UFS/ARC/DOA

RESEARCH **CHAIRS**

ARC • LNR
Excellence in Research and Development

agriculture
Department:
Agriculture
REPUBLIC OF SOUTH AFRICA

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

REPORTING OBJECTIVE

This report is aimed at providing a cumulative established in Sustainable, high-level, consolidated overview of the progress achieved by the Research Chairs t in the Faculty of Natural and Agricultural Sciences at the University of the Free State (UFS), in collaboration with the Agricultural Research Centre (ARC) and the Department of Agriculture (DoA).

STRATEGIC BACKGROUND

Climate change and sustainable food production systems are currently key drivers of the national and global development agenda, and they will continue to do so for the foreseeable future. The agricultural sector is highly exposed to the impacts of climate change, especially in Southern Africa, where biophysical conditions for farming are already challenging.

Agriculture is contributing significantly to food security and employment, especially in the informal sector, and thereby supports the livelihood of millions of people. However, climate change poses a substantial risk to these livelihoods. On the other hand, the food sector is one of the main contributors to greenhouse gas emissions, responsible for up to 35% of all global emissions.

It is evident that there is a pressing need for holistic and interdisciplinary research unpacking the complex and multi-layered relationships between climate change and the agricultural sector, thereby contributing to climate change adaptation and mitigation in the agricultural sector, supporting policy development and implementation in this field, and steering the societal discourse on climate change and sustainable agriculture.

In order for the University of the Free State to be the global academic leader in sustainable agrifood systems, the establishment of a well-funded, sustainable research centre at the Department of Sustainable Food Systems Development within the Faculty of Natural and Agricultural Sciences is obvious.

To this end, the University of the Free State UFS), the Agricultural Research Council (ARC), and the Department of Agriculture (DoA), joined forces to establish seven Research Chairs in a bid to not only espouse research and the development of climate smart (resilient) agriculture, but also to support and drive technology transfer and methods to broaden the food base for diversification of the food basket. This collaboration, which commenced during the latter part of 2024, and is co-funded by the ARC and the UFS, aims to achieve this over a period of five years. The objective is to develop these Research Chairs, which are built on principles of inclusivity and the active involvement of younger researchers into world-class research hubs, securing their sustainability beyond the current funding, thereby advancing a transformational institutional culture that demonstrates the values of the UFS.

It aligns with the UFS Vision 130 by its aim to transform the future of the South African and African agrifood system through innovative climate smart research, empowering industry-ready leaders with world-class scientific, educational, and practical skills. This in itself will bolster South Africa's academic excellence, reputation, and impact on a global scale. This impact-driven research, based on innovation and engagement, has both global reach and local relevance, as it supports and drives the National Development Plan, Agenda 2063, as well as the United Nations Sustainable Development Goals.

Research Chair	SDG alignment	Agenda 2063	National Development Plan
1. Climate Change Impacts and Mitigation in Agriculture	1.5, 2.3, 2.4, 13.1, 13.2, 13.3, 15.3, 17.16	1, 5, 7, 10, 12, 18	Ch.3, Ch.5, Ch.6, Outcome 7, Outcome 10
2. Innovative Agro-Processing	1.5, 2.1, 2.2, 2.3, 3.4, 3.9, 4.3, 4.4, 4.7, 5.a, 8.3, 8.5, 12.3, 12.5, 13.1	1, 5, 7, 17, 18	Ch.3, Ch.5, Ch.6, Ch.10, Outcome 4, Outcome 7, Outcome 10
3. Agriculture Risk Financing	1.5, 2.3, 2.4, 8.10, 9.5, 13.1, 13.3, 17.16	1, 5, 7, 10, 12, 18	Ch.3, Ch.5, Ch.6, Ch.13, Outcome 4, Outcome 10
4. Sustainable Livestock Production	1.5, 2.1, 2.3, 2.4, 3.3, 3.9, 12.2, 12.5, 13.1, 13.2, 15.3, 17.16	1, 5, 7, 16, 18	Ch.3, Ch.5, Ch.6, Ch.10
5. Diversification of Plant Genetics	1.4, 1.5, 2.1, 2.2, 2.3, 2.5, 2.a, 3.4, 5.a, 13.1, 13.3, 17.6, 17.16	1, 5, 7, 17, 18	Ch.3, Ch.5, Ch.6, Ch.10, Outcome 7, Outcome 10
6. Communication for Innovation	1.4, 1.5, 2.3, 2.a, 4.3, 4.4, 4.5, 4.7, 4.c, 5.b, 9.b, 13.1, 13.3, 17.6, 17.9, 17.16	1, 6, 10, 17, 18	Ch.6, Ch.7, Ch.15
7. Impact Assessment of CSA	1.5, 2.3, 2.4, 13.1, 13.2, 13.3, 17.16	1, 5, 7, 12, 18	Ch.5, Ch.6, Ch.13, Outcome 7, Outcome 10

The seven Research Chairs are:

RC1: Climate change impacts and mitigation in agriculture, chaired by Prof. Linus Franke
RC2: Innovative agro-processing for climate-smart food systems, co-chaired by Dr Alba du Toit and Prof. Wilna Oldewage-Theron
RC3: Agriculture risk financing, chaired by Prof. Cobus Oberholster
RC4: Sustainable livestock production, chaired by Prof. Arno Hugo
RC5: Breeding climate resilient vegetables and grains, chaired by Prof. Maryke Labuschagne
RC6: Communication for innovation, chaired by Prof. Hlami Ngwenya
RC7: Impact assessment of climate-smart intervention, of which the Chair is Prof. Johan van Niekerk.

The collaboration commenced in earnest during the latter part of 2024 with some Chairs actively commencing activities, whilst the other remaining Chairs were being appointed. Professors Oldewage-Theron, Oberholster, and Ngwenya were headhunted in November 2024, but only joined the team over the course of the past few months, for example, Prof. Oldewage-Theron in June 2025 and Prof. Ngwenya joining in August 2025.

CHAIRED BY
PROF. LINUS FRANKE

RESEARCH CHAIR 1

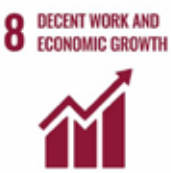
CLIMATE CHANGE IMPACTS AND MITIGATION IN AGRICULTURE CHAIRED BY PROF. LINUS FRANKE

Driving SDGs 1, 2, 6, 8, 9, 12, 13, 15

Targets 1.1, 1.2

Targets 2.1, 2.4

Targets 6.4, 6.5.



Target 8.2

Targets 9.5, 9b

Target 12.2.

Target 13.2.

Targets 15.1, 15.3, 15.8

Background

A Research Chair in Climate Change Impacts and Mitigation in Agriculture allows for the consolidation and major expansion of the expertise and research related to this topic, both at the UFS and the ARC. While there is substantial knowledge available in this field at both institutes, it tends to be scattered over sections and departments. The Research Chair will assist to put the UFS and the ARC regionally and nationally at the forefront of this field and contribute substantially to scientific and societal debates on the relationship between climate change and agriculture.

The overarching objectives of this Research Chair is to increase agricultural productivity and production in the face of changing climatic conditions, promote sustainable use of ecosystems and natural resources in agricultural landscapes and to enhance the resilience of agriculture and rural livelihoods to climate variability and extreme events. Furthermore, it aims to build a skilled and innovative agricultural sector through targeted research, knowledge generation, and capacity development, which will contribute to a skilled and capable agriculture sector.

The Research Chair in Climate Change and Agriculture is headed by Professor Linus Franke

Throughout his career, Professor Franke has worked on a wide array of topics related to crop production, food security, climate change and agricultural sustainability. Key tools he has used in his work include field experiments, farmer surveys, crop and farm simulation modelling, and advanced data analyses. Linking detailed crop research to wider questions about climate change, sustainability, and rural development is a key strength of his.

He implements projects on soil carbon dynamics of agricultural lands, resource use efficiency in irrigated crop production, and research on smallholder farming systems across Africa. He is also leading an intra-Africa mobility grant facilitating the exchange of students across universities in Africa. He has published 138 articles and reports and has an h-index (Google scholar) of 34.

STRATEGIC **OBJECTIVES**

Climate change and sustainable food production systems are currently key drivers of the national and global development agenda, and they will continue to do so for the foreseeable future. The agricultural sector is highly exposed to the impacts of climate change, especially in Southern Africa, where biophysical conditions for farming are already challenging. The objective of this Chair is to focus on holistic and interdisciplinary research, unpacking the complex and multi-layered relationships between climate change and the agricultural sector, thereby contributing to climate change adaptation and mitigation in the agricultural sector, supporting policy development and implementation in this field, and steering the societal discourse on climate change and sustainable agriculture. The joint ARC–UFS research chair provides a critical contribution to this field by bringing together and integrating the excellent subject knowledge available in these fields at the two institutes, aimed at an increase in agricultural production and productivity, creating sustainable ecosystems and natural resources, enhancing the resilience of agriculture, and providing a skilled and capable agriculture sector.

Specific research objectives are:

1. Climate change impacts
   - Historical and future climate changes.
   - Current and future impacts of climate change on productivity of crops, pastures and livestock.
   - Early warning systems for farmers.
2. Carbon connections
   - Soil carbon sequestration as affected by management of crops and pastures.
   - Impacts of soil C on soil functions.
   - C modelling coupled to remote sensing data to upscale soil C measurements over space and time, including assessments of the carbon sequestration potential of larger geographic areas.
   - Impact of soil C changes on the hydrology of landscapes.
   - Credible carbon credit schemes for farmers with improved methods to estimate actual sequestration.
3. Carbon footprinting
   - Quantifying greenhouse gas fluxes from soils (N2O, CH4, CO2) and upscaling flux measurements over space and time using models and remote sensing.
   - CH4 emissions by ruminants as impacted by genotypes, veld type and management (feed).
   - Rumen manipulation to reduce methane emissions.
   - Quantifying the C footprint of diverse crop - livestock production systems and agricultural products.
   - Carbon tax implications for the agricultural sector.
   - To enhance understanding of the interactions between climate change and agricultural impacts, and knowledge on options to adapt to the impacts of climate change. This is based on climate model predictions, crop and livestock production model simulations, micro-meteorological field studies, remote sensing applications, and an improved understanding of farmers' current responses to extreme weather conditions in both large-scale commercial and smallholder farming systems.
   - To play a key role in creating awareness in society on climate change and the large impact it has, and will have on agriculture, based on thorough understanding of state-of-the-art research in this field. The Research Chair should play a major role in steering the societal debate on the interactive relationship between climate change and sustainable agriculture.

PROGRESS HIGHLIGHTS

CAPACITY BUILDING:

Academics involved in the chair

The following academics from the UFS are currently activity involved in the chair's activities:
- Prof Linus Franke is the chair holder
- Prof Johan van Tol, Soil scientist, Hydropedology
- Prof Elmarie Kotze, Soil scientist, Soil Biology and Carbon Sequestration
- Dr. Neo Mathinya, Soil scientist, Farming systems analyses
- Dr. Elmarie van der Watt, Plant physiologist, Biostimulants
- Dr. Nkosinathi Kaptein, Micro-meteorologist

Personnel under the chair
- Ms. Minnie Mbokazi was appointed in May 2025 to provide administrative support to the Chair.
- Ms. Anneline Bothma was appointed through the chair's funds as a coordinator of the course CLIM7900
- Mrs. Nozidaba Radebe provides technical support to the chair for the operation of micro-meteorological equipment used in the field. She doesn't receive a salary through the chair.

Students under the chair

The start of the chair coincided with the selection of students under the CaReFoAfrica academic mobility project funded by the European Union with Prof Franke as Principal Investigator. The project facilitates mobility of students and staff between African universities in Kenya, Uganda, DRC, Benin and South Africa to build capacity in the field of climate change. The degrees funded under this project at the UFS directly contribute to the goals of the chair. Three students have been selected for degree-seeking bursaries at the UFS under this programme:

- Mr Daniel Isdory: PhD in Soil Science, beneficiary of a bursary in the CaReFoAfrica project. His research will focus on salinity stress in irrigated crop production schemes with smallholders in Tanzania. Mr. Isdory's promotors, Profs van Tol and Franke, visited him and his field site in Tanzania in October 2025.
- Mr Yasin Mohammed: PhD in Agrometeorology, beneficiary of a bursary in the CaReFoAfrica project. His research will focus on quantifying climate change impacts on crop production in Ethiopia. Mr. Mohammed continued his research. He obtained historical weather data from a large number of weather stations in Ethiopia and is currently analysing the data.

Four students supported by CaReFoAfrica project are expected to start an M. degree in Sustainable Agriculture at the UFS in 2026:
- Ms Irene Nagudi (Uganda)
- Mr. Moise Byiringiro (Rwanda)
- Ms. Edinah Shikoli (Kenya)
- Mr. Dawit Temesgen (Ethiopia)

– **Three more students will join the chair for about 10 months of credit-seeking mobility in 2026:**
- Ms. Janet Tutah (Kenya)
- Ms. Tigist Gebremedhin (Ethiopia)
- Mr. Mohammed Beshir (Ethiopia)

The following postgraduate students receive financial support through the chair:

- Mr Stefan Steenekamp: PhD in Agronomy, research on the use of biostimulants to help potato cope with drought, heat and cold stress induced by climate change. The research is done in collaboration with the private company InteliGrow and the University of Pretoria providing greenhouse space. Mr. Steenekamp sucessfully presented his research proposal to the department in October 2025. He is currently carrying out greenhouse trials.
- Mr. Sibalekile Ayabonga, PhD in Soil Science. The research focuses on carbon sequestration in rangelands of South Africa as affected by grazing management. Mr. Ayabonga has started his field work at sites nearby Vryburg and Aliwal Noord.
- Mr. Brian Sakala, PhD in Soil Science, focussing on soil carbon saturation potential as a concept to improve the quantification of carbon sequestration in agricultural soils. Mr. Sakala also started his field work by taking soil samples in rangelands. He is also analysing a large historical soil data set from South Africa to identify maximum soil carbon values for certain soil type, land use and rainfall combinations.
- Ms. Lisbeth Chauke, PhD in Agronomy. She started her PhD in March 2025. Her research will focus on biostimulants to improve tolerance to abiotic stresses and enhance nitrogen fixation in soybean. She planted two trials with soybean: a greenhouse trial and a field trial at Kenilworth experimental farm.
- Mr. David Shipingana, M.Sc. in Soil Science, research on the impact of bush removal on soil carbon dynamics in rangelands in Namibia.
- Mr. Jacobus Kotze for a postdoctoral position in the Department of Soil, Crop and Climate Sciences. He brings much-needed advanced quantitative skills for digital soil mapping, artificial intelligence, and hydrological modelling into the chair. This will be valuable for upscaling soil C measurements from field to landscape levels and assess implication thereof for hydrology of watersheds. He completed his PhD this quarter and will start as a postdoctoral researcher in the chair from January 2026.
- Mr . Batande Ndzelu was recruited as a postdoctoral researcher under the chair and will start in January 2026 as well. His work will focus on quantifying and modelling soil gas fluxes using the soil gas flux system obtained through the NRF NEP grant.

Graduate Teaching Assistants (GTA). The Regional Universities Forum for Capacity Building in Agriculture (RUFORUM) in partnership with Mastercard Foundation partially funded three PhD positions under the Research Chair. The positions will be co-funded by the Chair. The GTA programme seeks to strengthen universities and TVET institutions to better serve communities by skilling and empowering Africa's young people and their institutions to drive inclusive, equitable and climate resilient transformation of agriculture and agrifood systems. The three GT positions (two in Soil Science and one in Agrometeorology) have been advertised through the RUFORUM network. A candidate for a PhD in Soil Science has been selected (Mr. Vincent Katonda from Malawi), while the two other positions will be re-advertised.

Research projects under the Chair:

1. CaReFoAfrica - Capacity Building for Climate-Resilient Food Systems in Africa

This EU-funded project with Prof Franke as PI is still running smoothly. The project is currently advertising for applications for credit-seeking bursaries, traineeships and staff mobility. A candidate for a PhD in Soil Sciences has been selected (Mr Vincent Katonda from Malawi). Through the project, Prof Franke organised and presented an online training on climate change on May 22 2025, which was attended by 130 registered participants from across Africa. Prof. Franke also organised a training session on internationalisation of higher education in Africa as part of the project on March 13 2025. This training was also well attended with 121 registered participants. Numerous students will visit the UFS in 2026 through the project for short-term mobility.

2. NatuRA – Sustainable use of natural resources in Alpine and mountain grassland ecosystems under global change.

The project is led by Dr Ralph Clarke from the Afro Montane Research Unit at the QwaQwa campus of the UFS and funded by the Norwegian government and South Africa's National Research Foundation (NRF). The chair will contribute to the project through farming systems analyses of herding communities in the Drakensberge, and assessment of soil carbon and evaluation of carbon sequestration potential as affected by grazing management in the Drakensberge. Representatives from the University of Bergen, Norway, and Prof. Franke attended the Southern African Mountain Conference in March 2025. This opportunity was used to organise a planning meeting.

3. MASSTER - Managing South Africa and Senegal Sustainability Targets through Economic-diversification of Rural-areas.

This project is funded by the European Union and led by Weihenstephan Triesdorf University of Applied Sciences (HSWT) in Germany. The project contributes to training of farmers in South Africa. Prof. Franke will be responsible for the climate change component in this project.

4. NRF – National Equipment Programme

Prof Franke submitted a proposal to the NRF, National Equipment Programme, to obtain funding (R6.94 M) for a gas analyser and automated gas chambers to measure greenhouse gas fluxes from soil in 2024. This proposal was positively evaluated and project funding had been obtained. Subsequently, the system was purchased and arrived at the UFS. Preparations are ongoing to deploy the system in the field. The new system will provide a great opportunity to conduct state-of-the-art research, in collaboration with the South African Eart Observatory Network (SAEON) on the role of agricultural soils in South Africa as a source and sink of greenhouse gases (CO_2, N_2O, CH_4) in South Africa and how this is affected by management. The equipment will be complementary to the two eddy covariance systems available in the department to measure gas (H_2O and CO_2) fluxes over larger surface areas. This system will also provide ample opportunities for new postgraduate student research under the chair.

Local and international travel – knowledge sharing and training:

Prof Franke visited the Southern African Mountain Conference, March 17-20, Champagne Valley, and gave two oral presentation:

- Farming Systems Analysis to Explore Pathways for Rural Livelihoods in Mountainous Areas: A Case Study with South African Smallholders.
- Land-based Carbon Credits: Setting the Scene.

He also co-organised a special session on soil carbon sequestration in mountainous areas during the conference and participated in the scientific committee that reviewed abstracts submitted for presentation at the conference.

Prof. Franke visited Stellenbosch University March 3-7 to contribute to an external evaluation of the Agronomy Department at the University.

Prof. Franke and Dr Mathinya visited a meeting of the South African Agroecology Knowledge Network at Fleurdal (W Cape) May 26-28. This meeting focused on developing research capacity in the field of agroecology. Dr Mathinya and Prof. Franke will lead a group that will focus on climate change and agroecology.

He attended a workshop organised by the South African Circular Agriculture Initiative on June 26 in Pretoria. A MASSTER project planning meeting and train-of-trainers event was held in Bloemfontein and Stellenbosch from 28 January to 5 February 2025. Furthermore, he attended the Combined Congress in Polokwane, 20 to 23 January 2025, and delivered an oral presentation on carbon sequestration in South African rangelands.

Prof. Franke attended the ARC/UFS workshop in Pretoria 12–14 August 2025 to the discuss the positioning of the Chair and to establish contact and future collaboration opportunities as well as share insights and knowledge regarding the Chair with ARC mirror Chairs.

Profs Franke and Van Tol visited Tanzania Sep 29 – Oct 3 to assess the field work by PhD student Mr. Daniel Isdory.
Prof. Franke conducted site visits for soil sampling in rangelands in the vicinity of Vryburg (North West) and Aliwal Noord (Free State, Eastern Cape).

Thesis and conference full length papers in conference proceedings

- Franke AC, Mathinya VN (2025) Farming systems analysis to explore pathways for rural livelihoods in mountainous areas: a case study with South African Smallholders. Southern African Mountain Conference, March 17-20, Champagne Sports Resort, South Africa.
- Franke AC (2025) Land-based carbon credits: setting the scene. Southern African Mountain Conference, March 17-20, Champagne Sports Resort, South Africa.

Scientific publications

1. Kotzé E, Paulse-Ross J, Malan PJ, Franke AC (2025) Grazing management and edapho-climatic factors: drivers of soil carbon and vegetation dynamics in South African rangelands. Plant and Soil. https://doi.org/10.1007/s11104-025-07583-4
2. Mathinya VN, Franke AC, van de Ven GWJ, Giller KE (2025) A participatory scenario analysis of potential small-scale farming systems in rural Thaba Nchu and Emmaus regions of South Africa. Social Sciences and Humanities Open 11: 101613. https://doi.org/10.1016/j.ssaho.2025.101613
3. Hilukwa R, Franke AC, Labuschagne MT, Wanga MA, Hukununa RK, Hangula MN, Hasheela EBS, Zorilla C, Sarsu F (2025) Radio-sensitivity of selected Namibian landrace groundnut (*Arachis hypogaea L.*) genotypes to gamma radiation. Journal of Environmental Radioactivity 282: 107618. https://doi.org/10.1016/j.jenvrad.2025.107618
4. Mukiibi A, Machakaire ATB, Franke AC, Steyn JM (2025) A systematic review of vegetation indices for potato growth monitoring and tuber yield prediction from remote sensing. Potato Research 68: 409-448. https://doi.org/10.1007/s11540-024-09748-7
5. Hamadziripi ET, Collinson S, Voss RC, Baudron F, Labuschagne MT, Franke AC, Zaman-Allah M, Olsen MS, Burgueno J, Cairns JE (2025) Validating a novel genetic technology for hybrid maize seed production under management practices associated with resource-poor farmers in Zimbabwe. Plants People Planet 7: 801-815. https://doi.org/10.1002/ppp3.10590
6. Kwenda IW, Falconnier GN, Cardinael R, Affholder F, Couëdel A, Baudron F, Franke AC, Nyagumbo I, Mabasa S, de Freitas M, Pret V, Diop S, Mutsamba-Magwaza EF, Chikowo R (2025) Intercrop overyielding is maintained under estimated water and nitrogen stress in maize-cowpea on-farm trials in semi-arid Zimbabwe. Field Crops Research 327: 109890. https://doi.org/10.1016/j.fcr.2025.109890
7. Mutsamba-Magwaza EF, Baudron F, Franke AC, Van der Watt E, Nyagumbo I (2025) Learning from positive deviants' practices to improve the performance of mixed crop-livestock systems in Zimbabwe. Agricultural Systems 228: 104397. https://doi.org/10.1016/j.agsy.2025.104397
8. Mathinya VN, Franke AC, van de Ven GWJ, Giller KE, Andersson JA (2025) Are aspirations of rural households aligned with national rural development policies? Understanding aspirations of small-scale farming households in the former homelands of South Africa. The European Journal of Development Research. (Impact Factor 2.7)
9. Kiongo SC, Taylor NJ, Franke AC, Steyn MJ (2025) Elevated carbon dioxide only partly alleviates the negative effects of elevated temperature on potato growth and tuber yield. Potato Research 68: 855-875. https://doi.org/10.1007/s11540-024-09767-4 (Impact Factor 2.1)

Popular publications

- Article in Farmer's weekly 22 November 2024: "Does high-density grazing mimic grazing patterns of game?"
- High-Density grazing in semi-arid areas scrutinised. Farmer's Weekly. September 5 2025, p. 106 – 109.

STRATEGIC OBJECTIVE **IMPACT MONITORING**

Strategic objective: Area of impact and deliverables to reach objective		
Key Performance Area (KPA)	**Key Performance Indicator (KPI)**	**Milestones/Progress to date**
Collaborative training of PhD and MSc Students	Postdoc appointments: PhD students: Masters students: PhD conferred: 1	1 5 in various stages of progress 2 in early stages of progress 1 1
Collaborative research conducted	Identify and appoint collaborators:	University of Pretoria, University of Eldoret, Kenya, Tanzania, Ethiopia, Namibia, University of Bergen Norway, Weihenstephan Triesdorf University, Makerere University, Uganda, Universite Evangelique en Afrique, DRC, University d'Adbomey-Calavi, Benin, University of Venda, South African Environmental Observation Network (SAEON, InteliGrow, NRF, National Equipment Programme, Campbell Scientific/LICOR, The Regional Universities Forum for Capacity Building in Agriculture (RUFORUM).
Collaborative research outputs such as papers and conferences	Conferences: Conference posters: Articles published:	2 papers presented and 2 oral presentations 6 7
Research projects	Current projects: Finalised and implemented projects:	4
Learning and growth	Postgraduate degrees conferred:	
Community service delivery	Number of outreach initiatives: Number of training sessions:	
Finance	Additional External Income Initiatives:	National Research Foundation National Equipment Programme, R6,9 M
Publications	Number of scientific publications: Popular publications:	9 2
MOUs	Number of MOUs concluded:	
ARC mirror collaboration established	Number of confirmed collaborations:	

EXPENDITURE

Major expenditure categories: Anticipated to include salaries, bursaries, research project costs, laboratory equipment, and operational expenses.

Area of expenditure to achieve maximum impact and strategic objective		
Line Item	**Description**	**Spend**
Salaries		R2,5 million
Graduate students (tuition and other related costs)	Post-Doc appointments: PhD students: Masters students:	R600,000.00 R240,000.00 R120,000.00
Research costs	MSc., PhD, and Postdoc research. Publication page fees. Research Equipment and Infrastructure. Travel and Conferences. Coordination (Supervision, monitoring and other related costs). Administrative costs. Capacity Building (Training workshops, short courses, internships). Community Engagement / Outreach (public participation, awareness, extension services).	R156,241.00 R131,506.00 R30,603.00 R177,409.00
Collaboration Costs	MOUs. Joint activities. Exchange programmes.	

CHAIRED BY
DR ALBA DU TOIT

RESEARCH CHAIR 2

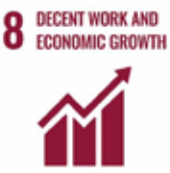
INNOVATIVE AGRO-PROCESSING FOR CLIMATE SMART FOOD SYSTEMS CHAIRED BY DR ALBA DU TOIT

Driving SDGs 1, 2, 6, ,8, 9, 12, and 15

Targets 1.1, 1.2, 1a

Targets 2.1, 2.2, 2.4, 2.5, 2a, 2c

Target 6.4



Target 8.2

Target 9b.

Target 12a.

Targets 15.1, 15.8

The aim of this Research Chair is to revolutionise agriculture in South Africa. Focused on climate change resilience, the initiative leverages innovative technologies to fortify staple crop production. It prioritises community-driven innovation, empowering local farmers through culturally sensitive solutions. The research emphasises value addition, particularly in horticulture, to reduce post-harvest losses, and enhance nutritional value. Employing a circular economy approach, it transforms crop waste into valuable by-products, promoting sustainability. The initiative also catalyses entrepreneurship, fostering economic growth and turning climate challenges into opportunities for sustainable development. In essence, this Research Chair envisions a future where climate-smart agro-processing becomes a catalyst for community prosperity and environmental stewardship.

The key objectives of the Research Chair in Innovative Agro-processing for Climate-smart Food Systems are nixtamalisation as a processing solution for producing a more affordable, more diversified diet and significantly enhanced nutrient content and safer meals, made from staple or underutilised crops, adding value through innovative product design and recipe development for the efficient processing of staple and underutilised crops within a sustainable domestic framework, all of which will be managed via a circular economy approach. The development of consumer-acceptable nixtamalised or smart-processed products will be developed through the application of consumer-led sensory evaluation methods, enabling reproduction in a household kitchen using economical ingredients or homegrown crops. Assessments will include, amongst others, the acceptability of nixtamalisation as an agro-processing method, together with the associated products and recipes, within rural communities. Additionally, evaluation of the compliance of low-income rural women with these methods after receiving training, focusing on their ability to consistently adhere to the new practices.

Another comprehensive project focuses on the strategic utilisation of soya in innovative recipe development, coupled with tailored nutrition education and practical recipe preparation training, specifically targeting low-income households. The core objective of this intervention is to cultivate sustainable, healthy dietary patterns and rigorously measure the impact of enhanced soy consumption on participants' nutritional and health status. This multifaceted approach is designed to mitigate the double burden of malnutrition, addressing under-nutrition among children and over-nutrition among adults. In addition, soy-based food products are developed by formulating to be nutritious (eg. high protein and fibre), and reduced levels of saturated fats, sodium, and added sugars compared to conventional market options, thereby serving a dual purpose in optimising public health outcomes. The food product development is integrated with an economic empowerment strategy focused on small, medium, and micro enterprise (SMME) promotion. By establishing the framework for community-level production and sale, supported by targeted processing and entrepreneurial training, the project ensures these essential, nutritious food products are made both available and accessible to the target low-income communities.

CHAIRED BY DR ALBA DU TOIT

The Research Chair in Innovative Agro-processing for Climate-smart Food Systems is headed by Doctor Alba du Toit

Doctor du Toit is a Senior Lecturer and Head of the Innovative Agro-Food Processing for Sustainable Food in the Department of Sustainable Food Systems and Development at the University of the Free State in South Africa. She leads a research team on the nixtamalisation of maize and sorghum to implement climate-smart staple crops. Throughout her career as a researcher, she has focused on the education and promotion of sustainable food product development, including the cactus pear, spekboom, nixtamalized maize, and sorghum. She aims to conduct consumer-led research that could revolutionise food processing, emphasising true value-adding and reducing food insecurity and malnutrition through innovative food products.

STRATEGIC **OBJECTIVES**

The aim of this Research Chair is to revolutionise agriculture in South Africa. Focused on climate change resilience, the initiative leverages innovative technologies to fortify staple crop production. It prioritises community-driven innovation, empowering local farmers through culturally sensitive solutions. The research emphasises value addition, particularly in horticulture, to reduce post-harvest losses, and enhance nutritional value. Employing a circular economy approach, it transforms crop waste into valuable by-products, promoting sustainability. The initiative also catalyses entrepreneurship, fostering economic growth and turning climate challenges into opportunities for sustainable development. In essence, this research chair envisions a future where climate-smart agro-processing becomes a catalyst for community prosperity and environmental stewardship.

The overall objective is to transform the food systems through smart agro-processing, with a particular research interest in the nixtamalisation of staple and underutilised crops. The research may encompass maize (including yellow maize), sorghum, soy, cowpea, pigeon pea, cassava, potato, sweet potato, amaranth and amadumbe.

Innovative agro-processing technologies could transform the food system and increase food security. However, it depends on the consumer's willingness to adopt and embrace new products and techniques. Innovations in new product development must be consumer-led and market-orientated to truly impact and transform communities in the face of cultural background and climate change. The Research Chair further aims to provide sustainable solutions to address hunger and malnutrition through innovative processing of staple cereals and underutilised crops in South Africa. Focused on climate change resilience, the initiative aims to use the principles of circular food design to develop innovative products and recipes that could provide solutions to food and nutrition insecurity and support the South African food system. It aims to investigate food processing technologies, such as nixtamalisation, that could be applied and implemented to staple and underutilised crops to improve food and nutrition security. It aims to stimulate the demand for more nutritional staple products by informing consumers and empowering small-scale farmers to produce nutritious meals from home-grown crops. It prioritises consumer and community-driven innovation, empowering local small-scale farmers through culturally sensitive solutions. The project should benefit rural farmers and communities, as well as small-scale and emerging farmers, by providing them with the knowledge to produce nutritious food for themselves and become economically active small business owners. In essence, this research chair envisions a future where climate-smart agro-processing becomes a catalyst for community prosperity and environmental stewardship.

The second aim is twofold, firstly to address the increasing need for an affordable, nutritive snack food by developing a nutrient-dense snack multimix from soy bean, peanuts, and seeds; and secondly to address the consumption of energy-dense nutrient-poor snacks directly and food insecurity and malnutrition (double burden of disease [under- and overnutrition]) indirectly in low-income households through the nutrition knowledge and consumption of the developed snack foods/multimixes over a three-month period. A secondary goal is to support the soy and oilseeds industry through SMME growth and development (year 3).

The strategic research objectives for this Research Chair are:

1. Climate-smart processing technologies for staple and underutilised crops: Nixtamalisation as a processing solution for producing more affordable, more diversified diet and significantly enhanced nutrient content and safer meals, made from staple or underutilised crops.
2. Value-adding through innovative product design and recipe development for the efficient processing of staple and underutilised crops within a sustainable domestic framework, utilising a circular economy approach.
3. Development of consumer-acceptable nixtamalised or smart-processed products through the application of consumer-led sensory evaluation methods, enabling reproduction in a household kitchen using economical ingredients or home-grown crops.
4. Assess the acceptance, preference and attitudes towards, as well as the willingness to consume and purchase innovative nixtamalised products and recipes.
5. Determine the impact of nixtamalisation on the nutritional, functional, and physicochemical properties of climate-smart staple and underutilised crop cultivars.
6. Assess the acceptability of nixtamalisation as an agro-processing method, along with the associated products and recipes, within rural communities. Additionally, evaluate the compliance of low-income rural women with these methods after receiving training, focusing on their ability to consistently adhere to the new practices.
7. Develop 10 recipes using soy, peanut and seeds to produce a nutritive snack multimix that is easy to prepare and does not need large and industrial equipment (completed 2023).
8. Teach the local community how to prepare the soy snack foods/multimixes with the assistance of a recipe booklet (completed 2023).
9. Conduct a nutrition education (including recipes and cooking demonstrations of healthy soy-based snacks) programme in a community setting to teach mothers and their children about the health benefits of soy for human health and the importance of consuming healthy snack foods/multimixes to evaluate the effect of improving soy knowledge (completed 2024) and providing mothers with soy snack preparation skills on will have on dietary intake and diversity of vulnerable target groups (children, women) compared to a control group in low-income households (planned for 2026).
10. Provide start-up training services to 10 SMMEs (completed 2025).

PROGRESS **HIGHLIGHTS**

CAPACITY BUILDING:

The Chair commenced in July 2024, consequently, the planning of structures, collaborators, and students has been strategically undertaken for implementation in 2025.

Up until the end of January 2026, Professor Wilna Oldewage-Theron co-chaired this Research Chair. The valuable and strategic contribution made by Prof. Oldewage-Theron during that time is therefore included under Research Chair 2.

Students were recruited, projects assigned, proposals completed, and ethical clearance obtained.

Two postdocs have thus far been appointed:
- Dr Faith Ruzengwe 2 January 2025
- Dr Parisa Rashtchi 15 September 2025

Five PhD studies are currently underway and progressing well:
- Ayanda Zulu (Sorghum funding)
- Taylon Colbert (Grain SA funding)
- Almare de Bruin July 2025)
- Fanny Sibabi (Togo exchange student)
- Mensah Espère Houngo (Togo exchange student)

Two PhD students (Maggie Marogo from the ARC) and Sandile Moagi have been recruited for registration in 2026.

T Maphepha is in the process of developing her PhD proposal and will register for PhD studies in 2026 for the soy project.

A PhD student from Ethiopia, Kumsa Negasa will join the Research Chair in 2026, he is funded by Ruforum Tagdev 2.

N Mokose. PhD thesis entitled : Clustering of Diet, Physical Activity and Sedentary Behaviour Among Urban Tshwane Adolescents: Cross-Sectional Associations with Adiposity.

Supervisor: JW Swanepoel

Co-supervisor: W Oldewage-Theron

Two Masters studies are currently underway and progressing well:
- Zenande Langa
- Lwandile Shezi

Collaborators identified and appointed

Grain SA

Sorghum Cluster Initiative

Oilseeds Advisiory Committee

ARC collaborators:
- Prof. Sunette Laurie
- Dr. Kingsley Shikwambana
- Dr. Florence Mamakgana
- Dr. Dashnie Naidoo-Maharaj
- Prof. Dalene de Beer
- Dr Chantelle Human

UFS collaborators
- Dr Faith Matiza Ruzengwe
- Dr Parisa Rashti
- Prof. Wilna Oldewage-Theron
- Prof. Johan van Niekerk
- Prof. JW Swanepoel
- Dr Angie Jacoby
- Almare de Bruin

Other collaborators:
Prof C Grobler from Nelson Mandela University was confirmed as a collaborator on the soy project.
Dr N Moustaid-Moussa from Texas Tech University was identified as a possible collaborator. She visited South Africa in November/December 2025 to further discuss collaborations.
Dr Dashnie Naidoo-Maharaj from VIMP Roodeplaat while Prof. Dalene de Beer and Dr Chantelle Human from Infruitec Stellenbosch were identified.

Research projects under the Chair:

Collaborative research projects were established with Grain SA (TIA and DSI) and the Sorghum Cluster Initiative (TIA and DSI), who are funding the Nixtamalisation of maize to support low-income communities with agro-processing technologies through research into recipe and product design of nixtamalised maize. The project involves the development of nixtamalised maize milk and associated products, namely flavoured milk, various frozen desserts and flavoured custard tarts project.

1. Nixtamalisation of sorghum
The study aims to evaluate four nixtamalised sorghum cultivars for consumer acceptance, sensory attributes and nutritional value of nixtamalised sorghum. The study aims to develop recipes and products to boost South Africa's sorghum industry, enhance sorghum production, processing, and utilization capacities, build a competitive and sustainable sector and create commercially viable sorghum products through nixtamalisation.

2. Underutilised crops
Innovative agro-processing for climate-smart food systems with a particular research interest in nixtamalisation of staple and underutilised crops such as maize (focussing on yellow maize), sorghum, soy, cowpea, pigeon pea, cassava, potato, sweet potato, amaranth and amadumbe.

3. Maize community project
Assess the acceptability of nixtamalisation of maize as an agro-processing method, along with the associated products and recipes, within rural communities. Additionally, evaluate the compliance of low-income rural women with these methods after receiving training, focusing on their ability to consistently adhere to the new practices.

4. Sorghum project
Project 1. Comparative analysis of sweet and bitter nixtamalised sorghum cultivars: Nutritional value, CATA profiling, and consumer acceptability – external funder Sorghum Cluster Initiative (DSI)

Ayanda Zulu (PhD) will complete data collection in 2025 and submit in 2026.

Project 2: Product Development of Malted Sorghum Beverage: Nutritional value, consumer acceptability and functional properties - external funder: Sorghum Cluster Initiative (DSI)

Almare de Bruin (PhD) registered in July 2025 and is working on the Ethical clearance. In October a CATA will be done on currently available malted beverages.

5. Maize Project
Consumer acceptability, nutritional, functional, physicochemical analysis and application of a novel dairy free milk developed using nixtamalised maize – external funder: Grain SA

Taylon Colbert (PhD) Cata is currently collecting data, collecting quotes for nutritional profiling, and scheduling sensory for the non- and nixtamalised non- and sweetened milk.

Groundnuts projects:

1. Bambara groundnut project
Physicochemical, nutritional and sensory properties of milk from nixtamalised Bambara groundnuts

Zenande Langa (Masters) is currently collecting data on the milk samples, analysing the nutritional value. Sensory will follow in 2026. Ethical clearance has been obtained.

2. Kerstings groundnut project
Biochemical and molecular characterisation of Macrotyloma geocarpum accessions cultivated in Togo.

Fanny Sibabi (PhD) will finish data collection of nutrients and anti-nutrients in 2025. Genotyping and DArT Sequencing will commence once the DNA extraction has been completed. Student will start writing articles as she returns to Togo in March 2026.

3. Cowpea project
Sensory acceptability and nutritional quality of wheat steamed bread fortified with nixtamalised cowpea flour

Lwandile Shezi (Masters) is currently preparing samples before the nutritional analysis. Sensory will follow in 2026. Ethical clearance has been obtained.

4. Phaseolus project
Biochemical and molecular characterisation of Phaseolus spp cultivated in Togo.

Ame Houngo (PhD) will finish data collection of nutrients and anti-nutrients in 2025. Genotyping and DArT Sequencing will commence once the DNA extraction has been completed. Student will start writing articles as she returns to Togo in March 2026.

5. Soy project
Nutritious soy snack multimix development for addressing under and overnutrition and promoting small, medium and micro-sized enterprises (SMMEs) in low-income communities. External funder: Oilseeds Advisory Committee.

6. Algae project
This project will be implemented with the assistance of a postdoctoral Fellow, Dr Frank Hayford, from Ghana in 2026.

Scientific publications

1. KORIR J, GICHOHI-WAINANA WN, NIRAULA S, DHURANDHAR N & OLDEWAGE-THERON W. 2025. Improved multisectoral nutrition governance in Kenya is influenced by ministry affiliation and level of nutrition prioritization in line ministries. Food and Nutrition Bulletin, 46(2-3). Improved Multisectoral Nutrition Governance in Kenya is Influenced by Ministry Affiliation and Level of Nutrition Prioritization in Line Ministries - Jacob Korir, Wanjiku N. Gichohi-Wainaina, Surya Niraula, Nikhil Dhurandhar, Wilna Oldewage-Theron, 2025
2. PARAJULI R & OLDEWAGE-THERON W. 2025. A growing triple burden of malnutrition in South Asia due to the cumulative effect of double burden of malnutrition and parasitic infections in South Asian low- and middle-income countries: A scoping review. Nutrients. https://www.mdpi.com/2072-6643/17/21/3494
3. Ursula Mokotso, Faith Matiza Ruzengwe, Maretha Opperman, Alba du Toit (2025) Development of a seaweed kombucha using Laminaria pallida as a fermentation substrate (under review)

Popular publications

Oldewage-Theron, W., Batra, V. 2025. The missing ingredient: Knowledge gaps and perceptions of soya from a low-resource community in South Africa. Oilseeds Focus,11(3): 56-59. https://digimags.agriorbit.com/books/toxs/#p=58

Local and international travel – knowledge sharing and travel:

- Dr Du Toit attended a workshop on AI in Agrotechnology. presented by the International Cooperation and Development Fund (ICDF) in Taiwan in March 2025. In addition, two students attended SENSE 2025 (product development training). Outputs include 6 x posters, 1x article and registration for five members of the Chair to attend the South African Food Science and Technology (SAAFoST) conference in Pretoria 24-28 August 2025.
- Dr du Toit visited Kenia 13 to 18 July to visit ICRASAT to experience sorghum breeding programmes and utilisation by small-scale farmers.
- An AgraVision instrument was obtained (R104 000) with kits for the determination of mycotoxins in grains such as maize and sorghum.
- The Sorghum recipe booklet has been finalised for printing and publication.
- The Nixtamalised maize project to train the beneficiates and update the recipe book commenced.
- The SAAFoST conference was attended from 25-27 August 2025 with presentation of 4 posters. Dr du Toit served as Chair for a session.
- The Future of Nutrition, Food & Consumer Sciences Education: Global Perspective conference was attended on the 28th of August. Abstracts were submitted for the Ruforum congress on 1-5 December 2025.
- Dr du Toit attended the ARC/UFS workshop in Pretoria 12–14 August 2025 to the discuss the positioning of the Chair and to establish contact and future relationships/collaborations with ARC Chair mirrors.
- Dr du Toit presented at South African Circular Agriculture Initiative on 15th of September 2025. Three articles are currently under review at journals, and two articles are in the process of being finalised for submission to journals.
- 23rd IUNS-ICN conference in Paris, France from 24-29 August 2025 – poster (Transforming Local Food Systems Using Urban Agriculture for Better Nutrition Outcomes) and paper (Association between anaemia and soybean and baobab use among rural women in Northern Ghana: cross-sectional study) presented by Prof. Oldewage-Theron.
- Professor Oldewage-Theron has also just recently returned from the US and has joined as co-Chair to lend her expertise and vast experience in community outreach and teaching. She plays a major role in transferring academic knowledge and relating research findings into practical use by communities.
- Prof. Oldewage-Theron successfully installed a new soy nut roaster/processor, fully funded by the Oilseeds Advisory Committee (OAC) and commissioned at the Best is Good Enough Academy (BIGE) soy processing facility in the Vaal region. The installation marks a significant step in expanding the capabilities of Prof Oldewage-Theron's nutrition programme, allowing for the local production of value-added soy products that are healthy, with little addition of salt, sugar and fat.
- A dedicated training session was conducted on 8 September 2025 to ensure the effective and safe operation of the new equipment and to standardise the production of healthy soy nut snacks. A total of seven community members and BIGE employees from IronSyde were trained by Professor Oldewage-Theron, assisted by Vuyelwa Nkoi and Khezwo Nematshema, two PhD students from the Department of Sustainable Food Systems and Development (DSFSD). The training included the complete process of producing roasted soy nuts, with specific emphasis on health-conscious preparation methods. Key training topics included: 1) Proper and safe operation of the soy nut roaster; 2) Techniques for roasting soy nuts to achieve optimal texture and flavour; and 3) Application of low-salt and low-fat flavourings to meet nutritional guidelines. In addition to the processor, Dr Brandon van Rooyen provided valuable assistance with the necessary packaging materials, equipment and labels for the soy nut snacks. This support is crucial for ensuring the final product can be stored and distributed hygienically.

- The immediate goal is to scale up production of the soy nuts and integrate them in 2026, along with the soy milk and soy yoghurt that already form part of the BIGE school nutrition programme. Prof. Oldewage-Theron is currently engaged in the menu planning phase, which includes a detailed nutritional analysis of the proposed school menus to ensure they meet the dietary needs of the learners.

- Engagement Scholarship Consortium Conference: Bridging Resources to Build Stronger Communities, The Roanoke Conference Centre, Roanoke, VA, USA, 8-9 October 2025. Poster presented: Recognising impact: Designing a distinction for engaged scholars and Paper presented: Chance to Change: Harnessing happenstance to bridge academia and communities. Main author: K Robertson (TTU, USA). Co-authors and affiliations: Schmitt, M., Alcorn, Miller, C.(TTU,USA) and Oldewage-Theron, W. (UFS).

- Fifteenth International Conference of Food Studies "Fed up, learning from the past, imaging new futures" Pretoria, South Africa 8-19 October 2025

- 19th EUList Global Conference Co-creating Sustainable Solutions for Climate-Resilient Societies, Madrid, Spain 20-21 November 2025
  Nominated by Prof. Paul Oberholtzer for the recipient of Erasmus+107 grant.

Poster presentation:

Roberson, K., Schmitt, M., Alcorn, M., Miller, C. & Oldewage-Theron, W. Recognizing Impact:

Designing a Distinction for Engaged Scholars.

Research and Partnership Workshop Presentation:

Roberson, K., Schmitt, M., Alcorn, M., Miller, C. & Oldewage-Theron, W. Chance to Change: Harnessing Happenstance to Bridge Academia and Communities, Research and Partnership

Oral presentation

Du Toit, A., Matiza Ruzengwe, F., Mpemba. O.S, Rebe, S. Development of a Sensory Acceptable Nixtamalized Maize Product Using Just About Right Analysis - Attendance only

Recipe book

From mielie to masa – a South African journey (online) https:??.online.fliphtml5.com/udwdt/ncfh/?1763114677763#p=77

Nixtamalized & Nourishing: Sorghum recipes reimagined https://online.fliphtml5.com/udwdt/mpjh/?1761116351143#p=26

An abstract was prepared and submitted for the SAAFECS conference in 2026 and subsequently approved.

Prof. Oldewage-Theron was invited to:

a. Serve on the Advisory Committee for the Consumer Sciences programme offered at UNISA and attended the Advisory Committee meeting on 7 August 2025.
b. Act as Reader for the Nutrition in the Life Cycle module forming part of the Consumer Sciences programme at UNISA and completed the work in August 2025.
c. Evaluate an Associate Professor for a Professorship at the University of North Florida, USA in August 2025.
d. Evaluate two DSFSD lecturers for Associate Professorships.
e. Serve on the editorial board of JAND Global Health with effect September 2025.
f. Serve on the editorial board of Nutrients since 2023.
g. Examine a PhD thesis for Nelson Mandela University in September 2025.

African Food Science and Technology (SAAFoST) conference in Pretoria 24-28 August 2025. Four posters were presented at the SAAFoST conference.

STRATEGIC OBJECTIVE **IMPACT MONITORING**

Strategic objective: Area of impact and deliverables to reach objective		
Key Performance Area (KPA)	**Key Performance Indicator (KPI)**	**Milestones/Progress to date**
Collaborative training of PhD and MSc Students	Postdoc appointments:	
	PhD students:	7
	Masters students:	3
Collaborative research conducted	Identify and appoint collaborators:	Nelson Mandela University, Texas Tech University Grain SA Sorghum Cluster Initiative NPC DSI (Department of Science and Innovation of the government of the republic of South Africa)
Collaborative research outputs such as papers and conferences	Conferences: 1 oral presentation	1 oral presentation
	Conference posters: 5	5
	Articles published:	4
Research projects	Current projects:	8
	Finalised and implemented projects:	
Learning and growth	Postgraduate degrees conferred:	
Community service delivery	Number of outreach initiatives:	5
	Number of training sessions:	4 (535 BIGE employees and parents from IronSyde and 20 post-graduate students from DUT).
Finance	Additional External Income Initiatives:	Oilseeds Advisory Committee (funding soy project).
Publications	Number of scientific publications:	3
MOUs	Number of MOUs concluded:	1 Sayari Earth
ARC mirror collaboration established	Number of confirmed collaborations:	

EXPENDITURE

Area of expenditure to achieve maximum impact and strategic objective		
Line Item	**Description**	**Spend**
Salaries		R2 million
Graduate students (tuition and other related costs)	Post-Doc appointments: PhD students: Masters students:	R600 000.00 R55,000.00 R280,00.00
Research costs	MSc., PhD, and Postdoc research. Publication page fees. Research Equipment and Infrastructure. Travel and Conferences. Coordination (Supervision, monitoring and other related costs). Administrative costs. Capacity Building (Training workshops, short courses, internships). Community Engagement / Outreach (public participation, awareness, extension services).	R700,000.00 R377,500.00 R92,000.00 R20,000.00
Collaboration Costs	MOUs. Joint activities. Exchange programmes.	

CHAIRED BY
PROF. COBUS OBERHOLSTER

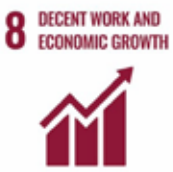
RESEARCH CHAIR 3

AGRICULTURE RISK FINANCING
CHAIRED BY PROF. COBUS OBERHOLSTER

Driving SDGs 1, 2, 8, 9, 10, 11, 13, and 15

Targets 1.1, 1.2, 1a

Targets 2.1, 2.2, 2.4, 2.5, 2a, 2c



Target 8.2

Target 9b.

Target 10b

Target 11c

Target 13.2, 13a

Target 17.8

This is a multi-stakeholder Research Chair focussed on holistic and interdisciplinary research, unpacking the complex and multi-layered relationships between climate change and the agricultural financing sector that will contribute to climate change adaptation and mitigation in the agricultural sector, support policy development and implementation in this field, and steer the societal discourse on climate change and sustainable agriculture.

The main activities of the Research Chair in Agriculture Risk Financing are aimed at creating banking sustainability, that is, sustainable business model structures for banks, exploring the intersection of climate, finance, and digital technology through Climate Fintech. Focus on multi-stakeholder participation in climate finance is of paramount importance, as is green investment, eco-innovation and financial inclusion (including regenerative agriculture and carbon credits). Furthermore, an executive education platform containing curriculum content that addresses climate finance is a key objective of this research chair.

The Research Chair in Agriculture Risk Financing is headed by Professor Cobus Oberholster

Together with his strong background in marketing, Professor Oberholster brings recognised expertise in agricultural financing and has extensive experience in delivering financial services to the agricultural and related sectors. He also has management experience within South Africa's non-bank agribusiness environment.

His areas of specialisation include agricultural marketing, agribusiness management, agricultural financing, and development financing. Prof. Oberholster is also an advocate for agricultural value chain financing as a dual framework for financing and development to guide future financing activities in Sub-Saharan Africa agriculture. He actively promotes the development of integrated, pro-smallholder agricultural value chains to facilitate market integration and increased levels of financial inclusion, contributing to sustainable agricultural development.

Professor Oberholster, currently working on his third doctoral degree, is developing an integrated framework for agribusiness executive education aimed at driving innovation in South Africa's food and agricultural markets through futures studies. He believes that visionary leadership and strong, collaborative teams are important for building a sustainable agricultural sector. For him, executive education is a powerful tool to help leaders navigate change and unlock innovation in food and agribusiness.

STRATEGIC OBJECTIVES

This is a multi-stakeholder Research Chair focussed on holistic and interdisciplinary research unpacking the complex and multi-layered relationships between climate change and the agricultural financing sector, that will contribute to climate change adaptation and mitigation in the agricultural sector, support policy development and implementation in this field, and steer the societal discourse on climate change and sustainable agriculture. As such knowledge creation will focus on equitable and inclusive financing innovation, that can positively contribute to food and agricultural sector transformation and adaption.

The overall aim of the Chair is mainstreaming of climate smart financing solutions within the food and agricultural sector, with a key focus on the integration of social, ethical and environmental parameters into climate financing decisions as well as the strategic, governance, and risk dimensions.

Specific research objectives are:

1. To have three strategic and interrelated pillars, which aim to provide a governance framework within which innovative financing (innovative digital products or instruments) and market mechanisms can be developed and commercialised:
   Pillar 1: Regulatory and policy – Transformational regulatory and policy framework that is required to effectively mobilise, access, and scale up climate financing solutions within the food and agricultural sector.
   Pillar 2: Entrepreneurial market exchanges – New-generation stock exchanges or second-tier exchanges, geared towards entrepreneurial and new innovative companies and investors seeking more robust debt and equity markets to invest in climate smart opportunities, while still enjoying sufficient investors protection.
   Pillar 3: Digital financial innovations – Technological innovation combined with financial and digital breakthroughs (IoT, blockchain, big data, cloud and edge computing, AI, etc.) to develop appropriate new and innovative climate financing solutions.
2. Banking sustainability (sustainable business model structures for banks).
3. Climate Fintech (exploring the intersection of climate, finance, and digital technology).
4. Multi-stakeholder participation in climate finance.
5. Green investment, eco-innovation and financial inclusion (including regenerative agriculture and carbon credits).
6. Executive education (curriculum content that address climate finance).
7. Financial services policy (policy reform in support of climate finance).

PROGRESS HIGHLIGHTS

The Chair commenced in February 2025, consequently the planning of structures and research focus areas are being strategically undertaken for implementation in 2026.

CAPACITY BUILDING:

Despite the fact that the Chair was finalised as recent as February 2025 only, the appointment of three advisory committees were finalised, those being:

Committee 1:
Dr Andrea Campher
Dr Johan Purchase

Committee 2:
Prof. Paul Ingelbleek
Dr Mariette Geyser

Committee 3:
Prof. Sanlie Middelberg
Prof. Kobus Jonker

Research positions and bursaries are in the process of being advertised and two articles regarding a literature overview in climate financing is progressing well.

Kirtsy - Lee Green will finish her Phd in 2026 in this chair.Albert Muller and Njabula Dlamini will register in 2026 for Phd.

The following entities have been confirmed as strategic partners of the Chair with the intent to contribute both expertise and finds:

- Banking Association of South Africa (BASA)
- Bureau for Food and Agricultural Policy (BFAP)
- South African Reserve Bank (SARB) International Agribusiness Management Association (IFAMA)
- Wageningen University and Research
- Harven Business School (Brazil)

Research projects under the Chair:

Research focus areas have been finalised and possible research projects are in the process of being finalised. The first three PhD topics are under consideration.

1. Policy and Regulation Framework for Climate Finance

Research focus areas under consideration are transformational regulatory and policy frameworks as well as mobilising, accessing, and scaling up climate finance solutions. Two advisory board members have been appointed to assist with this project, namely Dr A Campher and Dr J Purchase.

2. Entrepreneurial Market Exchanges

Research focus areas under consideration are: Envisioning new markets and The taxonomy of climate linked instruments. bee Two advisory board members n appointed to assist with this project, namely Dr M Geyser and Prof. P Ingelbleek (Wageningen).

3. Digital Financing Innovations

PhD topics under consideration: Development of a climate smart risk grading model (J Maass)
and: The development of an integrated intelligent technology platform to mainstream climate-smart agricultural financing and insurance (B Kruger).
Two advisory board members have been appointed for this project, Prof. S Middelberg and Prof. K Jonker.

4. NWU Mirror Chair

A new mirror Chair at the North-West University is under consideration and involves Prof. Cobus Oberholster (UFS) and Prof. Sanlie Middelberg (NWU), as well as one Post Doc (Dr M Geyser) that has been appointed.

Local and international travel – knowledge sharing and travel:

- Prof. Oberholster attended the ARC/UFS workshop in Pretoria 12–14 August 2025 to discuss the positioning of the Chair and to establish contact and future relationships/collaborations with ARC Chair mirrors.
- Prof. Oberholster attended the World Food Forum (WFF) held in Rome, Italy on 10 and 13–17 October 2025. South Africa's role in cooperation between the Global South and Global North and development partners to advance technology transfer and sustainable development was discussed at length. It was agreed that the FAO team will share letters of intent for collaboration with the ARC, UFS, and other possible SA partners.

STRATEGIC OBJECTIVE **IMPACT MONITORING**

Strategic objective: Area of impact and deliverables to reach objective		
Key Performance Area (KPA)	**Key Performance Indicator (KPI)**	**Milestones/Progress to date**
Collaborative training of PhD and MSc Students	Postdoc appointments: PhD students: Masters students:	7 2
Collaborative research conducted	Identify and appoint collaborators:	
Collaborative research outputs such as papers and conferences	Conferences: Conference posters: Articles published:	1
Research projects	Current projects: Finalised and implemented projects:	4
Learning and growth	Postgraduate degrees conferred:	
Community service delivery	Number of outreach initiatives: Number of training sessions:	
Finance	Additional External Income Initiatives:	
Publications	Number of scientific publications:	
MOUs	Number of MOUs concluded:	
ARC mirror collaboration established	Number of confirmed collaborations:	

EXPENDITURE

Area of expenditure to achieve maximum impact and strategic objective		
Line Item	**Description**	**Spend**
Salaries		R1 million
Graduate students (tuition and other related costs)	Post-Doc appointments: PhD students: Masters students:	
Research costs	MSc., PhD, and Postdoc research. Publication page fees. Research Equipment and Infrastructure. Travel and Conferences. Coordination (Supervision, monitoring and other related costs). Administrative costs. Capacity Building (Training workshops, short courses, internships). Community Engagement / Outreach (public participation, awareness, extension services).	
Collaboration Costs	MOUs. Joint activities. Exchange programmes.	

CHAIRED BY
PROF. ARNO HUGO

RESEARCH CHAIR 4

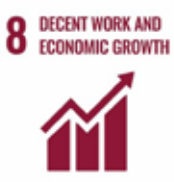
SUSTAINABLE LIVESTOCK PRODUCTION CHAIRED BY PROF. ARNO HUGO

Driving SDGs 1, 2, 6, 8, 9, and 15

Targets 1a,1.1,1.2.

Targets 2.1, 2.4, 2.5, 2a.

Target 6.4



Target 8.2

Target 9b.

Target 15.8

This Research Chair was established to tackle the critical challenges of the livestock industry, which is essential for global food security and economic development. With rising meat demand, the industry faces pressures to enhance production while reducing its environmental impact, including greenhouse gas emissions and resource depletion. This initiative will integrate sustainability throughout the livestock value chain, focusing on areas such as efficient feed management, water and land use efficiency, and sustainable meat and other animal product processing. By fostering collaboration among experts in various fields, the chair will develop innovative technologies and practices that promote sustainable livestock production. Additionally, the Chair will prioritise animal welfare, food safety, and farmer livelihoods through practical solutions and capacity-building efforts. Engaging with policymakers and stakeholders, as well as the research chair, will help create supportive governance structures for sustainable practices. Overall, the Research Chair seeks to advance the field, enhance food security, and promote environmental stewardship, contributing to sustainable food systems worldwide.

Some of the main objectives of this Chair is to drive innovation in the livestock sector, enhance food safety and food security, to ensure sustainable livestock breeding and genetics, and to enhance efficient feed and nutrition management. There is also focus on creating water and land use efficiency, as well as sustainable meat and animal product processing through circular economy approaches. Policy and governance for sustainable livestock systems will receive much needed attention, providing innovative and economically viable solutions and guidelines for successful implementation, thereby supporting the livelihood of farmers.

The research Chair in Sustainable Livestock Production is headed by Professor Arno Hugo

Professor Hugo, a distinguished academic in the Department of Animal Science at the UFS, is a Food Scientist specialising in meat science and technology. His research focuses on the chemical stability of food, with a particular emphasis on the lipid components in meat and meat products. Recent work explores innovative ways to manipulate lipid profiles in animal diets, aiming to improve both the technological and health properties of fat tissue. This research bridges food science and animal science, driving advancements in both fields. With an impressive scholarly record, Prof Hugo has authored or co-authored over 190 peer-reviewed journal articles, 230 congress contributions, 20 technical reports and 50 popular scientific articles. He has a Scopus H index of 31. In addition, Prof Hugo has mentored a significant number of postgraduate students, having supervised or co-supervised 80 MSc and 25 PhD candidates.

STRATEGIC **OBJECTIVES**

The aim of the research chair is to take a comprehensive approach to sustainable livestock production, involving multidisciplinary research that addresses different aspects of the value chain, collaborating with researchers and academics, farmers and livestock producers, industry stakeholders, policymakers and government officials, non-governmental organisations, and community members, among others. Key focus areas for the research chair include: Sustainable livestock breeding and genetics, efficient feed and nutrient management, water and land use efficiency, sustainable slaughtering and meat processing, animal physiology including reproduction physiology, circular economy approaches, and policy and governance for sustainable livestock systems.

Specific research objectives are:

1. Innovation in livestock production systems: Investigating new and improved production systems that minimise environmental impacts, enhance animal welfare, and increase productivity. This could include studies on animal genetics, nutrition, physiology and husbandry practices that promote resilience and efficiency.
2. Integration of the value chain: Focusing on the entire livestock value chain from farm to fork. This includes the production phase, animal transport, slaughtering practices, meat processing, packaging, and distribution. Sustainable practices can be applied at every stage of the value chain to reduce waste, improve resource use, and enhance the overall quality of meat and other animal products.
3. Reduction of environmental impact: Conducting research to reduce the environmental footprint of livestock farming, including the reduction of greenhouse gas emissions, the efficient use of water and land, and the management of animal waste. Strategies such as rotational grazing, integrated crop-livestock systems, and manure management can help minimize negative environmental impacts.
4. Improvement of animal health and welfare: Focusing on animal welfare is crucial for sustainable livestock production. Research in this area could include the development of humane handling practices, disease prevention strategies, and technologies to monitor and improve animal health.
5. Advancing meat processing technologies: Meat processing is a critical stage in the value chain where sustainability challenges arise, including food safety, energy consumption, and waste generation. The research chair could explore innovative meat processing techniques that reduce resource use, improve food safety, and enhance the nutritional value of meat products.
6. Capacity building and knowledge transfer: The chair will build capacity among students, farmers, and industry stakeholders. This includes training the next generation of researchers and practitioners in sustainable livestock production, as well as working with farmers and industry professionals to implement sustainable practices.

PROGRESS HIGHLIGHTS

CAPACITY BUILDING:

The Chair commenced in November 2024, consequently, the planning of structures, collaborators, and students has been strategically undertaken for implementation in 2025.

Students were recruited, projects assigned, proposals completed, and ethical clearance obtained.

Dr L van Wyngaard, a Post Doc fellow was appointed in the Grassland and wildlife science project.

Dr A Grobbelaar, another Post Doc was appointed in the projects: Determining the oestrus cycle and hormonal profile of free-roaming wild South African giraffes (Giraffa camelopardalis giraffa), and Responses of wild giraffes to anthropogenic sound disturbances: findings from a playback study.

In total, 33 post graduate students have registered for M.Sc. degrees and one for a PhD. In addition, ARC collaborators were identified and approached and these collaborations are in the process of being finalised.

UFS collaborators
Prof A Hugo
Dr Ockert Einkamerer
Prof Frikkie Neser
Dr Ayanda Maqhashu
Prof Francois Deacon
Dr Luther van der Mescht
Prof Errol Cason

Other collaborators:

Prof. Hugo secured local collaborations with:
- Red Meat Producers Organisation (RPO)
- South African Poultry Association (SAPA)
- National Emergent Red Meat Producers' Organisation (NERPO)
- South African Pork Producers' Organisation (SAPPO)
- Milk SA
- Red Meat Abattoir Association (RMAA)
- SA Feedlot Association
- Red meat Industry Services (RMIS)
- SAMIC: SA Meat Inspection Company (SAMIC)

As well as the following Development agencies:
- DSI (Department of Science and Innovation of the government of the Republic of South Africa)
- TIA (Technology Innovation Agency)

Collaborators from the UFS published six articles and had one scientific congress contribution during 2024. Collaborators from the UFS also present two oral presentations at farmers conferences. Although the research chair only formally commenced on 1 November 2024, collaborators from the UFS are already supervising or co-supervising 12 M.Sc. and a PhD student.

A major highlight was the completion of a new meat processing laboratory. The facility has already been used for undergraduate student practicals, meat quality analysis for the Beef Genomics 2 (BGP2) Programme, as well as several research projects.

Collaborators from the UFS published 9 peer reviewed articles and had 3 scientific congress contribution during 21 April to 30 June 2025. Collaborators from the UFS also wrote a popular scientific article in 2025. Although the research chair only formally commenced on 1 November 2024, collaborators from the UFS are already supervising or co-supervising 23 M.Sc. and two PhD students.

Dr Maqhashu attended a seminar on Ecological and Environmental Data Collection and Big Data Platform Construction for Developing Countries organised by Guizhou Academy of Sciences from the 3rd July-16 July 2025.

Mr Behrens was runner-up for the Dreosti award best oral presentation with his presentation titled "Do crocodile stunning methods have an influence on crocodile meat quality?" during the 26th Biennial South African Association of Food Science and Technology Congress. CSIR Convention Centre, Pretoria. Runner-up Dreosti Award for best oral presentation. 25 – 27 August 2025.

Ms Burger won the CompuSense Award for the best poster with a Sensory Science component with her presentation titled "The physico-chemical, microbial and sensory effects of Rooibos and honeybush extracts as preservative replacers of sulphur dioxide in Boerewors" The physico-chemical, microbial and sensory effects of Rooibos and honeybush extracts as preservative replacers of sulphur dioxide in Boerewors" at the 26th Biennial South African Association of Food Science and Technology Congress. CSIR Convention Centre, Pretoria. 25 – 27 August 2025.

Prof. Deacon is doing world class research on giraffes. He was responsible for the construction of a new "Giraffe Research Centre" at Amanzi near Brandfort. The following poster of Prof. Deacon won the prize for the best poster amongst 170 entries and 700 delegates at the 12th International Rangeland Congress, 2 to 6 June 2025 in Adelaide, Southern Australia, Australia: The ultimate risk to fit a GPS device to save the critically endangered Himalayan Brown Bear from extinction.

Research projects under the Chair:

1. Evaluation of fatty acid composition, organoleptic properties and mutton quality of Letelle and South African Mutton Merino sheep on different production systems.
2. Evaluation of fatty acid composition, organoleptic properties and mutton quality of Letelle sheep on different production systems.
3. The effect of stunning methods on crocodile meat quality. Completed.
4. Effect of replacing maize with hominy chop on the carcass characteristics of broilers. Completed.
5. Evaluating the influence of fenugreek (trigonella foenum-graecum) and mpesu (securidaca longipedunculata) on sperm parameters and cryopreservation efficiency in rams. Completed.
6. Effect of extender type on post-thaw quality of boar sperm: A comparison between plant-based and animal-derived diluents.
7. The supplementation and substitution of Tris-egg yolk extender with either lemon, onion, and garlic (LOG), avocado seed extract and sesame oil on ram semen cryopreservation. Completed.
8. Comparative evaluation of epididymal sperm extraction methods and semen extenders for cryopreservation.
9. The influence of reproductive performance on back fat thickness of Gilts, 1st and 2nd parity sows. Completed.
10. The effect of climate change and settlement expansion on animal nutrition in rural areas of Vhembe, Sekhukhune, and Capricorn districts.
11. Microbiome diversity and association of the microbiome with the animal genotypes
12. Animal welfare and safety during immobilisation events through real-time capnographic monitoring.
13. Decoding nutrient digestion and microbial interactions in giraffes for comparative application in livestock nutrition models.
14. Development of baseline haematological profiles for wild giraffes. Assessment of hormone cycles to improve breeding management.
15. Movement ecology to assess land-use efficiency and sustainability.
16. The impact of mining activities on animal health.
17. The influence of defoliation on tiller growth and quality of different grass species.
18. The impact of plasminogen activation in UHT milk.
19. Biochemical changes during cheese ripening.
20. The effect of lucerne (Medicago sativa L.) hay quality on the performance of finishing lambs.
21. Sustainable livestock and wildlife production with a more specific focus on giraffe conservation biology.
22. The effect of dosing oils high in omega-3, omega-6 or omega-9 fatty acids on Dohne Merino ewe milk composition and lamb growth performance.
23. The effect of commercial inoculant on maize silage quality and cattle performance when included in finisher diets.
24. The effect of rumen protected prebiotic on the performance, and gut health of finishing steers.
25. The effect of genetically modified (GM) maize (Zea mays L.) grain and its stover on the performance of finishing lambs.
26. Metagenomic characterisation of the microbiome associated with bone taint and optimal chilling protocols to mitigate the development of bone taint in beef carcasses.

27. The effect of natural feed additives on the performance, carcass and meat quality of finishing lambs.
28. Determining the oestrus cycle and hormonal profile of free-roaming Wild South African giraffes (Giraffa camelopardalis giraffa).
29. Animal welfare and safety during immobilisation events through real-time capnographic monitoring.
30. Decoding nutrient digestion and microbial interactions in giraffes for comparative application in livestock nutrition models.
31. Development of baseline haematological profiles for wild giraffes.
32. Movement ecology to assess land-use efficiency and sustainability.
33. Ehler-Danlos syndrome in South African Drakensberger beef cattle-clinical and genomic investigation.
34. The impact of plasminogen activation in UHT milk.
35. Microplastics present in Dairy products
36. Development of baseline haematological profiles for wild giraffes.
37. Movement ecology to assess land-use efficiency and sustainability.
38. Studbook development and wildlife genetics.
39. Thermal regulation
40. Diet and nutrition.
41. reproduction and breeding.
42. Spatial ecology for wildlife.

Local and international travel – knowledge sharing and travel:

- Prof. Hugo, post-doctoral fellow Dr Lize van Wyngaard, and technician Eileen Roodt performed meat quality analysis for the Beef Genomics 2 programme.
- Prof. Hugo attended the ARC/UFS workshop in Pretoria 12–14 August 2025 to the discuss the positioning of the Chair and to establish contact and future relationships/collaborations with ARC Chair mirrors.

Scientific conferences/congresses attended and papers presented:

1. Conference 2024. Maselspoort, Bloemfontein, South Africa.
2. 21 to 23 August 2024. Factors affecting meat quality: What makes Wagyu unique? Paper delivered on invitation at the Wagyu Conference 2024. Maselspoort, Bloemfontein, South Africa.
3. 9 to 11 October 2024. Meat quality: Farm to Fork. Paper delivered at the 16th Stockman School. Theme: Being a resilient stockman. Aldam Holiday Resort, South Africa.
4. The 12th International Rangeland Congress. 2 to 6 June 2025. Adelaide, Southern Australia, Australia. Impact of high-density grazing compared to conventional grazing on the woody vegetation of the Kalahari Savannah of South Africa.
5. The influence of two grazing approaches on vegetation parameters in the rangelands of South Africa and The ultimate risk to fit a GPS device to save the critically endangered Himalayan Brown Bear from extinction.
6. The 26th Biennial South African Association of Food Science and Technology Congress. CSIR Convention Centre, Pretoria. August 25-27, 2025.
7. Microbial community analysis of Boerewors manufactured with natural preservatives using Biolog™ Ecoplate™.
8. The physico-chemical, microbial and sensory effects of Rooibos and honeybush extracts as preservative replacers of sulphur dioxide in Boerewors.
9. Rejected wet carcass syndrome lamb meat: Is it suitable for human consumption.
10. A Survey on the salt & sodium content of South African. Biltong & Dry sausage.
11. Do crocodile stunning methods have an influence on crocodile meat quality?
12. 54th Annual SASAS Congress, East London, SA. 3- 5- July 2024.
13. The Effect of gender, days on feed and Zipaterol hydrochloride treatment on the growth performance of feedlot cattle.
14. The 55th SASAS Congress, 8-10 July 2025. Protea Hotel, The Ranch, Polokwane.
15. The influence of reproductive performance on Back fat thickness of Gilts, 1st and 2nd parity sows.

16. Cryopreservation of immature and mature cattle oocytes: the effect of oocytes quality following cryopreservation.

17. A critical review of literature, Optimization of bull epididymal sperm.

18. The relationship between flush feeding on placenta characteristics, lamb birth and weaning weights in Dohne merino sheep sperm cryopreservation by focusing on glycerol cryoprotectant concentration.

19. The stress responsiveness of habituated and non-habituated Merino-type sheep during electroejaculation and routine handling procedures.

20. Scholtz, M.M., Kooverjee, B.B., Soma, P., Neser, F.W.C. (UFS) Genome-Wide Association Analysis of Male and Female Sheep Affected by Wet-Carcass Syndrome in South Africa.

21. Makagashlela, M.L (UFS) Mafolo, K.S., Neser, F.W.C., M.D., Macneil, M.D. (UFS) Improving Genomic Prediction Accuracy and Reducing Bias using adjusted ssGBLUP in South African Holstein Cattle.

22. Makgahlela, M.L. (UFS) Ramooroka, M.P., Neser, F.W.C., Macneil, M.D., Lashmar, S.F.(UFS) Selection signatures and adaptive traits in non- descript cattle from smallholder farms in South Africa.

23. Cason, E.D. (UFS) Lashmar, S.F., Neser, F.W.C., UFS) A homozygosity-focused assessment of the genome-level inbreeding status of the South African Shorthorn breed in South Africa.

24. Neser, F.W.C. (.UFS) Makghahlela, M.L. Scholtz, M.M. (UFS) From Genes to Green: Indigenous genotypes and genome-based tools for climate resilient livestock production.

25. Cason, E.D. (UFS) Mohlamme, T. (UFS) Investigating the microbial diversity of the healthy sheep rumen towards a probiotic remedy for rumen stasis.

26. Kruger, L.P (UFS) Mokoena, M.S., Mbalenhle, S.; Maquashu, A., Sibande, K.V., Khayalethu, M., Cason, E.D., Salamane.K.H., Mateyise, B.G.L. (UFS) The relationship between flush feeding on placenta characteristics, lamb birth and weaning weights in Dohne Merino Sheep.

27. Kruger, L.P. (UFS) Sibande, K.M., Maqasahu, A., Cason, E.D., Mokoena, M.S., Kgopodiso, H.M., Mashilo, T.L. (UFS) The effect of erythropoietic supplements on sheep with regenerative anaemia.

28. Van der Merwe, S. (UFS) Mans, H., Pieterse, E., Gleesson. E.Y., van Niekerk, J.A.; Einkamerer, O.B. (UFS) Application of soybean hulls in lactation diets for dairy cows: A systematic review.

29. Einkamerer, O.B. (UFS) Valentin, B., Josling, G.C., Cason, E.D., Rothman, C., (UFS) The effect of fungal and bacterial probiotics on in vitro fermentation characteristics and microbial diversity.

30. The 76th EAAP Annual Meeting, Innsbruck, Austria, 24-29 August 2025.

31. Effects of supplemental calcium gluconate on the rumen and duodenum biome of Bonsmara steers.

32. The effect of fungal and bacterial probiotics on in vitro fermentation characteristics and microbial diversity.

33. The effect of hydroxy-Zn as a trace mineral source on the performance, carcass characteristics and wool quality of finishing lambs.

34. The effect of hominy chop inclusion on diet digestibility in modern broilers.

35. O'Neill, H (UFS) Scholtz, J. Maqhashu, A., Kruger,L., Ganswindt. A. (UFS) The stress responsiveness of habituated and non-habituated Merino-type sheep during electroejaculation and routine handling procedures,

36. The 55th SASAS Congress, 8-10 July 2025. Protea Hotel, The Ranch, Polokwane.

37. The 76th Annual Meeting of The European Federation of Animal Science. 25-29 August 2025

38. Genome-Wide Association Analysis of Male and Female Sheep Affected by Wet-Carcass Syndrome in South Africa.5.

39. The 76th EAAP Annual Meeting, Innsbruck, Austria, 24-29 August 2025.

40. The 55th Annual Congress of the South African Society for Animal Science, 8 – 10 July 2025, Polokwane, South Africa.

41. Improving Genomic Prediction Accuracy and Reducing Bias Improving Genomic Prediction Accuracy and Reducing Bias using adjusted ssGBLUP in South African Holstein Cattle.

42. Selection signatures and adaptive traits in non-descript cattle from smallholder farms in South Africa.

43. A homozygosity-focused assessment of the genome-level inbreeding status of the South African Shorthorn breed in South Africa.

44. A homozygosity-focused assessment of the genome-level inbreeding status of the South African Shorthorn breed in South Africa.

45. From Genes to Green: Indigenous genotypes and genome-based tools for climate resilient livestock production, Investigating the microbial diversity of the healthy sheep rumen towards a probiotic remedy for rumen stasis.

46. The relationship between flush feeding on placenta characteristics, lamb birth and weaning weights in Dohne Merino Sheep.

47. The effect of erythropoietic supplements on sheep with regenerative anaemia.

48. The effect of fungal and bacterial probiotics on in vitro fermentation characteristics and microbial diversity.

49. The 17th International Cereal Rusts and Powdery Mildews Conference, 15-20 June 2025. Vancouver, Canada.

50. A decade of wheat leaf rust surveillance reveals seven new races of Puccinia triticina in South Africa, and Genetic comparison of South African and global Puccinia striiformis f. sp. tritici isolates.

Scientific publications

1. Chelopo, G.M., Marume, U., & Hugo, A. 2025. *Vachellia erioloba* leaf meal inclusion in ammoniated maize stover-based finisher diets improves growth, meat quality and fatty acid profiles of lambs. *Meat Science* 223, 109773. https://doi.org/10.1016/j.meatsci.2025.109773. Impact factor 6.1, Q1

2. Kotzé, E., Paulse-Ross, J., Malan, P.J. et al. 2025. Grazing management and edapho-climatic factors: drivers of soil carbon and vegetation dynamics in South African rangelands. *Plant Soil* (2025). https://doi.org/10.1007/s11104-025-07583-4. Impact factor 4.1, Quartile 1

3. Ledwaba, M.R., O'Neill, H.A., Thema, M.A., Maqhashu, A., & Mphaphathi, M.A. 2025. Techniques for in vitro fertilization of vitrified cattle oocytes: challenges and new developments. *Agriculture* 2 15, 363. https://doi.org/10.3390/agriculture15040363. Impact factor 3.6, Quartile ?

4. A., Mokoena, M.S., Maqhashu, A., Sibande, K.M., Cason, E.D., Salamane, K.H., Matayise, B.N.L., & Kruger, L.P. 2025. The relationship between flush feeding on placenta characteristics and lamb birth and weaning weights in Dohne merino sheep. https://doi.org/10.1071/RDv37n1Ab59. *Reproduction, Fertility and Development* 37(1). Impact factor 2.1, Q2

5. Einkamerer, O. B., Ferreira, A. V., Fair, M. D., & Hugo, A. 2025. The effects of dietary acid detergent fibre content on the performance of finishing lambs. *South African Journal of Animal Science* 55(3), 115–126 http://dx.doi.org/10.4314/sajas.v55i3.02. Impact factor 0.7, Q3

6. De Klerk, I., Hugo, A., Ferreira, A. V., Fair, M. D., & Einkamerer, O. B. 2025. The effect of finishing diet neutral detergent fibre content on South African Mutton Merino lamb performance, meat fatty acid composition, tenderness and stability. *Livestock Science* 105698 https://doi.org/10.1016/j.livsci.2025.105698. Impact factor 4.3, Q1

7. Grobbelaar, A., Osthoff, G., Deacon, F., & Cason E.D. 2025. The faecal microbiome analysed from healthy, free-roaming giraffes (*Giraffa camelopardalis*). *Current Microbiology* 82, 151. https://doi.org/10.1007/s00284-025-04127-y. Impact factor 2.3, Q3

8. Grobbelaar, A., Osthoff, G., & Deacon, F. 2025. Faecal analysis as an indicator of the dietary quality utilised by free-roaming giraffe (*Giraffa camelopardalis*) in the Free State Province, South Africa. *African Journal of Ecology* 63(2), 1-14. https://doi.org/10.1111/aje.70026. Impact factor 1.1, Q3

9. Grobbelaar, A., Josling, G.C., van Lingen, F. Osthoff, G., & Deacon, F. 2025. Feasibility of using near-infrared reflectance spectroscopy to predict the chemical composition of giraffe (*Giraffa camelopardalis*) faeces. *Journal of Spectroscopy* 921290, 1-11. https://doi.org/10.1155/jspe/9921290. Impact factor 1.7, Q3

10. Skele, N., Augustyn, W. C., O'Neill, H.A., Hugo, A., Einkamerer, O.B. 2024. The effects of age of castration on carcass characteristics, meat quality and fatty acid profile on finishing South African Mutton Merino lambs. Small ruminant research 231: art 107205, 1 – 8. (Impact factor: 1.6; Quartile 2). (Elsevier B.V.) (eISSN: 1879-0941) doi: 10.1016/j.smallrumres.2024.107205

11. Mbambalala, L., Mpayipheli, M., Leeuw, K-J., Thabethe, F., Mahanjana, A., Hugo, A. 2024. Response in growth performance, carcass traits, physicochemical properties, and fatty acid composition of Dohne Merino rams fed inclusion levels of canola meal. Food Science of Animal Resources 44(6): 1 – 18. (Impact factor: 4.2; Quartile 1). (Korean Society for Food Science of Animal Resources) (eISSN: 2636-0780) doi: 10.5851/kosfa.2024.e55

12. Marume, U., Zvarivadza, W. & Hugo, A. 2024 Artemisia afra essential oils inclusion in diets induces desirable effects on meat quality and fatty acid profiles of broiler chickens. Veterinary & Animal Science 25 art 100390: 1 – 8. (Impact factor: 1.9; Quartile 2) (Elsevier B.V.) (eISSN: 2451-943X) doi: 10.1016/j.vas.2024.100390

13. Freitag, A., Cluff, M., Pretorius, W., Bothma, C., Hugo, A., Hugo, C. 2024. Chemical, microbial, and sensory effects of natural preservatives as Sulfur dioxide replacers in boerewors. Journal of Food Processing and Preservation 24 art 4336909: 1-11 (Impact factor: 2.0; Quartile 2) (John Wiley & Sons) (eISSN: 1745-4549) doi: 10.1155/2024/4336909

14. Einkamerer, O.B., Ferreira, A.V., Fair, M.D., Hugo, A. 2024. The effect of dietary non-protein nitrogen content on the meat quality of finishing lambs. South African journal of Animal Science 54(3): 340-357. (Impact factor: 1.16; Quartile 3). (South African Society of Animal Science) (eISSN: 2221-4062) doi: 10.4314/sajas.v54i3.05

15. Einkamerer, O.B., Ferreira, A.V., Fair, M.D., Hugo, A. 2024. The effect of dietary non-protein nitrogen content on the performance of finishing lambs. South African Journal of Animal Science 54(4): 583-593. (Imp[act factor: 1.16; Quartile 3). (South African Society of Animal Science) (eISSN: 2221-4062) doi: 10.4314/sajas.v54i5.05

16. Ramoroka, M.P., Macneil, M.D., Neser, F.W.C., Lashmar, S.F., Makgahlela, M.L., 2025. Assessing genetic diversity and population structure of non-descript cattle in South African smallholder systems. Frontiers in Genetics (Impact factor 2.8; Quartile 2)https://doi.org/10.3389/fgene.2025.1535730

17. Kooverjee, B.B., van der Nest, M.A., Macneil, M.D., Scholtz, M.M. & Neser, F.W.C., SOMA, P., 2025. Estimation of breed composition of South African sheep affected with wet carcass syndrome. Frontiers in Genetics (Impact factor 2.8; Quartile 2) (https://doi.org/10.3389/fgene.2025.1635947

18. Grobbelaar, A., Daffue, W., Albertyn, C., Deacon, F. 2025.. A fracture in the proximal pastern bone of a free-roaming giraffe (*Giraffa camelopardalis giraffa*) under field conditions. *Zoo Biology*, 1–4. (Impact factor 1.5 ; Quartile 2) https://doi.org/10.1002/zoo.70004

19. Pardave, R., Osthoff, G., Clauss, M., & Deacon, F. 2025. Nutrient Composition of Natural Diet Items and Faeces in Free-Ranging Southern Giraffes (*Giraffa camelopardalis giraffa*): A Pilot Study. (Impact factor 1.1; Quartile 2) *African Journal of Ecology*, 63(6), e70095. https://doi.org/10.1111/aje.70095

20. Bello-Akinosho, A.O.M.., Swart, V., Featherston, J., Cason, E.D., Bolsenbroek, A., Beneke, C., Musoke, J., Baker, T., Ismail, A., Sebolai, O., Albertyn, J., Pohl, C. 2025. Brown locusts, Locustana pardalina, host fluconazole-resistant Candidozyma (Candida) auris, closely related to Clade III clinical strains, Medical Mycology, Volume 63, Issue 8, August 2025, myaf069, (Imp[act factor:1.3; Quartile 3)https://doi.org/10.1093/mmy/myaf069

21. Opperman, R., van Wyngaard, B.E., Cluff, M.,Bothma, C., Roodt, E., Hugo, C.J., Hugo, A. 2025. Sustainable strategies for sodium reduction in biltong by improving healthiness without impairing safety. South African Journal of Science. (Impact factor:2.3; Quartile 1). DOI: 10.17159/sajs.2025/18999

22. Osthoff, G, Hugo, A., Niewoudt, P. 2025. Composition of White Rhinoceros Colostrum and Changes During Early Lactation to Mature Milk. Zoo Biology. (Impact factor 1.5; Quartile 2) DOI: 10.1002/zoo.21907

23. Osthoff, G., Mason, S. and Deacon, F. Dec 2025. H-nuclear magnetic resonance spectroscopy metabolomics of giraffe milk during mid- to late-lactation. Metabolomics, 22(1). https://doi.org/10.1007/s11306-025-02373-6

24. Deacon, F. Nov 2025. How Energetic Demands and Habitat Utilisation Can Make or Break Giraffes. African Journal of Ecology, 2025; 63:e70128. https://doi.org/10.1111/aje.70128

25. Deacon, F. and Black, W.J. Nov 2025. Importance of Stocking Rate, Grazing, and Browsing Capacity in Relation to Rainfall on a Wildlife Estate in the Central Free State of South Africa. Rangeland and Ecology Management 103: 388-394. https://doi.org/10.1016/j.rama.2025.09.011

26. Smit, M., Malan, P., Smit, N. and Deacon, F. Oct 2025. Drought impact on woody plant leaf phenology and browse availability in a semi-arid environment. Environmental and Sustainability Indicators, 28: (100960). https://doi.org/10.1016/j.indic.2025.100960

27. Opperman, R., van Wyngaard, B.E., Cluff, M.,Bothma, C., Roodt, E., Hugo, C.J., Hugo, A. 2025. Sustainable strategies for sodium reduction in biltong by improving healthiness without impairing safety. South African Journal of Science. (Impact factor:2.3; Quartile 1). DOI: 10.17159/sajs.2025/18999

28. Osthoff, G, Hugo, A., Niewoudt, P. 2025. Composition of White Rhinoceros Colostrum and Changes During Early Lactation to Mature Milk. Zoo Biology. (Impact factor 1.5; Quartile 2) DOI: 10.1002/zoo.21907

29. Mbambalala, L., Mpayipheli, M., Leeuw, K.-J., Thabethe, F., Hugo, A. 2025. Response in growth performance, carcass traits, physicochemical properties, and fatty acid composition of Dohne Merino rams fed different levels of canola meal. Food Science of Animal Resources 2025. DOI: 10.5851/kosfa.2024.e55

Popular publications

- Hugo, A., Mare, F. 2025. Beef and sheep carcass block test and its relevance in South Africa. Stockfarm, 28-33. March 2025.
- Pretorius, Z.A., Terefe, T.G., Visser, B. & Boshoff W.H.P. 2024. Battling Wheat Rust in South Africa: Challenges and Strategies. planthealthcases.2024.00. https://doi.org/10.1079/planthealthcases.2024.0019
- Terefe, T. & Boshoff, W.H.P. 2024. Wheat leaf rust – a widely distributed disease in South Africa. Wheat Focus 42.4, July/August 2024, 22-23.
- Terefe, T. & Boshoff, W.H.P. 2025. New stem rust races detected on wheat, Western Cape 2024 season. Koringfokus 43.3 May/June 8-9.

STRATEGIC OBJECTIVE **IMPACT MONITORING**

Strategic objective: Area of impact and deliverables to reach objective		
Key Performance Area (KPA)	**Key Performance Indicator (KPI)**	**Milestones/Progress to date**
Collaborative training of PhD and MSc Students	Postdoc appointments: PhD students: Masters students:	2 4 32
Collaborative research conducted	Identify and appoint collaborators:	**RPO:** Red Meat Producers Organisation **SAPA:** South African Poultry Association **NERPO:** National Emergent Red Meat Producers' Organisation **SAPPO** South African Pork Producers' Organisation Milk SA **RMAA:** Red Meat Abattoir Association **SA Feedlot Association** **RMIS:** Red meat Industry Services **SAMIC:** SA Meat Inspection Company
Collaborative research outputs such as papers and conferences	Conferences: Conference posters: Articles published:	51 24 31
Research projects	Current projects: Finalised and implemented projects:	42 5
Learning and growth	Postgraduate degrees conferred:	
Community service delivery	Number of outreach initiatives: Number of training sessions:	1 29
Finance	Additional External Income Initiatives:	
Publications	Number of scientific publications: Popular publications:	29 4
MOUs	Number of MOUs concluded:	
ARC mirror collaboration established	Number of confirmed collaborations:	1

EXPENDITURE

Area of expenditure to achieve maximum impact and strategic objective		
Line Item	**Description**	**Spend**
Salaries		R2 million
Graduate students (tuition and other related costs)	Post-Doc appointments: PhD students: Masters students:	
Research costs	MSc., PhD, and Postdoc research. Publication page fees. Research Equipment and Infrastructure. Travel and Conferences. Coordination (Supervision, monitoring and other related costs). Administrative costs. Capacity Building (Training workshops, short courses, internships). Community Engagement / Outreach (public participation, awareness, extension services).	R438,000.00 R626,581.00 R3,647.00 R12,422.00
Collaboration Costs	MOUs. Joint activities. Exchange programmes.	

CHAIRED BY
PROF. MARYKE LABUSCHAGNE

RESEARCH CHAIR 5

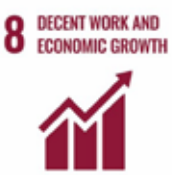
BREEDING OF CLIMATE-RESILIENT, NUTRITIOUS AND DISEASE RESISTANT CROP VARIETIES
CHAIRED BY PROF. MARYKE LABUSCHAGNE

Driving SDGs 1, 2, 6, 8, 9, 12, and 15

Targets1a, 1.1, 1.2.

Targets 2.1, 2.2, 2.4, 2.5, 2a

Targets 6.4.



Target 8.2

Targets 9b

Target 12a

Targets 15.1, 15.8

This Research Chair, through collaborative research, focuses on the development of nutrient-rich, disease resistant, high starch staple crops such as maize, sweet potatoes, potatoes and wheat, especially in the context of climate change, but will also harness the potential of neglected alternative high protein crops such as cowpea, pigeon pea and chickpea, and alternative high starch crops such as indigenous vegetables and cassava and also sorghum, which is climate resilient and a source of protein and starch.

The Research Chair in Diversification of Plant Genetics for Improved Nutrition is headed by Professor Maryke Labuschagne

Professor Labuschagne is a prolific scientist and at the forefront of plant breeding in the Department of Plant Sciences at the University of the Free State. She has been leading the National Research Foundation (NRF) South African Research Chairs Initiative (SARChI) in Disease Resistance and Quality in Field Crops for the last nine years. Since 2025 I have also led the ARC/DOA/UFS Chair in Breeding Climate Resilient Vegetables and Grains. Her research interest is in the genetic improvement of nutritional value of food security crops in South Africa and Africa, in the context of climate change. She is involved in pre-breeding activities on sorghum and wheat quality improvement, and together with the Agricultural Research Council, research is already being conducted on cowpea, pigeon pea, groundnut, sweet potato, maize, and sorghum to breed highly nutritious and climate resilient crops.

STRATEGIC OBJECTIVES

The primary aims of the Research Chair is to generate genetic diversity (develop alternative high protein and starch crops) and to improve the yield and nutritional value of indigenous vegetables. In addition, it aims to continue research on current staple crops (focusing on climate resilience, disease resistance, and improved nutritional value), revive sorghum breeding, and maximise the nutritional value of crops. This is to be achieved through, among other, the training of new plant breeders and by generating collaborative research outputs.

Furthermore, it will focus on improved yield and nutritional value of indigenous vegetables, continue research on current staple crops; focusing on climate resilience, disease resistance, and improved nutritional value. It aims to revive sorghum breeding, maximise the nutritional value of crops, train new plant breeders and generate collaborative research outputs.

The objectives of this Chair are:

1. To breed climate resilient, disease resistant and nutritious cowpea and pigeon pea cultivars.
2. To breed biofortified and climate resilient maize and sorghum cultivars.
3. To develop rust resistant wheat cultivars.
4. To develop climate resilient and disease resistant cassava and potato cultivars.
5. To improve indigenous vegetables for disease resistance and climate resilience (amaranth).
6. To collaborate with ARC-VIMP and ARC-GC to initiate breeding for cowpea and pigeon pea.
7. To collaborate with ARC-GC on the development of biofortified maize (high iron, zinc, provitamin A and essential amino acids) in the context of climate change.
8. To revitalise sorghum breeding in the South African context with ARC-GC, with a specific focus on climate resilience and nutritional value.
9. To collaborate with ARC-VIMP on sweet potato and potato breeding for disease resistance and climate resilience.
10. To contribute to nutritional value screening and breeding of indigenous vegetables in the context of climate change.

Conclusion

In conclusion, the Research Chair on Climate-Smart Agriculture and Food Systems Resilience represents a strategic and timely initiative to confront the pressing challenges of climate change. By integrating rigorous research, stakeholder engagement, capacity building, and policy advocacy, the Chair will contribute to the transformation of agricultural systems in ways that are sustainable, resilient, and inclusive. Through its work, the Chair will not only advance scientific understanding but also drive tangible improvements in food security and livelihoods, particularly for those most at risk from climate-related disruptions.

PROGRESS HIGHLIGHTS

BREEDING OF CLIMATE RESILIENT, NUTRITIOUS AND DISEASE RESISTANT CROP VARIETIES

CAPACITY BUILDING:

Recruitment of PhD students is underway. Potential students have been earmarked and will be submitting their proposal for consideration by the Scientific Committee.

Graduation of PhD student Milcah Masemola (now Milcah Matjeke) in April 2025 with the title: "Heritability and expression of grain yield and nutritional characteristics of cowpea". She was supervised by prof Labuschagne (UFS), prof. Minnaar-Ontong (UFS), dr Mbuma (ARC) and prof Gerrano (ARC).

Augustine Boakye-Boateng attained her PhD, December 2025: Genetic diversity, nutritional quality and yield potential of an international cowpea germplasm collection.

Other collaborators
SAWCIA is funding a project: Evaluation of cultivars and lines for genetic resistance to rust diseases to the value of R250,000.00.
British Council International Science Partnership Fund (ISPF) is funding a project: Building capacity in in molecular breeding of traditional crops for smallholder nutrition, livelihoods and climate resilient agriculture, to the value of R1,000,000.00

Note: Prof Maryke Labuschagne received the Exceptional Academic Achievers Awards: Established Researcher, University of the Free State for 2025 on 5 December.

Research projects under the Chair:

Project 1: Wheat rust resistance breeding

The cereal rust group at the UFS has collaborated with the ARC-Small Grain (ARC-SG) in Bethlehem for the last 30 plus years on the phenotypic and genotypic characterisation of winter cereal pathogens. These included Puccinia species that cause wheat-, oat- and barley rust and the Wheat stripe mosaic virus that was first described in the country in 2019.

- Analysis of *Puccinia triticina* isolates causing wheat leaf rust in South Africa using Genotyping-by-Sequencing (Emily Tsotetsi, PhD student).

New rust races were confirmed through pathotyping of representative isolates at UFS and further characterised using extended differential sets. We also assessed the response of wheat cultivars and breeding lines to the new races. For wheat leaf rust the response of lines with sources of adult plant resistance is outstanding. We further processed 50 isolates of *Puccinia triticina* collected in 2024. The response of six wheat lines, with characterised sources of adult plant resistance, and a susceptible control to the newly reported leaf rust race TDTST has been confirmed in a greenhouse trial.

All the greenhouse and field data from 2024 have been summarised and interpreted and was shared with industry members during a meeting coordinated by ARC-Small Grain on 20 February 2025. We completed the 2025 seedling assessment of 138 wheat cultivars and breeding lines submitted by breeders from all the local breeding companies. Trial seed have been prepared and is scheduled for planting at the main field locality at Greytown for end June. Wheat trial entries, consisting of recommended SA wheat cultivars and advanced breeding lines as well as key germplasm sources, were planted on the 26th of June in the Greytown area. Weed control was carried out on the 20th of August. Germination, stand and early plant development is excellent. Two weekly visits to do field inoculations and to capture stripe-, leaf-, and stem rust data were carried out from 20 August to 12 November 2025. The trial season has been successfully completed, and the data will be shared with industry members once summarised.

- Improved wheat rust surveillance in South Africa using MARPLE diagnostics (Isabella du Toit, PhD student).

This PhD project also focussed on 96 Pst isolates, but in this case MARPLE diagnostics was used to genetically characterize these isolates. All isolates were again divided into two groups, but in contrast to the MSc study above, the isolates of race 142E30A+ were split into two groups, with all isolates collected in Zimbabwe in 2018 grouping with the historic race isolates. Ms du Toit has also completed the genotyping of both 96 Pgt field isolates, which showed two sub-populations in Southern Africa, which supported previous microsatellite studies. She is currently busy with the genetic

analysis for fungicide insensitivity for both pathogens, and the identification of hidden virulence genes in Pst.

This PhD project also focussed on 96 Pst isolates, but in this case MARPLE diagnostics was used to genetically characterize these isolates. All isolates were again divided into two groups, but in contrast to the MSc study above, the isolates of race 142E30A+ were split into two groups, with all isolates collected in Zimbabwe in 2018 grouping with the historic race isolates. Ms du Toit has also completed the genotyping of both 96 Pgt field isolates, which showed two sub-populations in Southern Africa, which supported previous microsatellite studies. She is currently busy with the genetic analysis for fungicide insensitivity for both pathogens, and the identification of hidden virulence genes in Pst. Genotyping of clones of the original Pst isolates included in Hester van Schalkwijk's PhD, confirmed that their similarity to a UK isolate in 2021 was most probably incorrect, since they clearly grouped with current PstS1,2 (Kenia/Azerbaijan) and PstS4 (Sweden) South African Pst isolates.

In the last quarter, she sequenced the CYP51 gene from both the Pst and Pst isolates. While no SNPs were evident in the 96 Pst isolates, a single missense SNP was found within the 96 Pgt isolates and then specifically within the Ug99 genetic lineage. This SNP has been described but isolates with this SNP will be tested through germination studies.

For the CytB gene, no variants were found for both Pgt and Pst.

For the SdhB gene, no variants were found within Pgt, while 17 SNPs (15 silent and 2 missense) were found within the Pst isolates. Selected variants will be used in germination studies to confirm the effect of the relevant SNP in terms of fungicide sensitivity.

For SdhC, all isolates for Pgt and Pst must still be done. For the SdhD gene, no SNPs were found for Pgt, while the Pst isolates must be repeated due to poor sequencing coverage

- Characterisation of Puccinia striiformis f. sp. tritici isolates from wheat in South Africa (Amie Coetzer, MSc).
  Genotyping of 96 field isolates and races of Pst. Based on allelic data generated with 16 microsatellite markers was done and two optimal groups were found. The first group contained isolates from the first four races described in SA, while the second contained all the isolates of race 142E30A+ collected from Zimbabwe and South Africa. The first group could however be divided further by splitting the isolates representing the historic isolates into two groups. All data capturing has been completed, and the student is busy with statistical analyses and writing of her dissertation.

- Identification and characterisation of a putative virulence effector from Puccinia graminis f. sp. Tritici (Jaki du Plooy, MSc student).
  She is studying the effect of silenced putative effector genes on the virulence characteristics in Pgt inoculated wheat. She has tentatively identified two genes which, when silenced, red The student has completed all phenotypic assessments in (macro) greenhouse and (micro) microscopic comparisons between treated and untreated wheat against Pgt. Most molecular assessments have been completed. The student is busy with statistical analyses.

uce the virulence of the pathogen significantly. These genes will be further characterised in future.

Analysis of Puccinia triticina isolates causing wheat leaf rust in South Africa using Genotyping-by-Sequencing (Emily Tsotetsi, PhD student). New rust races were confirmed through pathotyping of representative isolates at UFS and further characterised using extended differential sets. We also assessed the response of wheat cultivars and breeding lines to the new races. For wheat leaf rust the response of lines with sources of adult plant resistance is outstanding. We further processed 50 isolates of Puccinia triticina collected in 2024 for Me Emily Tsotetsi PhD study. The response of six wheat lines, with characterised sources of adult plant resistance, and a susceptible control to the newly reported leaf rust race TDTST has been confirmed in a greenhouse trial. The student purified and confirmed the phenotypic responses of 120 Pt isolates collected since the early 1990's in South Africa. Uredinio spore bulks were made for all the isolates and are ready for DNA extraction.

All the greenhouse and field data from 2024 have been summarised and interpreted and was be shared with industry members during a meeting coordinated by ARC-Small Grain on 20 February 2025. We completed the 2025 seedling assessment of 138 wheat cultivars and breeding lines submitted by breeders from all the local breeding companies. We have prepared trial seed and scheduled planting of our main field locality at Greytown for end June. Wheat trial entries, consisting of recommended SA wheat cultivars and advanced breeding lines as well as key germplasm sources, were planted on the 26th of June in the Greytown area. Weed control was carried out on the 20th of August. Germination, stand and early plant development is excellent. Two weekly visits to do field inoculations and to capture stripe-, leaf-, and stem rust data were carried out from 20 August to 12 November 2025. The trial season has been successfully completed, and the data will be shared with industry members once summarized.

Characterisation of Puccinia striiformis f. sp. tritici isolates from wheat in South Africa (Amie Coetzer, MSc). Genotyping of 96 field isolates and races of Pst. Based on allelic data generated with 16 microsatellite markers was done and two optimal groups were found. The first group contained isolates from the first four races described in SA, while the second contained all the isolates of race 142E30A+ collected from Zimbabwe and South Africa. The first group could however be divided further by splitting the isolates representing the historic isolates into two groups. All data capturing has been completed and the student is busy with statistical analyses and writing of her dissertation. The student has completed her dissertation which has been submitted for examination in November 2025.

Project 2: Breeding biofortified and climate resilient maize and sorghum cultivars.

UFS: Prof Maryke Labuschagne, dr Kwame Shamuyarira
ARC: Drs Kingstone Mashingaidze, Nemera Shargie, Siphiwokuhle Shandu

Sorghum breeding

PhD projects:
- Genome-wide association analysis of agronomic and grain quality traits in grain sorghum (Thulo Sejake).
  The student has completed the phenotyping and genotyping of a part of the ARC sorghum collection and has completed all the field evaluation and the nutritional analysis. All the generated data has been cleaned up and GWAS (genome-wide association studies) have been done. He has to submit his thesis by July 2026.

- Heritability and expression of yield related and seed quality characteristics in milling sorghum (Sindi Ndlovu)
  She has completed her research proposal and has started on the literature review and ethical clearance application. She has also started with the crosses (line by tester) to generate progeny for her project.

Maize breeding

PhD projects
- The impact of provitamin A levels on the yield and yield components and nutritional values in yellow and orange maize hybrids (collaborative project between ARC, UFS and Zamseeds in Lusaka).

The student (Karane Nkoana) has completed the all field work of his project and is currently processing the second-year trials from Makhatini, Vaalharts and Potchefstroom. Nutritional analysis of all four trials underway. He is planning to submit his thesis in the first half of next year.

Heterotic grouping and combining ability of selected maize doubled haploid lines under optimal and stress conditions (Moshieng Ntswane) PhD student Moshieng Ntswane (employed by ARC) is currently harvesting his field trials and has extracted the DNA from his genotypes for SNP genotyping. He is awaiting the results of SNP genotyping from SEQUART in Kenya. All his trials have been completed and harvested, and he has completed a large portion of the nutritional analyses already. He is planning to submit his thesis in the first half of 2026.

- The student is awaiting the results of SNP genotyping from SEQUART in Kenya. All his trials have been completed and harvested, and he has completed a large portion of the nutritional analyses already. He is planning to submit his thesis in the first half of next year.

MSc project
- Characterisation of Agricultural Research Council (ARC) maize germplasm for heterotic groupings and yield-related traits: (Vhutshilo Luthingi). The student has presented his research proposal and he has received ethical clearance for his project. He has already submitted the first draft of his literature review to his supervisors. He will plant his first field trials in the coming summer season, and his project is on track.

Project title: Initiation of a cowpea breeding programme for disease resistance and nutritional quality

UFS Collaborators: Rouxléne van der Merwe, Chrisna Steyn, Adré Minnaar-Ontong, Diana Mngomezulu, Maryke Labuschagne

ARC Collaborators: Abe Gerrano, Edmond Ntswane, Michael Bairo, Stephen Amoo

Students:

1. 4th year BSc Agric – Willem (Wihan) Botha "Genetic diversity of cowpea germplasm" The SSR analysis of 276 cowpea accessions (out of 467) is completed and data is being analysed. This data was presented at the 12th International Conference on Agriculture (AGRICO 2025) in Bangkok, Thailand from the 22-24 September 2025.

2. 4th year BSc Agric – Nyikiwe Nkhwashu "Developing a disease screening protocol on orphan legumes for *Sclerotinia Rolfsii* and *Fusarium solan*i diseases".

The trials for the development of a disease screening protocol on orphan legumes for *Sclerotinia* and *Fusarium* diseases has been planted and inoculated with the relevant pathogens. Disease evaluation will commence after 3 weeks and results will be presented at the honours presentations on 11 November.

MSc Agric projects:

1) Katekani Nicolette Mgomezulu "Phylogenetic and morphological characterisation of cowpea germplasm".

The phylogenetic genetic study of 467 isolates commenced in June 2025 and runs simultaneously with the molecular marker screening. All the DNA was extracted, purity determined and will be evaluated using SSR markers. The Agilent fragment analyser was recently serviced (1 & 2 Sept) and will be used for this study instead of the Gelscan.

2) Simamkele Manyolo "Initiation of a Cowpea breeding programme for drought tolerance".

The trial was planted using seedlings to ensure same age plantlets. The trial consists of 9 cultivars (ARC14, ARC15, ARC005, ARC37, ARC24,98K, Fahari, Glenda, and TVU), planted in a factorial design with two water treatments (100% water holding capacity and 30% water holding capacity, respectively). The trial includes three replications and a total of 54 plots. Four plants per plot is planted, resulting in a total of 216 pots. The pots are weighed daily to determine the amount of water to be added to each pot. The biochemical and physiological data collection will commence during the vegetative growth stage and will include Chlorophyll fluorescence, using a PEA chlorophyll fluorometer to determine Fv/Fm and overall photosynthetic efficiency, Stomatal conductance using a leaf porometer (Li-Cor ADC) between 9:00 am to 13:00, Electrolyte leakage Leaf relative water content. Chlorophyll and carotenoid content, Proline assay, Total soluble sugars, Hydrogen peroxide, Malondialdehyde assay, Leaf cell metabolic activity, and Glutathione assay. These analyses will be performed between September to December 2025.

- Evaluation of the founder parents of a cowpea multi-parent advanced generation inter-cross (MAGIC) population for grain yield and nutritional characteristics (Tatenda Chiradza, MSc student).

The aim of the project is to evaluate the founder parents of the cowpea MAGIC population for grain yield potential and nutritional composition under South African conditions, and to conduct RNA sequencing of root and leaf tissues to gain insights into the genetic basis of trait inheritance, thereby supporting the selection of superior recombinant inbred lines in the MAGIC population for breeding purposes in South Africa. At rial was planted at Makhathini but was washed away in floods. A follow-up trial was planted at Groblersdal (Loskop Research Station), in September 2025, and the parents will be planted in a tunnel at the UFS in November 2025. His literature review is almost complete and he has received ethical clearance for his project.

Project title: Physiological responses and nutritional quality of *Cajanus cajan* genotypes under stress and optimal growing conditions.

Participating Members:

UFS: Angeline Jacoby (AJ), Boke Moloi (BM)

- Determining the nutritional content of pigeon pea genotypes using near-infrared spectroscopy (Keketso Letaba, 4th year student). Forty-two pigeon pea genotypes, provided by the Agricultural Research Council (ARC) - Grain Crop in Potchefstroom, were used in the study. The seeds for each genotype were scanned using the DA 7250 NIR system, and moisture, protein, and ash content were obtained. The total starch content was determined using the standard Ewers polarimetric method. The student is finalising her project which she will present at the departmental seminar day in October.

- The antioxidative response of pigeon pea leaves at the vegetative and flowering stages under drought stress (Mercy Tsubella, Honours student).

The project entails analysis of pigeon pea genotypes under drought stress for enzymatic antioxidants (ascorbate peroxidase and guaiacol peroxidase) and non-enzymatic antioxidants (carotenoids, phenolics, flavonoids and ascorbic acid). For the flowering stage, carotenoids, phytochemicals (phenolics and flavonoids) and ascorbic acid assay were conducted on the 1st, 2nd and 3rd of July 2025, respectively. Ascorbate peroxidase and guaiacol peroxidase were conducted on the 9th and 10th of July 2025, respectively. For pod filling, a carotenoid assay was conducted on the 27th of August 2025. These assays are conducted to investigate if there is a difference in enzyme antioxidant activity and non-enzymatic antioxidant accumulation in pigeon pea under induced-drought stress and well water plants to determine drought-tolerant cultivars out of the cultivars used in this study.

- Impact of drought stress on photosynthetic efficiency, chloroplast ultrastructure and seed nutritional composition in four pigeon pea varieties (Lindiwe Sondela, MSc student).

Chlorophyll pigment parameters were determined (30 April 2025, 15 June 2025 and 20 August 2025) on the different growing stages (vegetative, flowering and pod-filling) of the four cultivars. These parameters give more insight into how the process of photosynthesis is affected under drought stress conditions. For the chloroplast ultrastructure parameter, the samples were sent to Hungary for TEM and SEM analysis. The protocols for total soluble sugars and starch parameter are being verified. For the second objective (nutrition and yield) of the study all yield measurements were taken and data analysis has commenced. For nutrition analysis the mature seeds were harvested and analysis will commence in 2026.

Phenolic and proteomic characterisation of *Cajanus cajan* for the selection of elite nutritional lines for climate-resilient agriculture in South Africa (Kelvin Hlatshwayo, PhD student). This student has accepted a breeding position in Germany and will not continue with his studies. The project will be assigned to a new student in 2026.

Other projects not in above themes
PhD projects
- Integrating GWAS and molecular breeding to enhance *Ditylenchus africanus* resistance in groundnut (Stephan Henning)

Collaborators: profs Sonja Steenkamp and Liezel Herselman, and dr Kingstone Mashingaidze

The student already did his research proposal and received ethical clearance for his project. He started with the sequencing of the nematode genome. He has also just returned from a research visit to Senegal, in order to access germplasm, and interact with the groundnut nematode specialist working there. For the upcoming trial on the larger GINA collection, arrangements have been made to access and conduct the work at the ARC research station (greenhouse). After returning from Senegal, a seed-revival protocol was used, and after treatment all remaining 28 ISRA seeds germinated successfully and are currently growing in the greenhouse. The ARC seed was treated in parallel, and from the original 200 seeds, a total of 13 seedlings were recovered across multiple attempts (initial sowing, two incubation attempts of ±50 seeds each, and a final rejuvenation treatment of the remaining 100 seeds).

- Evaluation of cassava for high storage root yield, starch and dry matter content and early bulking in South Africa (Roelene Marx)

Collaborators: drs Angie Jacoby, Amelawork Assefa, Michael Bairu, prof Rouxlene vd Merwe

About 5500 cassava in vitro tissue culture plantlets were multiplied and hardened off. A trial was planted at Hluhluwe for cultivar evaluation to see seasonal variation. An additional three locations were planted in May - June 2025. The trials planted in Hluhluwe and Loskop in 2024 were harvested, and data were recorded on yield and quality-related traits. Cassava stems were harvested, and stakes were prepared. The stakes from Hluhluwe were planted at Mbombela and Roodeplaat for priming and hardening off. The stakes from Loskop were planted at Loskop for priming and hardening off. A second set of stakes from Loskop trial was harvested and planted in Musina during June for priming and hardening off and planted for trial and seed multiplication in Aug to September 2025. Protocol development and cyanide analysis were done on 100 samples, and another 300 samples were tested in Aug 2025. Protocol development and cyanide analysis were done on 100 samples, and another 300 samples were tested in Aug 2025. The first season (2024/25) cassava evaluation trial at Musina (Limpopo province) was completed. Yield and quality-related traits data were collected from 16 cassava genotypes, roots were harvested at each harvesting time, and data on eight yield and quality-related traits were recorded. Starch analysis, data clearing and organising were completed. The second season (2025/26) evaluation trial was planted on 7 April 2025, and replacement of dead or diseased plants was done.

- Introgressing of Fusarium wilt resistance in sweet potato (Mmapaseka Malebana)

Collaborators: drs Sunette Laurie and Prof. Maryke Labuschagne

The student will present her research proposal on 17 October and apply for ethical clearance before that. Her project is in planning and she is preparing material and the greenhouse for planting and inoculation. The student has done her proposal presentation and has obtained ethical clearance for her project. She has done the first greenhouse trial where disease inoculation was done. Arrangements for metabolomic analysis of plant material at the analytical unit at Stellenbosch University for metabolomics has already been made.

MSc project
- Breeding for guava wilt disease resistance (Phumelela Ngwenya, MSc).

The student will present her research proposal on 19 September. She had some constraints with material, but she is progressing with the project. The student has done her research proposal and obtained ethical clearance for her project. She remains with challenges to obtain plant material but is working.

We have reported on the results and progress of student projects per project above. Expectations have been exceeded with 9 PhD, 7 MSc and five honors/4th year students involved on the projects currently. All projects are co-supervised by UFS and ARC team members. Most of the projects commenced early in 2025 and are now running.

Scientific publications

1. Matjeke, M.B., Labuschagne, M., Gerrano, A.S., Minnaar-Ontong, A., Mbuma, N.W., 2025. Heritability and expression of yield and yield related components in cowpea, an underutilized crop in Africa. Frontiers in Sustainable Food Systems. 9: 1588245. https://doi.org/10.3389/fsufs.2025.1588245.

2. Matjeke, M.B., Labuschagne, M., Gerrano, A.S., Minnaar-Ontong, A., Mbuma, N.W., 2025. Combining ability, heterosis and heritability of selected cowpea genotypes for grain yield and morphological characteristics. Euphytica 221: 96. https://doi.org/10.1007/s10681-025-03520-9.

3. Mbuma, N.W., Steyn, P.J., Laurie, S.M., Labuschagne, M.T., Bairu, M.W., 2025. Phenotypic diversity of released South African bred potato varieties for tuber yield and processing quality. Potato Research 68: 1397-1417. https://doi.org/10.1007/s11540-024-09790-5.

4. Visser, B., Bender, C.M., Terefe, T., Pretorius, Z.A., Boshoff, W.H.P. 2025. Wheat rust surveillance in South Africa – a molecular approach. South African Journal of Botany 185: 205-212. https://orcid.org/0000-0003-2769-5546

5. Matjeke, B.M., Labuschagne, M., Gerrano, A.S., Minnaar-Ontong, A., Mbuma, N.W., 2025. Correlations between grain yield, its components and nutritional traits for cowpea (*Vigna unguiculata* L. Walp) F1 progenies and their parental genotypes. South African Journal of Botany 187: 268-275. https://doi.org/10.1016/j.sajb.2025.10.027.

6. Tallury, S.P., Gerrano, A.S., Deshmukh, D., Han, S., Mekonnen, T.W., Labuschagne, M., 2025. Peanut Genetic Resources: Status, Challenges, and Use in Peanut Genetic Improvement. In: Zhuang, W., Varshney, R.K., Wang, X., Zhang, X. (Eds). Peanut Genomics and Biotechnology. CRC Press. 18 pp. https://doi.org/10.1201/9781003360988

7. Du Toit, I., Visser, B., Rothman, L.A., Boshoff, W.H.P. 2025. Triazole sensitivity among South African *Puccinia graminis* f. sp. *tritici* isolates. South African Journal of Plant and Soil 42:1-3,24-34. https://doi.org/10.1080/02571862.2025.2498020

8. Sivhada, R., Boshoff, W., van Biljon, A., Labuschagne, M.T., 2025. The impact of wheat stripe rust in the presence of resistance genes *Yr9, Yr10*, and *Yr15* on gluten proteins: Insights from size-exclusion high-performance liquid chromatography analysis. Applied Food Research 5: 100684. https://doi.org/10.1016/j.afres.2024.100684

Popular publications

1. Terefe, T. & Boshoff, W.H.P. 2024. Wheat leaf rust – a widely distributed disease in South Africa. Wheat Focus 42.4, July/August 2024, 22-23.

2. Terefe, T. & Boshoff, W.H.P. 2025. New stem rust races detected on wheat, Western Cape 2024 season. Koringfokus 43.3

Research outputs (with ARC-author/s)
Papers

1. Matjeke, M.B., Labuschagne, M., Gerrano, A.S., Minnaar-Ontong, A., Mbuma, N.W., 2025. Heritability and expression of yield and yield related components in cowpea, an underutilized crop in Africa. Frontiers in Sustainable Food Systems. 9: 1588245. https://doi.org/10.3389/fsufs.2025.1588245.

2. Matjeke, M.B., Labuschagne, M., Gerrano, A.S., Minnaar-Ontong, A., Mbuma, N.W., 2025. Combining ability, heterosis and heritability of selected cowpea genotypes for grain yield and morphological characteristics. Euphytica 221: 96. https://doi.org/10.1007/s10681-025-03520-9.

3. Pretorius, Z.A., Terefe, T.G., Visser, B. & Boshoff W.H.P. 2024. Battling Wheat Rust in South Africa: Challenges and Strategies. Planthealthcases.2024.00. https://doi.org/10.1079/planthealthcases.2024.0019

4. Mbuma, N.W., Steyn, P.J., Laurie, S.M., Labuschagne, M.T., Bairu, M.W., 2025. Phenotypic diversity of released South African bred potato varieties for tuber yield and processing quality. Potato Research 68: 1397-1417. https://doi.org/10.1007/s11540-024-09790-5.

5. Visser, B., Bender, C.M., Terefe, T., Pretorius, Z.A., Boshoff, W.H.P. 2025. Wheat rust surveillance in South Africa – a molecular approach. South African Journal of Botany 185: 205-212. https://orcid.org/0000-0003-2769-5546

Industry papers (with ARC-author/s)

1. Terefe, T. & Boshoff, W.H.P. 2024. Wheat leaf rust – a widely distributed disease in South Africa. Wheat Focus 42.4, July/August 2024, 22-23.

2. Terefe, T. & Boshoff, W.H.P. 2025. New stem rust races detected on wheat, Western Cape 2024 season. Koringfokus 43.3 May/June 8-9.

3. Two publications in accredited journals (Euphytica, IF 1.6, Q2 and Frontiers in Sustainable Food Systems, IF 3.7, Q2) and three popular publications.
4. Paper in accredited journals (South African Journal of Botany, IF 2.7, Q2 and Potato Research, IF 2.3, Q1).

Local and international travel – knowledge sharing and travel:

Conferences

1. Terefe, T.G., Visser, B., Pretorius, Z.A. & Boshoff, W.H.P. 2025. A decade of wheat leaf rust surveillance reveals seven new races of *Puccinia triticina* in South Africa. 17th ICRPMC, Vancouver, Canada. 15-20 June 2025.

2. Coetzer, A., Visser, B., Terefe, T.G., du Toit, I., Pretorius, Z.A. & Boshoff, W.H.P. 2025. Genetic characterisation of *Puccinia striiformis* f. sp. *tritici* isolates suggests southerly migration to South Africa. 17th ICRPMC, Vancouver, Canada. 15-20 June 2025.

3. Du Toit, I., Boshoff, W.H.P., Saunders, D.G.O., Terefe, T.G., Pretorius, Z.A. & Visser, B. 2025. Genetic comparison of South African and global *Puccinia striiformis* f. sp. *tritici* isolates. 17th ICRPMC, Vancouver, Canada. 15-20 June 2025.

4. Botma, W., Minnaar-Ontong, A., Henning, S., Van der Merwe, R., Bairu, M. & Steyn C. 2025. Genetic diversity analysis of 276 cowpea (*Vigna unguiculata* L. Walp) accessions using SSR Markers. 12th International Conference on Agriculture (AGRICO 2025), Bangkok, Thailand. 22-23 September 2025.

5. The 76th Annual European Federation of Animal Science (EAAP), Innsbruck, Austria, 25 to 29 August 2025.

6. The 17th International Cereal Rusts and Powdery Mildews Conference, 15-20 June 2025. Vancouver, Canada.

7. 12th International Conference on Agriculture (AGRICO 2025), Bangkok, Thailand. 22-23 September 2025.

Conferences (with ARC-author/s)

1. Visser, B., du Toit, I., Terefe, T., Bender, C.M., Pretorius, Z.A. & Boshoff, W.H.P. 2024. Wheat rust surveillance in South Africa: past, present and future. University of Johannesburg Annual Postgraduate Student Symposium, University of Johannesburg, Johannesburg, South Africa. 21 October 2024.

2. Terefe, T.G., Visser, B., Pretorius, Z.A. & Boshoff, W.H.P. 2025. A decade of wheat leaf rust surveillance reveals seven new races of *Puccinia triticina* in South Africa. 17th ICRPMC, Vancouver, Canada. 15-20 June 2025.

3. Coetzer, A., Visser, B., Terefe, T.G., du Toit, I., Pretorius, Z.A. & Boshoff, W.H.P. 2025. Genetic characterisation of *Puccinia striiformis* f. sp. tritici isolates suggests southerly migration to South Africa. 17th ICRPMC, Vancouver, Canada. 15-20 June 2025.

4. Du Toit, I., Boshoff, W.H.P., Saunders, D.G.O., Terefe, T.G., Pretorius, Z.A. & Visser, B. 2025. Genetic comparison of South African and global *Puccinia striiformis* f. sp. tritici isolates. 17th ICRPMC, Vancouver, Canada. 15-20 June 2025.

5. Botma, W., Minnaar-Ontong, A., Henning, S., Van der Merwe, R., Bairu, M. & Steyn C. 2025. Genetic diversity analysis of 276 cowpea (*Vigna unguiculata* L. Walp) accessions using SSR Markers. 12th International Conference on Agriculture (AGRICO 2025), Bangkok, Thailand. 22-23 September 2025.

6. Pretorius, Z.A., Terefe, T.G., Visser, B. & Boshoff W.H.P. 2024. Battling Wheat Rust in South Africa: Challenges and Strategies. planthealthcases.2024.00. https://doi.org/10.1079/planthealthcases.2024.0019

7. Prof. Labuschagne also established collaborations with the following development agencies that provide support in kind:

8. Zamseeds: Lusaka, Zambia.

9. International Maize and Wheat Improvement Center (CIMMYT): Harare, Zimbabwe, of which their expertise lie in maize breeding. They plant field trials and provide the UFS with research material.

STRATEGIC OBJECTIVE **IMPACT MONITORING**

Strategic objective: Area of impact and deliverables to reach objective		
Key Performance Area (KPA)	**Key Performance Indicator (KPI)**	**Milestones/Progress to date**
Collaborative training of PhD and MSc Students	Postdoc appointments: PhD students: 1 Masters students:	4 11 9
Collaborative research conducted	Identify and appoint collaborators:	14 ARC 1 UNISA
Collaborative research outputs such as papers and conferences	Conferences: Conference posters: Articles published:	16 5
Research projects	Current projects: Finalised and implemented projects:	5
Learning and growth	Postgraduate degrees conferred:	5
Community service delivery	Number of outreach initiatives: Number of training sessions:	2
Finance	Additional External Income Initiatives:	
Publications	Number of scientific publications:	17
MOUs	Number of MOUs concluded:	
ARC mirror collaboration established	Number of confirmed collaborations:	9

EXPENDITURE

Area of expenditure to achieve maximum impact and strategic objective		
Line Item	**Description**	**Spend**
Salaries		R2,5 million
Graduate students (tuition and other related costs)	Post-Doc appointments: PhD students: Masters students:	 R900,000.00 R600,000.00
Research costs	MSc., PhD, and Postdoc research. Publication page fees. Research Equipment and Infrastructure. Travel and Conferences. Coordination (Supervision, monitoring and other related costs). Administrative costs. Capacity Building (Training workshops, short courses, internships). Community Engagement / Outreach (public participation, awareness, extension services).	
Collaboration Costs	MOUs. Joint activities. Exchange programmes.	

CHAIRED BY
PROF HLAMI NGWENYA

RESEARCH CHAIR 6

COMMUNICATION FOR INNOVATION CHAIRED BY PROF HLAMI NGWENYA

Driving SDGs 2, 8, 9, 13, and 15

Target 2c | Target 8.3 | Target 9.5 | Target 13.2, 13a | Target 15.3

The Research Chair in Communication for Innovation aims to address the challenges faced by agrifood systems globally. These systems are under pressure to deliver food and nutrition security while preserving important social, economic, and environmental foundations. With increasing food demands and climate change concerns, transforming these systems is key. However, in low- and middle-income countries (LMICs), the uptake of new technologies and practices remains limited, partly due to fragmented knowledge, poor communication, and lack of coordination among stakeholders. Innovation efforts often fail to address local needs or gain community support, hindering progress.

Communication plays an important role in overcoming these barriers. It connects researchers, practitioners, policymakers, and communities, enabling the exchange of knowledge, promoting stakeholder engagement, and supporting social learning. By facilitating context-specific adaptation, communication ensures that innovations are more relevant, accepted, and impactful. It also supports continuous feedback and dialogue, which is important for refining and improving practices, while addressing issues like knowledge silos and resistance to change.

In embedding communication in the innovation process, the Research Chair helps to ensure that solutions are not only technically sound but also socially responsive, contributing to more resilient, equitable, and sustainable outcomes.

The Research Chair in Communication for Innovation is headed by Professor Hlamalani Ngwenya

Professor Ngwenya is a lecturer at the Centre for Sustainable Agriculture, Extension and Rural Development at the UFS, holding multiple advanced degrees in education, agriculture, and community nutrition. Passionate about teaching, she has also worked globally since 1992 in roles spanning project management, policy advocacy, knowledge management, and agricultural development, gaining extensive expertise across agriculture, food security, education, and health sectors. Having conducted assignments in over 45 countries, Professor Ngwenya has moderated numerous multi-stakeholder engagements and contributed to global initiatives such as the New Extensionist Learning Kit, which shaped agricultural extension training worldwide. She collaborates with major organisations like FAO, AUDA-NEPAD, and IFPRI and holds leadership roles, including that of Board Chair for the Citrus Industry Trust and RAEIN-Africa. Her work focuses on agricultural extension, systems thinking, organisational development, and youth mentorship, with ongoing involvement in capacity-building research and community outreach.

STRATEGIC **OBJECTIVES**

This Research Chair was established to reposition communication as a core driver of different dimensions of innovations, leadership, and systemic change in agrifood systems. Its purpose is to advance the science of delivery, support scaling of innovations, strengthen capacity for systems thinking and transdisciplinary practice; strengthen knowledge translation, and institutionalise communication as a central function within governance and innovation systems.

Practitioners working in Government, NGOs, businesses, on farms and communities possess rich experiential knowledge but lack structured platforms to document, analyze, and translate their insights into policy and research processes. This creates a persistent gap between academic research and real-world innovation. Innovations often fail not because of technical gaps, but due to communication breakdowns: fragmented knowledge systems, contested worldviews, misaligned goals, and weak feedback loops.

The Chair operates as a living laboratory where academic inquiry and frontline practice co-evolve. It meets professionals where they are, equipping them with tools to reflect on their experiences, document tacit knowledge, and generate theory from practice. By validating practitioner knowledge and strengthening systemic learning, the Chair creates inclusive, adaptive, and resilient innovation ecosystems. At a time of growing global complexity, it offers a timely platform to bridge research, policy, and practice, supporting transformative change that is scientifically grounded, yet technically and socially sound.

The strategic objectives are:

1. Advance the science of delivery: Equip practitioners to "wear scientific goggles" and turn delivery into research-driven learning that empower practitioners, researchers, and institutions to understand what works, why, and under what conditions, thereby improving the implementation, contextual relevance, and scaling of innovations.
2. Catalyse inclusive scaling: Document, analyse and inform scaling pathways Out (replication), Up (institutionalisation), and Deep (cultural and behavioural change).
3. Strengthen communication and transdisciplinary capacity: Train a new cadre of scientifically grounded, communication-competent professionals. To build both individual and institutional capacity for strategic communication, systems leadership, and transdisciplinary collaboration, thereby strengthening innovation ecosystems. This includes formal academic pathways (e.g., Master's and PhD support) as well as non-formal training, mentoring, and peer learning.
4. Validate practitioner knowledge and translate evidence: Recognise practitioners as co-producers of knowledge; make evidence actionable. To democratise knowledge systems by recognising, documenting, and integrating practitioner, indigenous, and experiential knowledge into academic and policy frameworks. Strengthening knowledge brokering and translation mechanisms that ensure evidence is accessible, contextualised, and applied across stakeholder groups.
5. Policy and governance for innovation systems: Integrate communication as a governance lever to align policies with practice. To embed communication into governance, strengthen policy coherence, and ensure innovation systems are more inclusive, responsive, and coordinated. Activities include policy alignment studies, supporting domestication of policies, cross-ministerial coordination, communication strategies for policy processes, advocacy using practitioner evidence, and building policymaker capacity to engage with multiple knowledge systems.
6. Establish a community of practice and 'think tank': Create a global platform for dialogue, foresight, and co-leadership in systemic change. Foster critical reflection, peer learning, and collective leadership on communication, innovation, and systemic transformation.

PROGRESS **HIGHLIGHTS**

CAPACITY BUILDING:

This project only commenced on the 1st of May 2025, however, An amount of 20 000 USD (of R 400 000 equivalent) was leveraged from the Global Forum for Rural Advisory Services (GFRAS) to support the scientific writeshops for the Harvesting of Scientific Publications in the ongoing Accelerating agroecological transformation through Rural Advisory Services (RAS) in Uganda, Madagascar, Ecuador and Costa Rica. A submission to be table at UFS Exco on 1st October for approval. A series of workshops in the 4 countries were held to identify topics.

PhD Students
2 PhD students have been approved
- Mr Mmatlou Alfred Moloto: Assessment of food waste at distribution centers: a review in South African fresh produce retail markets level
- Mr Guduro Beriso: Re-Orienting Women's Empowerment through Gender-Responsive Climate Smart Agricultural Practices and Rural Advisory Services in Ethiopia.

4 Potential students have been earmarked and will be submitting their proposal for consideration by the Scientific Committee in Feb 2026:
- **Ms Masasani Eve Chavalala:** Reimagining Mining Towns: A Participatory Governance Framework for Sustainable Post-Mining Transitions in South Africa
- **Ms Sithembile Ndema Mwamakamba:** Policy Research Networks and Multi-Level Governance: Examining the Domestication of CAADP in Africa
- **Ms Vivian Nerea Atakos:** Negotiating with Evidence: Developing a Knowledge–Attitude–Practice (KAP) Framework for Gender-Responsive Climate Policy Engagement among African Agriculture and Gender Negotiators in the UNFCCC (2013–2025)
- **Natasha Tamarin Jackson:** Adoption of Scientific Based Production Advice: Understanding Decision-Making Among South African Citrus Producers

Leveraged Income:
UK PACT (R10 million)
UK PACT (R11 million)

MOUs Concluded:
- Institute of Development Studies (IDS) United Kingdom.
- Food, Agriculture, Natrual Resources Policy Analysis Network (FANRPAN).
- Center for Coordination of Agricultural Research and Development in Southern Africa (CCARDESA).

Through the Wearing Scientific Goggles several topics have been identifies for harvesting stories of scientific value with the GFRAS Agroecology project in Uganda, Madagascar, Costa Rica and Ecuador.

GFRAS made additional resources (about R 800 000) equivalent within the project to test the Wearing Scientific Goggles model.
- In Uganda alone, a team of 50 people from withing the project are actively engaged, created a WhatsApp group and have already identified 30 topics from within the same project to further develop into
- In Madagascar 14 topics where identified
- Costa Rica and Ecuador held workshops and the topics are yet to be confirmed.

In total, this initiative will:
- Generate over 50 knowledge products of scientific values (these include peer review papers, case studies, policy briefs, videos etc).
- Over 50 practitioners across the 4 countries who are Wearing Scientific Goggles and are able to identify and document stories of scientific value within ongoing project.
- Meta Action research papers

UK PACT Grant on Climate Change Act

The Chair secured R10 Million worth UK PACT grant to **Domesticate Climate Change Act** in two Municipalities in the Free State and Limpopo province. The project will be implemented in 2026 in partnership with the Food, Agriculture, Natural Resource Analysis Network (FANRPAN); International Food Policy Research Institute (IFPRI); Center for Municipal Research and Advice (CMRA) and the university of Venda

Policy Engagements

The Chair led the delegation to the FAO World Food Forum in Italy, Rome.

The Research Chair also moderated the following high level policy engagements

Popular Publications

Blog: Kristin Davis, Eliot Jones-Garcia, Hlamalani Ngwenya, Arielle Rosenthal, & Amanda Grossi (2025): Co-Designing AI Agents for Agricultural Policy (12 December 2025)

Research projects under the Chair:

Advance the Science of Delivery (through Wearing Scientific Goggles Model):
Harvesting science- based evidence and knowledge products in the Accelerating agroecological transformation through Rural Advisory Services (ÆRAS) Project. Dr A Makamane has been appointed and this project is supported by the Global Forum for Rural Advisory Services (GFRAS) and selected extension country fora in Uganda, Madagascar, Ecuador and Costa Rica.

Objectives:
To develop and test **Wearing Scientific Goggles framework** and turn delivery into research-driven learning that empower practitioners, researchers, and institutions to understand what works, why, and under what conditions, thereby improving the implementation, contextual relevance, and scaling of innovations. While producing knowledge products of scientific value.

Key activities
- Design and pilot context-responsive Wearing Scientific Goggles model through Meta Action Research; Facilitate action research cycles and structured reflection with practitioner teams; Mentor field actors to document, analyse, and make sense of their delivery processes; Host training sessions on the model of *"Wearing Scientific Goggles"*
- Synthesize findings across delivery sites and models to support system-wide learning

Catalyse Inclusive Scaling through a Living Laboratory for Systems Learning

Objective
To establish a Living Laboratory that develop, tests, refines, and scales adaptive communication strategies, enabling inclusive, systems-responsive innovation across diverse contexts.

Key Activities:
- Facilitate participatory systems mapping, feedback loops, and learning cycles; Document and analyse scaling pathways Out (replication), Up (institutionalization), and Deep (cultural and behavioural change)
- Convene cross-sectoral and multi-level learning exchanges to support shared reflection

Strengthen Capacity for Communication and Transdisciplinary Research and Practice

Objective:
To build both individual and institutional capacity for strategic communication, systems leadership, and transdisciplinary collaboration, thereby strengthening innovation ecosystems. This includes formal academic pathways (e.g., Master's and PhD support) as well as non-formal training, mentoring, and peer learning.

Key Activities:
- Recruit and supervise PhD and Master students through Transdisciplinary research program; Design and deliver **practice-based training programmes** and certificate courses; Develop a **competency framework** for communication and facilitation of systemic change; Mentor professionals in **co-creation, stakeholder engagement, and reflective practice**; Integrate learning modules into **university curricula and continuing professional development**; Host **experiential learning workshops, and communities of practice**

Validate Practitioner Knowledge & Translate Evidence

Objective:
To democratize knowledge systems by (1) recognizing, documenting, and integrating practitioner, Indigenous, and experiential knowledge into academic and policy frameworks, and (2) strengthening knowledge brokering and translation mechanisms that ensure evidence is accessible, contextualized, and applied across stakeholder groups.

Key Activities:
Facilitate impact **story harvesting**, case documentation, and reflective learning with practitioners; Establish **co-publication platforms** and participatory peer review mechanisms; Partner with academic institutions to accredit **practice-based inquiry**; Develop **mentorship and support pathways** for practitioner-led publishing; Create and disseminate **user-friendly knowledge products** (e.g., briefs, videos, toolkits, blogs); Convene **dialogues, learning events, and multi-stakeholder exchanges**.

Policy & Governance for Innovation Systems

Objective
To strengthen governance and policy coherence by embedding communication strategies into policymaking, fostering alignment across institutions and levels, and ensuring innovation policies are informed by grassroots realities.

Key Activities
Conduct research on policy alignment between national, regional, and global frameworks; Support domestication of policies at local level to ensure contextual fit; Embed communication and knowledge translation strategies in governance processes; Facilitate cross-ministerial and cross-sectoral coordination platforms; Provide targeted policy advocacy informed by practitioner knowledge and grassroots evidence; Build capacities of policymakers to engage with and act on diverse forms of evidence.

Establish a Community of Practice and Think Tank

Objective:
Establish a **Community of Practice and Think Tank** to foster critical reflection, co-learning, and collective leadership on communication and systemic change.

Key Activities:
Launch a Community of Practice and thematic working groups; Facilitate regular policy dialogues and foresight sessions; Organize webinars, talkshows, symposia, innovation roundtables, and joint publications; Feed insights into curricula, research agendas, and institutional strategies

Local and international travel – knowledge sharing and travel:

Prof. Ngwenya attended the World Food Forum (WFF) held in Rome, Italy on 10 and 13–17 October 2025. South Africa's role in cooperation between the Global South and Global North and development partners to advance technology transfer and sustainable development was discussed at length. It was agreed that the FAO team will share letters of intent for collaboration with the ARC, UFS, and other possible SA partners.

16-18 June 2025, Rome, Italy. FAO Global AgriFood Biotechnology Convened by UN Food and Agriculture Organisation (FAO) Prof. Ngwenya's role. Input into Programme, Resource person and Moderator of the following sessions:

1. Moderate Plenary sessions
June, 17, (14:00-15:30) Biotechnological innovations and sustainability frontiers
June 18, (9:00-10:300 Scaling Innovations in Biotech: From research to context specific adoption by rural communities

2. Moderate Networking session
16 June (18:00-19:30), Youth and women in Biotech: Innovating for Tomorrow
17 June 2025(18:00-19:30) Private sector in development, uptake and scaling of biotech solutions

3. Moderate Technical sessions
June, 17 (11:00 – 12:30): Biotechnologies in managing forest genetic resources
June 17, (16:00-17:30) Collaborative approaches for ensuring safety of biotechnological applications in food

2025, 17 October, Rome, Italy. One Health in agrifood systems is everyone's health. Convened by FAO HQ.
2025, 16 October, Rome, Italy. When farmers lead innovation! 2025 Innovation Award on Farmer Field School for Sustainable Agrifood Systems:
2025, 14 October, Rome, Italy. Driving technologies and innovations towards equitable agrifood systems transformation: launching of ATIO Initiative
2025, August. Johannesburg, South Africa. From Evidence to influence: Advancing Nutrition Advocacy for Policy reform. Food Agriculture Policy Analysis Network (FANRPAN) Regional Multistakeholder Policy Dialogue

9- 13 June, Kigali, Rwanda. African Conference of Agricultural Technologies (ACAT) convened African Agricultural Technology Foundation (AATF).

9 June: Speaker: User Centric Plenary Dialogue
10 June: Moderator: Researchers Dialogue: Integrating traditional knowledge systems with modern technology solutions
11 June: Moderator: Private Sector Dialogue
26 May, Limpopo Province, South Africa. G20 meeting of the Chief Scientists (MACS). Prof. Ngwenya's Role: Panel speaker in Agri-food systems panel session.

12-16 May, Lilongwe, Malawi. 7th Africawide Agricultural Extension Week (AAEW). Prof. Ngwenya'srole: Programme design and main Moderator and member of Regional Organising Committee and resource person.

Prof Ngwenya presented at the Western Cape Department of Agriculture, Extension Symposium. Date:16-18 July, 2025. Presentation on the Wearing the Scientific Goggle and Harvesting Knowledge Products.

GFRAS and UFS hosted Wearing Scientific Goggles Webinar on 15 December 2025

Prof. Ngwenya established collaborations with the following local research institutes:
- Food Agriculture, Natural Resource Policy Analysis Network (FARNPAN)
- Institute for Development Studies (IDS)
- Center for Coordination of Agricultural Research and Development in South Africa (CCARDESA) as well as:
- The Global Forum for Rural Advisory Services (GFRAS)
- Western Cape Department of Agriculture (WoDA)

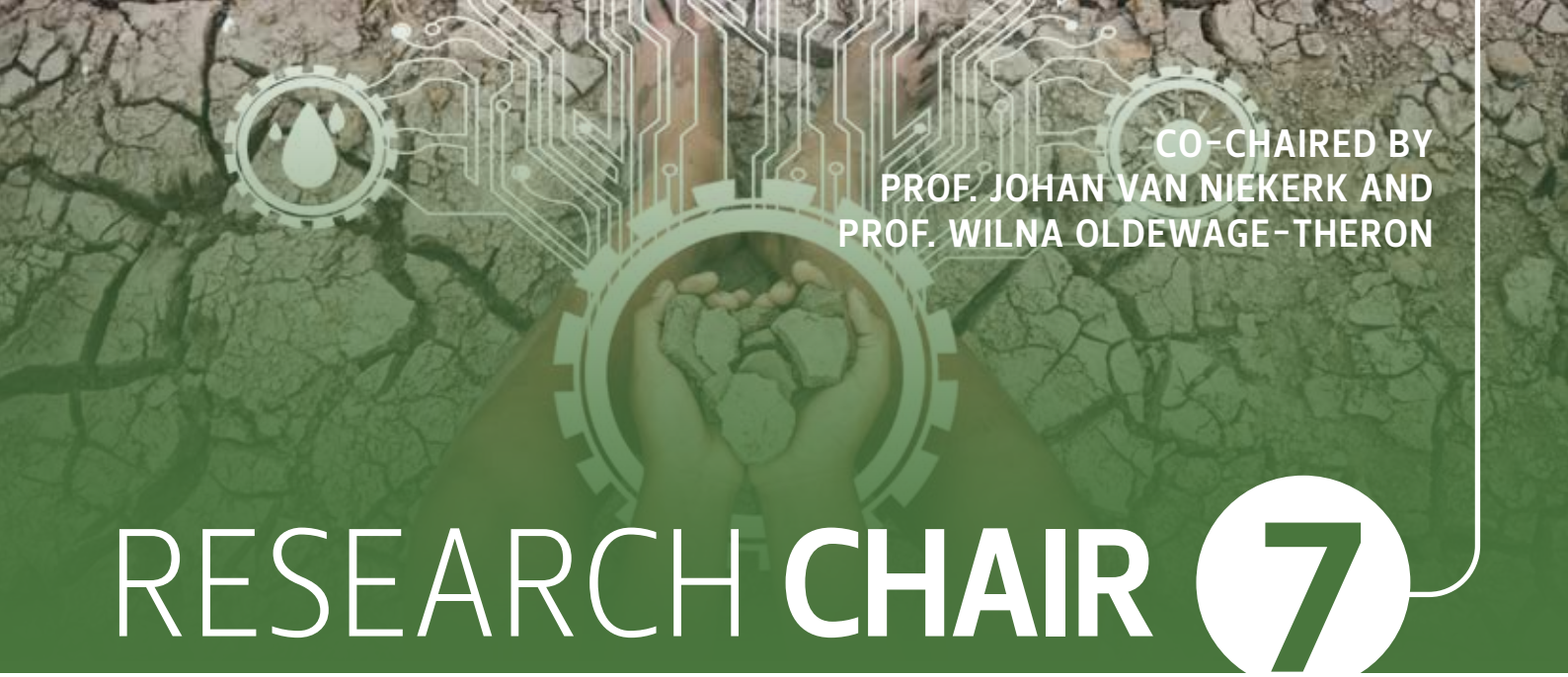
STRATEGIC OBJECTIVE **IMPACT MONITORING**

Strategic objective: Area of impact and deliverables to reach objective		
Key Performance Area (KPA)	**Key Performance Indicator (KPI)**	**Milestones/Progress to date**
Collaborative training of PhD and MSc Students	Postdoc appointments: 1 PhD students: Masters students:	1 6
Collaborative research conducted	Identify and appoint collaborators:	• Global Forum for Rural Advisory Services (GFRAS) and selection country for a in Uganda, Madagascar, Ecuador, and Costa Rica. • Food Agriculture, Natural Resource Policy Analysis Network (FARNPAN) • Institute for Development Studies (IDS) • Centre for Coordination of Agricultural Research and Development in South Africa • CCARDESA) • Western Cape Department of Agriculture (WCDA) • Center for Municipal Research and Advise (CMRA) • National Agricultural Marketing Council (NAMC) • International Food Policy Research Institute (IFPRI)
Collaborative research outputs such as papers and conferences	Conferences: Conference posters: Articles published:	5 1
Research projects	Current projects: Finalised and implemented projects:	6
Learning and growth	Postgraduate degrees conferred:	
Community service delivery	Number of outreach initiatives: Number of training sessions:	
Finance	Additional External Income Initiatives:	• USD20,000.00 (R400,000.00) leveraged from the Global Forum for Rural Advisory Services (GFRAS) to support the scientific writeshops for the Harvesting of Scientific Publications in the ongoing Accelerating agroecological transformation through Rural Advisory Services (RAS) in Uganda, Madagascar, Ecuador and Costa Rica. • The Chair secured R10 Million worth UK PACT grant to Domesticate Climate Change Act in two Municipalities in the Free State and Limpopo province. The project will be implemented in 2026 in partnership with the Food, Agriculture, Natural Resource Analysis Network (FANRPAN); International Food Policy Research Institute (IFPRI), Centre for Municipal Research and Advice (CMRA) and the university of Venda

Publications	Number of scientific publications:	
MOUs	Number of MOUs concluded:	2
ARC mirror collaboration established	Number of confirmed collaborations:	2

EXPENDITURE

Area of expenditure to achieve maximum impact and strategic objective		
Line Item	**Description**	**Spend**
Salaries		R1,5 million
Graduate students (tuition and other related costs)	Post-Doc appointments: PhD students: Masters students:	
Research costs	MSc., PhD, and Postdoc research. Publication page fees. Research Equipment and Infrastructure. Travel and Conferences. Coordination (Supervision, monitoring and other related costs). Administrative costs. Capacity Building (Training workshops, short courses, internships). Community Engagement / Outreach (public participation, awareness, extension services).	R438,000.00 R626,581.00 R3,647.00 R12,422.00
Collaboration Costs	MOUs. Joint activities. Exchange programmes.	



CO-CHAIRED BY
PROF. JOHAN VAN NIEKERK AND
PROF. WILNA OLDEWAGE-THERON

RESEARCH CHAIR 7

IMPACT ASSESSMENT OF CLIMATE-SMART INTERVENTIONS CO-CHAIRED BY PROF. JOHAN VAN NIEKERK AND PROF. WILNA OLDEWAGE-THERON

Driving SDGs 2, 8, 9, 13, and 17

2 ZERO HUNGER	8 DECENT WORK AND ECONOMIC GROWTH	9 INDUSTRY, INNOVATION AND INFRASTRUCTURE	13 CLIMATE ACTION	17 PARTNERSHIPS FOR THE GOALS
Target 2c.	Target 8.3.	Target 9b	Targets13.2, 13a	Target 17.8

This Research Chair aims to tackle the challenges of climate change on food systems and vulnerable populations. By focusing on evaluating climate-smart agriculture (CSA) practices, the Chair will conduct impact assessments to determine the effectiveness of various interventions, develop robust methodologies, and provide evidence-based policy recommendations. This initiative will adopt an interdisciplinary approach, fostering collaborations with academic institutions, government agencies, and local communities to ensure research relevance and effectiveness. Capacity building through training programmes will empower stakeholders in impact assessment techniques. Ultimately, the Chair seeks to enhance resilience, promote sustainable practices, and contribute to achieving sustainable development goals, ensuring food security in the face of climate change.

Some of the main outcomes the Chair aims to realise are to create effective climate-smart interventions (across different regions and sectors), methodologies for assessment of the impact of climate-smart practices, actionable policies for policymakers, capacity building (training in impact assessment techniques), and the dissemination of knowledge.

The Research Chair in Impact Assessment of Climate-Smart Interventions is headed by Professor Johan van Niekerk and Professor Wilna Oldewage-Theron

Professor Johan van Niekerk is a specialist in agricultural extension, rural economic development, and sustainable food systems. He currently serves as Vice-Dean: Agriculture in the Faculty of Natural and Agricultural Sciences at the University of the Free State (UFS), heads the Department of Sustainable Food Systems and Development, and is a Senior Lecturer in the Centre for Sustainable Agriculture, Rural Development and Extension.

His key competencies include lecturing in Agricultural Extension and Rural Economic Development, facilitating research methodology and academic progress in graduate and postgraduate programmes, and developing course content for postgraduate diplomas and Master's programmes in Sustainable Agriculture, Agricultural Extension, and Food Systems. He is also involved in curriculum design and the presentation of advanced diplomas and short learning programmes, alongside conducting research in his core fields.

Professor Van Niekerk's research interests include sustainable rural and urban development, agricultural advisory services, agricultural value chains, sustainable food systems, and food and nutrition security. Since 2015, he has successfully supervised 89 Master's dissertations and 24 PhD theses.
agribusiness.

Dr. Wilna Oldewage-Theron is a Registered Dietitian (RD) and a National Research Foundation-rated researcher, serving as a Professor in the Department of Sustainable Food Systems and Development at the University of the Free State (UFS), while also holding the title of Professor Emerita in Nutritional Sciences at Texas Tech University (USA). She has 25 years of extensive community and translational research experience focused on understanding and mitigating factors contributing to household food insecurity and malnutrition in resource-poor communities. Her research is aimed at investigating the efficacy of various interventions—school nutrition, nutrition education, supplementation, household and community gardening, recipe and food product development—to address the double burden of disease and achieve sustainable dietary and lifestyle behaviour change in vulnerable population groups. Demonstrating a broad international impact, Prof. Oldewage-Theron has successfully implemented projects across African, Asian, and South American countries, as well as the USA, and has provided consultancy services to global organisations including WISHH, WorldFish, and Joint Aid Management. Her current community research and development programme is focused on practical soy applications and maximising the nutritional benefits of soy for human health through integrated nutrition education, household and community soy and vegetable gardening, and comprehensive skills training intervention programmes, and the impact of these interventions on health and nutritional status of vulnerable population groups. She has authored/co-authored 150 articles and 2 letter in peer-reviewed scientific journals, as well as 6 chapters in books and has an h-index of 20 (Scopus), 26 (ResearchGate), and 33 (Google Scholar).

STRATEGIC **OBJECTIVES**

The Research Chair is established with a clear and urgent mission: to address the multifaceted challenges posed by climate change on food systems, particularly those affecting vulnerable populations. As global temperatures rise and weather patterns become increasingly erratic, agricultural productivity, food security, and livelihoods are under threat. This Chair aims to serve as a beacon of innovation, research excellence, and policy guidance in the realm of climate-smart agriculture (CSA), ensuring that interventions are not only scientifically sound but also socially equitable and economically viable.

At the heart of the Chair's work is the evaluation of CSA practices. These practices encompass a wide range of agricultural techniques and strategies designed to increase productivity sustainably, enhance resilience to climate shocks, and reduce greenhouse gas emissions. Examples include conservation agriculture, agroforestry, improved irrigation systems, and the use of climate-resilient crop varieties. The Chair will undertake rigorous impact assessments to determine the effectiveness of these interventions across diverse agroecological zones and socio-economic contexts. These assessments will be grounded in robust, interdisciplinary methodologies that integrate environmental science, economics, sociology, and policy analysis.

To ensure that the research conducted is both relevant and actionable, the Chair will foster strong collaborations with academic institutions, government agencies, non-governmental organizations, and local communities. These partnerships will be instrumental in co-designing research agendas, sharing data and insights, and translating findings into practical solutions. By engaging stakeholders throughout the research process, the Chair will promote ownership, enhance the applicability of results, and facilitate the scaling up of successful CSA interventions.

Capacity building is another cornerstone of the Chair's strategy. Through targeted training programmes, workshops, and mentorship initiatives, the Chair will empower a new generation of researchers, extension officers, and policymakers with the skills and knowledge needed to conduct impact assessments and implement CSA strategies effectively. These programmes will emphasize participatory approaches, gender inclusivity, and the integration of indigenous knowledge systems, ensuring that the benefits of CSA are equitably distributed and culturally appropriate.

The Chair also recognizes the critical importance of knowledge dissemination. Research findings, policy briefs, technical manuals, and educational materials will be made accessible through multiple channels, including academic publications, open-access platforms, community outreach events, and digital media. By prioritizing transparency and accessibility, the Chair aims to bridge the gap between science and practice, enabling stakeholders at all levels to make informed decisions that enhance food system resilience.

In alignment with the United Nations Sustainable Development Goals (SDGs), particularly SDG 2 (Zero Hunger), SDG 13 (Climate Action), and SDG 17 (Partnerships for the Goals), the Chair's work will contribute to global efforts to eradicate hunger, mitigate climate change, and foster inclusive development. The emphasis on evidence-based policy recommendations will support governments and development agencies in designing and implementing strategies that are both effective and sustainable.

Strategic research objectives of the Chair:
To achieve its mission, the Chair has outlined the following strategic objectives:

1. Design and evaluate context-appropriate Climate-Smart Interventions Across diverse Regions and agricultural systems
   The Chair will identify, test, and promote CSA practices that are tailored to specific regional and sectoral needs. This includes understanding the unique vulnerabilities and capacities of different farming systems, from smallholder farms in arid regions to commercial operations in more temperate zones. By contextualizing interventions, the Chair ensures that solutions are not only technically sound but also socially and economically feasible.
2. Develop and Apply robust Methodologies for measuring CSA Impacts on productivity, and sustainability
   A key focus will be the creation and refinement of methodologies that can accurately measure the outcomes of CSA practices. These methodologies will incorporate both quantitative and qualitative indicators, such as changes in yield, income, soil health, water use efficiency, and farmer perceptions. The Chair will also explore innovative tools such as remote sensing, GIS mapping, and machine learning to enhance data collection and analysis.
3. Generate evidence-based policy insights to guide climate adaptation, food systems transformation, and resource allocation
   Translating research into policy is a central goal. The Chair will work closely with policymakers to develop guidelines, frameworks, and legislative proposals that support the adoption of CSA. This includes identifying policy gaps, conducting cost-benefit analyses, and facilitating stakeholder consultations. The aim is to create enabling environments that incentivize sustainable practices and protect vulnerable populations.
4. Strengthen capacity of stakeholders (including researchers, extension officers, and decision-makers) in impact assessment tools and approaches
   Training programmes will be designed to equip stakeholders with practical skills in monitoring and evaluation, data analysis, and participatory research. These programmes will target a wide audience, including university students, agricultural extension workers, community leaders, and government officials. Special attention will be given to building capacity in underrepresented groups, including women and youth, to promote inclusive development.
5. Facilitate knowledge sharing through targeted publications, policy briefs, and stakeholder engagement
   The Chair will prioritize the dissemination of knowledge through diverse formats and platforms. This includes publishing in peer-reviewed journals, developing policy briefs, hosting webinars and conferences, and engaging with media outlets. The goal is to ensure that research findings reach a broad audience and inform practice at multiple levels—from local communities to international development agencies.
6. Support SDG implementation, particularly on food security, climate action, and poverty reduction, through rigorous, actionable research

PROGRESS HIGHLIGHTS

IMPACT ASSESSMENT OF CLIMATE-SMART INTERVENTION CAPACITY BUILDING:

Research Chair 7 is currently made up of three core members:

Two professors and one postdoctoral research fellow. One professor is based at the Agricultural Research Council (ARC), while the second is based in the Department of Sustainable Food Systems and Development, University of the Free State (UFS), allowing strong cross-institutional collaboration.

The postdoctoral research fellow plays an active role in supporting postgraduate students within the Department of Sustainable Food Systems and Development which contributes to research capacity development and postgraduate training aligned with the chairs' focus.

Dr Melanie de Bruyn was appointed as a Post-Doc and Mariska Vermeulen registered for a Master's degree.

Academic and research support has been provided to approximately 15 postgraduate students within the Department of Sustainable Food Systems and Development. Support includes guidance on research design, data analysis, interpretation of results, academic writing and preparation of manuscripts for publication. All these projects are closely aligned with the chair's objectives.

Research projects under the Chair:

1.Research infrastructure: Data collection tools

The chair has made progress in methodological approaches for assessing CSA interventions. A number of structured questionnaires and surveys have been developed as data collection tools. These tools enable collection of reliable and relevant data.

2. Analytical depth: Statistical and bibliometric analyses

The chair has advanced its analytical depth through application of advanced statistical and bibliometric analysis techniques. These approaches have been applied to synthesise existing literature, evaluate research findings and identify relevant research trends and gaps. Collectively, these analytical tools have enhanced the chair's capacity to generate insights relevant to policy formulation and decision making in support of CSA and the SDGs.

3. Historically Disadvantaged Universities, identifying strengths, potential collaborators, and future funding opportunities

What started as a Universities South Africa (USaf) funded project in 2024 exploring Science, Technology and Innovation (STI) for Sustainable Development with a specific focus on synergistic partnerships among tertiary institutions in South Africa, addressing widespread inequalities, quickly escalated into more profound research questions. In 2025, the Research and Innovation Strategy Group (RISG) reached out to the project leads and requested a follow-up study focusing on Historically Disadvantaged Universities, identifying their strengths, potential collaborators, and future funding opportunities.

The student requested permission from the RISG to look at the existing data collected in more detail and expand the research for the fulfilment of the requirements for the degree MASTER OF AGRICULTURE (MAJORING IN FOOD AND NUTRITION SECURITY). The student started by conducting an extensive literature review focusing on Higher Education Institutions, Sustainable Development, and the Sustainable Development Goals. A specific focus of the literature review was the current challenges facing the planet, how the Sustainable Development Goals could address them, and the progress being made towards their attainment. Lastly, the student focused on the effects of climate change on the Sustainable Development Goals and on their attainment.

The student conducted a desktop study using data already available in the public domain, spanning 2020 to 2024, to compare the 25 public universities in South Africa. Firstly, the student reviewed all research outputs produced by public universities that addressed any of the first 16 SDGs. Data for SDG 17 – Partnerships for the Goals cannot be quantified without an adequate search query to define it, and therefore, it was excluded from the results. This was done to identify leaders in each SDG and to identify national strengths and areas of opportunity. As the SDGs are interdependent and interconnected, with progress in one typically affecting progress in another, the student created heatmaps to showcase this interconnectedness. Co-

occurrence among the research outputs of the public universities was thus translated into measurable relationships that could be interpreted visually. Secondly, the student examined current collaborations (International, National, and Institutional) at South African public universities and how these collaborations are strengthening research contributions to the attainment of the Sustainable Development Goals.

Lastly, the student examined societal impact through policy development by identifying research outputs from South African public universities referenced in national and international policy documents. These results highlighted global trends showing that academic research often has a limited impact on policy agendas.

In conclusion, this study has been found very valuable, as the data are readily available; however, to date, no comparative studies have been conducted using the available data to identify the contributions of public universities in South Africa to achieving the SDGs. It is of utmost importance that focus areas and areas of opportunity are highlighted to create opportunities for future investments and collaborations, ensuring that South African universities have contributed to reaching the goals of the Agenda 2030. Given the significant role universities play in society, it is evident that studies like these can make substantial contributions to understanding progress toward the Sustainable Development Goals.

A follow-up PhD study is planned, in which the student will delve deeper into SDG 13 – Climate Action, one of the least addressed SDGs in terms of total research outputs, and will include academics, industry leaders, and local farmers.

Local and international travel – knowledge sharing and travel:
Prof. Van Niekerk attended the World Food Forum (WFF) held in Rome, Italy on 10 and 13–17 October 2025. South Africa's role in cooperation between the Global South and Global North and development partners to advance technology transfer and sustainable development was discussed at length. It was agreed that the FAO team will share letters of intent for collaboration with the ARC, DOA,UFS, and other possible SA partners.

Scientific publications

Peer-reviewed publications

1. De Bruyn, M.A., Nel, A.A., Beukes, D., Van Niekerk, J.A. (2025). Assessing crop rotation as a climate-smart agriculture strategy on sandy soils under seasonal rainfall variability. African Journal of Agricultural Research, 21(10),836-343. DOI: 10.5897/AJAR2025.17069

2. De Bruyn, M.A., Nel, A.A., Van Niekerk, J.A. (2024). Production and profitability of maize and soybean grown in rotation in the North-Western Free State, South Africa. African Journal of Agricultural Research, 20(2),155-162. DOI: 10.5897/AJAR2023.16568

3. De Bruyn, M.A., Nel, A.A., Van Niekerk, J.A. (2024). The effect of crop rotation on agricultural sustainability in the North-Western Free State, South Africa. African Journal of Sustainable Agricultural Development, 5(2), 32-45. ISSN: 2714-4402

4. De Bruyn, M.A., Nel, A.A., Van Niekerk, J.A. (2024). The effect of crop rotation on soil health in the north-western Free State region, South Africa. South African Journal of Plant and Soil, 40(4-5),1-8. DOI: 10.1080/02571862.2023.2282504

5. De Bruyn, M.A., Nel, A.A., Van Niekerk, J.A. (2024). The nutritional benefits of maize-soybean rotational systems in the North-Western Free State, South Africa. Agriculture and Food Security, 13(20), 1-7. DOI: 10.1186/s40066-024-00473-5

6. De Bruyn, M.A., Nel, A.A., Van Niekerk, J.A. (2022). Views and perspectives of local farmers on crop diversification in the North-Western Free State, South Africa. African Journal of Agricultural Research, 18(11),1006-1012. DOI: 10.5897/ajar2022.16150

7. De Bruyn, M., Van Niekerk, J., Venter, S. (2025). Impact of climate change research at a South African tertiary institution: Monitoring and evaluating research dissemination and policy influence using Altmetric and Overton. Technium Social Sciences Journal, 74(1), 217-224. https://doi.org/10.47577/tssj.v74i1.13122

8. Nesamvuni, A.E., Tshikolomo, K.A., Mpandeli, N.S., De Bruyn, M., Hlope-Ginindza, S. and Van Niekerk, J. (2022). Demography of smallholder agricultural woman and youth enterprises and their association with the cultivation of the tomato (Solanum Lycopersicum) vegetable crop. Technium Social Sciences Journal, 29, 2668-7798. DOI: 10.47577/tssj.v29i1.5928

9. Nesamvuni, A.E., Tshikolomo, K.A., Mpandeli, N.S., Mavhungu, J., De Bruyn, M. Van Niekerk, J. (2025). 'An investigation of the productivity and profitability of selected field crops of women smallholder agricultural enterprises in the Vhembe District of Limpopo, South Africa', in F Bhatti (ed.), Gender Economics and Gender Pay Gap - Trends and Explanations, IntechOpen, pp. 113-126. DOI: 10.5772/intechopen.1009170

10. Nesamvuni, A.E., Tshikolomo, K.A., Mpandeli, N.S., De Bruyn, M., Hlope-Ginindza, S. and Van Niekerk, J. (2022). Perceptions on irrigation water supply and utilization by smallholder agricultural enterprises in Vhembe district of Limpopo Province, South Africa. Technium Social Sciences Journal, 27, 968-979. DOI: 10.47577/tssj.v27i1.5298

STRATEGIC OBJECTIVE **IMPACT MONITORING**

Strategic objective: Area of impact and deliverables to reach objective		
Key Performance Area (KPA)	**Key Performance Indicator (KPI)**	**Milestones/Progress to date**
Collaborative training of PhD and MSc Students	Postdoc appointments: PhD students: Masters students:	1
Collaborative research conducted	Identify and appoint collaborators:	1
Collaborative research outputs such as papers and conferences	Conferences: Conference posters: Articles published:	1
Research projects	Current projects: Finalised and implemented projects:	3
Learning and growth	Postgraduate degrees conferred:	
Community service delivery	Number of outreach initiatives: Number of training sessions:	
Finance	Additional External Income Initiatives:	
Publications	Number of scientific publications:	10
MOUs	Number of MOUs concluded:	
ARC mirror collaboration established	Number of confirmed collaborations:	1

EXPENDITURE

Area of expenditure to achieve maximum impact and strategic objective		
Item/area	**Spend**	**% to Budget**
Salaries		R1,5 million
Graduate students (tuition and other related costs)	Post-Doc appointments: PhD students: Masters students:	R300,000.00 R200,000.00
Research costs	MSc., PhD, and Postdoc research. Publication page fees. Research Equipment and Infrastructure. Travel and Conferences. Coordination (Supervision, monitoring and other related costs). Administrative costs. Capacity Building (Training workshops, short courses, internships). Community Engagement / Outreach (public participation, awareness, extension services).	R100,000.00
Collaboration Costs	MOUs. Joint activities. Exchange programmes.	

DEGREES **CONFERRED**

Student name	Student number	Student ID	Degree	University	Date of completion (senate letter date)	Supervisor and affiliation	Co-supervisors and affiliations	Other co-workers and affiliations
M Hatting	2016002772		M.Sc Agric (Food Science	UFS	2024	Prof A Hugo (UFS)	Prof CJ Hugo (UFS)	
LD Barnard	2014140749		M. Agric (Animal Science)	UFS	2024	Prof F Neser	Dr AQ. O'Neill Prof ED Cason Prof A Hugo	
A Burger	2016036390		M.Sc Agric (Food Science)	UFS	2024	Prof CJ Hugo (UFS)	Prof A Hugo (UFS)	
M Masemola	2019084009		PhD (Plant Breeding)	UFS	2025	Prof M Labuschagne (UFS)	Dr N Mbuma (ARC), A Gerrano (ARC) Prof A Minnaar-Ontong (UFS)	
Esnath T Hamadziripi	2019212741		Ph.D. in Agronomy Interdiciplinary	UFS	2025	Prof L Franke, UFS	Prof MT Labuschagne, UFS	
LD Barnard	2014140749		M. Agric (Animal Science)	UFS	2024	Prof F Neser	Dr AQ. O'Neill Prof ED Cason Prof A Hugo	
Idani Annah Gundula	2014079574		M.Sc. in Agrometeorology	UFS	2025	Prof L Franke, UFS	Prof G Scholz, ARC – Animal Production Institute	
Sibabalwe Daniel	2015113067		M.Sc. in Agrometeorology	UFS	2025	Prof L Franke, UFS	Prof. E. Kotze, UFS	
RW Higgs	2016139194		M.Sc Agric (Animal Science)	UFS	2025	Prof F Deacon (UFS)		
RPV Saco	2024948677		M.Sc Agric (Animal Science)	UFS	2025	Prof F Deacon (UFS)	Prof M Clauss (University of Zurich Switzerland)	
A Grobbelaar	2004162596		PhD (Animal Science)	UFS	2025	Prof F Deacon (UFS)	Prof G Osthoff (UFS)	

B Valentin	2016086023		M.Sc Agric (Animal Science)	UFS	2025	Dr OB Einkamerer (UFS)	Dr C Rothmann (UFS) Prof ED Cason (UFS)	
H Mans	2016015998		M.Sc Agric (Animal Science)	UFS	2025	Dr OB Einkamerer (UFS)	J van Niekerk (UFS), E Pieterse (US) and L Gleeson (US)	
CA Neser	2018036430		M.Sc Agric (Animal Science	UFS	2025	Dr OB Einkamerer (UFS)	M Brink (ORFFA), GC Josling (UFS) and A Hugo (UFS)	
KD Keyser	2018000576		M.Sc Agric (Animal Science	UFS	2025	Dr OB Einkamerer (UFS)	A Oneill (UFS), C Hugo (UFS), A Hugo (UFS), GC Josling (UFS)	
EE Kriel	2024919538		M.Sc Agric (Animal Science	UFS	2025	Dr OB Einkamerer (UFS)	B van Zyl (US)	
R Le Roux	2013022542		M.Sc Agric (Animal Science	UFS	2025	Dr HA Oneill (UFS)	OB Einkamerer (UFS); A Hugo (UFS)	
P Blom	2018676102		M.Sc Agric (Animal Science	UFS	2025	Ms GC Josling (UFS)	FH de Witt (Clinvet), OB Einkamerer (UFS)	
W Botha			BSc Agric	UFS	2025	Prof M Labuschagne, Prof R van der Merwe, Dr C Steyn, Dr M Jackson UFS)	Profs A Gerrano, S Venter Mr E Ntswane, Drs M Bairo, S Amoo (ARC)	J Hlahla (UFS)
N Nkhwashu			BSc Agric	UFS	2025	Prof M Labuschagne (UFS), Prof R van der Merwe, Dr C Steyn, Dr M Jackson	Profs A Gerrano, S Venter Mr E Ntswane, Drs M Bairo, S Amoo (ARC)	J Hlahla (UFS)
K Letaba BSc Agric						Drs A Jacoby, B Moloi (UFS)	Dr Z Bello Prof A Gerrano (ARC)	
M Tsubella BSc Honors						Drs A Jacoby, B Moloi (UFS)	Dr Z Bello Prof A Gerrano (ARC)	

CHALLENGES AND BARRIERS AFFECTING OVERALL SUCCESS OF IMPLEMENTATION AND EXECUTION EFFORTS TOWARDS ACHIEVEMENT OF TARGETS

Some challenges experienced was the transition of projects already underway before the inception of the Chair being identified for transference to the Chair, especially the logistics regarding budgets. This has, to a large extent, been overcome.

Identifying and appointing the appropriate people remain a challenge, due to the time consuming aspect associated with the process. However, this will not remain a challenge once all appointments have been made.

The physical location of the ARC and the UFS was, and remains a challenge. The mirror-chairs at the ARC have in many cases not been finalised, which makes it difficult to establish relationships and collaboration. However, the respective Chairs met in person at a joint work session between the ARC and UFS researchers from 11 to 15 August 2025 in Pretoria and it is has set the scene for working relationships to be established and being cemented going forward.

In some cases, specific targets from the ARC for KPI's have not yet been finalised, since the DoA have undergone restructuring and transformation, but efforts are underway to finalise this and, going forward, it should be resolved soon.

Presenting the Research Centre as an all-encompassing entity has presented challenges, but that should be addressed before the end of 2025, "branding" is being developed in conjunction with the UFS Communication and Marketing Department, and a formal launch of the Research Centre is being planned for the end of the first quarter of 2026.

ARC • LNR
Excellence in Research and Development

agriculture
Department:
Agriculture
REPUBLIC OF SOUTH AFRICA

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