in the face of rapid, disruptive change.

Prof Strydom has been the principal researcher for the South African Surveys of Student Engagement (SASSE) since 2007. He has worked with George Kuh of the Centre for Postsecondary Research at Indiana University in the US to contextualise the student engagement instruments in South Africa.

Student engagement research has helped create a multi-disciplinary lens through which one can analyse the complex challenge of student success. It provided a research-driven approach that would put a data-driven student voice as a central pillar in institutional design while providing monitoring and evaluation data that could be used for evidence-based decision-making by universities. Change in universities could therefore be led using evidence instead of anecdote or opinion.

The SASSE project has helped make South Africa part of what is today a global community of student engagement higher education researchers. This has helped to ensure that student engagement and evidence-based decision-making are now regarded as critical components of the leadership, management and governance of universities today and in the future.

The SASSE project forms part of several research projects within CTL under the rubric of Evidence Based Change (EBC). These include the national blended learning research, bi-annual digital identity studies, student journey mapping, and more recently the use of AI in learning and teaching. The EBC also conducts research for the Department of Higher Education and Training, the Council on Higher Education and Universities South Africa as well as various international and local philanthropic foundations.

The SASSE informed the development of a contextualised framework for student success. A key component of enabling student success at scale is the introduction of high-impact practices (HIPs). HIPs are practices that enable students, especially those from disadvantaged backgrounds, to succeed and develop graduate attributes that make them more employable and critical citizens.

These high-impact practices have been scaled and linked to rigorous monitoring and evaluation tools using data analytics.

The CTL of the UFS has also been cited in the influential EDUCAUSE Horizon Report – Teaching and Learning Edition (2025) for the development of the self-paced, competency-based Digital Skills learning pathways for all students to become digitally literate.

This is critical as technological change, together with geoeconomic fragmentation, economic uncertainty, demographic shifts and the green transition – individually and in combination – are among the major drivers expected to shape and transform the global labour market of the future, according to the *2025 Future of Jobs Report*. One of the key findings of the report indicates that expanding digital access is seen as the most impactful trend, with 60% of employers expecting it to change their business by 2030. Key technologies, such as AI and data processing (86%), robotics and automation (58%), and energy systems (41%), are also expected to bring about major changes. These trends will impact jobs in various ways – some roles will grow rapidly, while others may become obsolete. As a result, there will be strong demand for technology-based and technical skills, especially in AI and big data, cybersecurity, and general technology knowledge, which are expected to be the fastest-growing skill areas.

Related SDG

Reducing inequalities in an urbanising world

The world is rapidly becoming more urbanised, with more than half of all people living in cities. The United Nations (UN) predicts that within the next five years, urban areas will be home to 60% of the global population, with one in every three people living in cities. According to the 2018 Revision of the World Urbanization Prospects, a report by the Population Division of the UN Department of Economic and Social Affairs, the global urban population is projected to grow by 2,5 billion urban dwellers between 2018 and 2050.

According to the Africa Urban Forum, urbanisation on the African continent represents a megatrend. By 2050, the percentage of people living in urban areas is predicted to rise from 47% in 2000 to around 60%. With an average annual urban growth rate of 3,5% in the past 20 years, Africa has seen the largest urbanisation in the developing world, and this trend is anticipated to continue until the year 2050. The Africa Urban Forum is a continental platform established by the African Union (AU) Commission and its member states in response to the rising consciousness of the rapid urbanisation in Africa. It promotes sustainable development in African human settlements.

Affordable housing, according to the Sustainable Development Goals Report 2025, has become a crisis for most people as up to three billion people struggle to afford a place to live. A further 1,12 billion live in slums or informal settlements without basic services. To address the mounting challenges cities face, including rising urban poverty, among others, the UN SDG 11 through target 11.1, aims to ensure access to adequate, safe and affordable housing and basic services for all and upgrade slums.

Prof Abraham R Matamanda, Associate Professor in the Department of Urban and Regional Planning at the University of the Free State, seeks to address issues of spatial inequalities through understanding the lived experiences of individuals and communities residing in marginal spaces. In this regard, his work has focused on citizens' access to basic services such as water, sanitation and food in cities. Spatial inequalities are a reality in most Southern African cities; these inequalities are exacerbated by multiple factors, including poor urban governance, corruption, civil unrest, environmental stressors such as climate change, and pandemics such as COVID-19. These challenges call for a robust urban planning policy that seeks to redress the inequalities and provide inclusive urban policies that help marginalised individuals and communities to access a better quality of life in cities.

In a research article titled, 'Small-scale rental housing in Southern Africa: from neglect to nurture?' published in *Housing and Society* and which speaks directly to SDG 11,

Prof Abraham R Matamanda (NRF Y2-rated), is an Associate Professor in the Department of Urban and Regional Planning. He is the Deputy Chair of the SARChI Chair in City-Region Economies in the Faculty of Economic and Management Sciences at the UFS. His research is motivated by the rapid urbanisation currently experienced in African cities and the myriad of challenges experienced by urbanites, especially marginal groups, including low-income households, migrants and youth. Prof Matamanda's work is interdisciplinary and aims to address complex challenges in city regions. In his research, he adopts a political economy and socio-spatial justice perspective to analyse and understand urban land governance issues, housing studies, specifically focusing on social housing and housing inequalities and informal urbanism in the Global South. Prof Matamanda has published more than 50 peer-reviewed articles, at least 30 book chapters, three book monographs and has edited more than six volumes. Currently, he serves as the co-editor of the *Town and Regional Planning Journal*, is a member of the editorial board for *Humanities and Social Sciences Communication* and serves as an advisory board member for *Urban Research and Practice*. He is the current chairperson of the South African Planning Institute (SAPI) Free State Chapter and is a member of the Society of South African Geographers, the Regional Studies Association and the Zimbabwe Institute of Regional and Urban Planners. Besides publications, Prof Matamanda is contributing immensely to the mentorship of postgraduate students and early career scholars. Prof Matamanda is currently supervising four MSc and seven PhD students, having graduated 12 MSc and seven PhD students previously. Additionally, he has also provided mentorship to three postdoctoral fellows.

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Profs Matamanda, Andreas Scheba, Associate Professor in the Centre for Development Support at the UFS, and Ivan Turok, who holds the Research Chair in City-Region Economies in the Faculty of Economic and Management Sciences at the university, argue that most governments and related stakeholders in Southern Africa fail to recognise the contribution of small-scale rental housing (SSRH) to national housing systems and solutions. They also illustrate how national housing policies, regulatory frameworks and institutions are unfit for purpose, and how they can do more harm than good. In the Global South, they write, the growth of private rented accommodation tends to take the form of SSRH provided by individual homeowners and micro-developers. This has played a vital role in mitigating urban housing shortages, enabling access to the city for low- and middle-income households, and bolstering local economies. Yet, this largely informal and unplanned phenomenon also creates health and safety risks for tenants, mounting

pressure on public infrastructure, and shortfalls in municipal revenue collection from the economic value created.

In 2022, Prof Matamanda was the primary investigator for a project exploring the impact of COVID-19 on young people in low-income households and their adaptations to food, education and leisure/play during the COVID-19 lockdown. This was an international collaborative project with researchers from South Africa, Brazil and the UK. The PANEX-Youth research project titled, The Impact of COVID-19 on Education, Food & Play/Leisure and Related Adaptations for Children and Young People: International Overview, provided many lessons and insights into the lived experiences of young people and their adaptations to the COVID-19 pandemic. Specifically, this project has revealed the policy gaps in dealing with pandemics and how young people are not integrated into policymaking. The voices of the youth remain silenced, and policymakers seem to ignore or overlook the needs and aspirations of this demographic group, yet the youth constitute a large share of South Africa's population, illustrating the continuing trend of how these young people are left behind in socio-economic and development processes.

As a result of this project, the team has collaborated with UNICEF to produce a call to action that advocates for youth participation in urban policy making, inclusive decisions and governance that recognise the needs and aspirations of young people and the emphasis on social networks and capital in community development. Additionally, a working paper has been developed in collaboration with UNESCO, illustrating the role of schools as critical hubs in urban areas, through which young people not only access education but also access care, food, leisure/play and peer support. Hence, Prof Matamanda's work helps in understanding the socio-spatial inequalities and realities, thus providing policy insights through identifying the policy and practical gaps, guiding inclusive and participatory planning, which can help to promote social cohesion and reduce inequalities.

The second strand of his work has focused on land governance and development outcomes in Southern African cities. Land is a largely contested and politicised issue in Southern African countries. Access to land, especially for housing development, is largely challenging for many urbanites due to land grabs by economic and political elites, weak disconnected land governance systems that fail to address local realities, and the limited supply against an ever-increasing demand for land. As such, Prof Matamanda's research has explored the land governance in selected Southern African cities with a focus on how migrants, youth, women and low-income households access land for housing. His work is significant for SDG 11 as it addresses issues around land governance systems and institutions that regulate urban land markets and the policy gaps that hinder the efficient distribution of land in these cities.

Over the years, he has collaborated with local and international scholars and researchers to examine the land governance dynamics in peri-urban areas. His work on land governance contributes to improved urban planning and governance through understanding the processes and impacts of urban land governance on sustainable urban development. Moreover, the work provides policy insights and helps shape land governance. Going forward, Prof

Housing is a crucial issue in African cities, where national governments are struggling to provide adequate housing to most citizens, and the national housing shortage continues to increase.

Matamanda is extending his work into small urban areas, with a particular focus on spatial governance and planning of mining towns. This is a fundamental issue in Southern Africa, considering the complexities associated with mine closures and how many countries do not have mine closure plans, which complicates the normalisation processes.

Another aspect of Prof Matamanda's work related to SDG 11 is situated around housing and human settlement studies, in which he explores housing as a complex challenge in Southern African countries. The focus of his work has been on informal settlements and SSRH. Housing is a crucial issue in African cities, where national governments are struggling to provide adequate housing to most citizens, and the national housing shortage continues to increase. The situation is dire for low-income households who are forced to reside in horrendous accommodations, often compromising their health and well-being. The financialisation of housing exacerbates the situation as many households fail to afford the cost of buying homes and end up residing in informal settlements or rental accommodation.

Here, he also collaborates with Profs Scheba and Turok on an innovative research programme focused on SSRH, with significant work undertaken across Southern Africa. This collaboration has resulted in a number of benefits, with the most recent impact being a major amendment to the Cape Town municipal planning bylaw, which minimised the regulations and building standards required for micro-developers to apply for land-use planning permission in designated areas.

In efforts to gain more insights and share experiences on the SSRH sector, Profs Matamanda and Scheba have established a network of urban researchers across Southern Africa to undertake a comparative analysis of this important phenomenon in South Africa, Zimbabwe, Angola, Botswana, Lesotho, Eswatini and Namibia. The network includes researchers, policymakers and NGOs working in the housing sector. Prof Matamanda is also working with Prof Daniel Kweku Baah Inkoom from Kwame Nkrumah University of Science and Technology in Ghana, Prof Alonso Ayala from the Institute for Housing and Development Studies, Erasmus University Rotterdam, the Netherlands, and Prof Tamara Klicek from National Taipei University, Taiwan. The team is tackling the knowledge and policy gap on land governance and SSRH, while also strengthening the regionalisation and internationalisation agenda emphasised by the university. ■

Delivery through partnerships

The University of the Free State continues to expand its regional, continental, and global footprint through meaningful partnerships that advance the institution's strategic commitments under Vision 130. These collaborations strengthen research excellence, deepen societal impact, and contribute directly to the United Nations Sustainable Development Goals (SDGs), particularly through Investing in People, Protecting the Planet, Enabling a Prosperous Society, and Peace and Justice for All.

In 2024, collaborations across faculties, centres, and research units demonstrated the power of collective expertise in addressing societal challenges, expanding academic excellence, and deepening the university's regional and international influence.

These partnerships reflect the university's emphasis on interdisciplinary engagement, capacity strengthening, and community-responsive research. Through its participation in the SARIMA Visibility Project, the Directorate Research Development is benchmarking institutional practices against leading global standards, enhancing the university's competitiveness in international grant funding and strengthening SDG 17 through purposeful collaboration. The project's emphasis on professionalising research management contributes directly to elevating the university's research ecosystem.

Across the institution, partnerships continue to unlock impactful innovations. Joint ventures with international research consortia, national agencies, and African higher education institutions have enabled the university to co-create solutions in climate resilience, public health, agriculture, engineering, and social justice. These include significant contributions to strengthening water security in the Maloti-A-Phofung region, collaboration on rotavirus vaccine development for the African continent, and pioneering climate-focused paleoclimate research with French and South African partners.

The university remains committed to advancing Africa-led scholarship through collaborations with regional universities, including the growing intra-African partnership between the UFS Qwaqwa Campus and Debark University in Ethiopia. Such initiatives strengthen knowledge exchange, postgraduate training, and community-engaged research aligned with SDG 10 and the African Union's Vision 2063.

Dr Glen Taylor

Prof Trudie O'Neill

The collective impact of these partnerships demonstrates the university's continuing investment in research excellence, societal relevance, and the advancement of responsible societal futures. Through sustained collaboration, the UFS is shaping transformative knowledge that addresses real-world challenges while preparing the next generation of globally competitive graduates who can contribute to a more just, sustainable, and prosperous world.

SARIMA Visibility Project

The university strengthened its institutional visibility and research management excellence in 2024 through its participation in the SARIMA Visibility Project, a high-impact initiative aimed at elevating research governance across Southern Africa. Led at the UFS by Dr Glen Taylor, Senior Director of the Directorate Research Development (DRD), the project positions the university alongside leading Tier 1 research institutions, benchmarking procedures, systems, and international engagement frameworks in line with global best practice.

The initiative directly advances SDG 17 (Partnerships for the Goals) and supports the national research management ecosystem by fostering professionalisation, leadership development, and alignment with international grant-making environments. Within the university, the project has contributed substantially to Enabling a Prosperous Society, strengthening internal standardisation, enhancing response times for research collaborations, and improving institutional readiness for competitive global funding opportunities.

The DRD's participation also reflects the university's long-term commitment to Investing in People. Through structured learning, peer exchange, and institutional reflection, UFS research management professionals gained strategic insights into emerging global practice, data-driven decision-making, and the evolving requirements of international research funders. This investment builds internal capacity while contributing to regional development and the university's Vision 130 aspiration of becoming a globally recognised research-intensive institution.

As a collaborative platform between SARIMA and African universities, the project further expands the university's networks within the continent and internationally, laying the foundation for future collaboration, improved data management systems, and stronger research integrity structures. These efforts not only strengthen the university's own research ecosystem but also contribute meaningfully to a more sustainable, equitable, and competitive African science landscape.

International Rotavirus Vaccine Development Consortium

The Molecular Virology Group at the university continues to play a vital role in an international consortium working to develop more effective rotavirus vaccines tailored to the African continent. Led by Prof Trudie O'Neill in the Department of Microbiology and Biochemistry, the project is funded by the German Research Foundation (DFG) and brings together researchers from Mozambique, Germany, and South Africa.

Rotavirus remains one of the most significant causes of severe diarrhoeal disease and mortality in young children, particularly in low- and middle-income countries. The consortium's objective is therefore directly aligned with SDG 3 (Good Health and Well-Being) and the university's commitment to Investing in People. Using advanced reverse genetics technologies, the research team works to develop

Dr Elizabeth Rudolph

Prof Prince Ngobeni

Sandile Dladla

vaccine candidates built from cloned genome segments – an innovation aimed at producing a locally relevant vaccine that responds to the viral strains circulating most widely in Africa.

The project is also a strong platform for capacity development. Postgraduate students and early-career researchers participate in international exchanges and hands-on laboratory training, strengthening Africa's long-term scientific capabilities. Visits by Mozambican and German researchers to Prof O'Neill's laboratory further support skills transfer and regional cooperation.

Through this work, the university contributes to a broader continental mission: ensuring that African children receive vaccines that are effective for African contexts. The consortium's progress underscores the university's commitment to scientific innovation, global health equity, and evidence-based solutions that improve the quality of life for vulnerable communities.

Paleoclimate research collaboration

In the face of accelerating climate instability, the UFS contributes to global climate knowledge through a pioneering paleoclimate collaboration led by Dr Elizabeth Rudolph of the Department of Geography. Working with the National Laboratory of Cosmogenic Nuclides (France), the University of Fort Hare, and the University of South Africa, the project reconstructs the glacial and volcanic history of the Prince Edward Islands and Kerguelen Archipelago.

Funded by SANAP-NRF and the NRF-PROTEA bilateral programme, the initiative is aligned with SDG 13 (Climate Action) and directly supports Protecting the Planet. The research team, composed of geomorphologists, geologists, and climate modellers, uses highly specialised isotope-dating equipment to reconstruct long-term climate dynamics. These findings inform global atmospheric models and contribute to improved predictions regarding the Southern Hemisphere's response to climate change.

UFS Qwaqwa – Debark University (Ethiopia) partnership

The UFS Qwaqwa Campus continued to deepen its strategic intra-African collaborations through a formal partnership with Debark University in Ethiopia. Facilitated by the Office for International Affairs (OIA) and championed by the Afromontane Research Unit (ARU), the partnership focuses on 'mountain-to-mountain' research, linking South Africa's Maloti Mountains with Ethiopia's Simien Mountains.

This collaboration supports SDG 10 (Reduced Inequalities) and contributes to Peace and Justice for All by strengthening universities serving remote and underserved communities. With guidance from Prof Prince Ngobeni, Principal of the Qwaqwa Campus, the initiative expands academic exchange, postgraduate supervision, and capacity development. It also establishes a framework for collaborative biodiversity, livelihoods, and resilience research in geographically unique high-altitude systems.

HEP SSA engineering partnerships

Through his work in the Higher Education Partnerships in Sub-Saharan Africa (HEP SSA) project, Sandile Dladla of the Department of Engineering Sciences is contributing to

strengthening engineering education and capacity building across the continent. Funded by the Royal Academy of Engineering (UK), the initiative supports curriculum innovation, accreditation readiness, industry engagement, and professional development.

A highlight of the year was Dladla's knowledge-exchange visit to the University of Lincoln's Institute of Agri-Food Technology (UK), where he explored cutting-edge innovations in agricultural robotics, automation, and precision engineering. These insights support curriculum modernisation at the university and enrich regional engineering practice.

The initiative aligns with SDG 4 (Quality Education), SDG 8 (Decent Work and Economic Growth), and SDG 10 (Reduced Inequalities), contributing directly to Investing in People and Enabling a Prosperous Society.

Algae Photobioreactor commercialisation initiative

One of the UFS' most ambitious multidisciplinary endeavours is the establishment of a large-scale algae photobioreactor plant, championed by Prof Paul Oberholster (Dean of the Faculty of Natural and Agricultural Sciences) and Dr Glen Taylor, Senior Director for Research Development. Acquired through strategic negotiations with the Technology Innovation Agency (TIA), the 20-unit photobioreactor system positions the university as a continental leader in algae-based biotechnology.

The facility supports high-value production of carotenoids, omega-3 fatty acids, antioxidants, and other bioactive compounds used in pharmaceuticals, nutraceuticals, cosmetics, and green chemistry. It also provides opportunities for wastewater bioremediation research, carbon reduction technologies, and algae-based biofertilisers.

This initiative contributes to SDG 3 (Good Health and Well-Being), SDG 6 (Clean Water and Sanitation), SDG 8 (Decent Work and Economic Growth), SDG 9 (Industry, Innovation and Infrastructure), and SDG 13 (Climate Action), reflecting the university's commitment to Investing in People, Protecting the Planet, and Enabling a Prosperous Society.

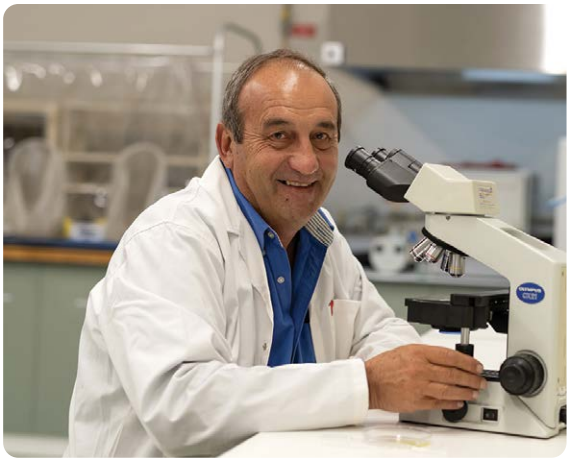
MASSTER Project: Agricultural development and migration management

The MASSTER Project, led at the UFS by Prof Corli Witthuhn, continued to strengthen agricultural resilience and address rural-urban migration dynamics in Senegal and South Africa. By integrating agricultural innovation with socioeconomic development, the project supports farmer field schools, extension worker training, agro-processing techniques, and regenerative agriculture.

Through demonstration plots and participatory learning, the initiative enhances food system resilience and livelihood diversification, directly supporting SDG 2 (Zero Hunger), SDG 4 (Quality Education), SDG 8 (Decent Work and Economic Growth), and SDG 10 (Reduced Inequalities). It is a powerful example of the university's contribution to Enabling a Prosperous Society.

Cancer research: A multidisciplinary approach to improving health outcomes

Cancer research at the university is strengthened by the complementary work of three units:



Prof Paul Oberholster

Prof Corli Witthuhn

Prof Alicia Sherriff

Dr Nerina van der Merwe

Prof Andreas Roodt and Prof Alice Brink

- Department of Oncology – Led by Prof Alicia Sherriff, the department achieved a continental milestone by delivering interstitial brachytherapy for cervical cancer, offering targeted treatment with reduced side effects.
- Division of Human Genetics – Under the leadership of Dr Nerina van der Merwe, the division advances hereditary breast and ovarian cancer diagnostics, offering first-tier genetic testing and improved patient pathways.
- Department of Chemistry – With contributions from Prof Andreas Roodt, Prof Alice Brink, and international collaborator Prof Roger Alberto, the department specialises in theranostic radiopharmaceuticals that combine diagnosis and targeted therapy.

Together, these units support SDG 3 (Good Health and Well-Being) and reflect the UFS commitment to Investing in People and improving clinical outcomes.

GABAergic compound discovery and Zebrafish Bioassay innovation

The UFS continues to advance neuroscience-focused drug discovery through pioneering work led by Prof Anke Wilhelm, Associate Professor and Divisional Head of Organic Chemistry in the Department of Chemistry. Her research explores the identification and characterisation of GABAergic compounds – plant-derived substances affecting the brain's gamma-aminobutyric acid (GABA) system, the primary inhibitory neurotransmitter regulating central nervous system activity.

Using a zebrafish larval movement bioassay, Prof Wilhelm evaluates the neurological impact of natural extracts with the goal of discovering affordable therapeutic alternatives for epilepsy and other CNS-related disorders.

Zebrafish provide a powerful and cost-effective model for early-stage neuropharmacological screening, sharing approximately 70% of human genes and more than 80% of genes associated with human disease. Their rapid development, optical transparency, and suitability for high-throughput assays allow observation of real-time neurological responses to test compounds.

This research contributes to SDG 3 (Good Health and Well-Being) and supports Investing in People by addressing the burden of neurological disease with more accessible therapeutic options.

A significant enabler has been the acquisition of Noldus Daniovision equipment, with specialised training undertaken in Switzerland under Prof Matthias Hamburger (University of Basel). The initiative provides valuable third-stream income for the Department of Chemistry, in collaboration with the Department of Genetics.

The long-term vision is to isolate a synthesisable bioactive compound with consistent efficacy in epilepsy management and fewer side effects. This project showcases the university's commitment to cross-disciplinary innovation and societal impact.

NAS-ARC-DoA research chairs: strengthening agricultural innovation

In 2024, in partnership with the Agricultural Research Council (ARC) and the Department of Agriculture (DoA), the UFS Faculty of Natural and Agricultural Sciences (NAS) established four new research chairs supporting climate-smart agriculture.

Coordinated by Prof Johan van Niekerk (Vice-Dean: Agriculture, NAS) and Prof Sonja Venter (ARC), the chairs advance national efforts in climate adaptation, sustainable food systems, and agricultural innovation.

- **Chair 1** – Climate Change Impacts and Mitigation in Agriculture, led by Prof Linus Franke.

- **Chair 2** – Innovative Agro-processing for Climate-Smart Food Systems, co-chaired by Prof Wilna Oldewage-Theron and Dr Alba du Toit.
- **Chairs 3 and 4** – Commencing December 2024, expanding research capacity across agronomy, engineering, and environmental sciences.

These chairs support SDGs 1, 2, 6, 8, 9, 10, 11, 12, 13, 15, and 17, and reflect the universit's commitment to industry partnerships, community impact, and long-term scientific capacity building.

Knowledge sharing: iKudu Erasmus+ initiative, South Africa-Sweden University Forum, and Karlstad University partnerships

Knowledge sharing, digital transformation, and inclusive internationalisation form the third pillar of the UFS' continental and global influence. Through multi-country networks, staff development, virtual teaching innovations, and collaborative curricula, these engagements advance SDG 4 (Quality Education), SDG 9 (Industry, Innovation and Infrastructure), SDG 10 (Reduced Inequalities), and SDG 17 (Partnerships for the Goals).

The iKudu Erasmus+ initiative serves as the central driver of digital innovation and curriculum transformation at the university. Through iKudu, academics co-create digitally supported curricula, implement Collaborative Online International Learning (COIL), and strengthen online teaching practices. iKudu expands student access to international learning, particularly for those unable to travel, and enhances the digital competencies of academic staff (SDG 4; SDG 10).

iKudu also acts as a catalyst for broader international engagement by integrating digital methodologies and collaborative pedagogies into UFS' partnerships across Africa and Europe. Its curriculum innovations underpin many of the collaborative successes reflected throughout this report.

The South Africa-Sweden University Forum (SASUF) continues to expand the UFS' global research presence. Through partnerships with Swedish universities across Health Sciences, Gender Studies, Computer Science, Architecture, Plant Sciences, Environmental Sciences, and Data Science, the university contributes to multidisciplinary research teams focused on sustainability, gender equality, digital inclusion, and community resilience (SDG 9; SDG 17).

SASUF has evolved into a broad, expanding network that generates joint publications, multi-institutional grant proposals, staff exchanges, and policy-influencing dialogues. This network connects UFS researchers to global scientific communities, enabling continuous scholarly exchange and collaborative innovation.

The partnership with Karlstad University enhances digital pedagogy and global learning opportunities. Jointly developed COIL modules, virtual classrooms, and online assessments allow university students to participate in international learning without physical mobility constraints, advancing inclusive internationalisation (SDG 10; SDG 4).

Across iKudu, SASUF, and COIL-related partnerships, the UFS participates in expanding innovation clusters that support interdisciplinary collaboration. These include postgraduate training networks, policy engagement groups, sustainability working clusters, and multi-country research teams that strengthen institutional capacity (SDG 9; SDG 17).

The contribution of Simba Matema highlights the importance of student leadership in academic diplomacy. Through participation in regional and global dialogues on higher education governance and youth leadership, his work reinforces UFS' commitment to producing socially responsible, globally aware graduates (SDG 16: Peace, Justice and Strong Institutions). ■

Prof Anke Wilhelm

Prof Johan van Niekerk

Simba Matema

Concluding **remarks**

As we conclude the 2024 UFS Impact Report, we reflect on a year that has reaffirmed the power of purpose-driven scholarship, collaboration, and innovation. Across disciplines, our academic community has demonstrated that impactful research is not only about advancing knowledge but also about transforming society, ensuring that the University of the Free State continues to be a space where ideas thrive, solutions emerge, and change takes root.

Each achievement captured in these pages is a testament to the collective spirit that defines the university. From the dedication of our researchers and postgraduate scholars to the leadership of our academic and professional staff, our progress reflects a shared commitment to inclusivity, excellence, and relevance. Together, we have strengthened our global connections while remaining deeply rooted in the realities of our local context – embodying a university that is both South African and globally engaged.

As we look ahead, our resolve is to continue walking with purpose: building knowledge that matters, nurturing talent that transforms, and creating partnerships that inspire hope. The narratives of impact in this report remind us that the university is not merely preparing for the future – we are helping to shape it.

Most importantly, we walk together towards **responsible societal futures**, unified in purpose, committed to excellence, and determined to make the University of the Free State a beacon of hope for our city, our province, our nation, our continent, and our world.

Editorial team

Dr Molapo Qhobela | André Damons | Dr Henriette van den Berg | Hendrien Smit | Elmada Kemp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UNIVERSITEIT VAN DIE VRYSTAAT
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