RESEARCH REPORT

2018/2019

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

UFS

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2018/2019


ENGAGED
EFFICIENT
EFFECTIVE

Foreword

Prof Francis Petersen, Rector and Vice-Chancellor

The theme of this edition of the University of the Free State's Research Report, **"Engaged. Excellent. Effective."** is particularly pertinent given the challenges that universities are facing.

Globally and locally universities are grappling with what and how to be **engaged** – to answer the question "What are universities good for?". This relates to issues of societal impact, and knowing and understanding the society we live and work and operate in. The only way is to be more engaged with our society. Our engagement cannot only be in the knowledge we produce through what we narrowly call "research". We need to engage with our society to know who and what it is, how it operates, what it needs, what is important to it. We need to be guided by the United Nations' Sustainable Development Goals and the African Union's Agenda 2063. This keeps us humble, relevant, and focused on doing things that have meaning for our society.

Excellence is more straightforward to address – "What are we good at?". While there can be no compromise on excellence, how do we measure it? For us it is measured by who we collaborate with, where we publish, where we present our work, and what our peers say about our work. This tells us to what extent we are competing at a global level, and whether we can attract other top researchers to come and collaborate with us – because we are doing excellent research that matters.

We can be engaged and excellent – but do we listen? Our **effectiveness** depends on how we listen to input and advice from external stakeholders, wherever they may be. For this reason, we have instituted a strategy that every academic department must have an advisory board, as must every one of our main research areas. This keeps us in touch, aware of where the needs are – so the work we are doing is not only engaged and excellent, but also effective. Universities need to know what is going on in the broader community (the community, industry, private sector, commerce, government) and integrate this into what we do - teaching and

learning, and research and innovation. Similarly the broader community needs to know what is going on in the university. If these relationships are good and we do this well, then we will have societal impact. Then we are effective.

Located as we are in the centre of the southern tip of Africa, many might describe us as isolated - but we are not. We are doing research that is making an impact locally, regionally, nationally and globally. So much of the research being done on all the campuses of this University, is making a difference and is of direct relevance to 'our' society.

Our research is engaged. Take, for example, the Centre for Gender and Africa Studies, tackling issues of deep importance to our transforming society; and the work of the Centre for Teaching and Learning, informing student success and employability through research-based evidence; and that of the Indigenous Knowledge Systems in the Faculty of Health Sciences, focusing on the interrelationship between traditional and western medicine.

Our researchers strive uncompromisingly for excellence – which is seen in the internationally acclaimed research of the SARChI Chairs in Solid-state Luminescent and Advanced Materials; in Disease Resistance and Quality in Field Crops; in Higher Education and Human Development; in Vector-borne and Zoonotic Pathogens; and in Pathogenic Yeasts.

And our work is effective – as these groups and their researchers listen to what is being said, and work towards 'forward integrating' their findings where they can be most effectively applied – in society at large.

I wish to express my appreciation to all our researchers, collaborators, partners and funders for their exceptional contributions to making our research engaged, excellent and effective.

Introduction

Professor Corli Witthuhn, Vice-Rector: Research, Innovation and Internationalisation

In fulfilling the University of the Free State's ambition of becoming a research-led university that contributes to local, regional and global knowledge we have, over the past two years, introduced strategies which have had a significantly positive impact on the metrics of our research activity, including the

- number of registered and graduated doctoral students,
- number of research and postdoctoral fellows,
- quality and number of research publication output units,
- quality and number of NRF-rated researchers,
- number and quality of co-authored papers with international collaborators, and
- number and monetary value of contractual research funding.

Although there has been an improvement in these indicators, we still experience challenges in terms of the research productivity of individual staff members, qualifications of some of our academic staff, limited supervisory capacity that could negatively impact our postgraduate student numbers, as well as the effective communication of the relevance and impact of our research.

In 2019 we updated the Research Strategy in order to guide our research activities for the next four years. One of the major drivers in the strategy is the differentiated approach to research development and support. In the current reality of decreasing national funding within a stagnant South African economy, we are forced to use our limited resources to ensure maximum impact and effect. We will therefore make our investments into areas of strength and strategic importance. The UFS aims to be the best in a selected range of areas through building scale, critical mass, developing and attracting excellent researchers and students, and through working endlessly to achieve excellence. The differentiated strategy will culminate in the development of Research Hubs that will consist of dynamic, multidisciplinary teams that address problems facing society. Sustainability and global recognition of these Hubs will be dependent on our ability to develop strategic and long-term private and public partnerships.

While we acknowledge that research, by its very nature, is a work in progress, we are proud of the progress we have made in terms of meeting some of the targets for implementing this differentiated research approach. Prof Carolien Pohl-Albertyn was awarded a SARChI Chair in Pathogenic

Yeasts in 2018, and all our other externally funded research chairs are making good progress. Our research development over the past few years was focused on growing multidisciplinary, collaborative research at the Qwaqwa Campus and these efforts culminated in the establishment of the Afromontane Research Unit, incorporating research in the fields of Natural Sciences, the Humanities and Social Sciences, and Education. In addition, the multi- and transdisciplinary nature of the former Centre for Africa Studies resulted in its expansion to become the Centre for Gender and Africa Studies. You can read more about these exciting developments in this Report.

We are committed to a significant investment into developing the research excellence of staff. We will support and develop the new generation of professors, with a focus on addressing the employment equity profile of the University at senior academic level. Through staff development programmes we selected excellent black and female candidates, with the aim of supporting their development to become senior academics with NRF ratings. Through the development of our academic staff we hope to increase staff qualifications and the supervisory capacity in order to increase the number of postgraduate students that successfully enrol and graduate at the UFS. Our research standing and quality will allow us to attract greater numbers of outstanding and talented postgraduate students, as well as greater numbers of international students who want to join our well-known and dynamic research teams.

During the next four years we will focus on the visibility and impact of our research. A critical component of this is the development of strategic collaborations and partnerships with a wider community of researchers, research funders and sponsors, including business and industry. There is clear evidence that this is already bearing fruit, with a growing number of co-authored papers in 2018/19, of which over 16% were in the top 10% of cited papers in their field. We will also continue to focus on

the development of commercialisation and entrepreneurship and we will work towards communicating our research through public engagement, informing public opinion, and influencing individual, organisational and mass behaviour in a positive way.

The Research Strategy can only achieve its goal of ensuring that the UFS is recognised as a research-led university through the commitment of all its academic and support staff. It is the dedication of these people that will put this plan into action and drive its success.

STRATEGIES

1. Implement a differentiated research approach.
2. Develop excellent researchers and scholars, providing sustainability and continuity.
3. Increase the visibility, impact and uptake of UFS research.
4. Provide a sustainable and supportive research environment with appropriate management, physical and financial resources.

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ENGAGED
RESEARCH

Committed to engaged research

Dr Glen Taylor, Senior Director: Research Development

Given their responsibility for the creation and dissemination of knowledge, universities are expected to be important drivers of global, national and local innovation, development, and societal well-being.

Research has a critical role to play in creating a safer, healthier, fairer and more sustainable planet, as well as in providing evidence of what could work. Universities, through their research agendas, should therefore play a proactive and leading role in driving solutions to global challenges, and in so doing, the universities themselves will benefit.

African countries have committed themselves to implement the African Union (AU) Agenda 2063, and the United Nations' 2030 Agenda for Sustainable Development. The UFS takes these commitments seriously – as illustrated in this Research Report, which provides a snapshot of some of our research activities.

On the occasion of the 50th anniversary of the establishment of the Organisation of African Unity (the predecessor of the African Union), in May 2013 the Heads of State and Government of the African Union acknowledged the continent's past successes and challenges, and rededicated themselves to Africa's accelerated development and technological progress. *Agenda 2063: The Africa We Want* is a call for action to all segments of African society to work together to build a prosperous and united Africa based on shared values and a common destiny. It articulates seven aspirations, with 20 associated goals.

The Sustainable Development Goals (SDGs), also known as the Global Goals, were adopted by all United Nations Member States in 2015 and provide a shared blueprint and call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity

by 2030. The 2030 Agenda for Sustainable Development acknowledges the importance of the AU Agenda 2063 and considers it an integral part of it.

There are 17 integrated SDGs, recognising that action in one area will affect outcomes in others, and that development must balance social, economic and environmental sustainability.

Education, research, innovation and leadership are essential in achieving the goals set out by these two important agendas. They thus also provide guidance for the research endeavours at the UFS. Each of the themes which encompass the research we undertake, is strongly informed by the aspirations and goals of these documents and, as today's development challenges are linked and interdependent requiring an integrated and trans-disciplinary research approach, so too are these themes.

Each of the themes is explained further in the following pages of this Report, and some of the research being undertaken is briefly reported on, illustrating our commitment to research that is meaningful and contributes to a broader understanding of our place, our continent and our world. In pursuing this agenda, we acknowledge the fact that the targets will not be achieved if our research is not based on excellence, strategic partnerships, engagement with all stakeholders and the development of potential.

The Brookings Institution's Africa Growth Initiative recently published its assessment of the top priorities for Africa over the next decade, and list achieving the SDGs as the number one priority. Therefore, as we look forward to 2020, I am confident that research at the UFS is on the right path, and contributing significantly to national and continental priorities.

I would like to thank all our researchers, faculties, centres and entities, including those who might not appear in this Report, for their substantial role in driving our research agenda.

RESEARCH THEMES

- Local and regional socio-economic development
- Food security and land reform
- Health and well-being
- Human rights, social justice and reconciliation
- New scientific and industrial challenges

Local and regional socio-economic development

1

The term 'socio-economic development' has different meanings for different people. However, while academics, politicians and economists all have different interpretations, all agree that development improves the standard of living and quality of life of people. We see it as a process of growth and realisation of potential, bringing regional resources into full productive use. It requires proactive collaboration and a multiplicity of efforts that collectively serve to improve progress and quality of life. Socio-economic development and empowerment of the individual leads to progress and well-being in all spheres, impacting all aspects of human existence. This starts with a deeper understanding of the dynamics of the social and the economic.

This theme includes, *inter alia*, research on natural resources, gender, rural development, Africa studies, southern African mountains as social-ecological systems, and regional and national economic history and development.

AGENDA 2063

- #1 High standard of living, quality of life & well-being
- #7 Enviromentally sustainable & climate resilient economies & communities
- #16 African cultural renaissance
- #17 Full gender equality

SDG

- #1 No poverty
- #5 Gender equality
- #6 Clean water & sanitation
- #7 Affordable clean energy
- #11 Sustainable cities & communities
- #15 Life on land

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LOCAL AND REGIONAL SOCIO-ECONOMIC DEVELOPMENT

Gender – integral to Africanist research

Dr Stephanie Cawood, Director: Centre for Gender and Africa Studies

Humanity is experiencing an existential crisis related to gender identity in the world today, with malignant patriarchal phenomena such as sexual violence, gendered inequality, hypermasculinity, misogynism and intransigence towards LGBTQI+ communities. It is clear that societal relations can never be transformed without a gender lens. It is time to step away from 'patriarchal nationalism' and remember the crucial role of women and sexual minorities in national liberation struggles, but also as co-constructors of society and community across the continent. Thabo Mbeki's conception of an African Renaissance rightfully demanded reclaiming humanity for Africans in response to colonial oppression and racism - but this humanity must include a gender lens, recognising and deconstructing the historical, gendered, lived realities – private and public – of African men and women under the colonial yoke, as well as in the postcolony.

It is impossible to do Africanist research without considering gender, and equally impossible to understand gender in our context without accounting for Africa. It is against this background that the UFS has placed gender at the heart of its (former) Centre for Africa Studies. When originally launched in 2007, the name 'Centre for Africa Studies' was a deliberate choice to emphasise the role of Africa's agency in Africa(n) studies and to reflect the fact that, while engaging with the many contested meanings of who is an African, the Centre focused on the study of Africa, its people, politics, culture and relations with the rest of the world, by taking a long and critical view of past and present. Over time it became evident that the Centre's identity had evolved to reflect a disciplinarity transcending and integrating Africa and Gender Studies to such a degree that they were impossible to disentangle.

As from 2018, the reconstituted **Centre for Gender and Africa Studies** (CGAS) is the home for cross-cutting inter- and multi-disciplinary research on current issues of relevance from a gendered and Africanist perspective, including not only the understanding of the burning issues related to Africa and its people, but remaining cognisant of the fact that identity is intersectional and gender is a non-negotiable part of it. African experiences are foregrounded by, for example, showing how knowledge is not just constituted through observation or through what can be measured. Intuition, spirituality and gendered experiences, should also be considered valid sources of information.

Instead of adopting an abstracted worldview or theory, students are encouraged to use their Afrocentricity as a standpoint for change - a view that privileges the agency of African people (including women and sexual minorities) without claiming that all Africans are the same or that the practice of African customs and values makes one Afrocentric. Human-centric thinking that presents itself as ahistorical, gender-neutral, heterosexual, and, by implication, white/Western, is challenged.

The CGAS is relatively small with three full-time academics, two postdoctoral research fellows, and 48 master's and doctoral students. However, the Centre draws on a network of more than 20 affiliated researchers, and two Extraordinary Professors – **Prof Henning Melber**, Emeritus Director of the Dag Hammarskjöld Institute, and **Prof Tim Murithi** of the Institute for Justice and Reconciliation.

An interdisciplinary research project, led by **Dr Stephanie Cawood** (CGAS) and **Dr Tascha Vos** (Centre for Environmental Management), brings together limnology and the cultural and social human dynamics of heritage, pilgrimage and ritual. Through previous research in the Mohakare Valley in the Eastern Free State, Cawood and Vos detected a cycle of risk between human, animal and ecological risk factors. Based on this cycle of risk and conventional aquatic biomonitoring models, they developed a unique bio-cultural screening model, called Rapid Integrity Appraisal (RIA), specifically designed for biomonitoring of informal heritage sites. The current research project is applying the RIA to the previously sampled sites in the Mohakare Valley, as well as two new sites, Oetse's Cave (Witsieshoek) and Mantsopa (Ladybrand). The human activity at these sites has already been thoroughly documented in previous studies, and this information is used to contextualise the new empirical data gathered.

Makashane Ntlhabo, Dr Tascha Vos and Dr Stephanie Cawood on fieldwork in the eastern Free State near Witsie's Cave

Postdoctoral research fellow **Dr Taniwa Madimu** is conducting research on illegal African miners, particularly of Zimbabwean origin, in the Welkom area. The study seeks to explore the social history of the illegal miners (or so-called 'Zama Zamas') in post-apartheid South Africa, as well as some of the gender dynamics involved in this phenomenon. It highlights the diachronic set of social relationships amongst the zama zama's inside and outside disused mines in Welkom. Unlike the few existing studies on the subject that focus on the mining processes and marketing of the illegally mined gold, this study explores the lived experiences of Zimbabwean illegal miners with a particular focus on their nuanced social and economic well-being. It creates a confluence of South Africa's mining and immigration policies and demonstrates how Zimbabwean illegal miners in Welkom have negotiated the two in their quest to earn a living during the period under study - 1994 to present.

A five-year project, involving **Dr Nadine Lake** and her research partners at the University of Eduardo Mondlane (Mozambique) and Uppsala University (Sweden), focused on gender mainstreaming and developing competences in higher education for gender equality, peacebuilding and gender-sensitive research. The project was funded by the Swedish International Development Agency (SIDA).

Heroes' Acre near Windhoek, Namibia S CAWOOD

Together with Dr Jonathan Fisher (University of Birmingham), **Dr Stephanie Cawood** completed a project on 'Memorializing struggle: Dynamics of memory, space and power in post-liberation Africa', funded by the British Academy Newton Advanced Fellowship Scheme. The research compared how liberation struggles have been memorialised in South Africa, Uganda, Namibia, Zimbabwe, Eritrea, Ethiopia, and Rwanda, by focusing on museums, monuments, spaces, discourses and ceremonies as sites of engagement and contestation among different memorial cultures. These African nations have difficult histories and the way in which people remember and commemorate these histories differs, making memory a site of political contestation.

Nobel Square at the V&A Waterfront in Cape Town S CAWOOD

Tackling sustainability issues through trans-local research

Dr Melissa Hansen, Department of Geography

The **Department of Geography** at the Qwaqwa Campus is a core driver in an international research collaboration funded by JSPS: Formation of Social Design Research Hub for Tackling Sustainability Issues. This is a partnership with the University of Tokyo's Graduate Programme in Sustainability Science (GPSS-GLI). The project sets 'migration' as the topic for the joint fieldwork, research seminars, and field-based courses. Rural-to-urban migration is becoming a major trend in today's rapidly urbanising world. Rural areas are experiencing both out- and in- migration and their influences have appeared in various ways.

The project is an important initiative for the Qwaqwa Campus, and feeds directly into the UFS strategic goal for developing inter- and transdisciplinary research through the Sustainability Sciences. It aims to establish a sustainability science hub by promoting a trans-local research approach to be formed across Asian and African universities. The trans-local approach links two (or more) specific rural areas, with the purpose of obtaining diverse perspectives, useful when engaging with community projects.

The Department has also been increasingly involved with the Education for Sustainable Development in Africa – Next Generation Researchers (ESDA-NGR). ESDA is an inter-university collaboration programme of graduate training and research, promoting sustainable development in Africa. Eight other collaborating African universities are involved – the University of Cape Town, University of Zambia, University of Nairobi, University of Ghana, University for Development Studies, Kwame Nkrumah University of Science and Technology, Kenyatta University, and the University of Ibadan. It is a valuable network, both for research and teaching, for the Qwaqwa Campus.

Sustainability of mining towns

Prof Lochner Marais, Centre for Development Support
Dr Deidre van Rooyen, Centre for Development Support
Prof Maléne Campbell, Department of Urban and Regional Planning
Mr Stuart Denoon-Stevens, Department of Urban and Regional Planning
Prof Philippe Burger, Faculty of Economic and Management Sciences

Prof Lochner Marais, Mr Stuart Denoon-Stevens, Dr Deidre van Rooyen and Prof Maléne Campbell

South Africa has an extensive and diverse mining economy, and the history of the industry stretches over more than a century. Although the South African mining industry's share of the national economy has declined since the 1970s, it still contributes approximately 7% of GDP and provides more than 400,000 direct and 1.4 million indirect jobs. South Africa's development is closely associated with the mines; however, mining must also take the blame for many of the country's inequalities.

Mining and company towns became prominent responses by companies to ensure that they had access to labour, and examples can be found in both the Global North and Global South. Company towns are predominantly, though not exclusively, mining towns. Mining towns are not all the same. Most mining towns are small or medium size, and this means that mining often makes them vulnerable to the volatility of international markets.

The importance of the mining industry to South Africa, and the fact that mining towns are generally under-researched, led to a **Mining Studies Group** evolving at the UFS, which studies the impact of mining on a number of mining towns. It is difficult to get a clear picture of the positive or negative consequences of mining from the perspective of a single discipline. Case studies (using both qualitative and quantitative methods) of individual towns are therefore being conducted from a variety of disciplinary perspectives, involving researchers from, *inter alia*, Development Studies, Economics, Urban and Regional Planning, Industrial Psychology, Sociology and Environmental Sciences. This provides an in-depth description of the local consequences of mining and explains the conflicts the mines can cause in such towns.

The first case study looked at the highly mechanised open-cast iron-ore mines in a remote, arid and sparsely populated region of the Northern Cape. The area has been associated with mining for many centuries and Postmasburg has always displayed some mining-community characteristics, but has largely performed a regional service function. This changed with the mining boom experienced between 2009 and 2015 – with the expansion of the Beeshoek mine in 2010, and the opening of a new mine, Kolomela, in 2011. Both are iron-ore mines near the town, with China as their main market. Thus the demand for iron and steel

in China has had repercussions for this small town. Postmasburg had to house an influx of miners employed by the two mines and built nearly 1 000 new houses. The town's population increased from around 19 000 in 1996 to an estimated 35 000 in 2015, and approximately 2 500 households now live in informal settlements that developed in and around the town. The expansion of the town as a result of mining has brought added pressure to bear on services as well as the social fabric of the town.

The studies have investigated the effects of mining on the people who live and work in this mining town – including the town's vulnerability to changes in global markets, how mining and multinational corporations have influenced government, planning, the environment, the people and the movement of people, their place attachment and social disruption. The open-cast mining and mainly mechanised mining operations also provided the opportunity to investigate how mining as an industry has changed over time and how the changes have affected the people working for the mines, as well as the town's original residents.

Coal still contributes almost three-quarters of South Africa's energy needs, in addition to being a major source of export earnings. Emalahleni, which owes its existence and fortunes largely to its abundant coal reserves, was selected as the second case study.

Approximately 50% of South Africa's energy comes from the more than 20 collieries located in the Emalahleni coalfields. The town and its economy has grown rapidly on the basis of coal mining, energy generation and the steel industry, which has attracted an inflow of migrants to the town. However, there is increasing consensus that sustainable development cannot be achieved unless people have affordable, reliable and clean energy services, and thus coal could lose its dominant role in energy provision, with negative consequences for Emalahleni.

The Emalahleni case study has investigated inequalities caused by mining, including inequalities between mineworkers, non-mineworkers, contract workers, open-cast and underground workers, in terms of income, assets, housing, gender and working conditions.

In looking at sustainability and the mining industry and the consequences of mining for the physical environment, the real risk lies in long-term cumulative damage, particularly in terms of water and air pollution. Health problems caused by mining and energy generation, which offset the benefits of a growing economy and large-scale employment, have also been investigated. In looking at the likelihood of mine closure and a reduction in the generation of energy from coal in Emalahleni, it was found that Emalahleni's informal sector is most at risk in the event of downscaling. Issues related to local government, spatial planning, and communication form part of the study. The influence of the Gauteng-Maputo corridor development - in terms of countering the effects of mine closure and bringing about a just transition for mineworkers, residents and local government - is also taken into account.

The latest interdisciplinary study is investigating the effects of both mine development and potential mine decline in Rustenburg, a rich platinum-producing area.

The Afromontane Research Unit – reaching for new heights

Dr Ralph Clark, Director: Afromontane Research Unit

Mountains in southern Africa (here defined as south of the Congo rainforests and Lake Rukwa in Tanzania) generally lack a robust science-policy-interface. Compared to, for example, eastern African mountains, they are poorly understood as social-ecological systems and consequently under-appreciated at policy level, despite the valuable public goods and services they provide. Even the 40 000 km^2 Maloti-Drakensberg, while much better appreciated at policy level than many other southern African mountains, still lacks a combined focus or vision for its sustainable development, with numerous role-players acting within institutional, geographic and disciplinary silos. This vacuum creates a powerful niche for the **Afromontane Research Unit** (ARU).

With the Maloti-Drakensberg as its 'backyard' and permanent core focus, the ARU – based at the Qwaqwa Campus – has grown to become a regional player through actively driving the growth of a community of practice for southern African mountains. This is being achieved through continued investment by the UFS, active growth in collaborations and external funding success, and proactive staff and student development. Ultimately, the ARU seeks to assist in bringing some 'southern hemisphere balance' to a globally northern hemisphere-focused mountain research community.

The ARU took a leap forward in 2018 through the creation of ARU management positions, and the completion of the ARU Building. **Dr Ralph Clark** was appointed as the first ARU Director in January 2018, with supporting staff commencing duties during the year.

Building on the ARU's Foundation Phase (2015–2017), a comprehensive Strategic Plan was developed in 2018, setting the ARU on a path to becoming a centre of excellence on southern African mountains as social-ecological systems. The objectives of the ARU are (i) to contribute intellectually and practically to the sustainable development discourse of the Maloti-Drakensberg as a unique social-ecological system; (ii) to place the poorly studied southern African montane systems into the continental and global mountain research, policy and governance arena; (iii) to facilitate the development of a mountain research 'community of practice' within Africa, that leads African mountain research from within the continent; and (iv) to inform mountain hypotheses, theories and impacts of global significance from an African perspective, and thus contribute to strengthening the role of the South in the global mountain research agenda.

Through its cross-faculty, decentralised model, the ARU involves some 25 academic staff, 40 postgraduate students, and 10 postdoctoral research fellows. Originally confined to Qwaqwa Campus academics, recently the ARU invited association with the ARU from the broader UFS community.

The ARU has a strong local presence in the community, with a number of research projects embedded in the immediate Qwaqwa region – including projects on community-conservation conflict; the uniqueness of families in mountain communities; spatial patterns of rural and peri-urban residential settlements and agricultural trends in the Thabo Mofutsanyana District Municipality; visual cultures of the Afromontane; and education for mountain communities. There is also a strong focus on biodiversity, conservation, and sustainable development – with research on pesticidal metabolites; mountain soil and habitat health; montane wetlands; monitoring paleo-resources using drones; how mountains shape animal behavior; evaluation and mapping of fire risk zones; and high-elevation invasive species, amongst others.

With the advent of the 'global village' and a welcoming, interactive global mountain research community, the ARU is taking the lead in southern Africa in building partnerships to achieve that vision. For the Maloti-Drakensberg specifically, the ARU has developed mutually-beneficial relationships with the South African

Amphitheatre near Qwaqwa Campus RALPH CLARK

The Camel, uKhahlamba–Drakensberg Park RALPH CLARK

Environmental Observation Network (SAEON), the Centre for Biological Control the Centre for Invasion Biology, the Maloti-Drakensberg Transfrontier Programme, the Grassland Society of Southern Africa, SANParks, Ezemvelo KZN Wildlife, the Tsitsa Project, BirdLife South Africa, the National University of Lesotho, and the Universities of Johannesburg, KwaZulu-Natal, Pretoria and Witwatersrand.

Relationships concerning other southern African mountains have grown, and include the Manica Highlands Initiative (Zimbabwe and Mozambique) and the University of Venda. Partnerships beyond Africa have increased substantially, including the Appalachian State University and Montana and Colorado State Universities, who are partnering with the ARU in the University Staff Doctorate Programme (USDP). The ARU also has a vital relationship with the United Nations University, especially the Institutes for Sustainability and Peace and Environment and Human Security, who, in partnership with Eurac Research, has formed the Global Mountain Safeguard (GLOMOS) programme, of which the ARU is the primary African partner. Newer relationships include the Centre for Mountain Studies at the University of the Highlands and Islands, and the Israel Institute of Technology. The ARU is also strengthening connections with and contributions to the other global groups, including the Mountain Research Initiative, the Global Mountain Biodiversity Assessment, and the Mountain Invasion Research Network.

Groundwater – out of sight but not out of mind

Eelco Lukas, Institute for Groundwater Studies

Water is life. Yet numerous reports indicate that South Africa is on the verge of a national water crisis. Drought and poor infrastructure maintenance have led to taps running dry in various provinces, and left thousands without water.

South Africa is a water-stressed semi-arid country with limited annual rainfall and a lack of perennial streams, which, together with population growth and the uncertainty brought on by climate change, are likely to have significant financial, human and ecological impacts on already scarce water resources.

Groundwater is widely but variably used across the whole of the country. Two-thirds of the country depends solely or partially on groundwater for domestic needs. More than 420 towns are totally or largely dependent on groundwater, with many areas in the country using groundwater as the sole source for irrigation purposes. With water scarcity an increasing threat, these sources are becoming more and more important.

Groundwater, which is critical to the functioning of the entire water cycle, is the water found underground, and which is stored in and moves slowly through geologic formations of soil, sand and rocks called aquifers. These aquifers provide us with freshwater that makes up for surface water lost from drought-depleted lakes, rivers and reservoirs. The country has roughly the same amount of groundwater as surface water – approximately 7 500 million cubic metres per year.

The challenges associated with utilising groundwater lie in the implementation of groundwater schemes and the sustainable management of groundwater resources. Most groundwater quality and quantity problems are related to human activities that result in infiltration of chemicals and toxins used in industry, acidification and increased metal content from mining, eutrophication, microbial effects in urban development, as well as the intensification of agricultural practices such as sedimentation, infiltration of agrochemicals and salinisation through irrigation return flows. Deteriorating standards in wastewater treatment, agricultural drainage, land-use patterns and waste disposal intensify the problem.

The **Institute for Groundwater Studies** (IGS) is the leading research unit looking at this critical resource. Research is undertaken for both the public and private sector, and includes recently completed work on water balance for rehabilitated open-cast mines, water

level monitoring, capacity building for data collection and management in SADC member states, and water supply for rural communities.

Research on aquifer parameters is continuing, including a revision of slug test analysis to estimate a 'potential' yield that is indicative of the sustainable yield of a borehole. The application of Constant Drawdown tests is also being evaluated as a possible replacement for a combination of the calibration test, Sthe ARU in thest and Constant Rate tests, in an effort to minimise time and costs on aquifer testing projects. Other research includes evaluating the influence of artefacts on point dilution tracer tests in groundwater and investigating the evolution and characteristics of borehole fluid electrical conductivity (FEC) profiles in different aquifer systems. In addition, numerical modelling is applied to assess and evaluate the application of analytical methods for interpreting aquifer pumping tests.

Research on the optimisation of groundwater monitoring networks and/or programmes for the synthetic fuel industry, including coal mining operations, has also started. Statistical methods will be employed to evaluate the available monitoring data, to better understand the trends observed over a time span of 20 years, in order to improve/optimise the monitoring programme.

Multi-levels System technologies already exist for monitoring multiple aquifers using a single borehole, but these systems are either permanent systems or, in the case of temporary systems, they do not exist for the larger diameter boreholes used in South Africa. Work has begun on the development of a multi-level monitoring system used for characterisation of Karoo aquifers.

Recharge and flooding of mines is nothing new, and in fact starts from the first day a mine is created. The amount of recharge depends largely on the overlying strata and is not uniform throughout the mine. Recharge water entering the mine cavity will be collected in the floor's depressions. When the recharge is higher than evaporation, the amount of water in the mine will grow and slowly finds its way towards the deeper (lower) parts of the mine. A problem may develop when mining still occurs in the deeper areas and the volume of water is substantial. Software is being developed to identify areas in the mine that will be flooded, given recharge factors for all parts of the mine and certain amounts of rainfall.

In other ongoing research, Dr Francois Fourie, as part of the international collaborative research team GRAVITAS, is studying the geophysical melt dykes of the Vredefort Impact Structure to understand their geometries and penetration depths.

Increasing pressure is being placed on industry to lower CO_2 emissions; however, for some industries is it difficult to establish a substantial reduction of CO_2 and in order to lower the release of CO_2 into the atmosphere, the CO_2 can be captured and stored in an underground storage place. These storage places are often empty natural gas or oil fields located far below our aquifers. The envisaged research will investigate the influence on the aquifer when a storage place starts to leak.

The research team at the IGS is undoubtedly contributing significantly to the optimum utilisation and management of groundwater – an increasingly important resource.

Hidden flowers and little dragons

Dr Sandy-Lynn Steenhuisen, Department of Plant Sciences

In a first for continental Africa, a discovery of a plant (high up in the Maloti-Drakensberg World Heritage Site) being pollinated by a lizard was made by a research group including **Dr Sandy-Lynn Steenhuisen**, from the **Department of Plant Sciences** and affiliate of the **Afromontane Research Unit** at the Qwaqwa Campus, in collaboration with Dr Timo van der Niet, Prof Steven Johnson, and project leader Ruth Cozien, all from the Pollination Ecology Research Laboratory and Centre for Functional Biodiversity at the University of KwaZulu-Natal.

The 'Hidden Flower', growing on the slopes of Sentinel Peak, is a plant species with flowers hidden at ground level, underneath the leaves of the plant. Like the leaves, the flowers are also green, and they are filled with strongly-scented nectar. The researchers initially thought that it was being pollinated by a non-flying mammal. According to Dr Steenhuisen, who was brought into the project because of her experience with rodents pollinating proteas, many plants are adapted to attract and be pollinated by a specific animal. They attract their pollinators using particular scents and colours and reward them for their service with, for example, nectar, oil, fragrance, and sometimes even shelter.

Pollination of *Guthriea capensis* by lizards RUTH COZIEN (UKZN)

The research team investigated all optional pollinators, using several techniques to assess the contribution of different possible animals to seed set. To further assist them in their quest to find the true pollinator, the team put up motion sensor cameras that recorded activity in the area of the 'Hidden Flower'. After a week of field work the video material showed shy lizards dipping their snouts in the 'Hidden Flower' and lapping up the nectar. When lizards were experimentally excluded from the plants, the number of seeds produced dropped dramatically by almost 95%. The strong scent and the touch of orange at the base of the inside of the flowers are believed to play important roles in attracting the lizards.

Although flower visitation by lizards is not unknown, it occurs almost exclusively on oceanic islands. However, as Ruth Cozien points out, mountains are like sky islands and might therefore have similarities with oceanic islands in terms of their ecology.

The research findings of this study were published in the April 2019 edition of *Ecology*.

Food security and land reform

The right to sufficient food and water is enshrined in the South African Constitution. According to the Food and Agriculture Organization (FAO), food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life. A household is considered food secure when its occupants do not live in hunger or fear of starvation. Stages of food insecurity range from food secure situations to full-scale famine.

The United Nations has set ending hunger, achieving food security and improved nutrition, and promoting sustainable agriculture as the second of its 17 SDGs. This requires addressing a range of issues, from gender parity, access to productive land, and ageing demographics to skills development and climate change. Agriculture sectors have to become more productive.

South Africa's National Development Plan recognises agricultural productivity and rural development among the essential priorities for creation of employment, economic growth, reducing poverty and addressing food security in South Africa.

UFS researchers are involved in research along the entire agricultural value chain, ranging from input, production and collection, to processing and retailing, with a special focus on developing the skills of emerging farmers. There is also a strong focus on plant diseases and disease resistance of field crops, as well as breeding novel plant varieties that are adapted to changing global climate.

AGENDA 2063

- #3 Healthy & well-nourished citizens
- #5 Modern agriculture for inreased productivity & production
- #7 Environmentally sustainable & climate resilient economies & communities

SDG

- #2 Zero hunger
- #10 Reduced inequality
- #12 Responsible consumption & production
- #13 Climate action

FOOD SECURITY AND LAND REFORM

Solutions to food insecurity

Prof Maryke Labuschagne, SARChI Chair on Disease Resistance and Quality in Field Crops

The dire state of food insecurity globally prompted the United Nations to highlight this in their second Sustainable Development Goal – End hunger, achieve food security and improved nutrition, and promote sustainable agriculture.

Africa remains the continent with the highest prevalence of undernourishment, affecting one-fifth of its population. And the most vulnerable are the children, with a third of all deaths of children under five years in developing countries being linked to undernourishment.

One of the major concerns worldwide is whether the agricultural sector can meet the growing demand for food. Population growth, dietary changes and extreme changes in climatic conditions are driving up global food demand, which is expected to increase anywhere between 59% to 98% by 2050.

Appropriate measures are required – and the **SARChI Chair on Disease Resistance and Quality in Field Crops** aims to positively contribute to resolving the challenge. The Chair, headed by **Prof Maryke Labuschagne**, places a strong emphasis on advancing food security and nutrition in Africa. The uniqueness and strength of the Chair lies in its dual focus - food quality on the one hand, and disease resistance on the other.

The research group involved with food quality focuses on the genetic improvement of major crops such as wheat, maize and cassava. In wheat the focus is on the genetic improvement of baking quality, especially in the light of changing climate. In collaboration with the International Centre for the Improvement of Wheat and Maize (CIMMYT) in Mexico, research is being done to determine how gluten proteins in bread and durum wheat, and consequently baking and pasta quality, are influenced by heat and drought stress.

There is also a focus on the improvement of the nutritional value of staple crops through plant breeding. This includes the improvement of provitamin A, protein quality, and iron and zinc content in maize, banana and cassava.

Vitamin A deficiency is rampant in Africa, leading to different forms of blindness in adults and children, as well as cognitive problems in children. A major focus of the research is on several provitamin A biofortified crops, such as the recently completed project on provitamin A banana in West Africa (with the International Institute of Tropical Agriculture in Nigeria),

and related projects on the improvement of provitamin A content in cassava.

Zinc deficiency is a major contributing factor to child mortality in Africa, and progress is being made on the research project to improve the zinc content of normal and biofortified maize.

The research on disease resistance of cereal crops focuses on the genetics of rust resistance through multidisciplinary approaches - including Plant Pathology, Genetics, Plant Breeding, Botany, Statistics and Microscopy.

Efforts to meet the current and increasing demand for wheat is severely constrained by stagnating yields, increasing costs, and new emerging virulent variants such as race Ug99 of the stem rust. Five of the thirteen known variants of the Ug99 race group occur in South Africa, stressing the vulnerability of its wheat crop to migrating and mutating.

The UFS has become the leader in research on breeding for resistance against wheat diseases, and has released several lines to South African breeding companies. These lines contain different combinations of rust (stem, stripe and leaf rust) and Fusarium head-blight (FHB) resistance genes, that will be further introgressed into South African wheat cultivars. This project was recently strengthened by the acquisition of a KASPar SNPline apparatus.

The fifth variant of the Ug99 stem rust race in South Africa was recently characterised and reported. The first report of stripe rust in Zimbabwe was also recently documented and the impact of this race on Zimbabwean wheat cultivars, as well as its potential risk to South African wheat cultivars, was assessed and illustrated the relevance of the UFS rust programme in the region.

The research team has strong collaborative ties. A landmark study between the UFS, the Plant Breeding Institute of the University of Sydney, the University of Cambridge and others, addressed the movement of stem rust urediniospores from southern Africa to Australia on high-altitude winds.

Collaboration with Dr Melania Figueroa from CSIRO (Australia) provided the first genomic evidence for somatic hybridization in rust pathogens. Using next-generation sequencing technology, the researchers confirmed that somatic hybridization of two different stem rust races that exchanged complete nuclei, gave rise to the Ug99 stem rust race described by **Prof Zakkie Pretorius** 20 years ago. One of the races involved in this hybridization event was confirmed as Pgt21, found in South Africa nearly 100 years ago before migrating to Australia in the 1950s. Dr Jianping Zhang at CSIRO, who completed a significant part of her research at the UFS, successfully cloned two broadly effective stem rust resistance genes - *Sr26* and *Sr61*.

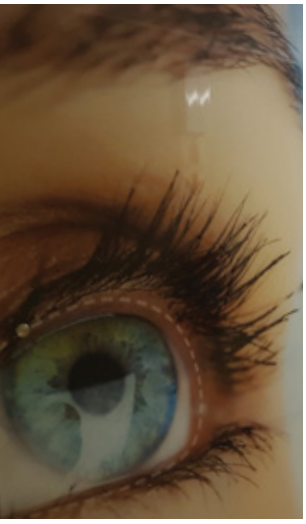
Collaborative research with Dr Hongwei Li, of the Chinese Academy of Sciences, resulted in the establishment of wheat-*Thinopyrum ponticum* translocation lines, carrying a new source of resistance to stem rust.

In collaboration with co-workers at the Centre for Rapid Prototyping and Manufacturing at the Central University of Technology, devices commonly used during collection and application of rust spores to plants, but which are not commercially available, were redesigned and 3D-printed through an innovative additive manufacturing process.

The research being conducted under the auspices of the Chair is undoubtedly contributing significantly to poverty reduction and sustainability goals in a variety of ways.

Sensory analysis for healthier foods

Dr Carina Bothma, Sensory Analysis Laboratory



'Food Security' is a diverse concept. According to the Food and Agriculture Organization (FAO), food security "exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life". When science and agriculture are taken into account, the interpretation also includes sustained production and improved quality of the raw agricultural produce, as well as improved quality of processed food. Sensory acceptability is a very important part of the total food quality concept.

The UFS Faculty of Natural and Agricultural Sciences recently invested R4.5 million in establishing a new **Sensory Analysis Laboratory**. The focus of the Laboratory is to determine consumer acceptability of existing, as well as newly developed, food products. Sensory evaluation is a scientific discipline used to evoke, measure, analyse and interpret reactions to those characteristics of foods and materials, as they are perceived by the senses of sight, smell, taste, touch and hearing. Analytical sensory evaluation uses trained judges as analytical instruments to measure the sensory characteristics of the products, while consumer sensory evaluation measures how much humans like/dislike, prefer, or accept/reject a product, with a view to predicting sales or use. Over and above teaching and research, the Laboratory also delivers commercial sensory analysis services to the local and international food industry.

Two recent research projects undertaken by researchers associated with the Laboratory illustrate its importance.

Food shortages and poverty, which eventually lead to micronutrient malnutrition, are two of the main reasons for food insecurity. While various fortification and supplementation strategies have been put in place to address micronutrient malnutrition, people are advised to include a variety of foods in their diet, including traditional leafy vegetables (TLVs) to serve as an inexpensive alternative food source for a nutritious and balanced diet. Over the past few decades, there has been more interest in improving the nutritional quality of plant-based foods.

Although amaranth has only recently gained popularity as a health food, this ancient grain has been a dietary staple in certain parts of the world for millennia. Amaranth is classified as a pseudo cereal, in that it is not technically a cereal grain like wheat or oats, but it shares a comparable set of nutrients and is used in similar ways. Besides being incredibly versatile, this nutritious grain is naturally gluten-free and rich in protein, fiber, micronutrients and antioxidants - added to which it adapts to various climatic conditions, as it is highly resistant to heat and drought stresses.

The abundant availability of *Amaranthus* species explains why these plants are used as a leafy vegetable in most parts of South Africa, where it is known by over 20 vernacular names, such as (amongst others) *thepe* in Sesotho, Setswana and Pedi, *imbuya* in isiXhosa and isiZulu, *isheke* in siSwati, *misbredie* in Afrikaans, and pigweed in English.

Not surprisingly, it has recently gained importance as a promising food crop, and UFS researchers from various disciplines

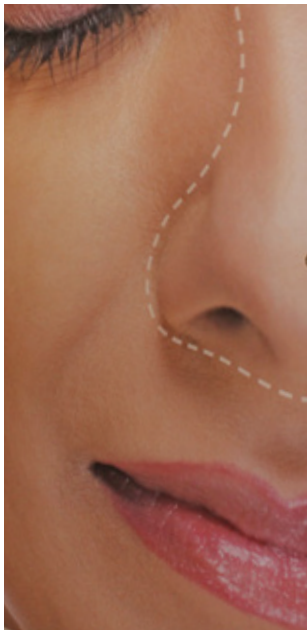
have for some time been investigating the potential of *Amaranthus*, including its chemical composition and allelopathic influence, the influence of altered temperatures, and models for stimulating its production. More recently researchers associated with the Sensory Analysis Laboratory, including **Carina Bothma** (Food Science), **Lucil Hiscock** (Consumer Science), **Arno Hugo** (Food Science), **Angeline van Biljon** (Plant Science), and Willem Janse Van Rensburg from the Agricultural Research Council, have looked at consumers' acceptability of amaranth leaves as an alternative vegetable source.

The foremost leafy vegetable consumed in South Africa is beet spinach, and amaranth leaves are often added as an extender to dishes prepared with spinach. However, consumers find certain *Amaranthus* genotypes less acceptable due to its sometimes bitter taste and aftertaste, which is derived from glucosinolates and isoflavones. As part of the research, amaranth leaves were incorporated into a stewed dish that is widely and habitually consumed by rural people in South Africa, and consumers' hedonic responses towards the overall acceptability of 13 stewed *Amaranthus* genotypes were evaluated. Their sensory profiles were also determined through the application of Check-all-that-apply (CATA). The results of the investigations suggest that a stewing method, containing ingredients such as potatoes, tomatoes and onions, was able to mask the bitterness of *Amaranthus* genotypes and increased acceptability, although consumer hedonic evaluation and sensory characteristics differed significantly between the genotypes and species.

Additional methods that mask the bitterness of this LGV should be considered, as this can lead to commercially viable products that are acceptable to the target population – thus promoting nutrition, creating employment opportunities for small-scale farmers and promoting the conservation of this indigenous LGV.

Despite the promotion of alternative foods to promote health, meat and meat products remain an important component of the global diet, and while consumers may sometimes raise health concerns about meat, they generally do not seem to adopt healthier eating habits. If the meat industry wishes to stimulate meat consumption, it has to face the challenges of offering more convenient and healthier options while identifying the new and changing roles of meat and meat products in the diet. Efforts in this regard are being made to reduce the sodium content of processed meat products in South Africa.

After sugar, salt is regarded as the second most used food additive. Technologically, salt is critical in manipulating and controlling the texture of processed meat products by activating the meat proteins, leading to greater water binding. Polony (a form of bologna sausage), is a comminuted, cured and cooked, low cost and affordable meat product. Reducing the salt content may require alterations in other parameters to ensure that affected foods maintain acceptable texture and a robust shelf-life. Maintaining consumer preference and acceptance is also a major challenge encountered by the industry when sizeable salt reduction is involved. Increased production costs that can affect the affordability of these altered products need to be avoided to protect the most price-sensitive consumers.



A study undertaken by **Prof Arno Hugo** and his research team, investigated the potential of intermediate added salt levels as a direct sodium reduction strategy in a processed meat product model reliant on the various functions of added salt. These models were evaluated for chemical, microbial and textural stability,

as well as sensory quality. Interestingly, one of the findings emerging from the consumer panel, was that consumers had a slight preference for a lower salt content. An important recommendation from this research is that salt reduction as sole approach in sodium reduction should be evaluated for similar products in limiting the possibly costly and negatively perceived use of sodium replacers.

A number of other interesting projects are being undertaken within the Laboratory. Fonio, a new pseudograin to South Africa, has been profiled, along with two other pseudo grains (tef and quinoa), and three grains (maize, sorghum and millet). An exciting new product was also developed, turning *uburo* (black fonio) into a meatball-type product, served with a variety of sauces. In addition, consumer behaviour toward the consumption and liking of *Amagwenya/vetkoek* is being studied, as well as the sensory attributes of the products purchased from street vendors and commercial outlets.

The consumption of insects by humans (entomophagy) is currently being investigated amongst South African consumers and new food products are being developed from cricket flour. Additionally, a study on the effect of #foodporn on eye movement (using eye movement tracking technology) and whether it will influence the consumer to prepare a recipe on social media, is currently underway.

Working towards a healthier environment

Dr Puseletso Mofokeng, Department of Chemistry

Packaging - much of it single-use food wrapping – has created a worldwide rubbish problem. Urban, rural and wilderness areas are fighting a continuous battle to overcome the scourge of plastic litter. The impact of efforts to recycle plastic bottles and packaging material remains relatively insignificant, and it is estimated that only 11% of waste is recycled, with over 1 million tonnes of plastic being thrown away each year. Much needs to be done to reach the ideal of a plastic waste -free South Africa by 2030.

Up to 40% of plastics produced annually are used by the packaging industry, of which most end up in landfills. Our landfills are full of non-biodegradable, petroleum-based materials. Such plastics end up in our aquatic environment and in the vicinity of our wildlife. But it does not end there. During incineration of these petroleum-based plastics, harmful gases, carbon monoxide, dioxins, and furans are released, which are major atmospheric pollutants.

In the beautiful surroundings of the UFS Qwaqwa Campus, **Dr Puseletso Mofokeng,** from the **Department of Chemistry**, finds inspiration in working towards a healthier environment. To combat the damage that plastic does to the environment, she is investigating the morphology and properties of polymer blends, composites, and nanocomposites, aiming to find a product that causes less harm than the non-biodegradable plastics commonly used for short-shelf life and disposable products.

Through her research, which focuses on preparing completely biodegradable polymer blends and nanocomposites, Dr Mofokeng is cultivating energy-saving and environmental awareness amongst her students.

Sustainable food systems to ensure food security

Dr Natasha Cronje, Department of Consumer Science
Prof Johan van Niekerk, Centre for Sustainable Agriculture, Rural Development and Extension

Two imperatives drive the collaboration between researchers from the **Department of Consumer Science** and the **Centre for Sustainable Agriculture, Rural Development and Extension** (CENSARDE) – food security through improved agricultural productivity, and reducing food waste. This links into the focus of their research on sustainable food systems – that is, delivering food security and nutrition for all in a way that limits negative environmental impacts and improves socio-economic wellbeing.

These aspirations are echoed in two Sustainable Development Goals (SDGs). SDG 2.3 aims, by 2030, to double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists and fishers, through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment. Alongside that, SDG 12.3 has as its target to halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses

South Africa is considered a food secure nation, with enough food for all citizens, yet 26% of the population regularly experience hunger, and another 28.3% are considered to be at risk. Ensuring sustainability and increasing access and availability remains an essential aspect in aiding food security. Agriculture is central to fostering economic growth, reducing poverty, and improving food security in the southern

African region. Yet, many countries have not yet succeeded in increasing agricultural productivity in spite of initiatives at stimulating agriculture and urban agriculture. Food security in developing countries is continually hindered by insufficient access due to poverty. This is exacerbated by drought, policies that are not conducive to assisting vulnerable households, inadequate infrastructure and changing food habits. Relief and recovery operations focus on strengthening livelihoods and meeting the needs of the food insecure in the short term, but do not address the root causes of the problem. The scarcity of food and restricted infrastructure, especially in rural areas, results in coping strategies adversely affecting the nutritional status of households.

The Department of Consumer Science and CENSARDE have identified interventions which can support local and regional governments in

future policy drafting and training of extension officers, as well as developing platforms for consumer information dissemination, thereby impacting food security positively on household and regional level.

In a project related to an oyster mushroom cultivation initiative by the Lesotho Government, the researchers set out to determine the influence of the initiative on access and availability of the involved households. The information obtained will be used to develop consumer acceptability profiles, followed by product development in order to create markets for the cultivators.

Another collaboration, involving local government extension workers, resulted in interventions to increase food security amongst rural households in the Lubombo region of Eswatini. New insights were gained into coping strategies of households as well as the inputs and assistance needed from government. The Eswatini people who formed part of the research actually disregarded traditional diets and vegetables, in favour of more 'Western diets'. They did not grow the indigenous vegetables suited to their region and did not adopt coping strategies traditionally depicted for rural areas - such as taking children out of school to work, or other less socially acceptable coping mechanisms. They did, however, eat less meals per day, and kept limited livestock for own consumption. The project also shed light on the role of relief food aid in the livelihoods of these households.

In a world that faces both scarcities of natural resources and extreme poverty, food waste prevention research is essential. Approximately R21.7 billion per annum is lost as a result of household food waste - a challenge that not only relates to food security but also to environmental issues, such as greenhouse gas emissions along the food supply chain and waste disposal.

Limited research exists on the drivers of household food waste in relation to consumers' perceptions, attitudes and behaviour in South Africa. Due to our diversity we need location- and culture-specific solutions and interventions. To this end, the Department of Consumer Science and CENSARDE undertook five studies attempting to fully comprehend and contextualise consumers' household food waste behaviour in Mangaung, Kimberley and Parys, as well as rural and urban Lesotho.

The findings indicate that in Mangaung, culture plays a significant role in what food is wasted/discarded. Although approximately 75% agreed that there would be less hungry people in South Africa if less food is wasted, less than half were willing to adjust their behaviour.

In Lesotho, there were distinct differences in consumption patterns between rural and urban areas, with food waste being a somewhat abstract concept for rural citizens. Education was a significant indicator of food waste knowledge and awareness. This was the first empirical study in Lesotho attempting to establish a baseline for further interventions. The involvement in the project of an extension advisor of the Lesotho Ministry of Agriculture is cause for hope that the there will be positive outcomes.

Taking hands with emerging farmers

Dr Jan Swanepoel, Centre for Sustainable Agriculture, Rural Development and Extension

Agriculture is of fundamental importance, not only in terms of food security, but for entire economies, especially in developing countries. A productive and well-functioning agribusiness sector advances food security, and agricultural products are a major source of national income. Over the past 30 years, there has been a major shift in agricultural markets and the international trade of agricultural products. The world is moving from local and national markets towards a global system of trading, which means that farmers working on small plots of land may be competing with large industrial farmers from another country in a single marketplace.

In developing countries, there is increasing pressure on farmers to commercialise their operations. This change is driven by a number of factors. Declining land size means that farmers need more intensive production systems to support their family needs, while urbanisation, rapid population growth and general modernisation mean that farming families need to generate larger incomes to support their family needs and expectations.

To meet the drive for greater commercialisation, new skills must be developed to support the farmers to become better entrepreneurs. Assistance in terms of infrastructure must be provided, and the needs of farmers and other actors in the value chain must be identified and catered for. For the farmer, this includes working with fellow farmers to develop farm plans, as well as working with various levels of farmer organisations - from groups to cooperatives - in areas such as market analysis, financing, sales and building business opportunities for farming clientele. The agricultural sector must be assisted to shift its focus from mere subsistence farming, as is still the case in many parts of the world, to sustaining the lives of millions of people. As the agricultural sector recognises this more fundamental role and their responibilities with regard to production, new strategies are needed to drive the enhancement of the socio-economic status of all role players in the agricultural sector.

The UFS has consistently addressed this through the **Centre for Sustainable Agriculture, Rural Development and Extension** (CENSARDE). In partnership with Standard Bank it established the Agribusiness Transformation Programme which leverages existing expertise, skills and infrastructure to develop black commercial farmers and black-owned sustainable agribusinesses in the Free State.

A further initiative assists emerging farmers in the wool industry, which, in South Africa, has ample opportunity for growth due to international market demand exceeding supply. Furthermore, the creation of niche products from the wool will add to the existing value chain, creating more jobs and an opportunity for enlarging the export market.

With support from the Regional Universities Forum for Capacity Building in Agriculture (RUFORUM), CENSARDE is undertaking a project on 'Building competitiveness for communal farmers through developing the wool value chain in the Free State Province'. The overall objective is to transform communal wool growers' production from an underachieving enterprise to a profitable, sustainable and renewable venture to enhance the livelihoods of communal wool producers.

Health and well-being

3

Our concept of health and well-being aligns with the biopsychosocial model of health, which considers physiological, psychological and social factors in health and illness, and interactions between these factors. This is consistent with the World Health Organisation (WHO) definition of health as "a state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity".

The Sustainable Development Goals make a bold commitment to end the epidemics of AIDS, tuberculosis, malaria and other communicable diseases by 2030, and the South African National Development Plan identifies promoting health as a key priority, and considers health and wellness to be critical to preventing and managing diseases of lifestyle, such as heart disease, high blood cholesterol, and diabetes.

The UFS has responded to this call, focusing particularly on key diseases in southern Africa, including cardiothoracic surgery, cancer research, radiation treatment, tuberculosis, malaria, HIV and AIDS, and hypertension. The University excels in understanding and preventing vector-borne and zoonotic diseases, and in the field of pathogenic yeasts. In pharmacology, in-depth research on the pharmacology of traditional medicines and medicinal plants is undertaken, and the UFS is the leader in South Africa on pharmacology research and product development of cannabis. In allied health areas, research is undertaken on improving the nutritional status of children.

AGENDA 2063	SDG
#3 Healthy & well-nourished citizens	#3 Good health & well-being

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HEALTH AND WELL-BEING

Pharmacology of traditional medicines

Prof Motlalepula Matsabisa, Department of Pharmacology

Traditional medicinal practices formed the basis of most medicines, which were followed by clinical, pharmacological and chemical studies. It is well-documented that natural products played critical roles in modern drug development, especially for antibacterial, antifungal and antitumor agents, to mention a few.

South Africa has a rich biodiversity and a wealth of indigenous knowledge, both largely untapped in terms of their combined potential. Traditional medical practice remains the largest healthcare system in the world and it is estimated that about 80% of South Africans regularly use traditional medicines, most of which come from indigenous plant species. This provides a unique opportunity to harness aspects of our biodiversity, traditional health practitioners' expertise, other indigenous knowledge-based systems and growing scientific expertise, to develop novel health products that address the high burden of disease in Africa, but with a global outlook.

Although the industrial revolution and the development of organic chemistry resulted in a preference for synthetic products, there has been a revival of interest in the potential of medicines derived from natural products. However, the potential use of plants as a source of new drugs is still poorly understood, with only a small percentage of the world's plant species having been investigated phytochemically, and an even smaller percentage properly studied in terms of their pharmacological properties. The revitalisation of the herbal industry also brings with it new challenges related to quality control,

standardisation, safety, efficacy and cost-effectiveness.

There is a wealth of knowledge and expertise embedded in South African traditional healing practice and indigenous knowledge systems (IKS) from communities of practice which may be outside of the traditional healing practice. Indigenous knowledge is important for the world as a whole, and should be shared, as long as communities are consulted and acquiesce to its use, and most importantly, benefit from its use.

The **Indigenous Knowledge Systems of Health Unit**, under the leadership of **Prof Motlalepula Matsabisa**, has two flagship projects related to the pharmacology of traditional medicines.

The Cannabis Project, funded by the Department of Science and Innovation, is a flagship of not only the UFS, but indeed of the country. It has attracted interest nationally and internationally, in all spheres of academia, industry and community, and continues to contribute to positive policy change and the medical cannabis debate. The research undertaken by the group has shown that local cannabis from eMampondweni in the Eastern Cape out-performed all other international cannabis extracts, in terms of inhibition of breast cancer cell growth, invasion, and survival and angiogenesis.

The Indigenous Herbal Infusions/Teas Project is a government flagship project, also funded by the Department of Science and Innovation. This best-practice project highlights the importance of meaningful constructive collaboration between academia, communities, and industry partners (as well as local government and traditional leaders), and provides an example of how scientific research can add meaningful value to grassroots innovations and the commercialisation of researched IKS knowledge.

In research related to herbal teas and health infusions, six indigenous teas/infusions that have stood the test of time as health beverages are being studied. These include the *Myrothamnus flabellifolius* (Moritela Tshwene), *Croton gratissimus var gratissimus* (Moologa), *Lippia scaberrimma* (Mosukujane), *Phyla dulcis* (Ihawu hawu), *Lippia javanica* (Inzinziniba) and *Buddleja saligna* (Igqange). The research is a joint undertaking with the communities of Mokgola, Lekubu, Ntshatshongo and Krwakrwa in the North West and Eastern Cape provinces. These herbal teas are widely traditionally used in southern Africa, and have potential for commercialisation. These studies, for the first time, reported the nutritional composition of the leaf decoctions of teas, and their protective effect on hepatic oxidative stress including potential for diabetes and hypertension treatment. The results can inform the dietary and nutritional use of the teas, as well as provide preliminary scientific validation of their use as health beverages with antioxidants and nutritional value.

Over and above the flagship projects, the Unit's research focuses primarily on key priority diseases of the country and region – including cancer, diabetes and malaria.

The research group is working with traditional healers from Gauteng, Mpumalanga, Eastern Cape and Western Cape, who claim to have traditional cures for different cancers. The project sets the standards for collaboration between academic researchers and knowledge holders in the community, while performing research on traditional medicines that is on a par with international standards. This is evidenced by continued international collaborations with renowned universities and institutions in China, Germany, Jamaica, India, Brazil, Chile, Canada, Turkey, Republic of South Korea and the United Kingdom. In the continent the group works with scientists and researchers from Lesotho, Botswana, Eswatini, Namibia, Congo Republic, Democratic Republic of the Congo, Nigeria, Tunisia and Algeria.

In one study, the anticancer activity of biogenic silver nanoparticles synthesised using *Dicoma anomala* plant root extract, was researched. This plant, locally known as *'hloenya'*, *'hlonya'*, *'maagbossie'*, and *'inyongwana'*, is widely recommended by South African traditional health practitioners to treat different health issues. The findings indicate the potential of the extract as an antimalarial candidate, and the research has led to the identification of novel molecules in the plant for which international patents have been successfully filed in South Africa, the African Regional Intellectual Property Organization (ARIPO), the Organisation Africaine de la Propriété Intellectuelle (OAPI), Madagascar, Nigeria, USA, EU, India, China and Brazil.

In southern Africa herbal mixture preparations are often used as alternative treatments for diabetes, though most have not been well-investigated and regulated. One particular study by the research group evaluated the

anti-diabetic potential of a South African herbal formulation locally called '*Mabaso*', made from three plants - *Sclerocarya birrea* (marula), *Opuntia ficus-indica* (prickly pear) and *Solanum pimpinellifolium* (a type of wild tomato). The results indicate that this herbal preparation may have ameliorative potential against diabetes and its complications.

In another study, the anti-diabetic potential of the stem bark resin of *Araucaria cunninghamii* (hoop pine) was investigated. The hoop pine is known for its traditional medicinal uses. The stem bark exudes resin which possesses anti-microbial properties, but its anti-diabetic potential remains unknown. The findings show that stem bark resin has great potential for the management of diabetes.

Vernonia amygdalina (bitter leaf) is among the common leafy vegetables in West Africa used as a food ingredient, as well as supplement for the treatment and management of type 2 diabetes. A study of the histochemical properties and antidiabetic activities of *V. amygdalina* leaves found they have the ability to inhibit intestinal glucose absorption, enhance muscle glucose uptake, and protect against hepatic oxidative stress – giving credence to its reported antidiabetic properties.

Another noteworthy project being undertaken by the Indigenous Knowledge Systems of Health Unit, is the Inulin Extraction Project - an industry-led project which aims to develop a cost-effective extraction method for inulin used in confectionary, pharmaceuticals and baby food. This project has been earmarked for funding by TIA to upscale the laboratory extraction to a pilot scale extraction.

FARMOVS

Dr Michelle Middle, FARMOVS

The UFS acquired 100% of the shares in PAREXEL's Bloemfontein-based clinical research centre, FARMOVS-PAREXEL, on 7 March 2018. FARMOVS (as it is now known), has its roots deeply embedded in the UFS, having been established in 1974 by the Department of Pharmacology. In 2000 the UFS sold a 70% stake of the shares to PAREXEL International and during the following 18 years it developed into a world-class clinical research facility, which is on par with the best in the world. Through this acquisition, the UFS owns the largest Phase 1 clinical research business in South Africa, with the only GLP compliant and internationally accredited Bioanalytical Facility on the African continent.

Drug development is one of the most regulated processes, with strict ethics and patient safety requirements governing any undertaking. Operating in this regulated environment, FARMOVS conducts important clinical research for the global pharmaceutical industry that enables marketing of affordable generic drugs in South Africa and elsewhere. In addition, FARMOVS supports the development of important new medicines for a variety of diseases and illnesses, including rare diseases. FARMOVS has a close partnership with the Faculty of Health Sciences, and has a strong focus on clinical research capacity building, with clinicians from the Faculty being integrated into the FARMOVS research team, affording valuable hands-on research training as well as training focused on good clinical practice and ethics. Apart from commercial clinical trials, FARMOVS also supports MMed students with academic research projects.

At a national level, FARMOVS staff are considered key opinion leaders in drug development, and staff members serve on different National Governance bodies. During the signing of the agreement on the establishment of FARMOVS, Prof Petersen, UFS Vice-Chancellor, indicated that the vison of the UFS is to become actively involved in the South African National Clinical Research Capacity Building Initiative, with FARMOVS becoming a Clinical Research Centre of Excellence.

Superheroes in the fight against superbugs

Prof Carolina Pohl-Albertyn, SARChI Chair in Pathogenic Yeasts

Advances in medical interventions and treatments mean that many diseases are no longer life-threatening to humans. However, this has also caused an increase in various opportunistic infections, particularly in fungal infections. Over 300 million people suffer from serious fungal infections annually, resulting in over 1 million deaths globally, which is at least as many as tuberculosis or malaria. The increase in drug resistance of these pathogens as well as the emergence of new multi-drug resistant pathogenic yeast 'superbugs' are of serious concern. The state-of-the-art research being conducted by the **Pathogenic Yeast Research Group** is critically important as it contributes towards understanding the pathobiology of the *Candida* species and *Cryptococcus neoformans* – two of the most common invasive fungal pathogens in humans.

The Pathogenic Yeast Research Group currently consists of four academic staff members, five postdoctoral research fellows, ten PhD students, ten MSc students, and four Honours students. It forms part of the **SARChI Chair in Pathogenic Yeasts** (headed by **Prof Carlien Pohl-Albertyn**), awarded by the DST/NRF in 2018, and focuses on three main areas.

The first area aims at establishing experimental tools. In order to understand host-pathogen interaction and find novel treatments, it is vital to establish certain experimental tools – including improving molecular tools and establishing relevant infection models. The group has already established infection models using various cell lines, including macrophages and lung epithelial cells, as well as in-house *Caenorhabditis elegans* (nematode) and *Acanthamoeba castellanii* (amoeba) models. The research has been expanded with the establishment of an in-house *Danio rerio* (zebrafish) model, specifically looking at behavioural changes related to non-lethal fungal infection, such as the potential role of pathogenic fungal infection in Alzheimer's disease. Although gene editing tools have been developed for *Candida albicans*, these are not yet available for many other yeasts. A group of researchers is developing a CRISPR-Cas 9 gene editing tool for resistant *Candida* species, such as *Candida auris* and *Candida kruseii*. The molecular tools will allow for the effective construction of deletion mutants of the pathogenic yeasts, in order to test the

role of selected genes in influencing virulence and antifungal susceptibility. This research will shed light on how the host-pathogen interactions influence the expression of certain virulence factors by the pathogens, as well as the immune response of the host to infection. In addition, the high throughput nature of the nematode and zebrafish models will enable an additional *in vivo* level screening of potential novel antifungal compounds.

Secondly, the research focuses on understanding host-pathogen interaction. These interactions are being explored in a variety of ways, including how expression of virulence factors of the pathogens are influenced by the host, as well as the host immune response to infection. A study on the interaction between *Candida albicans* and *Pseudomonas aeruginosa* centres around the fact that many infections are actually polymicrobial in nature. These pathogens influence the host as well as each other in various ways, and may ultimately influence the level of disease.

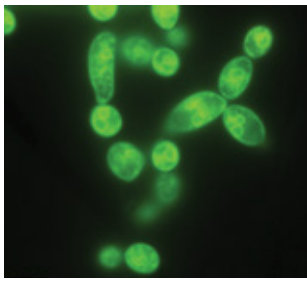
Another study is investigating environmental/host factors that influence resistance and virulence of yeasts. Here the projects focus on different protective mechanisms that enable *Cryptococcus neoformans* to survive within macrophages in mammals, the virulence factors of *Candida parapsilosis* (the leading cause of candidaemia in premature babies), and the influence of the different carbon sources available to *Candida albicans* in the hosts on the interaction between the yeast and macrophages. A further study is investigating the potential of *Cutaneotrichosporon cyanovorans* to produce virulence factors. The yeast, which was previously isolated from soil contaminated with cyanide in South Africa, has recently also been isolated from the lungs of patients with cystic fibrosis.

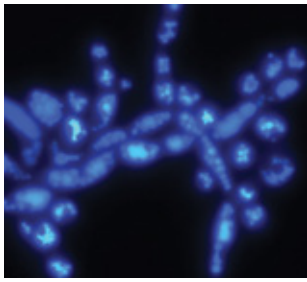
Research in the third area - finding novel treatment options for pathogenic yeasts - follows three approaches. Firstly, the search for novel antifungal drugs includes synthesising derivatives based on known antifungal lead compounds which may be useful in photo dynamic inactivation of the pathogens.

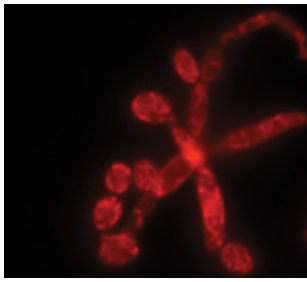
These compounds are screened *in vitro* as well as in the high throughput infection models. The synergistic effects of certain compounds in combination with known antifungals are also being studied, which may provide a solution to prolonging the useful life-span of current antifungals.

The second approach deals with repurposing of FDA-approved drugs for use as novel antifungals. This dramatically decreases the lead time needed for the development of new drugs – something that is crucial given the increasing incidence of antifungal drug resistance in these pathogens. Current research is investigating repurposing aspirin derivatives and antimalarial drugs as novel anti-Cryptococcal drugs.

The third approach is to search for novel drug targets, including virulence factors. The effect of inhibitors on the production of these metabolites as potential alleviators of host cell damage and survival of the pathogens inside macrophages is studied, as well as the identification of the genes involved in the production of eicosanoids in *Candida albicans*. The research undertaken by the group has found that certain genes are expressed by yeast cells under stress. Many of these genes have no known direct function in dealing with these stresses, but deletion of some of these genes result in dramatic changes in antifungal resistance of the mutants. A suite of projects undertaken by six postgraduate students and one postdoctoral research fellow, focuses on the fact that polyunsaturated fatty acids can potentiate the activity of antifungal drugs in *Candida albicans*. By understanding how this works, new genes important for antifungal resistance/susceptibility have been identified and are being investigated. These projects have also found that the activity of drug efflux pumps of the yeasts is inhibited by fatty acids, and this mechanism is being studied in two notoriously resistant yeasts, *Candida kruseii* and *Candida auris*. Other projects focus on 3-hydroxy fatty acids in relation to *Cryptococcus neoformans* and *Pseudomonas aeruginosa*.







Cervix cancer – new solutions in women's health

Dr Willie Shaw, Department of Medical Physics

Cervix cancer, especially in resource-constrained countries, is known for its high rates of incidence and mortality compared to other cancers. Worldwide it is the second most common cause of female cancer deaths and impacts economic, socio-economic and women's health related issues. In South Africa it is the second most common cancer for women (after breast cancer), and has been recorded as more than 600 000 new cases annually and with more than 50% yearly deaths. In fact, southern Africa ranks the highest globally in terms of incidence and has some of the highest mortality rates due to a lack of screening, late diagnosis, presentation at advanced stages with hypoxic tumours and sub-optimal treatment.

In many developing countries, cervix cancer is a result of high-risk human papillomavirus (hrHPV) infection of individuals with compromised immune systems, where HPV vaccination programmes have been ineffective and where a poorly controlled human immunodeficiency virus (HIV) epidemic result in high HIV prevalence. Furthermore, late diagnosis and incomplete access to timely and effective treatment worsens prognosis and outcome. Current standard treatment protocols for this disease in these countries are sub-optimal and result in poor treatment outcomes.

Radiotherapy treatment of cervix cancer is the most essential component for effective tumour eradication. Current chemotherapy drugs have a supporting, yet less effective role, especially in large tumours. Radiotherapy includes a combination of external beam

radiotherapy (EBRT) and brachytherapy (BT), which has proven to achieve significant tumour response during and after treatment. However, patients with advanced and co-morbid disease have not shown optimal response to these multi-modality treatment approaches because of limitations with respect to normal tissue

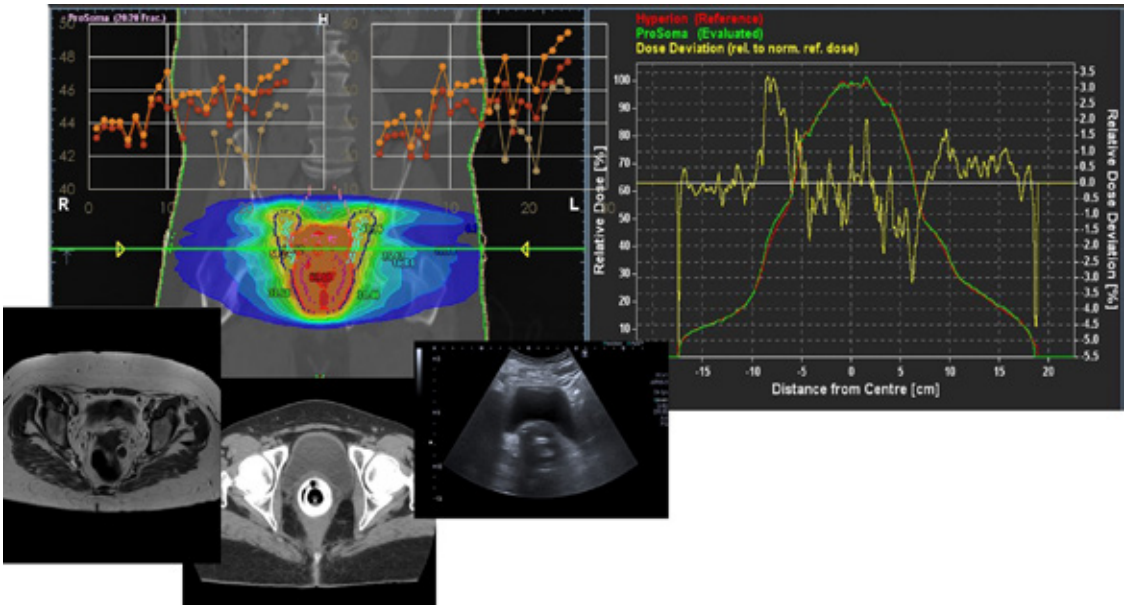
toxicity, while treatment techniques have not been optimised for this group of patients.

Despite this gloomy scenario, the UFS research group, led by **Dr Willie Shaw**, believes that cancer can be cured and effectively controlled if suitable high quality care is offered. Cervix cancer in developing countries should be treated with more robust methods and optimised for the individual. Only then can the disease be cured, and late toxicity reduced. As the nationwide authority on cervix cancer radiotherapy and the most advanced treatment centre in Africa, the group is pursuing the development of modern, advanced and innovative applications in Oncotherapy and Theranostics to research and improve cervix cancer treatment outcome and provide access to leading quality care.

This research group is diverse and therein lies its strength, since cancer treatment is not a single modality approach. This assembly of professionals (with expertise in Medical Physics, Oncotherapy, Nuclear Medicine, Virology, Chemistry and High Performance Computing) into an inclusive cluster collectively undertaking research in cancer diagnosis and therapy, will extract maximal knowledge from this disease's response to novel and advanced treatment methods, in addition to identifying new biomarkers for therapy and diagnosis.

The overall objective of their current research, which addresses the sub-optimal treatment outcome of both HIV+ and HIV- patient populations in resource-limited southern Africa, is to create an automated solution for cervix cancer radiotherapy treatment, and to test this system against current existing manual processes. The overall outcome of this project will be a system which can provide fast, repeatable and high quality treatment planning solutions to radiation oncologists and medical physicists, to enhance the current clinical workflow by reducing the required resources through automated processes, relaxing the demand for specialised radiotherapy planning, quality assurance, dose accumulation, preparation and procedural time.

Together with their collaborators, including Maastricht Radiation Oncology Centre, Heidelberg Cancer Hospital, the Netherlands Cancer Institute, and the MD Anderson Cancer Centre at the University of Texas, this research group is leading the fight against this disease, which is a national priority.



Targeting arboviruses with a one health approach - are we missing something?

Prof Felicity Burt, SARChI Chair for Vector-borne and Zoonotic Pathogens Research

Arboviruses, or arthropod borne viruses, are viruses that are transmitted by insect vectors such as mosquitoes, ticks, midges or sandflies. In contrast, zoonotic diseases are transmitted from animals to humans. However, there is significant overlap between arboviruses and zoonotic viruses.

Four major clinical syndromes are associated with arboviral infections, namely acute benign fevers of short duration that may include a rash; neurological disease (including encephalitis with possible fatal outcome); polyarthritis with rash; and haemorrhagic fevers. The occurrence of the tick-borne arbovirus/zoonosis, Crimean-Congo haemorrhagic fever virus (CCHFV), is well-established in southern Africa. Similarly, the mosquito-borne viruses Rift Valley fever, West Nile, Wesselsbron and Sindbis are known to cause sporadic outbreaks annually, as well as larger outbreaks frequently associated with heavy rainfall favouring vector breeding. In addition, there is serological and/or virological evidence supporting the presence of lesser known arboviruses including the flaviviruses Usutu, Banzi and Spondweni, an Old World alphavirus - Middelburg, orthobunyaviruses such as Germiston and Shuni, and Dugbe, a tick-borne orthonairovirus.

The medical significance of some of these viruses has not been established, and the absence of awareness, specific diagnostic capacity and the potential for serological cross reactivity among related viruses, may lead to misdiagnosis. In recent years there has been an increase in emergence and re-emergence of arboviruses worldwide, likely due to changes in land-use, as well as changes in weather patterns and bird migration. Currently there is limited data available indicating which viruses with potential to cause outbreaks are circulating in the mosquito and tick populations in central South Africa.

The interdisciplinary team of researchers associated with the **SARChI Chair for Vector-borne and Zoonotic Pathogens Research**, aims to find out which of these viruses are circulating in our region, to understand how they cause disease and how the human responds to infection - in other words, what is the immune response induced by these pathogens?

Using a One Health approach which recognises that human health, animal health and the environment are interlinked, the activities of the Chair take into consideration the importance of investigating the interface between humans and animals, and public health implications. Much of the work performed by the research team, led by **Prof Felicity Burt**, functions at the level of surveillance and detection, but also encompasses understanding immune responses that would play a role in development of novel vaccines and therapeutics.

The development and validation of detection assays is an important component of the research programme, as it impacts on all aspects of the research - facilitating surveillance, virus discovery, increasing diagnostic capacity and profiling immune responses. For many of these pathogens commercial assays are not available and hence the research being undertaken by the Chair requires the development of in-house assays. Using recombinant technology, detection assays for use as surveillance tools have successfully been developed. For epidemiological studies the Chair has developed a platform of molecular assays, each with a unique role and application. The assays include conventional amplification of viral genome using techniques in which results can be monitored real time, and rapid assays which require no sophisticated equipment and are currently being adapted for use in field studies.

A nucleic acid amplification assay for screening mosquito vectors for viruses from the family *Flaviviridae*, has been developed which can detect West Nile, Wesselsbron, Usutu and related viruses. The assay can be used in a laboratory with sophisticated equipment, but has also been modified to be used in the field with a rapid lateral flow assay for detection of positive results. The technology used to develop this assay is currently being modified for detection of other common mosquito-borne viruses belonging to the families *Togaviridae* and *Orthobunyaviridae*. These assays are being applied to screening of thousands of wild caught mosquitoes in central South Africa, to facilitate our understanding of where they circulate and their seasonal activity.

Ticks can transmit some deadly human and veterinary pathogens, such as CCHFV, commonly called Congo fever or *'Kongo-koors'*. Outbreaks in humans occur sporadically and annually and cause serious disease with fatalities. The possibility of a mild disease that goes undiagnosed was investigated by the research team; however, the screening of human populations at risk of contracting the disease due to occupational or recreational activities, confirmed that mild disease seldom occurs in South Africa. The investigations on Congo fever did reveal persistence of the virus after acute infections (which was previously not shown), as well as detection of long-lived T-cell and antibody responses - all important

considerations for vaccine development. The research has shown that genetically diverse strains of CCHFV are antigenically similar enough to be detected using recombinant viral nucleoprotein from one strain of the virus, but that peptides representing epitopic regions are too dissimilar and multiple peptides would be required for detection of geographical and genetically distinct strains.

To understand how CCHFV avoids the immune system, the researchers have investigated mechanisms that the virus uses to mediate innate immune dysregulation. *In vitro* studies focusing on selected viral proteins have shown a possible role for CCHFV OTU protease in down regulating the innate immune response. Handling infectious CCHFV requires high biocontainment limiting research on disease mechanisms; a genetically, and antigenically, related non-pathogenic virus has thus been investigated as a model to understand how this virus causes disease and mechanisms which it uses to avoid or modulate our natural immune responses.

Surveillance for CCHFV in Africa is limited due to lack of suitable reagents. The Chair has prepared recombinant reagents for CCHFV that are currently being validated for use as a surveillance tool, and these will be further developed for rapid, point-of-care assays, for quick screening. The aim will be to use the assays and to work with collaborators in other parts of Africa to determine CCHFV distribution on the continent and risk factors for disease outbreaks.

Zoonotic and vector-borne pathogens have potential for emergence and re-emergence - hence the importance of both human and veterinary surveillance, developing capacity for detecting these viruses and increasing awareness.

The One Health Warriors

Today over 60% of recognised human infectious diseases are zoonoses, in that they originate from the movement of pathogens - mostly from animals to humans. The One Health approach recognises the interconnection between the health of people, animals and their shared environment, and is thus particularly relevant in terms of the control of zoonoses.

What zoonotic diseases should children and adults be aware of? How do zoonoses affect healthcare providers and livestock owners?

These are some of the questions addressed by the aptly named 'One Health Warriors', in their endeavours to increase public awareness of zoonotic diseases. This student group, established in 2016 and comprised of postgraduate students from Prof Felicity Burt's research group, holds annual events targeting primary school children with potential exposure to zoonotic diseases from pets and domestic livestock, healthcare workers at risk from occupational activities, and livestock owners. In 2019, the Warriors participated in a community event organised by the Kroonstad State veterinarians and discussed zoonotic pathogens with the livestock owners.

Human rights, social justice and reconciliation

4

Nationally and internationally we are faced with development and societal challenges that require critical and multi-faceted scholarly approaches to revisit and redefine notions of reconciliation, social cohesion, inclusivity, social justice, human rights, diversity and citizenship in a changing world. This is particularly pertinent to South Africa – as a nation we can no longer forget or ignore the truth of our past.

All people of this country have the right to human dignity, equality and freedom; but not all experience it. 'Social Justice' is when all citizens are able to take advantage of the benefits and opportunities in society. 'Reconciliation' is to bring people together, to acknowledge the past and co-create the present and future. Social Justice and Reconciliation are thus more concerned with the outcomes of implementing Rights and using effective and respectful engagement strategies.

The research of UFS scholars focuses on societal challenges, with an emphasis on diversity, change, social justice, transformation, and the removal of inequalities in and though education.

AGENDA 2063

- #2 Well-educated citizens & skills revolution
- #11 Democratic values, practices, universal principles of human rights, justice & rule of law
- #13 Peace, security & stability
- #14 A stable & peaceful Africa
- #17 Full gender equality in all spheres of life

SDG

- #4 Quality education
- #5 Gender equality
- #10 Reduced inequality
- #16 Peace & justice strong institutions

HUMAN RIGHTS, SOCIAL JUSTICE AND RECONCILIATION

The relationship between human rights and transformation

Prof Danie Brand, Director: Free State Centre for Human Rights

The **Free State Centre for Human Rights** (FSCHR) at the UFS is a critical, interdisciplinary and contextually engaged research, advocacy and legal practice institution, focusing on the relationship between human rights and transformation. Established in January 2016, the Centre's genesis is the 2007 incident of racial discrimination at the Reitz student residence on the Bloemfontein Campus. Following this incident, an agreement was reached between the UFS and the South African Human Rights Commission that a centre for human rights would be established, with the mandate to work toward the transformation of the UFS and the campus community.

Given this background, the Centre's broad focus is not on human rights in the abstract, but on the relationship between human rights and the actual mandate, transformation.

This relationship is approached from a critical perspective, one that recognises its double-handed nature - the fact that human rights, in whatever context, relate both positively and negatively to transformation, can both enable and hinder transformation. This inevitably means that the Centre's work and its research community is interdisciplinary in nature, drawing on a range of different disciplines. The Centre thus participates in its research and other activities with the whole UFS community.

Although the Centre is primarily an academic research institution, its work is contextually engaged. Apart from its Research and Postgraduate Division, the Centre consists of an Advocacy Division and a Legal Services Division. All of the Centre's work is geographically located, focused on issues in the University, and in Bloemfontein, the Free State and Lesotho.

Focusing on the relationship between human rights and transformation, the mission of the Research Division is to deepen critical and interdisciplinary study of human rights and further critical human rights praxes, within three areas - The Right to Development in Africa; Human Rights, Transformation and Poverty; and Human Rights, Politics and University Transformation.

In 2019, members of the Centre published on topics as diverse as spatial justice, transformation of university residences, the right to development in Africa and the regulation of hate speech. Highlights include two books, both by Centre postdoctoral research fellows. **Dr Carol Ngang** co-edited a book, *Perspectives on the Right to Development*, with Serges Djoyou Kamga and Vusi Gumede. The book explores

the complex nature of the right to development from a diversified angle, including conceptual, thematic, country and regional points of view. **Dr Liezl Dick** co-edited a book, *Scholarly Engagement and Decolonization: Views from South Africa, the Netherlands, and the United States*, with Maurice Crul, Halleh Ghorashi and Angela Valenzuela.

The Centre is involved in a number of collaborative research projects. Planners, geographers, architects, art historians, social activists, and lawyers from South Africa, Brazil and the United Kingdom have, since October 2018, collaborated on an interdisciplinary project on what a home constitutes, and how best to provide and protect homes in a sustainable and inclusive manner in 21st century cities. The project is organised by the FSCHR, the Kent Law School (Kent University, UK) and the Federal University of Minas Gerais (Belo Horizonte, Brazil,) with funding from the Global Challenges Research Fund of the Royal Academy in the UK. The project commenced with a workshop hosted by the FSCHR on the Bloemfontein Campus. The same group of participants met for a follow-up workshop at Kent University in February 2019, and concluded with a third workshop in Belo Horizonte in September 2019. The project will conclude with the publication, in 2020, of two inter-disciplinary books containing the papers workshopped at the three events.

The Centre, in collaboration with the Centre for Development Support (CDS) and the Department of Public Law, engaged in a research project on the endurance of inequality in the spatial development of Bloemfontein and its surrounds. The main investigators are **Prof Danie Brand** (FSCHR), **Prof Lochner Marais** (CDS) and **Prof Karin van Marle** (Department of Public Law). The project is explicitly interdisciplinary, attempting to combine qualitative fieldwork research with constitutional, property and critical legal theory to investigate how inequality persists in the spatial development of greater Bloemfontein.

The FSCHR has organised and hosted a range of relevant and impactful discussions, workshops and conferences, in keeping with its mandate. In 2019 it hosted the annual workshop of the International Socio-economic Rights Project (iSERP), an international network of academics, lawyers and activists interested in the implementation and enforcement of socio-economic rights. The theme of the workshop was 'Alternative visions of property rights'. The FSCHR also hosted two important conferences - the conference on 'Health, healthcare and urban spaces: Perspectives from the law and medical humanities' and the 'Third International Conference on the Right to Development'.

In addition, the Centre presented two public panel discussions during 2019. The first was on the Report of the Presidential Advisory Panel on Land Reform and Agriculture, and the second focused on primary school infrastructure failures as a human rights issue, with the case of Michael Komape, who died at his primary school after falling into a pit latrine, as focal point. This discussion was presented in collaboration with the NGO Section 27.

The Centre has been strengthened with the appointment Judge and Professor Dennis Davis of the Western Cape High Court and Professors Lucy Williams and Karl Klare of Northeastern University in Boston, Prof Serges Alain Djoyou-Kamga of Unisa, and Prof Gracienne Laauwers of the Vrije Universiteit Brussel, as extraordinary professors. Two new research associates/fellows were also appointed - Dr Gerard Emanuel Kamdem Kamga, formerly of the University of Pretoria, and Prof Natalia Angel Cabo of the Universidad de Los Andes in Bogota, Colombia. The Centre also hosts four postdoctoral research fellows.

Challenging the inequalities of higher education for social justice

Prof Melanie Walker, SARChI Chair in Higher Education and Human Development and Director of Higher Education and Human Development Research Group

Prof Melanie Walker, **SARChI Chair in Higher Education and Human Development** (HEHD) since 2013, works with human development ideas - with Amartya Sen's capability approach (CA), as well as Nussbaum's 'capabilities approach'. Sen's approach aligns well with current concerns with epistemic justice, decoloniality, epistemic governance, and an 'ecology of knowledges', together with development ethics. Moreover, Sen's conceptualisation of non-ideal and comparative education sits well with education, which cannot wait for perfection in policy or practices.

Given the imperfect nature of higher education, Prof Walker's research considers inequalities (structures and norms of social class/income, gender and race), and how they reproduce stratified and unequal higher education across getting in, getting on and getting out of higher education, but also transformative possibilities. Thus, her work is shaped by concerns with real world injustices and the education practices that can sustain or dismantle such injustice in contexts where having a higher education can potentially reshape livelihoods and social mobility.

With the strapline 'Leading research and graduate capacity building in higher education and human development', the strategy for the next five years (2018-2022) is to strengthen the HEHD research group as an external-facing world-leading research group, generating high quality academic knowledge, but also expanding knowledge generation to include more engagement and impact with diverse stakeholders. The research group currently comprises six doctoral students, two master's students, six postdoctoral research fellows, three researchers and one office manager.

The research focus is on higher education's contributions to human development and capabilities and agency expansion - and hence to social justice and the public good in education and society. Through their research, the HEHD challenges inequalities in and through higher education for social justice and sustainable development. The Chair aligns its

work to the 2030 Sustainable Development Goals to guide conversations and choices for research and engagement activities, but also to locate work in the global development conversation. All research projects undertaken within the HEHD fall within three intersecting themes - Transitions and Trajectories; Knowledge, Curriculum and Pedagogies; and The Public Good.

A recently completed international partnership project on 'Pathways to personal and public good: Understanding access to, student experiences of, and outcomes from South African undergraduate higher education' (funded by ESRC-NRF), led by Paul Ashwin (Lancaster University) and Jenni Case (University of Cape Town), asked in what ways access to undergraduate education has a transformative impact on societies, what conditions are required for this impact to occur, and what are the pathways from an undergraduate education to the public good. The work rested on a conceptualisation of undergraduate higher education as comprising three aspects - access, experience of students within the system, and the impact these students have on society after graduation. The partnership brought together leading and emerging higher education researchers from South Africa, the UK and internationally. Prof Walker was one of the coordinators of the Access theme. This theme was valuable in revealing how thin the access to higher education research is in South Africa. The project culminated in a conference in Cape Town in November 2018, and an open access book *Pathways to the Public Good: Access, Experiences and Outcomes of South African Undergraduate Education* (P Ashwin and J Case [Eds.]).

The paucity of research on access revealed in the 'Pathways' project, led to a project on 'Access: Aspirations, choices and opportunities' (funded by the SARChI Chair), which aimed to understand the underlying complexities of higher education decision-making, choices and admissions processes by diverse students from different quintile schools. The project also sought to understand key points when aspirations and career choices are shaped, and what influenced the process of decision-making at different stages. Two interlinked projects were developed - a qualitative interview project which generated 54 in-depth student interviews, and a participatory photovoice project working with 11 'access' students to produce their own visual accounts of access and its challenges. Nussbaum's 'combined capabilities' was used to interrogate inequalities in the data from which intersecting contextual conditions and multi-dimensional capabilities emerged to shape agency and conditions of choice. The interpersonal comparisons revealed a picture of unfair access and the need for change. The project highlighted the need to consider admissions and to do so in an elite university context in further research.

A flagship research project with extensive external funding from ESRC-DfID, titled 'Inclusive (achieved) higher education learning outcomes for rural and township youth: Developing multi-dimensional capabilities-based higher education index' (or the 'Miratho' project), commenced in 2016. The project investigates how interaction and complex biographical, socio-economic, policy, and educational factors enable or inhibit pathways for rural and township youth to get in, get on, and get out of undergraduate higher education into further study or work, in terms of 'learning outcomes' achieved. Based on the findings, a normative multidimensional higher-education capabilities dashboard will be developed, taking into consideration how the capabilities approach can be applied analytically to multiple data sets in order to produce the dashboard, and how this

can be used to inform policy and practice interventions that confront the structural inequalities impacting on learning outcomes of students from challenging contexts. The project is undertaken in collaboration with Monica McLean (University of Nottingham), and in close partnership with the youth-led Thusanani Foundation.

Funding provided by the University of Nottingham and an NRF-grant supported a small-scale comparative longitudinal study of new academics in two universities in the UK - one elite (Nottingham), the other post-1992 (Bath). Fourteen academics were tracked over eight years, with three interviews each. The academics are women and men, of different nationalities and ethnicity, from different socio-economic backgrounds, and who started their careers in different types of university at different ages. The study explored how their characteristics and biographies influenced how they exercised agency in negotiating the shifting economic, cultural, social, political and historical landscape of work, as they established academic careers, as well as the transformatory contribution they made and make.

Research, ethics and theology

Prof Rian Venter, Department of Historical and Constructive Theology

There are many forms that the intersection between research and ethics can take, from the obvious ones, such as the percentage of similarity and ethical clearance, to the more subtle ones which focus on the nature of research agendas and paradigms employed. In theology a drastic shift to engaged research with a sensitive social antenna can be identified. One can label this turn as subversive ethics, ultimately motivated by a quest for justice.

A few examples of recently completed research in the **Faculty of Theology and Religion** illustrates this. Dr Lodewyk Sutton edited a volume of essays on 'Unheard voices in the Bible', and Rev Meyer van Wyk completed a research master's on the implicit ethics in the letter to Philemon, a book dealing with ancient slavery. 'Conflict and leadership' was investigated by Dr Joseph Pali, whilst Rev Martin Laubscher in three articles explored how liturgy functions ethically in the South African society. Poverty in informal settlements in the Mangaung area and the task of the church was investigated in an article by Prof Pieter Verster and Mr Bongani Ngesi. In July 2019 a conference on the Fourth Industrial Revolution and theology was organised by Prof Jan-Albert van den Berg, and the ethical implications of emerging technology were explicitly addressed. A volume of essays resulting from the conference will be published shortly.

These examples evidence that knowledge and research are never innocent or neutral. When an explicit ethical optic is used, academic endeavours could potentially contribute to a more just society.

Using evidence to design 21st century universities

Prof Francois Strydom, Senior Director: Centre for Teaching and Learning

Expanding access to higher education and increasing students' chances of success are two of the critical challenges facing higher education, not just in South Africa, but globally. Quality of education is the basic building block of all functions of a higher education institution. Quality is usually associated with other impactful words, such as excellence, accountability or performance. However, for **Prof Francois Strydom**, Senior Director of the **Centre for Teaching and Learning** (CTL), evidence is the critical factor and has become his rallying cry. The value of educational quality corresponds with how evidence, institutional data and research, is used to evaluate and reflect on past, current and future states. For Strydom and the CTL team, it is essential to build an evidence-based decision-making culture.

A focus on evidence allows for reflection on targets and progress, as well as creating a sense of accountability – factors central to quality teaching and learning. The UFS, through the CTL, has become a leader in research on student engagement, which is a key to success.

Student engagement data, obtained through survey and in-depth research, can further an evidence-based understanding of the time and effort students expend in using the resources that universities provide for their learning and personal development, and universities can use the data to improve conditions that support student success. Therefore student engagement research highlights the responsibilities of both students and institutions in success. The research brings a data-informed student perspective to institutional planning and policy development and allows institutions to promote effective educational practices aimed at enhancing the chances of success for all students and reducing the inequalities in society.

Due to their leading competence in this type of research, the CTL was asked to partner with the Universities South Africa (USAf) project on redesigning universities for the 21st Century. The project was a direct response to concerns that enhancing undergraduate students' learning experiences was not receiving adequate attention. Student engagement data provides a data-driven student voice that can form the centre of institutional design due to the proven theoretical and empirical research foundations in higher education research. A range of student engagement surveys are conducted by the CTL annually. The surveys include the Beginning

University Survey of Student Engagement (BUSSE), the South African Survey of Student Engagement (SASSE), the Lecturer Survey of Student Engagement (LSSE) and the Classroom Survey of Student Engagement (CLASSE). Nationally, 20 universities have participated in at least one survey over the past decade and the project also plays an important role in supporting other national initiatives, such as the Siyaphumelela project, which will now become the Siyaphumelela Network. The original Siyaphumelela project consisted of a partnership of five institutions, funded by the Kresge Foundation, to facilitate the use of data analytics to enable student success.

Beyond the Department of Higher Education and Training's (DHET) Higher Education Management and Information System (HEMIS) database, SASSE data provide the only other national databases on students in South African higher education. This resulted in a three-part series of publications in collaboration with USAf in 2018, titled 'Understanding Students'. These publications shared findings from the surveys on the kind of students we are enrolling at our universities, and what it is that they bring to the higher education environment, thereby helping institutions to develop environments that support success (https://www.usaf.ac.za/what-were-learning-about/).

The UFS, through the CTL, has long taken the lead in research on student engagement. Data from the CTL research has helped the University to better align teaching and learning, and design environments that put student success and quality at the centre of institutional thinking. Based on their research on student engagement, a range of high-impact practices have been implemented at the UFS. These are scaled practices, in that they reach a wide range of students, and are intentionally designed to optimise students' interactions with diverse peers and staff, and aimed at increasing students' development and success. Currently four support interventions are in place: Academic advising, the Academic Student Tutorial Excellence Programme (A_STEP), the compulsory UFS101 module aimed at providing support and strategies to assist students to successfully transition into higher education, and language development (through academic literacy modules and the Write Site).

The impact of these evidence-based support interventions is demonstrated by the SASSE and other data, where the UFS emerged for the last couple of years as leading other institutions in terms of engagement. SASSE data shows that UFS students participate more in academic advising and tutorials than students at other institutions. Student engagement and other data sources also show that UFS students are consistently more engaged than comparative institutions, generally satisfied with their educational experience, and appreciate institutional efforts to help them succeed.

Additional interventions aimed at increasing student success which have been started or are in development as a direct result of the research linked to the Siyaphumelela project, are an Early Warning System (EWS), Academic Advising Case Management System (CMS), Nudging, and Data Analytics Capacity Development Programme (DACD) to build analytics capacity inside the UFS.

In the words of Prof Strydom, "We need to meet our students where they are, rather than where we assume they should be. SASSE data enables us to use globally benchmarked and deeply contextualised measures to design a 21st century university."

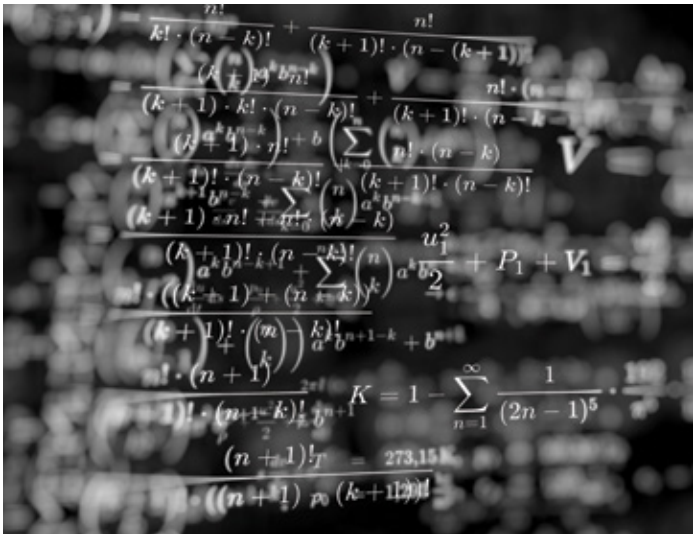
Achieving change in teaching science and mathematics

Prof Loyiso Jita, SANRAL Chair in Science and Mathematics Education

The **South African National Roads Agency SOC Ltd (SANRAL) Chair** is a rich and vibrant site of innovative research and coherent initiatives that are aligned and designed to achieve the hitherto elusive change in the teaching and learning of science and mathematics in schools, and for training high-level practitioners in the field.

The Chair was formally established by the UFS in September 2014, through an endowment from SANRAL, as a strategic intervention to improve science and mathematics education by developing excellence in research and the training of teachers in those strategic subjects. Significantly, the SANRAL Chair is the only research chair in the country that also focuses on Science Education, to complement the other research chairs in Mathematics Education at other universities. The current cohort of postgraduate students consists of 29 doctoral and 7 master's students

In 2017 the SANRAL Chair was approached by the Standing Committee on science, technology, engineering and mathematics (STEM) Education of the Human Resources Development Council (HRDC) to facilitate and host a discussion on the development of recommendations for a new science education curriculum for pre-service teachers. During 2018 and 2019 the Chair continued to convene and host these dialogues among science education experts from all universities in the country. This important role is positioning the SANRAL Chair as the nodal point for science education research in the country, as envisaged in the strategic objectives of the memorandum of agreement between the UFS and SANRAL.



The Chair is also becoming a nodal point for policy and practice in science and mathematics education and school change. This is demonstrated by the number of influential appointments of our graduates at national and local government level. A number of new scholars have also been mentored, who are now filling important positions in the academic environment.

Further evidence of the important impact the Chair is having at policy level, is the institutionalisation of the Lesson Study approaches to Professional Development of science teachers nationally. The institutionalisation of the Lesson Studies, through the formation of the Teacher Institutes, continues to be a strategic development that will improve training of teachers, and is likely to generate lasting and sustainable impacts on both teachers and the schools.

The twelve disciples of Nelson Mandela: A forgotten struggle?

Dr Chitja Twala, Vice-Dean: Faculty of the Humanities

To the majority of South Africans, the struggle for liberation centres around high-profile political leaders such as Nelson Mandela, Walter Sisulu, Govan Mbeki, Robert Sobukwe, Steve Biko, and others. Less known is the experience of a generation of young men who left South Africa clandestinely to build the African National Congress (ANC) and spread its liberation message in places abroad. These young men became known as the Twelve Disciples of Mandela. Like many other youngsters who became political activists elsewhere in the country, this group received its political conscientisation at school at the then Bantu High School (later known as Sehunelo High School) in Bloemfontein.

This group of youngsters came from the Mangaung township in Bloemfontein, and when they left Bloemfontein, they were destined to join uMkhonto weSizwe (MK) in exile. The formation of MK was announced on 16 December 1961. At the same time, MK began a sabotage campaign against strategic installations throughout South Africa. In a leaflet issued on 16 December 1961, the MK high command made its political allegiance quite clear by stating: "Umkhonto we Sizwe will carry on the struggle for freedom and democracy by methods which are necessary to complement the actions of the established national liberation organisations. Umkhonto we Sizwe fully supports the national liberation movement and calls on members, jointly and individually, to place themselves under the overall political guidance of the movement". During the initial stages of its formation, MK avoided openly mentioning the ANC for tactical reasons. MK sought to protect the leadership of the ANC from reprisals by the South African government, in particular those who had nothing to do with the decision to take the route of armed struggle.

It is clear from interviews conducted with the surviving members of this group that nobody knew exactly why they were called the Twelve Disciples, except that there was a plan conceived by Mandela, called the M-Plan, calling for the total restructuring of the ANC to enable it to operate underground should it get banned. However, although several authors such as Edward Feit, Karis and Carter, Nelson Mandela, and Bruno Mtolo and a number of court records provide information on the M-Plan, details are sketchy.

The group of young men from Bloemfontein were Billy 'Marakas' Mokhonoana (left the country earlier than the others and allegedly died in London); Selebano 'Tlhaps' Matlhape

(left for Tanganyika and later studied in Yugoslavia and East Germany); Theodore 'Max' Motobi (left for Tanganyika and underwent military training in Cuba); Moses 'Dups' Modupe (left for Tanganyika and later studied Economics in Yugoslavia); Benjamin 'Lee' Leinaeng (left for Tanganyika and later studied journalism in East Germany); Joseph Shuping 'Coaps' Coapoge (left for Tanganyika and later attended Lincoln and Temple Universities in the USA); Elias Pule Matjoa (worked in the Ministry of Communications in Tanzania and underwent military training in Cuba, where he later studied dentistry); Percy Mokonopi (received military training in Cuba and later served on the Helsinki World Peace Council); Mochubela 'Wesi' Seekoie (left for Tanganyika and underwent military training in Cuba, and later studied chemistry in the USSR); Matthew Olehile 'Beans' Mokgele (left for Tanganyika and became a professional boxer in exile, but following an injury, he went to East Africa and joined MK); Bethuel Setai (left for Tanganyika and later obtained a PhD in Economics from Colombia University, and taught at the University of California Santa Cruz, and Lincoln University in the USA); and Peter Swartz (an active member of the ANC from the coloured community in Bloemfontein, he met with the group in Dar es Salaam, following his arrest on his way to Tanzania. He attended Kivukoni College and later went to the UK where he attended the London School of Economics. He went missing in London in 1965, never to be seen again).

In honour of many of these unsung heroes, the history of the Twelve Disciples needs to be told to reflect what one could refer to as a 'bottom up' kind of history. Without doubt, this kind of history will add value to the country's historiography about the liberation struggle and demystify the one-sided narrative that the (Orange) Free State played little if no role at all in the struggle for liberation.

This opinion piece by Dr Chitja Twala, reflects on the sacrifices and roles played by the Twelve Disciples in the Liberation Struggle in honour of #Freedom Day.

Insights into the modern Muslim world

Prof Hussein Solomon, Department of Political Studies and Governance

Travel to Dubai or Doha and the intrepid traveller may well believe that the Muslim world is peaceful, prosperous and a shining beacon for tolerance. Yet, we know this is simply not true for the vast majority of the world's 1.8 billion Muslims. Militant movements like Al Qaeda and Islamic State have wreaked havoc across the globe. An often neglected aspect of media coverage of these terrorists is that their victims are overwhelmingly fellow Muslims. Civil wars rage across seven Muslim countries, authoritarianism and ethno-centric nationalism is the norm in others – all the while curtailing economic prospects for Muslim youth. Much of the reason for this condition lies in the fact that the Muslim world for more than a millennium has turned its back on democracy – believing it to be antithetical to the Qur'an, the Muslim Holy Book.

For the past 21 years, **Prof Hussein Solomon** has worked on Political Islam in an effort to marry Islamic texts with modern conceptions of liberal democracy. His latest book, *Islamism, Crisis and Democratization: Implications of the World Values Survey for the Muslim World* (Springer Nature, 2020), contains his most recent reflections on this pressing issue. His tone in the book is one of hope. Processes of urbanisation, modernisation and globalisation facilitated by modern technology have resulted in Muslim youth becoming more secular, liberal and egalitarian in their values. In the process hope emanates from the growing acceptance of the proverbial other as these societies become more tolerant.

New scientific and industrial challenges

5

We are living in an age of unprecedented advances in science and technology. The results are starting to permeate virtually every sphere of human and planetary life.

This includes major advances in information and communications technology, biotechnology, nanotechnology, artificial intelligence – the list goes on. And with these advances go ethical implications.

Within this theme, the UFS focuses on strategic and/or emerging areas - such as astronomy, energy, biotechnology, nanotechnology - as well as the implications of the Fourth Industrial Revolution. The research does not and should not take place in isolation. For technology to be effective, and locally and globally relevant, it has to be integrated, relating to all the other themes.

AGENDA 2063

#2 Well-educated citizens & skills revolution underpinned by science, technology & innovation

SDG

#4 Quality education

#9 Industry, innovation & infrastructure

NEW SCIENTIFIC & INDUSTRIAL CHALLENGES

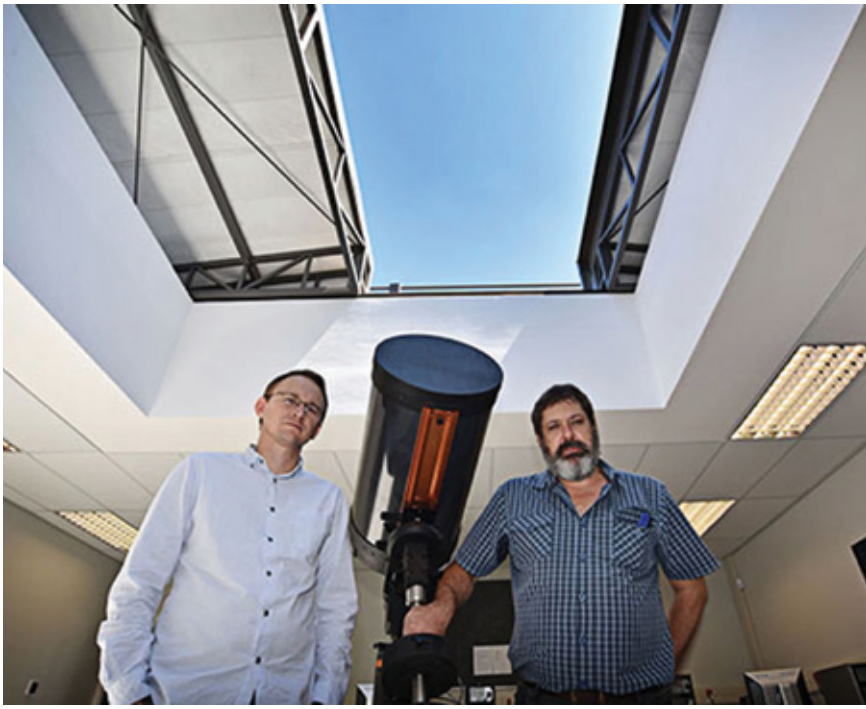
Super-novas, pulsars, nebulae, blazars, and all things celestial

Prof Pieter Meintjes, Department of Physics

Astronomy – the science that studies celestial objects and phenomena. The definition has an air of mystery about it, and early astronomers, noticing patterns in the sky, attempted to organise them in order to track and predict their motion. The image of an astronomer is one of a lone individual at a telescope during all hours of the night. But how things have changed!

Today astronomy is done with observations made at remote telescopes, controlled by computers, with very large multidisciplinary teams studying computer-generated data and images. The excellent reputation that the UFS **Astrophysics Research Group** has developed and the resources at their disposal, have made them an integral part of top flight international research teams. They are actively involved in the two major international gamma-ray astronomy collaborations, the High Energy Stereoscopic System (H.E.S.S.) gamma-ray collaboration, which operates telescopes in Namibia, as well as the newly created Cherenkov Telescope Array (CTA) collaboration, which operates two major telescope facilities – one in Chile and one at La Palma in the Canary Islands.

Prof Pieter Meintjes and **Dr Brian van Soelen** are members of the H.E.S.S. collaboration, which involves more than 220 scientists from universities such as the University of Oxford, the University of Leicester, and the University of Bordeaux. A study on pulsars, titled 'Resolving the Crab pulsar wind nebula at tera-electronvolt energies', was recently published in *Nature Astronomy*.



Dr Brian van Soelen and Prof Pieter Meintjes Andreas Viljoen

Pulsars are rotating neutron stars produced in supernova explosions that produce beams of radiation. As a result of the enormous mass squeezed into a small volume, these objects have the same density as that of an atomic nucleus. These extremely dense pulsars spin very rapidly and have enormous magnetic fields. For example, the pulsar at the centre of the Crab Nebula spins around its axis once every 33 milliseconds and possesses a magnetic field strength of the order of one tera-Gauss. For comparison, the average strength of the Earth's magnetic field is 0.5 Gauss, and the magnetic field

strength on the Sun ranges between 1 000 and 4 000 Gauss. Because of this super-strong rapidly spinning magnet, electric fields are induced that can accelerate particles such as electrons and protons to energies in excess of one tera-electronvolt. These neutron stars are thus extraordinarily powerful generators of electricity, which fills the surrounding cloud (supernova remnant) with super-high energy-charged particles that can produce, in turn, very high energy gamma rays through various processes, such as synchrotron radiation and inverse-Compton radiation.

The H.E.S.S. gamma-ray collaboration is but one collaboration that has studied this source intensively over the past few decades. Being the most powerful gamma-ray telescope facility currently operational, very careful analysis of the data revealed that the gamma-ray emitting region inside the nebula is about 10 times bigger in size than the region where the x-rays are emitted within the nebula. This has solved a long-standing question as to how big the gamma-ray emitting region within these supernova remnants are, compared to the region where the x-rays, for example, originate. The fact that the paper was accepted for publication in *Nature Astronomy* is testament to the importance of this finding in the high-energy astrophysics community.

The UFS-Boyden Observatory

The UFS-Boyden Observatory, situated some 25 km outside of Bloemfontein and run by the UFS Department of Physics, provides an excellent research and training facility which attracts valuable collaborations. Stable atmospheric environments and near perfect weather conditions were the main reasons for the establishment of the Observatory, which hosts several research class telescopes, of which the 1.5 m Reflector is the largest.

Adaptations and additions to the telescope during 2018 ad 2019, have significantly enhanced its capabilities. In 2018 the mirror was re-aluminised and the new coating of aluminium has dramatically increased the optical reflectivity and the performance of the telescope.

In 2019, through a collaborative agreement with the Appalachian State University (ASU) in North Carolina, a sophisticated spectro-polarimeter has been installed on the UFS-Boyden 1.5 m telescope. About ninety percent of what we know about objects in the sky comes from spectrography. Up till now, the UFS-Boyden Observatory has not had a spectrograph, so this instrument, mounted at the backend of the telescope, opens up a whole new set of possibilities, and will greatly expend the research capabilities of the telescope. Scientists will now be able to gain visual access to both the Northern and Southern Hemisphere skies.

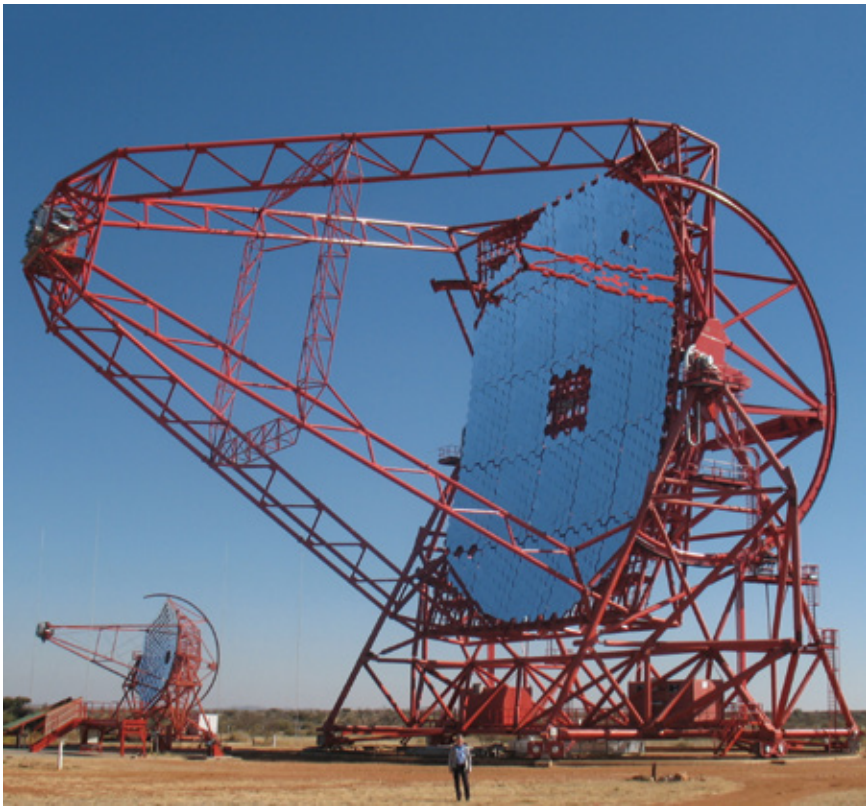
The instrument, valued at about 1.5 million Rand, enables the researchers to do simultaneous polarimetry and spectroscopy of astronomical sources – which is vital for the type of research being undertaken by the UFS Astrophysics Research Group. The polarimetry allows discrimination between radiation

produced via non-thermal processes, such as synchrotron radiation, and thermal radiation. The combined polarimetric-spectroscopic capability in one single instrument is unique. Combined with the fact that it is hosted on a research instrument that is utilised and maintained exclusively by the UFS Astronomy Group, gives this group a competitive edge in relation to most international astronomy groups. The availability of a sophisticated instrument of this nature will thus place the UFS Astrophysics Group in an elite bracket in terms of the available infrastructure for astronomical research.

The spectrograph was mainly developed and built by Dr Richard Gray, Professor in the Department of Physics and Astronomy at ASU, who is a world-renowned expert in stellar spectroscopy and co-author of one of the most influential textbooks on stellar spectroscopy, *Stellar Spectral Classification*. Dr Gray received a Fulbright Scholarship to spend the 2019-2020 academic year with the UFS Astrophysics Research Group, during which he will carry out research and teaching in the field of astronomical spectroscopy.

The possibility of making the UFS-Boyden 1.5 m telescope completely remote controlled is being investigated. This will serve the observational needs of researchers from both the UFS and ASU, with researchers at ASU able to access the telescope for their own in-house research programmes. The instrument will strengthen collaboration between the two institutions, and also brings with it the possibility of forging other international collaborations fro research, staff and student exchange and development, and training a new generational of astronomers.

Two other very important international agreements were negotiated and came into operation in 2019. The agreement between the UFS Astrophysics Group, University College of Dublin and the Agencia Estatal Consejo Superior de Investigaciones Científicas (CSIC) – the



The High Energy Stereoscopic System (H.E.S.S.) (2 of 5 panels)

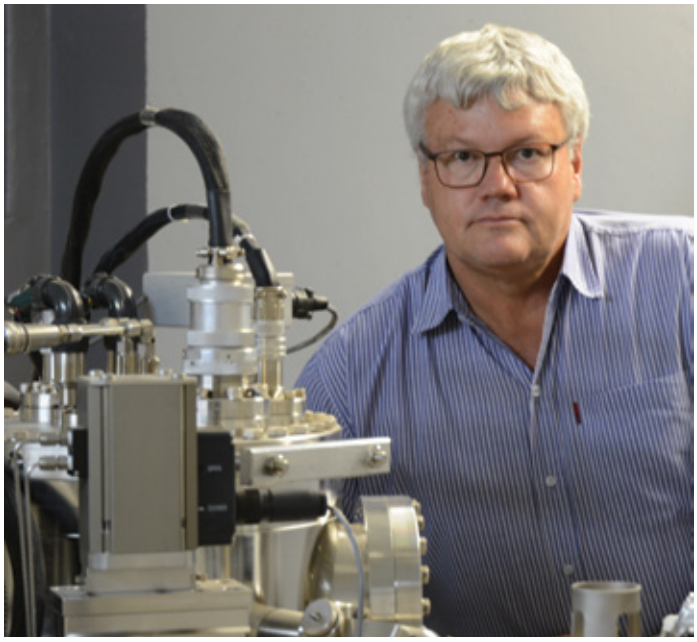
Spanish Research Council, will set up a robotic observatory (BOOTES-6) at the UFS-Boyden Observatory. This telescope will be devoted to the follow-up study of fast transients, especially the follow-up studies of colliding neutron star binaries and colliding neutron star-black hole binaries.

The research collaboration negotiated between the UFS Astrophysics Research Group and the Masaryk University in the Czech Republic, involves the installation of a 14 Celestron telescope that will be devoted to observational studies of astronomical sources of mutual interest.

The expertise, facilities and networks that make up the Astrophysics Research Group, enables them, in a very real literal and figurative sense, to reach for the stars. Added to that, the spin-off effects of fundamental research of this nature, cannot be underestimated.

Transparent solar panels

Prof Hendrik Swart, SARChI Chair on Solid-state Luminescent and Advanced Materials



The energy crisis in South Africa, with constant power outages, and no solutions in sight, has stimulated the debate around alternative sources of energy. But the imperative is more than just local - the search for alternatives is worldwide. Renewable energy is key to achieving sustainable economic, social and environmental development and it is paramount in any discussion on changes that can be made to address the effects of rising temperatures associated with climate change.

Two UFS researchers, **Prof Hendrik Swart** and **Lucas Erasmus**, are undertaking joint research with colleagues from Ghent University in Belgium, to find solutions for energy production. A revolutionary new type of window glass that also acts as a solar panel to capture the sun's energy for buildings, mobile phones and electric cars is the objective of this research collaboration.

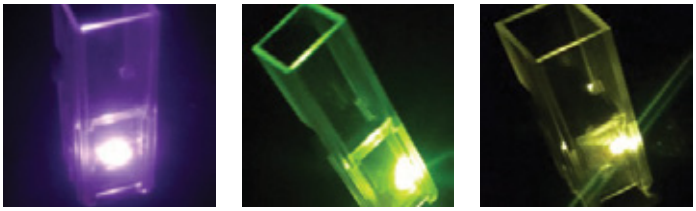
Glass that is transparent to visible light will be developed, incorporating phosphor materials, which will enable the light from the sun that is invisible to the human eye (ultraviolet and infrared light) to be collected, converted and concentrated to the sides of the glass panel where solar panels can be mounted. The study is on-going, and the UFS-based researchers are experimenting and testing different materials in order to optimise the device in the laboratory. The device will then be refined, made more efficient, upscaled, and brought to the market. It is envisaged that the technology will take about a decade to refine and implement.

This new product – in effect a transparent solar panel - will have the capacity to revolutionise the generation of power cheaply from the sun to power homes, factories and cities in a new clean way. Another possible application is in electric cars, where the windows can be used to help power the vehicle.

The researchers will also investigate implementing the technology into hard, durable plastics that can act as a replacement for zinc roofs. This will allow visible diffused light to enter housing and the invisible light can then be used to generate electricity. As the device concentrates the light from a large area to the small area on the sides where the solar panels are placed, the number of solar panels needed will be reduced, and therefore also the cost.

This research forms part of the **SARChi Chair on Solid-state Luminescent and Advanced Materials**, led by Prof Swart, a senior professor at the UFS. The Chair is mainly a research and capacity-building programme built around advanced and luminescent materials. Although most of the research conducted as part of the Chair is of a fundamental nature,

the materials developed may be applied in several applications. The phosphors can also potentially be used as temperature sensors in fire alarms and fire safety protection devices, fingerprint detection and cancer therapy. The current and planned broad research focus areas under the Chair include photonic materials; phosphors for various applications (such as field emission, flat panel and plasma displays; light emitting phosphors; solar cell efficiency improvement; long afterglow phosphors phototherapy; and sensor materials); advanced materials (catalysts and sensor); and theoretical modelling (nanomaterials).



The research group associated with the Chair currently comprises 8 researchers, 12 postdoctoral research fellows, 11 doctoral candidates, and 8 master's students. In addition, the group has active collaboration with research institutions in South Africa, Africa and abroad.

The zebrafish – punching above its weight

Prof Paul Grobler, Department of Genetics

Danio rerio, commonly known as the zebrafish, is a tropical fish belonging to the minnow family (*Cyprinidae*), kept in aquaria and now becoming increasingly indispensable for scientific research. In fact, it is one of the few species of fish to have been flown into space. But why is it so useful?

The zebrafish is a special animal to researchers because, in combination with its transparency, high fecundity and remarkable growth rate (passing from the egg to the larvae stage in less than three days), its complete genome sequence is known - and it turns out that it shares about 70% of the genetic code of *homo sapiens*. As a result, zebrafish are a unique model animal for biomedical research, including studies of biological processes and human diseases. As much as 84% of genes known to be associated with human disease, have zebrafish counterparts.

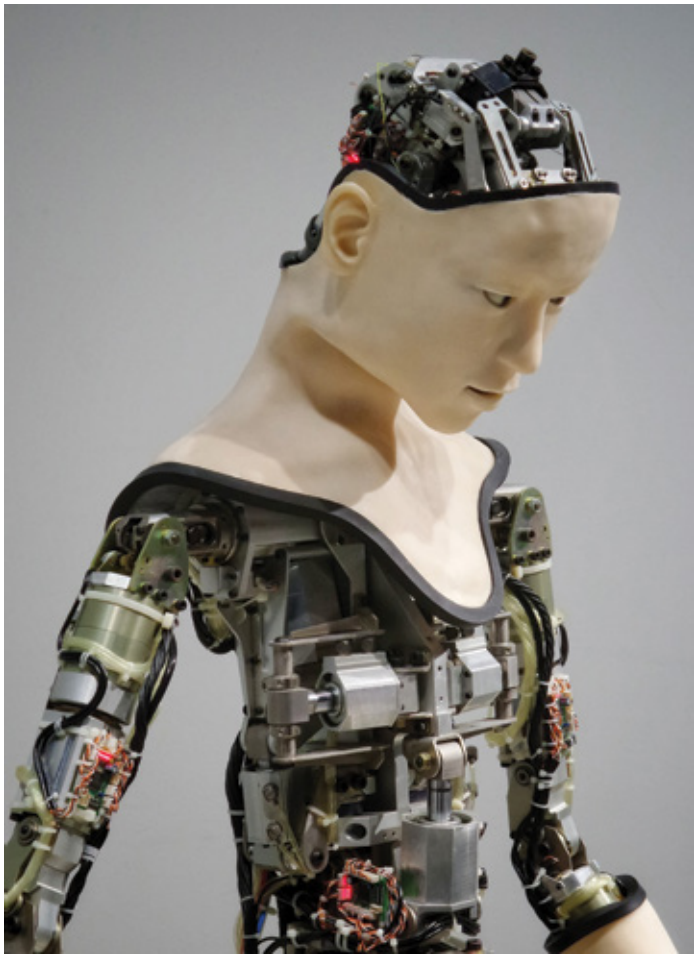
For genetic research groups, the zebrafish is an excellent test subject and is used in many labs to replace or to supplement higher vertebrate models, such as rats and mice. The UFS **Department of Genetics** started focusing on the potential of this tiny four-centimeter-long fish over two years ago. Current projects focus on using the zebrafish as a model for population genetic processes and adaptive genetic variation in higher vertebrates, and for investigating the link between genotype and the detection of illegal substances used in sport. In the near future, the zebrafish will also be used for training purposes. Besides the research being undertaken by **Prof Paul Grobler** and his team in the zebrafish unit, there are collaborative projects with researchers from the Department of Chemistry, the Department of Microbial, Biochemical and Food Biotechnology and the SA Doping Control Laboratory.

First zebrafish offspring RIËL COETZER / SUE-RICA SCHNEIDER

Gearing for the Fourth Industrial Revolution

Prof Heidi Hudson, Dean: Faculty of the Humanities
Dr Makeresemese Qhosolo, School of Social Sciences and Language Education
Dr Eduan Kotzé, Department of Computer Science and Informatics
Prof Jan-Albert van den Berg, Department of Practical and Missional Theology
Prof Philippe Burger, Pro Vice-Chancellor

The Fourth Industrial Revolution. 4IR. IR4. Industrial 4.0. The words (however formulated) invoke excitement in some, fear and caution in others, and scepticism in yet others. Be that as it may, we are in it and need to gear up for it.



The Fourth Industrial Revolution involves the integration of previous industrial revolution advancements that were characterised by mechanisation (1IR), electrification (2IR) and computers (3IR). The first three thus involved the dehumanisation of physical labour – making machines do the work, 4IR involves the dehumanisation of intellectual labour – making machines do the thinking. 4IR combines aspects from the physical, digital and biological spheres, resulting in cyber-physical systems that connect the human mind to digital technology, and create a mesh of the virtual, social and the physical worlds. This will impact all professions, economies and industries, and possibly even challenge ideas about what it means to be human. These emerging technologies include artificial intelligence (AI), augmented reality, robotics, nanotechnology, the Internet of Things (IoT), biotechnology, autonomous vehicles, 3D printing/manufacturing, digital innovation, quantum computing, and others that are still being conceptualised.

According to the World Economic Forum we stand on the brink of a technological revolution that will fundamentally alter the way we live, work, and relate to one another. We do not yet know just how it will unfold, but the response to it must be integrated and comprehensive, involving all stakeholders from the public and private sectors to academia and civil society, bearing in mind that nations, societies and communities

throughout the world are at different stages of change and transformation with regard to the Fourth Industrial Revolution.

The UFS Faculty of the Humanities has a strong and distinct voice with regard to 4IR, even challenging the ideological and historical laziness of terms and buzzwords such as 4IR. They argue that if we accept the concept as value-neutral, it might entrench the very inequalities that many argue it can overcome. 'Not seeing' the consequences in terms of unequal access to the technologies, unequal employment outcomes, unequal access to education, etc. is underpinned by a lack of attention to normative and identity issues. Accepting ordered hierarchy produced as a result of computational processes, and not realising how it works against fluidity and open-endedness of humanities research, is a real risk, embedded in which is the danger of the possibility of surveillance and authoritarianism, and thus the kernel of great threats to freedom and liberty.

In the opinion of scholars in the Faculty, the 4IR debate has, to date, been all about the Natural Sciences. In order to address this somewhat skewed debate, those in the so-called 'hard sciences' must accept their normative role, while the so-called 'soft sciences' (Humanities and Social Sciences) should claim their space to not only say what we should do, but how the world works.

The role of Humanities scholars should therefore consist of a combination of dimensions, aimed at bringing different disciplinary perspectives to bear to critically unpack the concept, and also to ground the 4IR concept in social science and humanities disciplines and inter-disciplines that are appropriate to the South African and African context. This would also include focusing on the interface between machine learning, robotics, biotechnology, and automation on the one hand, and humans on the other hand, and the specific contextual meanings where human creativity and technology innovation merge. We need to prepare our students for the challenges of acquiring technical and data literacy on the one

hand, and on the other, to figure out what we can do that machines cannot. Students must be trained to judge the ethical, legal, philosophical and political merit of machine-made decisions. One of the drawbacks of the current state of AI is that machines/software are able to generate decisions without being able to explain how these decisions were arrived at.

Although somewhat contested, the term Digital Humanities (DH) comes closest to what the Faculty of the Humanities stands for, i.e. an area of scholarly activity that lies at the intersection of computing or digital technologies and the disciplines of the Humanities. Within the Faculty a range of 4IR/DH-related projects are underway, including textual analysis tools (Afrikaans and Dutch); word frequency distribution studies (German); an edited volume on big data, *Reinventing the Social Scientist and Humanist in the Era of Big Data: A South African Perspective* (English – co-edited with colleagues from the Faculty of Natural and Agricultural Sciences); problems of 4IR for post-colony Africa in a religious environment, digital humanities for the southern hemisphere and Andersen-Forbes database of Biblical Hebrew (Hebrew); critiquing the 4IR concept and the socio-political impact of technology (Philosophy); and online radicalisation and new ways of funding terrorism (Political Studies and Governance).

Researchers in both the Faculty of the Humanities and the Faculty of Natural and Agricultural Sciences are involved in developing digital archives. The information era has brought new challenges with regard to heritage preservation and researchers from Computer Science and Informatics have been involved in establishing a digital archive as part of a heritage conservation and interdisciplinary research project. Other research undertaken within that department focuses on open source intelligence (OSINT) for conflict monitoring and security purposes in contemporary South Africa.

Often, the discourse on the 4IR is accompanied by promises of improved quality of life for societies and by warnings of its potentially disruptive effects. As for the Faculty of the Humanities, this dichotomy also poses serious questions for the Faculty of Theology and Religion. During the past half century, theology has been practised with an increased sense of context and perspective, and theologians have actively started to re-imagine their task in the light of multiple cultural and intellectual 'turns' – whether to language, to the other, to experience, to the post-metaphysical, or to the body. However, the determining impact of technologies has often been overlooked. The focus of a research project located in the Faculty of Theology and Religion is the new emerging reality that moves beyond the digital revolution involving cyber-physical systems, and the question as to how that relates to theology. A reciprocal and mutual interaction is envisioned – a challenge to theology and a challenge from theology. In July 2019, a number of prominent and influential thinkers from interdisciplinary fields participated in a conference on the topic 'The Fourth Industrial Revolution, emerging technologies and theology', hosted by the Faculty.

The Faculty of Education holds a somewhat different view, in the belief that the 4IR holds promise for greater access and more level playing fields when it comes to education. It is a common belief that teaching is a noble profession; however, after so many revolutions, teachers find themselves questioning the sustainability of their profession. Could a robot replace a teacher?

Should a robot replace a teacher?

Dr Makeresemese Qhosola, from the Faculty of Education, has been challenging these perceptions head-on for some time. She believes that the best approach to the challenges presented by the 4IR, is to embrace them, finding effective ways for humans to co-exist with technology, developing those uniquely human attributes, which she calls the '4 Cs' – compassion, collaboration, creativity and critical thinking.

In the higher education sector, 4IR preparedness means focusing on producing graduates with these qualities, increasingly making use of technology to expand teaching platforms, as well as driving innovation in curriculum content. In the 4IR the student is now in control of her/his own learning, because she/he can access the knowledge and its production through various media and platforms. Knowledge can be equally distributed and accessible to all. Through its technologies, the 4IR enables the student to be at different places at the same time, to interact with different peoples and knowledges. Teachers now have instruments to enrich learning far beyond what has been possible, and become the facilitators and mediators beyond the confines of the local. Classes can be flipped and real-life experiences virtually brought into the classrooms. Learning is ubiquitous. Former cultural divides are broken and cultural insularity in learning and research is no longer a hindrance. Access to a diversity of socio-historico-cultural contexts with their knowledges and ways of knowing become unlimited resources and sources of information to the learners at minimal cost.

These differing viewpoints are the substance of interesting and wide-ranging debate at the UFS.

Next Generation Sequencing Unit

Dr Martin Nyaga, Next Generation Sequencing Unit

Today's complex genomic research questions demand a depth of information beyond the capacity of traditional DNA sequencing technologies. Next-generation sequencing, a massively parallel sequencing technology, has filled that gap with its ultra-high throughput, scalability, and speed.

The UFS Next Generation Sequencing (UFS-NGS) Unit, established in 2016, provides services to both internal and external investigators requiring DNA sequencing – primarily for research projects**. Dr Martin Nyaga** oversees and leads all operations of the Unit. He is widely acknowledged for his work on the whole genome sequencing of animal and human rotaviruses – the most common cause of diarrhoea in children and infants worldwide, with over 250 000 children under the age of five dying from this virus annually, mostly in sub-Saharan Africa.

The UFS-NGS Unit, enjoys longstanding networking and collaborative ventures with renowned researchers in Africa, the USA, Australia and Europe – which in return, have contributed immensely to the research activities of the University as a whole. The Unit has received research awards from the World Health Organization, South African Medical Research Council, Poliomyelitis Research Foundation, and the National Research Foundation for different aspects of genomics research.

More recently a project funded by the Bill and Melinda Gates Foundation for the African Enteric Viruses Genome Initiative (AEVGI), involving four African countries (South Africa, Ghana, Malawi, and Cameroon), is investigating the long-term effects of the introduction

of monovalent rotavirus vaccine. Under the auspices of the AEVGI, the inaugural UFS-NGS Unit's Data and Bioinformatics Workshop was held in 2018, attracting over 90 participants from 15 national and international institutions.

During a visit to the University in 2018/2019 by a delegation from the United States-based Centers for Disease Control and Prevention (CDC), areas of mutual cooperation in pursuit of advancing research at the UFS-NGS Unit were identified and agreed upon, including acquiring CDC subsidised reagents from the International Reagent Resource (IRR), and capacity building. The CDC delegation was impressed with the advanced equipment at the UFS-NGS Unit, in particular the Miseq Illumina platform. This is a powerful state-of-the-art next generation sequencing system, which uses sequencing-by-synthesis technology capable of sequencing up to 15GB of high-quality filtered bases per run, with up to 600 base-pair read lengths. This allows the assembly of small genomes or the detection of target variants with unmatched accuracy, especially within homo-polymer regions.

RESEARCH REPORT
2018/2019


RESEARCH
OVERVIEW

2018/19 At a Glance

Research Capacity

171
NRF-rated researchers

42
Y-rated researchers

47%
Permanent Academic Staff with PhD

169
Research-related agreements and contracts (2019)

Next Generation Researchers

Postdoctoral Research Fellows

168
Postdoctoral Research Fellows

67 South Africa

25 Other SADC

36 Other African

40 Other countries

Postgraduate Students

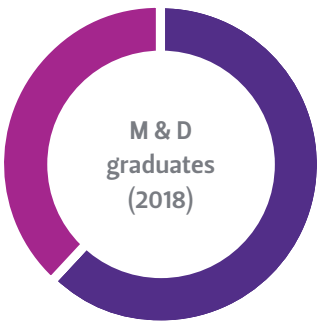
232
Research Master's Graduates (2018)

138
Doctoral Graduates (2018)

1039
Doctoral enrolments (2019)

38% White

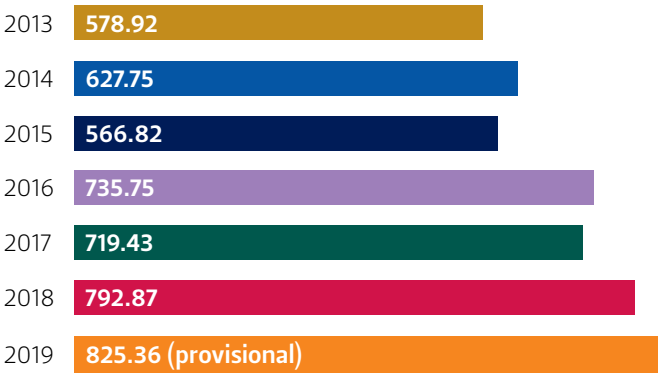
62% Black



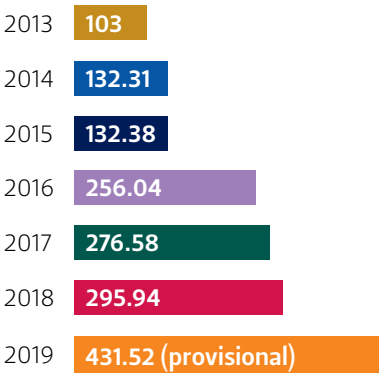
Research Productivity and Impact

Research outputs

Journal articles



Books/Chapters in books/
Published conference proceedings



Co-authored papers (2018/19)

1583

Total co-authored papers

16%

Co-authored papers in 10% most cited in relevant field

Source: Scopus

321 With South African scholars

321 With scholars from Africa (excluding South Africa)

941 With other international scholars

Clinical trials (2019)

7

Top NRF-Rated Researchers

Prof MJ Walker (A1),Centre for Research on Higher Education and Development

Prof MS Finkelstein (A2), Department of Mathematical Statistics and Actuarial Science

Prof J Neethling (B1), Department of Private Law

Prof ZA Pretorius (B1), Department of Plant Sciences

Prof L Scott (B1), Department of Plant Sciences

Prof HC Swart (B1), Department of Physics

Prof H Hudson (B2), Dean of the Humanities

Prof HM Melber (B2), Centre for Gender and Africa Studies

Prof JH Meyer (B2), Department of Mathematics and Applied Mathematics

Prof CL Miller-Naude (B2), Department of Hebrew

Prof A Roodt (B2), Department of Chemistry

Prof FJ Burt (B3), Department of Medical Microbiology

Prof PJ Meintjes (B3),Department of Physics

Prof JA Naude (B3), Department of Hebrew

Prof G Olivier (B3), Department of Philosophy

Prof SD Snyman (B3), Department of Old and New Testament Studies

Prof H Solomon (B3), Department of Political Studies and Governance

Prof DF Tolmie (B3), Department of Old and New Testament Studies

Faculty of Economic and Management Sciences

Key metrics

5
NRF-rated researchers

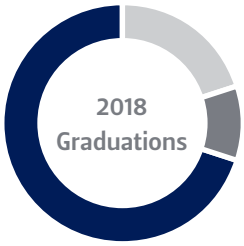
9
Postdoctoral Research Fellows

Research outputs

64.20
2018

52.09
2019 (provisional)

Postgraduate students



14 PhD

7 Master's by Research

49 Master's by Coursework & Research

100
PhD enrolments (2019)

296
Master's enrolments (2019)

Dean: Prof Hendri Kroukamp

Highlights from 2018/19

2018

New NRF rating: **Dr Deidre van Rooyen** (Centre for Development Support – Y2).

Prof Jacques Nel (Business Management) received an Emerald Literati award for the article 'Customer-brand engagement and Facebook fan-page "Like"-intention', published in the *Journal of Product & Brand Management*.

The book *Community and Mining in South Africa: From Small Town to Iron Town*, edited by **Prof Lochner Marais** (Centre for Development Support)**, Prof Philippe Burger** (Vice-Dean) and **Dr Deidre van Rooyen** (Centre for Development Support), was published, as part of a multi-disciplinary project.

Prof Philippe Burger (Vice-Dean), with 20 other economists, was invited to join President Cyril Ramaphosa for a round-table discussion on 'Strategies for long-term prosperity: What would it take to place South Africa on a high growth trajectory'.

A book by **Prof Philippe Burger** (Vice-Dean) titled *Getting it Right – A new Economy for South Africa*, was published.

2019

Prof Dave Lubbe (Accountancy) was honoured with the Lifetime Achievement Award by the South African Accounting Association (SAAA).

Dr Eugine Maziriri (Business Management) was included as a member of the Editorial Board of the *South African Journal of Entrepreneurship and Small Business Management* (SAJESBM).

The book *Peace Leadership: Self-Transformation to Peace*, edited by **Prof Ebben van Zyl** (Industrial Psychology) and Dr Andrew Campbell, was launched in West Palm Beach, Florida, USA, on the invitation of the International Leadership Association. **Prof Liezel Lues** (Public Administration & Management) and **Dr Martha Harunavamwe** (Industrial Psychology) contributed chapters to the book.

Dr Musawenkosi Saurombe (Industrial Psychology) was the winner in the Education category of the 2019 Mail & Guardian's 200 Young South Africans. This honour comes after being named the 2018/19 Youth Leader of the Year by the Institute of People Management for being Africa's youngest PhD graduate and contributing significantly to the talent management field.

Late in 2019 approval was granted for a new SARChI Chair on 'Strengthening urban economies: People, place, production and policy'.

Faculty of Education

Key metrics

3
NRF-rated researchers

4
Postdoctoral Research Fellows

Research outputs

51.87
2018

89.88
2019 (provisional)

Postgraduate students

30 PhD

41 Master's by Research

2 Master's by Coursework & Research

175
PhD enrolments (2019)

201
Master's enrolments (2019)

Research Centres/Chairs

SANRAL Chair in Science and Mathematics Education (Prof LC Jita)

Dean: Prof Loyiso Jita

Highlights from 2018/19

2018

Dr Makeresemese Qhosola (Social Sciences & Language Education) was invited to the American Educational Research Association (AERA) in New York.

Prof Mogege Mosimege (Mathematics, Natural Sciences & Technology Education), delivered his inaugural lecture in September 2018, titled 'Enhancing conceptual development and mathematical understanding through ethnomathematical research and approaches'.

2019

New NRF rating: **Dr C Beyers** (Education Studies – C3).

The Faculty of Education hosted the Annual Science for the Future Summit in September 2019. **Prof Cobus van Breda** (Mathematics, Natural Sciences & Technology Education) is the Programme Director of the UFS S4F, a partnership between the UFS and SANRAL.

Faculty of Health Sciences

Dean: Prof Gert van Zyl

Key metrics

13
NRF-rated researchers

17
Postdoctoral Research Fellows

Research outputs

68.82
2018

96.89
2019 (provisional)

Postgraduate students

13 PhD

17 Master's by Research

66 Master's by Coursework & Research

97
PhD enrolments (2019)

477
Master's enrolments (2019)

Research Centres/Chairs

RWM Frater Cardiovascular Research Centre

Next Generation Sequencing Unit

SARChI Chair in Vector-borne and Zoonotic Pathogens (Prof FJ Burt)

Top NRF-rated researcher

Prof FJ Burt, Department of Medical Microbiology (B3)

Highlights from 2018/19

2018

New NRF ratings: **Prof Daniel Franken** (Obstetrics & Gynaecology – C2), **Dr Martin Nyaga** (Next Generation Sequencing Unit - Y2), and **Prof Louise van den Berg** (Human Nutrition – C3).

The new **Cardiac Simulation Laboratory**, resulting from a partnership between Meditronic and the UFS, was opened. This represents a first in Africa.

The **Next Generation Sequencing Unit** hosted the inaugural NGS Data and Bioinformatics Workshop in June 2018, under the auspices of the African Enteric Viruses Genome Initiative (AEVGI), funded by the Bill and Melinda Gates Foundation.

Ronelle Jansen (Nursing) is part of an international multi-stakeholder project to provide adolescents with improved access to mental health services and care in primary health care settings, Other partner institutions are Turku University of Applied Science (Finland), Hamburg University of Applied Science (Germany), Riga Technical University (Latvia), University of Zambia and the Lusaka Apex Medical University (Zambia), and the Universities of Stellenbosch, Cape Town and Pretoria. The research is co-funded by the EU Erasmus+ Programme.

Annatjie Bouwer (Paediatrics & Child Health) won the UFS award in Recognition of Outstanding Research Support.

Prof Motlalepula Matsabisa (Pharmacology) was one of six researchers selected and recognised during the official launch of the South Africa and Jamaica Joint Research Projects and Indigenous Knowledge Technology and Innovation workshop held in Kingston Jamaica.

The World Anti-Doping Agency (WADA) announced the immediate and full restoration of the **South African Doping Control Laboratory's** (SADoCoL) accreditation in September 2018.

A workshop hosted by **Prof Felicity Burt** (Virology) and funded by NRF STINT SA-Sweden Collaboration, was held in December 2018, on 'Development of diagnostics and therapeutics for CCHFV'.

2019

New NRF rating: **Prof Anandan Moodley** (Neurology – C2).

The **School of Clinical Medicine**, in collaboration with SACRA, FARMOVS and the Free State Department of Health, hosted a Clinical Trials Capacity Building Workshop in November 2019.

The **Department of Human Genetics** has established two new national collaborations – one on cystic fibrosis, and the other on hereditary cancer syndromes.

Prof Corinna Walsh (Human Nutrition) was appointed Associate Editor of *Heliyon Scientific Research*, and to the Management Board of the *South African Journal of Clinical Nutrition*.

Anneke van der Spoel van Dijk (Medical Microbiology) won the prize for the best oral presentation in Microbiology at the PathRed 2019 Congress.

The South African Accreditation System (SANASD) endorsed the quality management systems of the UFS-based **National Control Laboratory for Biological Products** (NCL) as being of high standard according to the International Standards Organisation's requirements. The NCL also received a certificate of Good Manufacturing Compliance (GMP) from the South African Health Products Regulatory Authority (SAHPRA). These achievements are recognition that the NCL complies with specific international standards, making it a world class facility.

Faculty of the Humanities

Dean: Prof Heidi Hudson

Research Centres/Chairs

Centre for Gender and Africa Studies (CGAS)

Centre for Health Systems Research & Development (CHSR&D)

International Studies Group (ISG)

Indexicality Research Forum

Top NRF-rated researchers

Prof CL Miller-Naude, Department of Hebrew (B2)

Prof H Hudson, Dean (B2)

Prof HM Melber, Centre for Gender and Africa Studies (B2)

Prof G Olivier, Department of Philosophy (B3)

Prof JA Naude, Department of Hebrew (B3)

Prof H Solomon, Department of Political Studies and Governance (B3)

Key metrics

51
NRF-rated researchers

39
Postdoctoral Research Fellows

Research outputs

289.51
2018

356.16
2019 (provisional)

Postgraduate students

27 PhD

35 Master's by Research

33 Master's by Coursework & Research

169
PhD enrolments (2019)

324
Master's enrolments (2019)

Highlights from 2018/19

2018

New NRF ratings awarded to **Prof Michelle Engelbrecht** (CHSR&D – C3), **Prof Paul Fouché** (Psychology – C3), **Dr Kate Law** (CGAS – Y1), **Dr M Mwaniki** (Linguistics & Language Practice – C3), **Prof Nico Nortje** (Psychology), **Dr Oliver Nyambi** (English – Y1) and **Dr Asta Rau** (CHSR&D – C2).

Dr Cilliers van den Berg (Afrikaans & Dutch, German & French) was awarded the Ester Greeff Prize from the SA Akademie vir Wetenskap en Kuns.

The **Centre for Health Systems Research & Development** (CHSR&D), in collaboration with the University of Antwerp in Belgium, undertook a four-year randomised control trial, which aimed to scientifically assess the extent and sources of HIV and TB stigma among the healthcare workforce in the Free State and to refine and test innovative stigma-reduction interventions. During this project they trained 523 health care workers (49.2% of the entire hospital population across four hospitals) on TB-HIV stigma-reduction activities. The project was funded by VLIR-UOS (Vlaamse Interuniversitaire Raad [Flemish-Interuniversity Council]).

Prof Robert Peacock (Criminology) was elected as the president of the World Society of Victimology (WSV). He is the first from Africa to serve in the positon. Prof Peacock was also invited by the Catholic University of Pemambuco and the Federal Law University of Rio de Janeiro, to present his research, as a Visiting Professor, on topics related to decolonising research methodology, and African victimology. He delivered the keynote address 'Emerging victimisation patterns: A critical appraisal of conceptual theoretical frameworks with reference to the uniqueness of local context, generalizability and praxis in a globalised world', at the 9th Annual Conference of the Victimology Society of Serbia, in November 2018.

Prof Heidi Hudson (Dean) was the Claude Ake Visiting Professor at the Department of Peace and Conflict Research at Uppsala University and the Nordica Institute in Sweden, from September to November 2018.

Dr Oliver Nyambi (English) was awarded an Alexander von Humboldt Postdoctoral Fellowship. He will undertake the fellowship at Bayreuth University, Germany from May 2018 to August 2020.

Prof Willem Boshoff (Fine Arts) exhibited a body of sculptural work in the Pompidou Gallery in Paris, France.

Prof Neil Roos (International Studies Group and History) delivered his inaugural lecture in February 208, on the topic 'The souls of white folk: Histories of whites beyond whiteness'**.**

Prof Kobus Marais (Linguistics & Language Practice) delivered his inaugural address in May 2018, titled 'From DNA to ANC to LSD – to zero: Translating social/cultural emergence'.

Dr Anchen Froneman and **Gerda Pretorius** (Odeion School of Music) contributed to the book *Spirituality and Music Education: Perspectives from Three Continents*, edited by June Boyce-Tilman.

Prof Hussein Solomon (Political Studies & Governance) launched the book *African Security in the Twenty-first Century*, at the Archive for Contemporary Affairs on the Bloemfontein Campus in March 2018. In addition, a 736-page book *Research on Islam and Muslims in Africa: Collected papers 2013 – 2018* edited by Hussein Solomon, Glen Segell and Moshe Terdman, was published. This book, which evolved out of a collaboration between academics from the Department of Political Studies and Governance, and the University of Haifa, is the most comprehensive book undertaken on the subject, drawing from Political Science, History, Religious Studies, Anthropology and Economics.

2019

New NRF ratings awarded to **Prof Henning Melber** (B2-CGAS), **Dr O Ogunnubi** (Y2-CGAS), **Dr O Orrego-Carmona** (Y1-Linguistics & Language Practice), and **Dr Christian Williams** (C2-Anthropology).

Dr Jerry Mofokeng Wa Makhetha received an honorary Doctor of Letters (DLitt [*honoris causa*]) for his commitment to scholarships and his service to humanity, during the 2019 June Graduations.

As part of the ongoing dialogue on language policies and decolonising the curriculum, the **Department of African Languages** hosted a range of panel discussions in July 2019, under the theme 'Indigenous African languages and decolonisation: Revitalising African ways of knowing in a digital age'.

Prof Hennie van Coller (Afrikaans & Dutch, German & French) was awarded the DF Malan Medal by the SA Akademie vir Wetenskap en Kuns.

The publication, *JC Steyn en Afrikaans – 'n viering*, pays tribute to Prof Jaap Steyn, research fellow and former colleague at the UFS. The book, edited by **Profs Angelique van Niekerk, Hennie van Coller** (Afrikaans & Dutch, German & French) and Bernard Odendaal, was launched in October 2019, and serves as a celebration of Afrikaans as a language and discipline, and also covers the research areas which formed the basis of Prof Steyn's work

Prof Joy Owen (Anthropology) visited the University of Oxford from March to June 2019 as one of the TORCH Global South Visiting Professors. Her host was Prof Wale Adebanwi, Director of the African Studies Centre, and she was involved in the organisation of the conference 'Racialisation and publicness in Africa and the African Diaspora'.

The book *Victimology in Africa*, by **Prof Robert Peacock** (Criminology), was endorsed by the Desmond and Leah Tutu Foundation and described as a move away from the westernised approach to justice in Africa. The European Premiere of the work took place in Belgium at KU Leuven in October 2019. Prof Peacock served as a member of the International Scientific Committee of the 10th Annual Conference of the Victimology Society of Serbia – 'Victimisation and diversity: Towards a holistic approach to victimology and victims' rights', held in Belgrade in November 2019.

Prof Willem Boshoff (Fine Arts) exhibited a body of graphic works and small sculptures from March to June 2019 at Yorkshire Sculpture Park (YSP) in the United Kingdom. For his *Druid Walks* Prof Boshoff received the KykNET Fiesta Nomination for Best Achievement in Visual Arts.

Prof Cynthia Miller-Naudé (Hebrew) presented the 8th Hyvernat Memorial Lecture at the Catholic University of America, Washington, DC, titled 'Sentential Edges and Their Structures in Biblical Hebrew'.

Prof Cynthia Miller-Naudé and **Prof Jacobus Naudé** (Hebrew) were invited to deliver a paper titled 'Negative Polarity in Quantification Constructions in Qumran Hebrew' at the 9th International Symposium on the Hebrew of the Dead Sea Scrolls and Ben Sira, in Toronto in April 2019.

Prof Jacobus Naudé (Hebrew) presented the Van Selms Memorial Lecture at the Southern African Society for Near Eastern Studies at the University of KwaZulu Natal. His lecture was titled 'Translations of sacred texts and the shaping, reshaping and circulation of religious knowledge in monotheistic religions with written traditions: A Southern African perspective'. Prof Naudé also delivered an invited lecture at the Catholic University of America, Washington, DC, titled 'I must speak to you plainly. The Great Age of English Bible Translation'.

Prof Neil Roos (History) was appointed as the new editor of *The Journal for Contemporary History*, coinciding with the repositioning of the journal to be grounded in the Global South.

Dr Lazio Passemiers, a postdoctoral research fellow in the International Studies Group, published a book on six years of extensive research across three continents, titled, *Decolonisation and Regional Geopolitics: South Africa and the 'Congo Crisis', 1960-1965*.

Dr Rebecca Swartz, a postdoctoral research fellow in the International Studies Group, published a book on *Education and Empire: Children, Race and Humanitarianism in the British Settler Countries, 1833-1880*.

The brainchild of **Prof Kobus Marais** (Linguistics & Language Practice) a new interdepartmental research forum, called the **Indexicality Research Forum**, was launched in July 2019. The forum will study various aspects of the emergence of social-cultural reality – the ways in which we interactively work out understandings, meanings, norms and rules in communication.

Dr Kristina Riedel (Linguistics & Language Practice) visited the University of Essex, UK, from October to November 2019, as part of a British Academy Newton Mobility Grant held with Dr Hannah Gibson. This forms part of their research project on variations in Sesotho and Setswana as spoken in the Free State.

Prof Johan Rossouw (Philosophy) delivered his inaugural lecture, titled 'The soul of the academy' in February 2019.

Prof Hussein Solomon (Political Studies and Governance) received the UFS Book Prize for his book *African Security: Challenges and Opportunities*.

The South African Association for Language Teaching (SAALT) honoured **Prof Albert Weideman** (SA Sign Language & Deaf Studies) with a Lifetime Achievement Award for his contribution to research and practice in applied linguistics, test design, and curriculum development in academic literacy.

Dr Sethulego Matebesi (Sociology) received the Mellon Inclusive Professoriate Fellowship: Department of Earth and Atmospheric Sciences, at the University of Alberta, Edmonton, Canada, for the period May to August 2019.

Dr Chitja Twala (Vice-Dean and History) received the Mellon Inclusive Professoriate Fellowship: Centre for the Study of Political Graphics (CSPG) at the University of California, Los Angeles (UCLA) for the Anti-apartheid Digitisation Project from July to October 2019.

Faculty of Law

Dean: Prof John Mubangizi

Key metrics

5
NRF-rated researchers

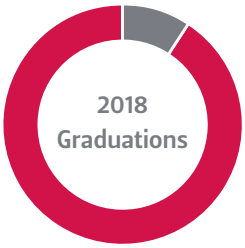
5
Postdoctoral Research Fellows

Research outputs

38.86
2018

58.78
2019 (provisional)

Postgraduate students



3 Master's by Research

29 Master's by Coursework & Research

Highlights from 2018/19

Dr Denine Smit (Mercantile Law) achieved a C3 NRF rating.

Justice Mahube Betty Molemela received the LLD (*honoris causa*) at the July graduations. Justice Molemela made history when she was appointed as the first female Judge president of the Free State.

Prof Shaun de Freitas (Public Law) delivered his inaugural lecture, on the topic 'Law's mystification of religion: Challenging the boundaries of the bizarre, the irrational and the supernatural'.

23
PhD enrolments (2019)

106
Master's enrolments (2019)

Research Centres/Chairs

Free State Centre for Human Rights

Top NRF-rated researcher

Prof J Neethling, Department of Private Law (B1)

Faculty of Natural and Agricultural Sciences

Key metrics

79
NRF-rated researchers

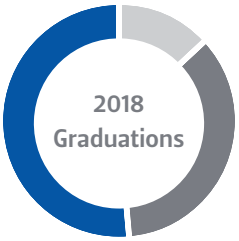
93
Postdoctoral Research Fellows

Research outputs

415.97
2018

407.23
2019 (provisional)

Postgraduate students



46 PhD

124 Master's by Research

178 Master's by Coursework & Research

433
PhD enrolments (2019)

872
Master's enrolments (2019)

Dean: Prof Danie Vermeulen

Research Centres/Chairs

Centre for Sustainable Agriculture, Rural Development and Extension (CENSARDE)

Centre for Environmental Management (CEM)

Disaster Management Training and Education Centre for Africa (DiMTEC)

Institute for Groundwater Studies (IGS)

SADC Groundwater Management Institute

SARChI Chair in Disease Resistance and Quality in Field Crops (Prof M Labuschagne)

SARChI Chair in Pathogenic Yeasts (Prof C Pohl-Albertyn)

SARChI Chair in Solid State Luminescent and Advanced Materials (Prof H Swart)

Top NRF-rated researchers

Prof MS Finkelstein, Department of Mathematical Statistics and Actuarial Science (A2)

Prof ZA Pretorius, Department of Plant Sciences (B1)

Prof HC Swart, Department of Physics (B1)

Prof L Scott, Department of Plant Sciences (B1)

Prof JH Meyer, Department of Mathematics and Applied Mathematics (B1)

Prof A Roodt, Department of Chemistry (B2)

Prof PJ Meintjes, Department of Physics (B3)

Highlights from 2018/19

2018

New NRF ratings were awarded to **Dr Richard Harris** (Physics – C2), **Dr V Kumar** (Physics – Y1) and **Dr VK Kumar** (Physics – C2).

A documentary on giraffes, 'Catching giants' by the National Geographic Society, in which **Dr Francois Deacon** (Animal, Wildlife & Grassland Sciences) played a leading role, won the award for the best feature film at the Wild Life Conservation Film Festival.

Mario van den Heever (Animal, Wildlife & Grassland Sciences) was awarded the Old Mutual Animal Science Student of the Year Award.

2018 marked the first year of the new PhD with Design programme, offered by the **Department of Architecture**.

Dr Hendrik Auret (Architecture) published a book titled *Christian Norberg-Schultz's Interpretation of Heidegger's Philosophy: Care, place and architecture.*

The **Department of Architecture** and the **Department of Urban and Regional Planning**, together with the Central University of Technology, and supported by the South Africa-Sweden Universities Forum (SASUF), jointly presented a research seminar on 'Urban Rural Dynamic'.

In April 2018 **Dr Falko Buschke** (Centre for Environmental Management) visited KU Leuven, Belgium, for a collaborative research project funded by the Global Minds Programme of the Flemish Interuniversity Council. The project explores the effects of environmental variability on biodiversity.

Dr James Brink, research fellow at the Centre for Environmental Management, and **Dr Lloyd Rossouw**, research fellow in Plant Sciences, published an article in *Nature Ecology and Evolution*, with Dr Michael Ecker from the University of Toronto as lead author. The findings described in the article 'The palaeoecological context of the Oldowan-Acheulean in southern Africa', provides the first extensive palaeoenvironmental sequence for the interior of southern Africa by applying a combination of methods for environmental reconstruction of Wonderwerk Cave, which have yielded multiple evidence of early human occupation dating back almost two million years.

For the first time since the **Department of Chemistry** was founded some 114 years ago, a single research group in Chemistry delivered five PhD students. This was achieved by the research group in Inorganic Chemistry, under the leadership of **Prof Andreas Roodt**, and colleagues **Dr Johan Venter**, **Dr Alice Brink** and **Dr Marietjie Schutte-Smith**.

Prof Vladimir Azov (Chemistry), who joined the UFS in 2018, delivered his inaugural lecture, titled 'Molecular receptors and devices: From natural examples to functional artificial systems'.

Gavin Dollman (Computer Science & Informatics) participated in fossil excavations at the Qhemegha Dino Bone Bed site in the Eastern Cape, working with the Evolutionary Studies Institute (University of the Witwatersrand).

The **Natural Language Processing** research group, under the guidance of **Dr Eduan Kotzé** (Computer Science & Informatics), reached an informal collaboration agreement with the Research Computational Research

Centre (CLiPS) at the University of Antwerp. Together they investigated the linguistic aspects of online hate speech, and undertook a study to predict the possibility of conflict from a big data perspective.

The **Department of Genetics** hosted the annual joint symposium of the South African Society for Genetics (SASG) and South African Society for Bioinformatics (SASBi) in October 2018.

Dr Karen Ehlers (Genetics) served as a member of the National Forensic Oversight and Ethics Board.

Prof Paul Grobler (Genetics) served on the editorial board of the Elsevier journal, *Mammalian Biology*. He also served on the Council of the South African Wildlife Management Association.

Prof Abdon Atangana (Institute for Groundwater Studies) delivered his inaugural lecture on the topic 'Understanding God's nature with non-local operators'. In 2018 he was also announced as one of the 25 early career scientists who were elected to form part of the third cohort of the African Academy of Sciences (AAS) Affiliates Programme, which recognises exceptional young African scientists. Prof Antana is editor of over 23 international journals of Applied Mathematics – including *Chaos, solitons and fractals*, and a reputable journal published by the American Institute of Mathematical Sciences. For both journals he is the only African to serve as editor.

The NRF approved a fifth SARChI Chair for the UFS – in Pathogenic Yeasts. The chair holder is **Prof Carlien Pohl-Albertyn** (Microbial, Biochemical & Food Biotechnology).

The **Department of Physics** hosted the South African Institute of Physics Annual Conference (SAIP 2018), in June 2018. A number of students won awards at the Conference – **DN Oosthuizen** (best PhD publication in Solid-state Physics and best PhD oral in Applied Physics), **Z Tshabalala** (best PhD oral in Solid-state Physics), **E Lee** (best MSc publication in Semiconductor**), L Erasmus** (best MSc oral in Solid-state Physics), and **MJ Mphuthi** (best MSc poster in Solid-state Physics).

Dr N Mbuma (Plant Sciences) won the prize for the best student oral presentation at the 12th Southern African Plant Breeding Symposium, held in March 2018.

Members of the **Department of Plant Sciences** were actively involved in the organisation of the international conference 'Sorghum in the 21st Century', held in April 2018. **Prof Maryke Labuschagne** and **Prof Neal McLaren** jointly chaired the Local Scientific Programme Committee, and **Lisa Rothmann** served as chairperson of the Student Chapter of the Sorghum in the 21st Century Global Conference. **Mamosa Ngcala** won the 3-Minute thesis competition for graduates at the conference.

Prof Botma Visser, Prof Zakkie Pretorius, Prof Liezel Herselman, Dr Willem Boshoff and **Corné Bender** (Plant Sciences) organised the very successful 'International Cereal Rusts and Powdery Mildews Conference (ICRPMC), held in September 2018.

Lisa Rothman (Plant Sciences) was awarded the American Phytopathological Society Books of the World Prize.

Prof Maryke Labuschagne (Plant Sciences) served on the scientific committee of the 13th International Gluten Workshop in Mexico City. She continued as South African representative of the American Association for Cereal Chemists International, and as a member of the advisory committee to the South African government on genetically modified organisms. She was also appointed to the editorial board of the *British Journal of Cereal Science*.

The official Memorandum of Understanding between Grain SA and the UFS **Department of Plant Sciences**, was signed. This deals with the administration of the South African Sclerotinia Research Network.

Prof Kahilu Kajimo-Shakantu (Quantity Surveying & Construction Management) was elected and inaugurated as the sixth and first female President of the Association of Schools of Construction of Southern Africa (ASOCSA). She was also appointed as the editor-in-chief of the journal *Acta Structilia*.

Prof Cornie van Huyssteen (Soil, Crop & Climate Sciences), delivered his inaugural lecture on the topic 'The world in a grain of sand'.

Stuart Denoon-Stevens (Urban & Regional Planning) is the primary investigator in the South African Planning Education Research (SAPER) project, jointly funded by the UK Economic and Social Research Council (ESRC) and the NRF as part of the Newton call for collaborative research in Higher Education in South Africa.

Dr Thulisile Mphambukeli and **Dr Victor Okorie** (Urban & Regional Planning), together with Prof Lere Amusan of North-West University, successfully hosted the first BRICS-PLUS Conference on the theme 'Water, Food and Health Nexus in BRICS-PLUS: Problems, Progress and Prospects' in September 2018.

Gerard de Jager (Zoology & Entomology) won the Junior Neitz Medal for the best MSc in Parasitology in South Africa, from the Parasitological Society of Southern Africa.

2019

New NRF ratings were awarded to 12 researchers - **Dr Anofi Ashafa** (C2 - Plant Sciences), **Dr Alice Brink** (Y1 - Chemistry), **Prof Maryna de Wit** (C3 - Biochemical, Microbial & Food Biotechnology), **Dr Mart-Mari Duvenhage** (Y2 - Physics), **Dr Richard Ocaya** (C3 - Physics), **Dr Marietjie Schutte-Smith** (Y2-Chemistry), **Dr Olihile Sebolai** (C2- Biochemical, Microbial & Food Biotechnology), **Prof Abrie van der Merwe** (C2-Mathematical Statistics & Actuarial Science), **Dr Brian van Soelen** (Y1-Physics), **Dr Julia Mofokeng** (Y2-Chemistry), **Dr Abiodun Ogundeji** (Y2-Agricultural Economics) and **Dr Anke Wilhelm** (Y2-Chemistry).

The UFS bestowed an Honorary Doctorate (DSc [*honoris causa*]) on **Dr Bernard Fanaroff**, former director of SKA SA, at its Winter Graduation Ceremony in June 2019.

Prof Ashok Chapagain (Agricultural Economics) delivered his inaugural lecture in March 2019. The title of his lecture was 'Counting Water: Simple yet Complex'.

The South African Society for Animal Science (SASAS) Congress, held in June 2019, was organised by the **Department of Animal, Wildlife and Grassland Sciences**.

Prof Frikkie Neser (Department of Animal, Wildlife & Grassland Sciences) received the LRF Award for a lifetime service to the livestock industry.

Dr Nacelle Collins (Centre for Environmental Management) received the Education and Skills Development Award during the National Wetlands Awards in October 2019.

Dr Shola Ololade (Centre for Environmental Management) was nominated and approved as a full member of Sigma Xi: The Scientific Research Honour Society.

A new X-ray Diffractometer to the value of R13 million, was purchased by the **Department of Chemistry** with funding from the NRF National Equipment Programme.

A cell culture laboratory is now operational in the the **Department of Chemistry**; thus, any synthesized compound can be tested for cytoxicity in-house.

Prof Jeanet Conradie (Chemistry) was co-author of an article that was displayed on the front cover of *Inorganic Chemistry* - Shan, W, Desbois, N, Pacquelet, S, Brandès, S, Conradie, J, Ghosh, A, Gros, CP, Kadish, KM, 2019. Ligand noninnocence in cobalt dipyrrin-bisphenols: Spectroscopic, electrochemical and theoretical insights indicating an emerging analogy with corroles.

The article by **Dr Marietjie Schutte-Smith, Prof Andreas Roodt** and **Prof Hendrik Visser** (Chemistry) titled 'Ambient and high-pressure kinetic investigation of methanol substitution in fac-[Re(Trop)(CO)3(MeOH)] by different monodentate nucleophiles' was invited to be published on the back page of *Dalton Transactions* (2019, 48, 9984-9997), due to the value of the research results.

An International PCT Patent, was filed by **Prof Andreas Roodt, Dr Alice Brink, Dr Pennie Mokolokolo** and **Dr Dumisani Kama** (Chemistry), in association with the University of Zurich, and accepted in June 2019.

Prof Jeanet Conradie (Chemistry) was Visiting Professor of Inorganic and Materials Chemistry at the Arctic University of Norway.

Organic Chemistry established the zebrafish bioassay unit in the Department of Chemistry.

The **Roodt Inorganic Chemistry Research Group**, in conjunction with collaborators from the University of Zurich, held the ReMec2: The International Symposium in Reaction Mechanisms in October/November 2019. The symposium was held under the umbrella of the Swiss South Africa Joint Research Programme (SSAJRP).

Adebola Musa and **Gavin Dollman** (Computer Science & Informatics) visited Appalachian State University as part of the University Staff Doctoral Programme.

An international group of researchers, including scientists from the UFS **Department of Geology**, the GFZ German Research Centre for Geoscience, the University of the Witwatersrand, and the Friedrich-Alexander University, received funding to the value of US$1.5 million from the International Continental Scientific Drilling Program (ICDP) to conduct scientific drilling in the Bushveld Complex, regarded as one of the most valuable mineral provinces on Earth.

With **Dr Hendrik van Heerden** (Physics) as their coach, three UFS students – **Shaun Redgard** (Chemistry), **Edward Lee** (Physics) and **Chantelle Booysen** (Human Molecular Biology Unit) – won the 2019 International Natural Sciences Tournament held in Estonia in February 2019.

In January 2019, **Prof Wynand Swart** (Plant Sciences) was elected as President of the Southern African Society of Plant Pathology. During the course of the year he negotiated the signing of a Memorandum of Understanding with the President of the American Phytopathological Society.

Lisa Rothman (Plant Sciences) won the John Taylor Floating Trophy, as first prize for PhD research at the New Voices Symposium, held in October 2019. She was also invited to join the international multi-disciplinary organisation Open Plant Pathology in a Junior Leadership position, to encourage Open Science practices in Plant Pathology.

As part of the Memorandum of Understanding between UFS **Plant Sciences** and GrainSA, the South African National Sclerotinia Network was officially launched in September 2019. This Network provides a platform for researchers, industry and producers to work together towards a management solution for Sclerotinia diseases in South Africa.

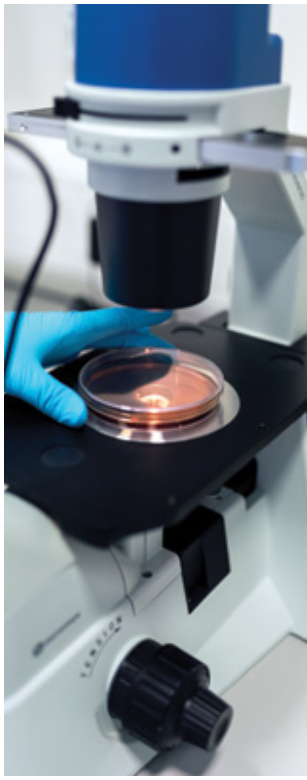
The research group led by **Dr Wynand Louw** (Plant Sciences) were contracted by Medigrow in Lesotho, with regard to the cultivation of cannabis in tunnels. The project started in November 2019, and will continue for two years.

The official Memorandum of Understanding between the UFS **Plant Sciences** and the Universidade Federal de Viçosa, Minas Gerais, Brazil, was signed. This will facilitate research collaboration and potential future exchange opportunities.

All academic staff members in the **Department of Urban and Regional Planning** contributed chapters in the book *Space and Planning in Secondary Cities: Reflections from South Africa*, edited by **Prof Verna Nel** (Urban & Regional Planning) and **Prof Lochner Marais** (Centre for Development Support).

Dr Frank Chidawanyika (Zoology & Entomology) received the Carnegie Corporation of New York Scholar award at the African Studies Association meeting in Boston, USA, in November 2019. He also acted as one of the Carnegie Fellows' panellists on the session on Climate Change in Africa.

Dr Antonie Geyer was named Agriculturalist of the Year by Agricultural Writers SA.



Faculty of Theology and Religion

Dean: Prof Rantoa Letšosa

Top NRF-rated researchers

Prof SD Snyman, Department of Old and New Testament Studies (B3)

Prof DF Tolmie, Department of Old and New Testament Studies (B3)

Key metrics

8
NRF-rated researchers

1
Postdoctoral Research Fellows

Research outputs

132.61
2018

175.08
2019 (provisional)

Postgraduate students

7	PhD
5	Master's by Research
21	Master's by Coursework & Research

42
PhD enrolments (2019)

50
Master's enrolments (2019)

Highlights from 2018/19

2018

New NRF ratings were awarded to **Dr Johanna Meyer** (Practical & Missional Theology – Y2) and **Prof Kobus Schoeman** (Practical & Missional Theology – C3).

Dr Joel Mokhoati (Biblical & Religious Studies), with collaboration from the Inter-Religious Forum (IRF), conceptualised and organised a conference on 'The Land Question? An Interchange Conference on Land and Religion' in September 2018. This provided a platform for various religious groups in the Free State to critically engage with the question of land, and add a unique voice to the socio-political debates on land restitution.

Dr Lodewyk Sutton (Old & New Testament Studies) organised a conference on 'Unheard voices in the Bible'. This conference, held in April 2018, focused on the unheard voices in the Bible and in our contemporary world – those voices in our community that are frequently ignored, suppressed ad discriminated against.

The International Colloquium for the Study of the New Testament (ICSNT) convened, with the aim of pursuing joint research projects between South African New Testament scholars and overseas scholars. **Prof Francois Tolmie** (Old & New Testament Studies) and Prof Jan van der Watt (University of Nijmegen) are co-chairs of the ICSNT.

2019

Extraordinary Professor Chris Hermans, delivered his inaugural lecture in February 2019, on the topic 'Theology in an Age of Contingency'. Prof Herman, a veteran researcher in pastoral theology, empirical and practical religious studies, is based at the Radboud University Nijmegen, in the Netherlands.

Prof Jan-Albert van den Berg (Practical & Missional Theology) delivered his inaugural lecture on 'Tweeting God: Finding the sacred in everyday life'.

Prof Kobus Schoeman (Practical & Missional Theology) delivered his inaugural lecture titled 'Re-imagining the congregation's calling – Moving from isolation to involvement'.

The Annual Tutu-Jonker Prestige Lecture was held in September 2019, and focused on dignity as the foundation for justice. The lecture was presented by Prof Nico Koopman (University of Stellenbosch), on the topic 'No future without forgiveness: The forgiveness logic of Desmond Tutu and Willie Jonker'.

Prof Kees Waaijman from the Titus Brandsma Institute for Spirituality in Nijmegen, the Netherlands, and Research Fellow of the **Department of Old and New Testament Studies**, delivered a guest lecture on '(Re)search for spirituality'.

Retired scholar Martin Prozesky, a research fellow in the **Department of Constructive and Historical Theology**, visited the Faculty to launch his new book *Honest to Goodness*.

South Campus/ Open Distance Learning

It is the task of the Research Unit, headed by **Dr Lynette Jacobs**, to strengthen the research capacity of the specialists in the different programmes and units on the South Campus. The Unit focuses on two broad areas:

- Open Distance Learning (ODL), exploring ways to expand access to higher education and developing innovative blended and online programmes; and
- Comparative and International Education, highlighting contemporary education issues within international education systems.

Prof Corene de Wet, a research associate on the South Campus, was the first woman to receive a full professorship in the Faculty of Education, and the first woman in the Faculty to obtain an NRF rating. She currently holds a C2 rating.

In 2018 **Prof de Wet** and **Dr Jacobs** were invited by Springer to contribute to a book series on workplace bulling, resulting in: De Wet, C & Jacobs, L. 2018. Workplace Bullying, Emotional Abuse and Harassment in Schools. In: D'Cruz, P, Noronha, E, Keashly, L, & Tye-Williams, S. (Eds.) *Special topics and particular occupations, professions and sectors*. Handbooks of Workplace Bullying, Emotional Abuse and Harassment, Vol 4. Springer: Singapore (pp. 1-34).

The Internet Broadcast Project (IBP), coordinated by **Eugene van Wyk**, focuses on the use of technology in school education as well as teacher development. The IBP makes innovative use of emerging and new technologies, and plans are underway to develop a mobile app that will allow learners to download lesson content and even share it.

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RESEARCH REPORT
2018/2019

Articles

The articles in this Report were prepared with the assistance of many people, whose contributions are gratefully acknowledged:

Ms Leonie Boleurs (Hidden flowers and little dragons)
Prof Danie Brand (The relationship between human rights and transformation)
Prof Philippe Burger (Gearing up for the Fourth Industrial Revolution)
Prof Felicity Burt (Targeting arboviruses with a one health approach; and The One Health Warriors)
Dr Stephanie Cawood (Gender –integral to Africanist research)
Dr Ralph Clark (The Afromontane Research Unit – reaching for new heights)
Dr Natasha Cronje (Sustainable food systems to ensure food security)
Prof Paul Grobler (The zebrafish – punching above its weight)
Dr Melissa Hansen (Tackling sustainability issues through trans-local research)
Prof Heidi Hudson (Gearing up for the Fourth Industrial Revolution)
Prof Arno Hugo (Sensory analysis for healthier foods)
Prof Loyiso Jita (Achieving change in teaching science and mathematics)
Mr Thabo Kessah (Working towards a healthier environment)
Dr Eduan Kotze (Gearing up for the Fourth Industrial Revolution)
Prof Maryke Labuschagne (Solutions to food insecurity)
Mr Eelco Lukas (Groundwater – out of sight but not out of mind)
Prof Lochner Marais (Sustainability of mining towns)
Prof Motlalepula Matsabisa (Pharmacology of traditional medicines)
Prof Pieter Meintjes (Super-novas, pulsars, nebulae, blazars, and all things celestial)
Dr Michelle Middle (FARMOVS)
Dr Martin Nyaga (Next Generation Sequencing Unit)
Prof Carlien Pohl-Albertyn (Superheroes in the fight against superbugs)
Dr Makeresemese Qhosola (Gearing up for the Fourth Industrial Revolution)
Dr Willie Shaw (Cervical cancer - new solutions in women's health)
Ms Lethiwe Sokhela (The Afromontane Research Unit – reaching for new heights)
Prof Hussein Solomon (Insights into the modern Muslim world)
Dr Sandy Steenhuisen (Hidden flowers and little dragons)
Prof Francois Strydom (Using evidence to design 21st century universities)
Dr Jan Swanepoel (Taking hands with emerging farmers)
Prof Hendrik Swart (Transparent solar panels)
Dr Chitja Twala (The twelve disciples of Nelson Mandela: A forgotten struggle?)
Prof Jan-Albert van den Berg (Gearing up for the Fourth Industrial Revolution)
Prof Johan van Niekerk (Sustainable food systems to ensure food security)
Prof Rian Venter (Research, ethics and theology)
Dr João de Deus Vidal (The Afromontane Research Unit – reaching for new heights)
Prof Botma Visser (Solutions to food insecurity)
Prof Melanie Walker (Challenging the inequalities of higher education for social justice)

RESEARCH

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