DSI-NRF
Centre of Excellence
in Food Security

# ANNUAL REPORT

## 2019

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# ACRONYMS

| | |
|---|---|
| ARC | Agricultural Research Council |
| ART | Antiretroviral Treatment |
| ARUA | African Research Universities Alliance |
| ASSAF | Academy of Sciences of South Africa |
| CCRED | Centre of Competition Regulation and Economic Development |
| CIRAD | Centre de coopération internationale en recherche agronomique pour le développement/French Agricultural Research Centre for International Development |
| CoE-FS | DST-NRF Centre of Excellence in Food Security |
| COMMIC | Committee for the Morbidity and Mortality in Children |
| CoP | Community of Practice |
| DAFF | Department of Agriculture, Forestry and Fisheries |
| DoH | South African Department of Health |
| DSI | Department of Science and Innovation |
| DVC | Deputy Vice-Chancellor/Deputy Principal |
| ECD | Early Childhood Development |
| EED | Environmental Enteric Dysfunction |
| FAO | Food and Agriculture Organisation of the United Nations |
| GFS | Global Food Security Conference |
| GovInn | Governance Innovation |
| GRCO | Gauteng City Region Observatory |
| HSRC | Human Sciences Research Council |
| IDRC | International Development Research Centre (Canada) |
| IDS | Institute for Development Studies |
| ISSER | Institute of Statistical, Social and Economic Research |
| KPA | Key Performance Area |
| LEAP-Agri | Long-term EU-Africa Research and Innovation Partnership on Food and Nutrition Security and Sustainable Agriculture |
| MANCO | Management Committee |
| MRC | Medical Research Council |
| MU | University of Missouri |
| NECDOL | Network of Early Childhood Development of Lesotho |
| NIDS | National Income Dynamics Study |
| NMU | Nelson Mandela University |
| NRF | National Research Foundation |
| NSNP | National School Nutrition Programme |
| NWU | North-West University |
| PI | Principal Investigators |
| PL | Project Leaders |
| PLAAS | Institute for Poverty, Land and Agrarian Studies |
| ROFE | Researching the Obesogenic Food Environment |
| SACSoWACH | South African Civil Society for Women's Adolescents and Children's Health |
| SADC | Southern African Development Community |
| SAFL | Southern African Food Laboratory |

| | |
|---|---|
| SALGA | South African Local Government Association |
| SANHANES | South African National Health and Nutrition Examination Survey |
| SARChI | South African Research Chairs Initiative |
| SASAC | Southern African Systems Analysis Centre |
| SLF | Sustainable Livelihoods Foundation |
| SSA | Sub-Saharan Africa |
| SteerCom | Steering Committee |
| SU | Stellenbosch University |
| TUT | Tshwane University of Technology |
| UCT | University of Cape Town |
| UFH | University of Fort Hare |
| UJ | University of Johannesburg |
| UL | University of Limpopo |
| UNAS | Uganda National Academy of Sciences |
| UNDESA | United Nations Department of Economic and Social Affairs |
| UNISA | University of South Africa |
| UP | University of Pretoria |
| UWC | University of the Western Cape |
| WP | Work Package |
| WWF | World Wide Fund for Nature |

# 1. DIRECTORS' REPORT

In 2019 the Department of Science and Innovation (DSI), National Research Foundation (NRF), and the Centre of Excellence in Food Security (CoE-FS) concluded the process of responding to the recommendations arising from the mid-term review. This Annual Report reflects on the achievements, challenges and the lessons learnt from this process while also providing detail on progress on the core mandate of the CoE-FS.

Oversight of the CoE-FS is provided by a Steering Committee (SteerCom) comprising the DSI, the NRF, the Deputy Vice-Chancellors (DVCs) of the University of the Western Cape (UWC) and the University of Pretoria (UP), and a group of international and national experts. The full SteerCom provides comment on the scientific content of the research undertaken by the CoE-FS, as well as providing guidance on both the annual and multi-year strategies. An Operational Subcommittee deals with matters of compliance, quality control, the Key Performance Areas (KPAs), and approval of the specific project proposals. A Management Committee (MANCO) comprising the Centre's Principal Investigators (PIs) meets every second month. The MANCO is responsible for preparing and implementing the Annual Business Plan. PIs coordinate the projects undertaken by the CoE-FS, which are implemented as Work Packages (WPs) undertaken by teams of researchers and postgraduate students.

Appropriate management and operational strategies and processes are now in place, including the annual Business Plan, Organisational Guidelines, a Communications and Engagement Strategy, and Charters for the SteerCom and the Operational Subcommittees. Administrative templates help with planning, monitoring and evaluation, as well as ensure that the strategic and operational role of the CoE-FS is carried out effectively and efficiently. These are consistently improved to avoid duplication and to automate reporting procedures. Our biannual planning sessions (Lekgotlas) provide a platform through which researchers and the MANCO are brought together to discuss and refine research plans specific to the various research projects. The Lekgotla held in May 2019 was constructively utilised to plan and provide input into the 2020 Business Plan. This outcome reflects our efforts to build a research team that crosses institutional and disciplinary boundaries.

Since 2016 we have focused on a comprehensive and integrated programme of research and, as a result, we have not issued further open calls for proposals. The majority of projects that were selected for funding at the inception of the CoE-FS were completed during 2018, with a small core continuing into 2019. Programmes were realigned during 2019 to build a more robust but interconnected working unit for 2020 to 2024. Research findings are described in more detail in the body of this Annual Report. Several Working Papers have been prepared and published on the CoE-FS website. The 2020 Business Plan has been based on this process and a programme of reconfiguration of the CoE-FS has been completed and will continue to be refined when this is needed. This programme is based on what we have found, what we have learnt, and what we hope to achieve during the penultimate Stage/Gate of the CoE-FS process.

The time taken to complete agreements with researchers and to transfer funds between institutions remains a concern. This is due, in part, to the legal advice that has to be sought for each agreement, and in part due to the reporting requirements that must be fulfilled. However, we are continuously working to improve on processes and performance.

In 2019 a total of 78 (60.9%) women were supported, which is above the target of 55%. The Centre supported a total of 79 (61.7%) black students, and nine (7.03%) postdoctoral fellows. In terms of equity distribution of South African students, 86 black students (67.2%) and 56 women (43.75%) were supported. In addition, the CoE-FS core staff also supervised eight students in 2019, who did not receive leverage or NRF funding. A total of 54 students graduated in 2019, supported with NRF and leverage funding. The Centre had a total of 59 publications, 18 of which have an impact factor of three and more. In addition to our concerted efforts to include women in research teams and as recipients of our student bursaries, a number of the projects focus explicitly on gender, recognising the role that patriarchy plays in food security. Our Mellon Foundation-funded programme on Food Politics and Cultures further addressed this.

We continue to achieve or exceed the majority of our Service-Level Agreement (SLA) targets, especially in terms of presentations at local conferences, publications in peer-reviewed journals and book chapters, and the share of South African female students. We still struggle with substantially increasing the share of bursary-holders who are black South Africans. We have been taking steps to address this since 2016, both by proactively seeking collaborations with Historically Disadvantaged Institutions (HDIs), and by requiring detailed motivations when candidates proposed for bursaries are not South African. We are also actively seeking funding opportunities from international sources to support our non-South African students.

We now have collaborative agreements in place with 27 institutions in South Africa and internationally, and collaborate with more than 100 researchers. Furthermore, we take advantage of networking collaborations with scholars and institutions across South Africa and internationally, through the work of both the lead investigators and grantees. The CoE-FS now boasts international collaborations in, among other countries, Algeria, Argentina, Belgium, Benin, Brazil, Côte d'Ivoire, the Czech Republic, Ethiopia, Finland, France, Germany, Ghana, Kenya, Libya, Mozambique, Namibia, the Netherlands, Nigeria, Tunisia, Uganda, the United Kingdom and the USA. In 2017, we were awarded a UNESCO Chair in African Food Systems, which is assisting in widening the footprint of the CoE-FS in Africa. Furthermore, in 2018 UP launched its African Research Universities Alliance (ARUA) Centre of Excellence in Food Security, and the CoE-FS invited the Centre's Director, Professor Hettie Schönfieldt, onto our MANCO in order to facilitate cooperation. Supported by the Mellon Foundation, our work linking the humanities to food security continued to grow during 2018 and in 2019. We again supported creative writing students at UWC, some of whom participated in the McGregor Poetry Festival, a community-based festival in the rural Western Cape. The students also worked in rural and farm schools in the regions.

The successful awarding by the Mellon Foundation of an R8-million supra-institutional grant resulted in a new research programme in the humanities in 2019, which is implemented in collaboration with UP and the University of KwaZulu-Natal. This allowed the Humanities programme led by Prof Desiree Lewis to spin off from the CoE-FS while continuing to collaborate closely with the CoE-FS. Through our Communications and Engagement Strategy, we have publicised funded research and activities in numerous ways, including through networking and public events, the monthly newsletter, social media platforms, the website and external media coverage. Similarly, researchers through their various institutional departments and units make efforts to engage with various stakeholders either as part of dialogues, public forums or policy contributions.

We have used the Mid-Term Review Report in 2019 to reconfigure the CoE-FS and to improve the impact of our research and capacity building.

**Professor Ndiko Ludidi, Acting Director (UWC)**

**Professor Lise Korsten, Co-Director (UP)**

## 2. INTRODUCTION

The Centre of Excellence in Food Security (CoE-FS) was established in 2014. It is hosted by the University of the Western Cape (UWC) and co-hosted by the University of Pretoria (UP). The Centre's vision is to be *"a global leader in research, capacity building, knowledge brokerage and service provision in food security and nutrition in Africa*". This is to be achieved through collaborations with outstanding institutions and scholars.

The CoE-FS operates as a virtual centre that brings together the expertise of South African and international institutions across various disciplines. We receive an annual core grant from the NRF and have successfully bid for additional research grants to increase our output and reach. Our mission is to undertake research, capacity building and dissemination on how a sustainable food system can be achieved to realise food security for poor, vulnerable, and marginal populations. Our driving value proposition is that food and nutritional security is imperative for human survival with dignity and must take account of economic vitality, social justice, and human and environmental health.

Our goals are:

- To build a comprehensive understanding of the changing national and global food system and how this affects the sustainability, availability, access, and attributes of food in South Africa;
- To identify the *'food insecure'* in South Africa, where they are located, what their choices are, strategies and opportunities when seeking food security, health, and well-being and to understand how these change in response to the changing food system;
- To develop and promote policies, technologies, interventions, and products that enable access to affordable and nutritious food in ecological, economic, social and politically sustainable ways; and
- To grow the capacity in South Africa to undertake this research through training, grants, and bursaries.

We have pursued these goals through:

- Trans-disciplinary modes of inquiry: This mode of knowledge production and cooperation offers innovative methodologies for high-impact science through understanding and acting on complex societal problems. The design of our research programmes is informed by direct engagement with actors in the food system in addition to more conventional approaches to scholarly endeavour;
- A partnership approach in the organisation of our research activities: This has required building purposive strategic relationships for the co-design and co-ownership of research problems, methodologies, and solutions by the Host institutions and our collaborators;
- A transformative agenda in terms of the South African and African food security situation: We provide leadership, evidence for decision-making and informed debate, and critique of policies and programmes aimed at addressing food insecurity through a comprehensive and systems approach to development

that recognises the underlying causes of food insecurity, including poverty, patriarchy, unemployment, and inequality;
- Research excellence: We see this as both increasing our output of rigorous fundamental and applied research, and increasing our impact as determined by citations, peer review, research ratings, altmetrics and evidence of the use of research papers and products;
- Active engagement in knowledge brokerage and stakeholder engagement to contribute to policy development.

The Centre has adopted a comprehensive 'farm to fork" approach to the food system. We contend that in the African context, food security is shaped not simply by agro-ecological factors, but also by the terms upon which producers, processors, distributors, and consumers participate in the food system. Understanding this environment requires inquiries grounded in agronomy, political-economy, health sciences, humanities and a legal perspective, including the right to food.

To focus our work on our comparative advantages, we prioritise research that includes:
- Multi-level governance and policy dialogues to create a sound and resilient food system at the global, national and local level;
- Innovation for the sustainability, productivity and utilisation of indigenous African and other locally available foods that affect food security;
- Quantity, quality, diversity and safety of diets in relation to all forms of malnutrition.

As a trans-disciplinary approach is vital to deepening each of these areas, our research includes cross-cutting themes:
- A Humanities perspective to explore the complex, dynamic and diverse relationships between food and human beings;
- A food systems perspective addressing the complexities of the production, processing, marketing, distribution and consumption of food with consideration of the environmental impacts of the food system;
- A social protection and poverty reduction perspective concerned with the causes and consequences of, and solutions to, multiple deprivations.

We work as a multi-disciplinary team of research leaders, project managers, and students drawn from more than 27 collaborating institutions in South Africa and abroad. The CoE-FS uses both deductive and inductive reasoning to better understand the changing nature of food environments of vulnerable consumers and food producers - their responses, food security strategies, and choices within the context of a growing health and environmental crisis.

Furthermore, the CoE-FS continues to seek innovative ways to apply its research at the local level, as well as to engage with policymakers, practitioners, other academics and the general public. While pursuing its mission and vision, the CoE-FS uses every effort to contribute to government initiatives, as well as to deliver on international development food security priorities. Our research focus includes a South Africa/United Kingdom Research Chair in Social Protection and Food Security

(SARChI), a UNESCO Chair in African Food Systems and the Long-term EU-Africa Research and Innovation Partnership on Food and Nutrition Security and Sustainable Agriculture (LEAP-Agri). One of the leverage benefits of the CoE-FS has been the recently awarded African Research Universities Alliance (ARUA) Centre of Excellence in Food Security to UP in collaboration with the Universities of Legon (Ghana) and Nairobi (Kenya). The focus of ARUA is to enhance research and graduate training at member universities through a number of channels, including setting up Centres of Excellence to be hosted by member universities.

# 3. STEERING COMMITTEE

In 2019, the CoE-FS Steering Committee consisted of members representing academia, civil society and the public and private sector. The members are listed in Table 1. Dr Lawrence Haddad and Professor Renosi Mokati resigned during 2019 and Professor David Sanders passed on during 2019. The Steering Committee recommended four new members at the meeting in October 2019 to fill the vacant positions. Information on these members will be reported on in the 2020 Annual Report.

**Table 1: List of Steering Committee members**

| Position | Name |
|---|---|
| Co-Chairperson | Professors Jose Frantz/Burtram Fielding (UWC) |
| Co-Chairperson | Professors Stephanie Burton/Dr Nthabiseng Taole (UP) |
| Director | Professor Julian May (UWC) |
| Co-Director | Professor Lise Korsten (UP) |
| DST representative | Dr Bheki Hadebe/Ms Rose Msiza (DST) |
| NRF representative | Mr Nathan Sassman (NRF) |
| Member | Dr Lawrence Haddad (Global Alliance for Improved Nutrition) - Resigned during 2019 |
| Member | Dr Patrick Caron (High Level of Panel of Experts) |
| Member | Professor Renosi Mokate (UNISA) – Resigned during 2019 |
| Member | Professor David Sanders (Emeritus Professor, UWC) – Passed on in 2019. |
| Member | Ms Bongiwe Njobe (Independent consultant) |

# 4. CENTRE DETAILS

## 4.1 Director and Co-Director

The leadership of the Centre comprises a Director and Co-Director who are responsible for the overarching management of the CoE-FS. They are supported by the MANCO comprising Principal Investigators (PIs), who lead multi-year, multi-institutional programmes of research.

The PIs are expected to be scientists who craft the research agenda, mediators who bridge gaps, project leaders who manage diverse teams, knowledge brokers and 'boundary spanners', and networkers assembling a community of practice on specific topics of national importance. The details of the Director and Co-Director are listed in Tables 2-3.

**Table 2: Details of the Director and Co-Director**

| Details | Director | Co-Director |
|---|---|---|
| Title | Professor | Professor |
| Name | Julian | Lise |
| Initials | JD | L |
| Last name | May | Korsten |
| Organisation | UWC | UP |
| Citizenship | SA | SA |
| Gender | Male | Female |
| Race | White | White |
| Highest qualification | PhD | PhD |
| NRF Rating | C1 | B2 |
| Rating period | 2016 – 2021 | 2013 – 2018 |

**Table 3: Contact details of the Director and Co -Director**

| | Director | Co-Director |
|---|---|---|
| Organisation where based | University of Western Cape | University of Pretoria |
| Department | DVC: Research & Innovation | Vice Principal: Research & Post Graduate Education |
| Primary funder Director's salary | NRF | University of Pretoria |
| Faculty/School | Institute for Social Development | Department of Plant and Soil Sciences |
| Work telephone | 021 959 3846 | 012 420 3295 |
| Mobile number | 082 771 7368 | 079 522 8476 |
| Website address | www.foodsecurity.ac.za | |
| E-mail address | jmay@uwc.ac.za | Lise.Korsten@up.ac.za |
| Contact person | Ms Elaine Petersen | Ms Daleen Muller |
| Work telephone | 021 959 3817 | 012 420 6149 |
| Alternate email | eapetersen@uwc.ac.za | Daleen.Muller@up.ac.za |

### 4.2 Collaborators

The CoE-FS has concluded formal Collaborating Agreements (CAs) or Memoranda of Understanding (MoUs) with the following 26 institutions:

1. Agricultural Research Council (ARC)
2. Medical Research Council (MRC)
3. Nelson Mandela University (NMU)
4. North-West University (NWU)
5. Stellenbosch University (SU)
6. Tshwane University of Technology (TUT)
7. University of Cape Town (UCT)
8. University of Fort Hare (UFH)
9. University of Johannesburg (UJ)
10. University of Limpopo (UL)
11. University of South Africa (UNISA)
12. University of Missouri (MU)
13. Institute for Development Studies (IDS), University of Sussex
14. Human Sciences Research Council (HSRC)
15. Academy of Sciences of South Africa (ASSAf)
16. DST-NRF CoE-FS in Human Development at the University of the Witwatersrand (WITS)
17. French Agricultural Research Centre for International Development (CIRAD)
18. Women on Farms (WOF)
19. Neighbourhood Farms (NBF)
20. World Wildlife Fund (WWF)
21. Sustainable Livelihoods Foundation (SLF)
22. MACProject (MAC)
23. Centre for Development Research (ZEF), University of Bonn
24. Stichting Vrije University (SVU)
25. Makerere University (MKU)
26. Katholieke Universiteit Leven (KUL)
27. University of Pretoria (UP)

### 4.3 Centre details for verification

| | |
|---|---|
| **Host Institution:** | University of the Western Cape |
| **Co-Host Institution:** | University of Pretoria |
| **Year of current funding cycle:** | Six |
| **Gate Stage:** | 4 |

## 5. OVERVIEW OF ACHIEVEMENTS DURING THE REPORTING PERIOD

### 5.1 Achievements related to the current stage

Tables 4-7 set out the 2019 achievements against the targets for stage 2018-2023. Following the launch of the CoE-FS in 2014, a register of researchers was developed. The list of researchers for 2019 is provided in Appendix 4. This list is updated and

maintained as the base for communication and identifying potential collaborators and referrals for networking opportunities. Student records are updated each year with the acceptance of new students to the CoE-FS's programmes.

Appendices 6 and 7 reflect details of new and continuing NRF-funded students for the reporting period. Details of Leverage-funded students are provided in Appendix 8. The achievements and deliverables reflected in this report are only applicable to the 2019 reporting period.

**Table 4: Activities related to the current stage of deliverables**

| Output | Achieved |
|---|---|
| Participate in official events of the DST-NRF Centre of Excellence programme. | ✔ |
| Continuously update the register of participants (including students) in the CoE-FS. | ✔ |
| Continuously update the project register that lists all research being conducted within the Centre. | ✔ |
| Make available to the NRF on a quarterly basis "nuggets" of information for publication on the Centre and NRF websites. | ✔ |
| Maintain digital repository of completed research outputs funded by its resources, including theses, research reports, policy briefs and published papers. | ✔ |
| Submit a written claim with supporting documentation to trigger transfer payments each January. | ✔ |
| Submit monthly cash flow statements, within 15 days of the end of each calendar month. | ✔ |
| Collect income and expenditure reports from all collaborating partners on completion of projects. | ✔ |
| Collect income and expenditure reports from all collaborating partners on completion of the 2018 and 2019 projects that have received extensions. | ✔ |
| Submit Annual Progress Report by no later than 30 May each year. | ✔ |
| Submit and External Audit Report by no later than March each year. | ✔ |
| Submit Gate Review Documentation by no later than 27 February 2023. | To be done in 2023 |
| Submit a Statement of Compliance by no later than March each year. | ✔ |

An online management information system was established to record, track and monitor all projects funded and managed by the CoE-FS in 2014. This system has been integrated to a cloud-based bursary and project management information system. The current system, which includes Excel spreadsheets of the progress of projects and research outputs, and an electronic filing and administrative system, is accessible at UWC and UP. Nuggets of information are extracted and published on

the CoE-FS's website and social media pages and reported to the NRF on a quarterly or more frequent basis.

### 5.2 Achievements related to the Service Level Agreement: 2018-2023

Table 5 provides the 2018-2023 output targets for the current "Gate stage", Performing and annual achievements against the Service Level Agreement. *It should be noted that the output targets listed in the SLA are applicable for 2018 to 2023, but the outputs outlined in Table 5 are only for 2019*.
The evidence for each target is provided as appendices and tables in the report. In 2019, the CoE-FS projects supported 128 students. Of these, 58 students were funded through the NRF and 70 through Leverage funding.

In terms of gender, a total of 78 (60.9%) women were supported, which is above the target of 55%. The Centre supported a total of 79 (61.7%) black students, and nine (7.03%) postdoctoral fellows. In terms of equity distribution of South African students, 86 black students (67.2%) and 56 women (43.75%) were supported. In addition, the CoE–FS core staff also supervised eight students who did not receive leverage or NRF funding. A total of 54 students graduated in 2019, supported with NRF and leverage funding. The Centre had a total of 59 publications, 18 of which have an impact factor of three and more. The Centre's website had 26 375 website views, and 2303 likes. In addition to this, the CoE-FS had 189 media activities. Lastly, the CoE raised an additional R18.7 million to support its research and students.

**Table 5: Service level agreement 2018 -2023**

| Description | Outputs for 2019 | Output Targets 2018 -2013 | Source |
|---|---|---|---|
| Number of students registered in 2019 with CoE-FS / NRF bursaries | 58 | ≧180 | Appendices 6/7 |
| Students included in projects funded by the CoE-FS (all students) | 128[1] | ≧360 | Appendices 6/7/8 |
| Women students supported (all students) | 78 (60.9%) | ≧ 55% of all students | Appendices 6/7/8 |
| Black students supported (all students) | 79 (61.7%) | ≧ 70% of all students | Appendices 6/7/8 |
| Equity distribution of South African students (African, Coloured, Indian, Asian) | 86 black (67.2%)<br>56 women (43.75%)<br>0 disabled | ≧80% black,<br>≧ 55%women,<br>≧4% disabled | Appendices 6/7/8 |
| Citizenship distribution of South African and non-South African students | 99 (77.3%) | ≧87% South African (incl. | Appendices 6/7/8 |

[1] This figure includes 58 NRF funded and 70 Leverage funded students.

| | | | |
|---|---|---|---|
| | 15 (11.7%)<br><br>12 (9.4%)<br><br><br>2 (1.6%) | permanent residents)<br>≦5% SADC (excl. SA)<br>≦4% of rest African continent<br>≦4% non – African | |
| Proportion of students graduating by the next Gate Review | To be determined in 2023 | ≧ 75% of all students since inception | n/a |
| Average duration of submission of Master's degrees (post-Honours) | 24 months | ≦ 24 months | Tables 11/12 |
| Average duration of submission of PhD degrees | 36 months | ≦ 40 months | Tables 11/12 |
| Average duration of submission of PhD degrees (upgraded from Master's) | 60 months | ≦ 60 months | Tables 11/12 |
| Postdoctoral fellows | 9 (7%) | ≧ 10% of students | Table 9/ Annexure 8 |
| Number of unrated researchers who become rated, or rated researchers who retain or improve their rating | 7 | ≧ 20 | Appendix 4 |
| Number of patents, products & artefacts | 1 | ≧ 10 | Section 18 |
| Number of articles accredited journals, chapters in peer-reviewed books or books | 59 | ≧ 160 | Appendix 3 |
| Number of articles with an Impact Factor greater than 3 | 18 | ≧ 32 | Appendix 3 |
| Number of joint venture student training initiatives | 12 | ≧ 10 | Section 11 |
| Number of local conferences organised | 11 | ≧ 2 | Section 8.3 |
| Number of international conferences organised | 2 | ≧ 2 | Section 8.3 |
| Presentations at local conferences | 68 | ≧ 160 | Appendix 1 |
| Presentations at international conferences | 30 | ≧ 40 | Appendix 1 |
| Food security panels organised at conferences | 4 | ≧ 4 | |

| | | | |
|---|---|---|---|
| Annual Social media (Facebook, etc.) posts | 649 | ≧222 | Table 14 |
| Number of face-to-face policy maker engagements | 15 | ≧40 | Appendices 1/2 |
| Annual website views | 26375 | ≧4500 | Table 13 |
| Annual media activities (radio, TV, press) | 189 | ≧ 12 | Appendix 5 |
| Annual Facebook likes | 2303 | ≧100 | Table 14 |
| Number of citations of pooled articles/ book chapters that acknowledge CoE-FS funding (Google scholar) | 45 | ≧40 | Appendix 3 |
| Additional funds raised | 18.7 million | ≧ R100 million | Tables 17/18 |

Despite notable improvements in various targets set out in the SLA, the Centre fell short in two crucial areas in 2019: The participation of students with disabilities, and the equity distribution of black South African students. To address these issues, the CoE-FS will identify postgraduate programmes relevant to food security wherein black South African students are well represented, and will target bursaries towards these students.

The CoE-FS will also explore opportunities to strategically support the HDIs in 2020. Similarly, we continue to carefully monitor applications by students with disabilities to implement measures to provide support where appropriate, so as to make it easier for eligible students to gain access to the Centre. Although progress has been made to increase the number of black researchers, more should be done to expand this group. In order to increase the number of black researchers, the CoE-FS's sustainable strategy targets black South African senior researchers to replace PI's who have resigned and identifies successors to the current Director and Co-Director from within this group. One example is the appointment of Professor Ndiko Ludidi as acting director while Professor May is on sabbatical leave. Also, there is a notable improvement in the number of female researchers and students supported through the CoE-FS. Regarding the Centre's management and support structure, we have made excellent progress in appointing staff from previously disadvantaged backgrounds. Additionally, the Centre's full-time staff comprises black women.

### 5.3 Transformation targets for the current stage

The table below reflects achievements against transformation targets. The collaborative nature of the projects provides unique opportunities for capacity development, within and between collaborating partners. The Centre's MANCO, together with Project Leaders and researchers comprises colleagues from previously disadvantaged groups. In addition to developing the capacity of senior and emerging researchers, the CoE-FS also encourages its staff and students to strengthen their individual skills.

For example, Ms Mologadi Makwela participated in UWC's "Developing a Scholar initiative", offered through the office of the DVC Research and Innovation. She registered for a PhD in Media Studies at the start of 2018. This programme provides training and writing workshops to assist her in completing her studies. Workshops included training related to various aspects of postgraduate research, including workshops on research methodologies, creating a scholar profile, using online referencing tools, publishing from presentations as well as drafting research and funding proposals. Ms Elaine Petersen's role over the last few years has developed from a finance administrative role into a coordinating role. The benefits offered in terms of staff rebate assisted her with building her knowledge and skills in the specific field. The skills and knowledge gained enabled her to make better strategic decisions and apply the knowledge learned. The projects increased her knowledge of the various funding instruments. She has also completed various inhouse Finance and Human Resources training courses.

Ms Nolutando Didiza is currently enrolled in an Honours programme at the Institute for Social Development (ISD) at UWC, and also completed various inhouse training courses in the University's Finance and Human Resources Developments. Dr. Elaine Sinden is currently supervising three Master's students enrolled at the Institute for Social Development (ISD) at UWC, and will, in 2020, supervise a Phd student. She published a paper in 2019, and another paper has been accepted by a Gender journal and will be published in 2020. Further information on some of the CoE-FS's transformation achievements, gender impact and human resources management initiatives is provided in sections 14 to 16 in this report.

**Table 6: Transformation targets**

| Output | Achieved |
|---|---|
| At least five senior academics from formerly disadvantaged groups have experienced further capacity development | ✔ |
| At least fifteen emerging academics from formally disadvantaged groups have experienced capacity development | ✔ |

### 5.4 Specific targets for the current stage

The table below provides evidence related to achievements of specific targets for the reporting period.

**Table 7: Specific output targets**

| Output | Achieved |
|---|---|
| Six MANCO meetings have been held | ✔ |
| One MANCO planning meeting/ Lekgotla has been held (5-day) | ✔ |
| Annual Business plan was submitted | ✔ |
| 40 nuggets per year have been provided to the NRF | ✔ |

# 6. KPA 1: RESEARCH

The CoE-FS undertakes research, capacity building, multi-stakeholder dialogue, and policy advocacy on how sustainable food systems can achieve food and nutrition security for all. The objective of this work is to improve people's nutritional status by linking innovative science with critical enquiry and implementation strategies. Three areas of work are prioritised as follows: (i) Multi-level governance and policy dialogues to create a sound and resilient food system at the global, national and local level, (ii) Innovation for the sustainability, productivity and utilisation of indigenous African and other locally available foods that affect food security, and (iii) Quantity, quality, diversity and safety of diets in relation to all forms of malnutrition. Cross-cutting themes are a Humanities perspective to explore the complex, dynamic and diverse relationships between food and human beings; a food systems perspective addressing the complexities of the production, processing, marketing, distribution and consumption of food with consideration of the environmental impacts of the food system; and a social protection and poverty reduction perspective concerned with the causes and consequences of, and solutions to multiple deprivations.

In 2019 the number of programmes was reduced from eight to five, and the Systems and Policy programmes were merged, as were the Plates and Children programmes. This has enabled synergies to be identified between the Projects and Work Packages of each programme.

The scope of work for the CoE-FS's research activities for the period 2014-2019 has been delineated by three research questions:

(i) How is the global and national food system changing and how does this affect the sustainability, availability, access, and attributes of food?
(ii) Who are the *'food insecure'*, where are they located, what are their choices, strategies, and opportunities when seeking food security, health, and well-being and how do these change in response to the changing food system?
(iii) What policies, technologies, interventions and products enable access to affordable, nutritious and safe food in ecological, economic, social and politically sustainable ways?

In 2019, the CoE-FS retained its Programme Principal Investigators (PIs) drawn from the two host institutions and consortium partners, based on relative strengths in each area in a supportive context. These PIs form the CoE-FS Management Committee. The research programme of the CoE-FS is undertaken as projects within multi-disciplinary programmes and synthesised at the core through trans-disciplinary analysis.

Thw CoE-FS supported sixteen NRF-funded projects in 2019. Some of this support took the form of bursary and conference funding. Two projects continued from 2017 and one project continued from 2015. The CoE-FS's 2019 funded projects are listed in Appendix 9. This list also outlines the contributions to HDIs, marked in yellow. From the sixteen NRF projects funded in 2019, eight were administered by HDI's.

## 6.1 PROGRAMME 1: FOOD SYSTEMS, GOVERNANCE AND POLICY (SYSTEMS)

This programme is led by Prof Bruno Losch (Govinn/ UP).

Knowledge brokerage is a process-oriented approach to analysing, guiding and ultimately improving the science-policy-practice interface. The focus of knowledge brokerage is not on transferring the results of research, but on organizing an interactive process between the producers and users of knowledge, resulting in the production of feasible, context sensitive, and research-informed policy options. The underlying assumption is that knowledge is most likely to be used (and therefore to have a high impact) if researchers involve the intended users of that knowledge at an early stage of research design and even co-produce knowledge with those users. The co-production of knowledge is also thought to contribute to knowledge becoming more 'socially robust' by contextualising it in the specific social, ecological and historical circumstances of particular places. This requires a shift towards a more extended notion of scientific enquiry that incorporates the participation of a wide range of actors.

Through developing these knowledge brokerage platforms, the Food Systems Governance and Policy Programme aims to increase the visibility and societal impact of the CoE-FS's research as well as produce new socially robust knowledge on how to better govern South Africa's food system. The Food Systems and Policies programmes were merged in 2019 to operate as a single programme.

Research undertaken, as well as the achievements in 2019 under this programme are organised under the following projects.

### 6.1.1 Systems thinking for food security - 190101

This project is led by Prof Frans Swanepoel (UP) and other team members include Dr Willeke de Bruin (UP), Dr Kayode Adepoju (UFS) and Prof Moenieba Isaacs (UWC/PLAAS).

In order to aid Africa in realizing its goals stated in the Agenda 2063, the policy objectives for the food, agriculture, health, environment and societal sectors should be considered jointly within local and national food environments. This inherent complexity calls for a systems thinking approach in order to find viable solutions. By providing a rigorous systems overview of food value chains and their shortcomings, this project assists in bridging the gap between policy design and implementation, ultimately strengthening the status of important crops on the African continent. Through the proposed systematic framework, the study provides regional and national institutions with essential information that focuses on ensuring access to safe, nutritious and sufficient food for all people, in particular the poor.

The objectives of the project are to:

(i) Provide a rigorous systems overview of food value chains and their shortcomings through providing capacity development opportunities in systems methodology and thinking; and
(ii) Develop agri-food pathways that are productive, sustainable and climate-smart through an innovative model of policy learning and experimentation.

The main achievements of the project in 2019 are as follows:

- One conference abstract, one popular and one peer reviewed article were published.
  The postdoctoral fellow Dr. Willeke de Bruin, spent six weeks at Wageningen University & Research (WUR) in the Netherlands to participate in a preparatory learning experience about applying systems thinking to improve the food safety of food production systems. This led to the development of a collaborative project proposal between WUR and the CoE-FS that has been submitted for funding in the CoE-FS' next five-year cycle. This new project will involve participation from different disciplines in the CoE -FS.
- Theoretical literature has been reviewed, packaged and analysed using systems dynamics methodology to gain an in-depth understanding of the behavioural, physical and control mechanisms that contribute to aflatoxin contamination in the groundnut value chain. A poster that summarizes the work was accepted for presentation, and was exhibited at the" Systems Analysis and Africa" workshop in Pretoria on 3 December 2019. A review paper is being prepared for publication in 2020.
- A PhD proposal is in the final stage of preparation for approval, and the student will register in 2020.
- Researchers and postgraduate students of the CoE-FS were invited to participate in the" Systems Analysis and Africa" workshop, co-hosted by the International Institute for Applied Systems Analysis (IIASA) and the CoE- FS on 3 December 2019 in Pretoria, South Africa.
- A continuing PhD student from UWC conducted interviews with stakeholders in the West Coast rock lobster supply chain, and data is being analysed and written up.
- The focus group interviews on the role of post-harvest activities on food and nutrition security were partly completed.
- The theoretical approach for this research project has been submitted.
- Data has been collected for the ongoing household survey on livelihoods and food security.

The objectives were achieved by exposing project team members and students to systems thinking learning experiences such as workshops, international visits and conferences; as well as through conducting research that can be translated into policy for real impact. Satisfactory progress has been achieved, supported by both quantitative data and qualitative information.

### 6.1.2 Towards National-Level Knowledge Brokerage - 170601

This project involves Dr Camilla Adele (UO), Mr Florian Kroll (UWC), and Professor Lise Korsten (UP).

The main activities of the project are:

- Research on food safety: Investigating the management and implementation of food safety policies;
- Workshops on governance of South Africa's food system; and
- Research on national food governance as well as on territorial approaches to food security.

The main achievements of the project in 2019 are as follows:

- A series of public seminars on food were organized at the University of Pretoria, entitled #FoodTalks Seminar Series. The first event was on *Creating a more equitable, just and democratic food system in South Africa,* held on 4 June 2019. Two other seminars were held in 2019: *Taking Land and Food*, 7 August 2019; and *Food in Universities*, 5 November 2019.
- A national workshop on *The state of food governance in South Africa* was held at the University of Pretoria on 25 September 2019. The workshop had around 50 diverse national and international stakeholders in attendance and comprised several sessions which focused on the different aspects of the food governance challenge.
- Postgraduate research started in June 2019 on the South African food system with a systematic literature review.
- A paper titled "Food sovereignty: shifting debates on democratic food governance" was published.
- Two further papers titled "Multilevel food governance in South Africa: local government powers and food security" and "Understanding the complexity of the food and nutrition system in the Western Cape: A Net-Map approach" were submitted for publication in 2019.
- The meta-level analysis consolidating research is ongoing and will be reported on in 2020.
- A governance symposium was organised for parliamentarians at the Food Safety Conference.

### 6.1.3 Local Food Governance -170602

This project involves Dr Camilla Adelle, and Dr Robin Bourgeois (all at GovInn, UP) and Mr Florian Kroll (PLAAS, UWC).

During 2019 the main aim of the Local Food Governance project was to deepen a series of 'Knowledge Brokerage Platforms', bringing together government officials, practitioners and other stakeholders in the food system with academic researchers associated with the CoE- FS in an iterative process through which policy problems were discussed, existing research shared, research gaps identified and ultimately new knowledge co-produced. The knowledge brokerage platforms set up focus on local food governance.

The main activities under this project are:

- Researching local governments' legal powers and competencies in food security supported by surveys conducted with local municipalities in the different districts of the Western Cape;
- Holding a stakeholder workshop to discuss how to move towards inclusive food economies in specific districts;
- Undertaking action research exploring with Civil Society how a Food Charter could be developed and implemented in the Western Cape;
- Undertaking a co-elaborative exercise on plausible future scenarios for local development and how they connect and interact with the evolution of the food system;
- Running and reflecting on the Community of Practice on local food system governance in the Western Cape;
- Establishing a Community of Practice on local food system governance in Gauteng; and
- Exploring Knowledge co-production methodologies for local food governance.

The main achievements of the project in 2019 are as follows:

- Professor Jaap de Visser delivered his CoE-FS working paper, *Multilevel Government, Municipalities and Food Security*, which was presented to government officials, practitioners, and academics at both the Western Cape and Gauteng Community of Practice respectively in April and May 2019. This paper performed two main tasks: i) To debunk the myth that food security is only a National and Provincial concern; ii) To take the Constitution as a point of departure to identify points of leverage where municipalities can contribute to food security. These arguments are important because there is a reluctance with municipalities struggling to deliver everyday services like housing to acknowledge that food security is in their mandate.
- A workshop with residents of Bellville, Cape Town to present the draft working paper on food sensitive planning and design principles and elicit their input was organized on 7 November 2019 in Bellville, Cape Town.
- The final scenario planning workshop with stakeholders took place in Witzenberg in February 2019. In this workshop, food and food system issues were 'plugged' into the scenarios, which had been developed by the stakeholders in workshops held in 2018. Up to this point, the scenarios had focused more globally on economic and social development and had not specifically investigated the food component. After several interactions with the municipality a brainstorming session between SALGA and the CoE-FS was organized on 23 October 2019 to discuss the further engagement and development of the collaboration.
- The Western Cape Food Governance Community of Practice was further consolidated in 2019. Five half-day meetings were held with roughly 30-35 people in each meeting. The first meeting in January 2019 was a field trip visiting some of the key locations in the Cape Town food system. In the next meeting in April 2019, Professor Jaap de Visser presented his CoE-FS working paper on the mandate of local government on food security. This research had been requested in a Community of Practice meeting in 2017. The meeting in June 2019 discussed the challenge of transversal governance and how this related to food governance in the Western Cape (Presentation of the Whole of

Society Approach – WOSA). A meeting in September 2019 attempted to bring in new Civil Society organisations to start a conversation that we envisage continuing in 2020 to map and help mobilize demand for food governance from the bottom up. This initial workshop set the scene for workshops in 2020 on the food charter research. The final Community of Practice meeting, held on 4 December 2019 focused on research on food environments with presentations from CoE-FS funded researchers, also showing short digital stories. The process of establishing and nurturing Communities of Practice was written up in three co-authored academic articles.

- Two meetings of the Gauteng Community of Practice were held - one in May 2019 when Professor Jaap de Visser presented his paper on the mandate of local government for food security and the second in October 2019, which focused on the critical role that transport and transit nodes play in metropolitan food systems and how they shape key food environments. In addition to these meetings, Mr. Florian Kroll conducted several interviews with key government officials in order to build understanding and buy-in about the objectives and value of a Community of Practice.
- In September 2019 the programme partnered with the Sustainable Livelihoods Foundation to facilitate a digital storytelling workshop which brought together a group of 12 residents from Khayelitsha in Cape Town. The visual storytelling approach enabled the participants to explore the multiple factors that influence their access to food and the daily trade-offs they make when deciding what types of food to buy. The knowledge and experiences that have been shared through the digital stories promote a better understanding of what food security means for people who live in marginalized areas of urban South Africa. The stories of the Khayelitsha participants will feed into ongoing CoE-FS-related research projects on food environments, such as the ROFE project (Researching the Obesogenic Food Environment), as well as contribute to informing future thinking on food policy and programme activities through the Communities of Practice. The films were shown in the December 2019 meeting of the Western Cape Community of Practice.

### 6.1.4 The Right to Food for School Leavers – 180601

This project is led by Professor Ebenezer Durojaye (UWC).

The objectives of the project are:

- Addressing food insecurity and hunger among learners in South Africa using a rights-based approach;
- Addressing social inequality which serves as a fertile ground for several social ills including food insecurity; and
- Assessing the role of non-state actors in the realization of the right to food for learners in South Africa.

The main activities under this project are:

- Conducting research on gender dimension of food insecurity among school leavers in South Africa.

- Organizing two policy dialogues in Johannesburg and Cape Town involving different stakeholders.
- Developing Policy Briefs with a viewing to engaging with Parliament.
- Submitting a petition to the South African Human Rights Commission on hunger and food insecurity among learners in South African tertiary Institutions.

The main achievements of the project in 2019 are as follows:

- Two policy dialogues were conducted on realising access to food for students in South African tertiary institutions. One was held in Johannesburg on 26 June 2019 and the second in Cape Town on 25 July 2019. These dialogues brought together government departments, Parliamentary representatives and other stakeholders including academics and civil society groups to deliberate on various issues relating to access to food for students in tertiary institutions.
- A documentary screening was held on Rehad Desai's #EverythingMustFall documentary and a conversation on student hunger based on the screening on 15 October 2019. This was attended by a cross-sector of stakeholders, including academics, activists, and student leaders.
- A petition was submitted to the South African Human Rights Commission on 25 July 2019, requesting an urgent investigation into hunger and food insecurity among students in tertiary institutions in South Africa. The petition, among others, demands that the SAHRC require the government to develop laws and policies that will address hunger and food insecurity among students in tertiary institutions in the county.
- A policy brief was developed based on the two dialogues conducted in June and July 2019. This Policy brief will serve as a tool to engage with Parliament and other stakeholders in advocating for policy reform regarding hunger and food insecurity in tertiary institutions. Based on interactions with Parliament, the research team was invited to Parliament as resource persons at a Colloquium (organized by the Portfolio Committee on Higher Education, Science and Technology) on funding of the post-school education and training sector, on 6 November 2019.
- The research team is currently working jointly with the Consumer Goods Council of SA (retailers and food manufactures) and Food Forward SA, to bring to bear inputs and perspectives of the business sector in the policy brief to be shared with Parliament.
- The two postgraduate students under this project have continued with their research relating to a rights-based approach to hunger and food insecurity on campuses and exploring the gender dimension of the right to food for students in tertiary institutions. They are making good progress. The Master's student submitted her dissertation at the end of 2019.

Research under this programme is continuing in 2020, and further research outputs will be provided in the 2020 Annual Report.

## 6.2 PROGRAMME 2: INNOVATION AND TECHNOLOGY (INNOVATION)

The PI's for this programme are Professors Naushad Emmambux (UP) and Ndiko Ludidi (UWC).

The focus of this programme is to investigate the organisational and technological innovation of food systems in terms of the food production and processing required to maintain and improve livelihoods through enterprise development for food security. Enterprises include all sizes of farm and non-farm enterprises, although the focus is on small- and medium-size activities rather than on subsistence or micro-enterprises. The nature of the problem is complex and requires a trans-disciplinary approach although with a strong science focus. The technological transformation for enterprise development should impact positively on environmental, economic, social and nutritional health.

### 6.2.1 SMART Food Processing – 160201

This project is led by Professor Naushad Emmambux and Professor Gyebi Duodu, both from UP. Other team members include Professor KG Duodu (UP) with Dr Kayitesi (UJ), Professor Marena Manley (US), Professor MN Amambay (UP), Dr N Mehlomakulu (UP), Dr Danie Jordaan (UP), Professor E Buys (UP), Professor KG Duodu and Dr M Mphosi (UL), and Professor R de Kock (UP).

The primary aim of the project for 2019 is the creation and processing of 'SMART' [safe, marketable, affordable, ready to eat and tasty] foods and food ingredients that have been enriched to combat malnutrition and diet-related non-communicable diseases and necessary tools in terms of appropriate food processing technologies for entrepreneurs to produce affordable, safe, convenient, consumer-driven, nutritious foods and food ingredients.

Research under this project is organised under the following WPs: (i) Bioactive compounds from indigenous grains (ii) Reducing energy/increasing nutrient density of food (iii) Appropriate food processing technologies (iv) Techno economic feasibility.

The main achievements of the project in 2019 are as follows:

**(i) Bioactive compounds from indigenous grains**

- Lactic acid fermentation (both spontaneous fermentation and using a *Lactobacillus plantarum* starter culture) and exogenous lactic acid acidification led to enhanced protein quality, iron and zinc bio accessibility, phenolic content and antioxidant properties of sorghum-based gruels.
- Fortification of sorghum-based gruels with amaranth grain led to enhanced protein quality due to the superior digestibility of amaranth proteins.
- Lactic acid fermentation (both spontaneous fermentation and using a *Lactobacillus plantarum* starter culture) and exogenous lactic acid acidification

led to enhanced protein quality, phenolic content and antioxidant properties of finger millet gruels.

- Beta-carotene bio accessibility and health-promoting properties of a porridge product prepared by co-extrusion of sorghum with orange flesh sweet potato flour were determined. The effect of conventional cooking and extrusion cooking on the beta-carotene content and antioxidant properties of the porridges and their contribution to the recommended dietary allowances for vitamin A for different groups were determined. Extrusion cooking decreased beta-carotene content and radical scavenging properties of the composite porridges to a greater extent compared to conventional cooking likely due to extensive thermal degradation. As a result, the conventionally cooked porridges contributed more to the daily requirements for vitamin A for different groups. Beta-carotene in the conventionally cooked porridge samples was more bio-accessible than corresponding extrudates and appeared to be related to their contents of beta-carotene.
- Starch can be encapsulated with ascorbyl palmitate for better storage at room temperature, under light conditions and stomach acidic environment stability. This shows that ascorbyl palmitate as a potent antioxidant can have a longer shelf life when encapsulated.

**(ii) Reducing energy/increasing nutrient density of food**

- Maize meal and maize starch modified with lipids and heat moisture treatment can produce a lower GI product as they produce resistant starch. The resistant starch can be beneficial to the gut microflora. It seems that the gut microflora was enhanced and produced more butyrate, while the DNA analyses of the microbes is under analyses.
- Tribology and rheology as well as sensory suggest that starch modified with lipid to form ready-to-use starch-based fat replacers can be used in mayonnaise-type emulsion to have similar properties compared to full fat mayonnaise. The use of fat replacer reduces oil content in food to reduce calories. In addition, the fat replacer can also act as resistant starch.
- Starch can be modified with crude phenolic extract from grape pomace and sorghum bran to reduce the glycaemic index as the starch phenolic complexes are resistant to enzyme digestibility. The excess phenolics also act as enzyme inhibitors. This modified starch also has good antioxidant properties.
- Starch modified with lipids can produce starch micropheres that can be used as fat replacer for fat globules in emulsion type foods. The starch micropheres have good lubricity similar to liquid fat and are stable under high shear homogenization.
- Starch nanomaterials to be used as fat replacer can be modified using infrared treatment to increase the crystallinity values. The increase in crystallinity potentially has better fat replacer properties as they will be similar to fat crystals at nanoscale in food.
- Maize starch can interact with cellulose and cellulose derivatives to change its viscous and gelling properties. The cellulose and its derivatives can also be used as a bulking agent to reduce the sugar content of chewable sweets.

**(iii) Appropriate food processing technologies**

- Sensory evaluation can be used to determine the texture properties of baby foods in terms of their oral processing capability.

- Extrusion

- Maize starch and zein can be extruded to produce compatible biopolymers. The extrudate has good film-forming properties to be used in food systems.
- Addition of OFSP to produce extruded gluten-free maize pasta improves the nutritional properties in terms of significantly lower starch digestibility, higher dietary as well as higher beta carotene (provitamin A) as well as higher antioxidant properties.

- Fermentation

- Isolated and identified 5 bovine probiotic bacteria (*L. plantarum from gut fermentation*) that can synthesis β-carotene (22.82±1.05 to 111.95±3.10 µg/mg dry cell weight) and retinol (9.18 to 12.58 µg/mg dry cell weight). The gut-friendly properties like bile tolerance, gastric juice and tolerance at different pH and temperature were satisfactory. The genetic elucidation to confirm the presence of vitamin A synthesizing genes will be confirmed through real-time PCR and or whole-genome sequencing.
- Extraction and quantification of folate from sorghum fermented with 5 single strains *L. plantarum* (FS2, B411, S7 and S49) as well as spontaneous fermentations, with and without malt was done. It was found that the fermentation with B411 resulted in the highest increase in folate. The microbiomes of the fermentations (without malt) were also analysed.
- Fermentation as a processing method has the ability to release bound compounds due to the reduction of pH and the activity of enzymes (e.g. phytase) secreted by the microbial cultures. The inoculation of *L. plantarum* proved to be a better fermentation strategy than brine. Lactic acid fermentation resulted in reduced acidity which allowed for the extractability of zinc and iron from the fermented samples. The lactic acid fermented leaves also resulted in high antioxidant activity and total phenolic content compared to the brine fermented samples.
- Sorghum whole grain ting? produced with *Lactobacillus fermentum* is a safe and potential functional food product. *L. fermentum* as a starter in fermentation produce a better ting product, it was accompanied by a desirable reduction in mycotoxin contamination and pesticide residue levels and led to desirable formation of relevant metabolites.

- Heat treatment

- Conventional with ultrasound: Ultrasonication can be used to modify starch and produce partially acetylated starch. Ultrasound with heat can be used to extract and characterize biopolymers (pectin and cellulose) and phenolics from grape pomace, grapefruit skin and lime using acetic acid. Grape pomace is a good source of phenolics and cellulose, but grapefruit skin and lime are good sources of both pectin and cellulose. Acetic acid is a friendlier chemical that can be used for the extraction.

- Roasting: Roasting of wheat has been shown to increase the grain's shelf-life and improve its organoleptic properties, especially for whole grain flour that contains dietary fibre. The aim of this study was thus to determine the optimal roasting conditions required to minimise the detrimental effect on the protein properties of the produced white flour.
- Conventional heat: The viscosity of most indigenous/local African complementary porridges is not well matched to the oral developmental readiness of infants and young children when cooked. Commonly used porridges tend to be highly viscous (high viscosity values) at low solids content, when evaluated under shear rates estimates for infant oral processing (0.001/s - 50/s). Consequently, they do not meet the recommended daily energy and protein intakes for infants and young children between 6 – 24 months of age. This study provides scientific insight for baby foods manufacturers on the oral processing characteristics of complimentary foods for infants and young children in African communities.
- Infrared and microwave heat treatment: (i) Heat treated and untreated Bambara seeds milled into flour, significantly affect the dough rheology and possibly change protein and starch network. This should be taken into consideration when Bambara flour is added to wheat flour for bread manufacturing. (ii) Microwave energy pre-treatment also produced quick cooking Bambara groundnut and provided more phenolic availability in terms of extraction suggesting better health promoting properties.
- Solar dehydration: A rapid method for determination of moisture content of mango slices during solar drying was developed. The findings indicate that the moisture content can be determined instantaneously, in-field using a portable Vis-NIR spectrophotometer. The root mean square error of prediction was <4.0% moisture content.

**(iv) Techno economic feasibility**

Sensory properties of low-calorie sauces showed that the fat replacer used did not show inferior properties to high fat sauces. Sensory evaluation of sorghum biscuit showed that more research is required to produce a good quality sorghum biscuit to reduce the grittiness. Financial analyses of quick cooking samp showed potential economic feasibility, but it should be manufactured at large scale and for 24 hours. This suggest economy of scale is important for the feasibility.

Research under this project is continuing in 2020, and further research outputs will be provided in the 2020 Annual Report.

### 6.2.2 Innovation for Environmental Change Resilient Agriculture

#### 6.2.2.1 Drought responses in Cereals and Legumes -170201

Professor Ndiko Ludidi (UWC) led this project in collaboration with Robert Sharp (University of Missouri), Hon-Ming Lam (Chinese University of Hong Kong), Mounawer Badri, (Centre of Biotechnology of Borj Cedria), Alina Mofokeng (Agricultural Research Council) and Ifeanyi Egbichi, Walter Sisulu University.

The project aimed at identifying lines of maize, sorghum, cowpea, soybean, Medicago species and marama bean with good tolerance to drought and understanding the molecular mechanisms controlling the drought tolerance, while investigating the relationship between crop cultivation and soil health under rain fed and irrigated conditions (using chicory plants as a model). It also aimed to use the contrasting (tolerant versus sensitive) responses of these lines to identify physiological and molecular determinants of drought tolerance in the crop species.

The research identified proteins of the plant antioxidant system that controls drought responses in maize, sorghum and *Medicago truncatula* (barel medic, as livestock fodder crop) and cowpea. Furthermore, the research identified proline and nitric oxide as key metabolites accounting for differences in the level of tolerance between a drought tolerant line of *Medicago truncatula* and a drought sensitive line of the same species. Importantly, we have identified a set of proteins that accounts for the higher level of drought tolerance in sorghum compared to maize. This is an important finding which will enable targeting of these genes in maize to confer maize drought tolerance that is similar to the drought tolerance in sorghum. These findings have direct implications on developing crop varieties with enhanced drought tolerance. The study identified natural soil-occurring bacteria, from our chicory experiments, which resist high salinity levels and water deficit while having soil nutrient solubilizing activity and thus have potential in preserving soil health and crop yield under water deficit and high salinity. The research also identified a role for hydrogen sulfide as a signaling molecule that enhances the ability of maize to resist infection with the pathogenic fungus *Aspergillus flavus*, which is an important finding for prevention of mycotoxin contamination of maize as a result of the fungal infestation.

#### 6.2.2.2 Reclamation of Heavy Metal Contamination of Soils – 170202

Dr Marshall Keyster (UWC) led this research with associate researchers Professor Anje Heese and Professor David Mendoza-Kozatl (both of the University of Missouri) as team members.

The objectives of the project were to screen vesicle-trafficking mutants for heavy metal tolerance, and to use novel signalling molecules such as Myristic acid (MA), Diindolylmethane (DIM) and Methylglyoxal (MG) to increase plant tolerance to heavy-metal stress. The third objective was to perform field trials using tolerant plants generated in objectives one and two. Objective one was obtained in 2017 and objective two was obtained in 2018.

In this research the objective was to test whether the mutants generated and screened in objective one could be used in heavy metal land reclamation. In addition, tests were done on whether plants in objective two (which can produce the small signalling molecules endogenously) are tolerant to heavy metals and whether we can use these plants for heavy metal land reclamation. This work was performed in plots acquired from the Western Cape Government (Department of Agriculture). The reason for using open-air field plots was to simulate heavy metal contaminated sites. The research also consisted of two sets of experimental plots: i) a control plot (no heavy metals), and ii) an experimental plot (treated with heavy metals). Plants from

objectives one and two were propagated inside each plot and screened for physiological differences (constant photography). Plants were then harvested when the 1st flower was visible. The harvested plant material was used in biochemical as well as physiological assays. Research on lipid signalling molecules in plants and their role in abiotic stress is in the infancy stage. These assays will then be evaluated or correlated with assay results from objectives one and two to identify similarities as well as differences in greenhouse experiments vs field trials. The rest of the harvested material will then be used in ICP ionomic analysis to assess whether plants could successfully remove heavy metals from the treated plots. This hypothesis will be confirmed by including ICP ionomics on soil collected from the plots. Translocation factor analysis between soil to root and root to shoot will be used to calculate the efficiency of heavy metal removal from the treated plots.

Tolerant plants generated from both approaches in objective one and two were grown in various field trial experiments. These plots are situated in the Eastern Cape (South Africa) as well as in Columbia-Missouri (United States of America). The research team analyzed the first harvest for Canola cultivars as well as Bean cultivars. The harvest plants were used to screen for biochemical as well as physiological changes. ICP ionomic analysis was perfomed on soil, plant roots and plant shoots to assess whether plants could successfully remove heavy metals from the treated plots. Ionomic data was analysed to calculate the translocation factors of controls vs experiments.

Research found that the Canola cultivar Agamax performs better than all the six South African commercially grown cultivars when we screened the cultivars for adaptation to the Eastern Cape conditions. Currently, Canola is predominantly grown in the Western Cape region. Furthermore, research identified two Bean cultivars which can be grown in Missouri-Columbia after our first screen. The cultivars namely Gadra and Ukulinga grow very well in Missouri conditions and have yielded pods. Hopefully, these pods will be filled with seeds which we will then use to grow the F2 generation. The research performed ICP analysis from both the Eastern Cape and Missouri soil and have found interesting nutrient profiles. The research revealed that the Eastern Cape site which was not used for farming for more than a decade, have deficiencies in many of the macro and micro nutrients where the Missouri sites (farming intensive) contain all the proper nutrients for plant growth.

#### 6.2.2.3 Cropping Systems and Soil Health in South Africa – 170204

This work was led by Professor Nico Labuschagne with team members Professor Jacquie van der Waals, Dr Malick Bull and Professor Lise Korsten (all from UP).

The objective of the study was to develop a molecular-based soil health testing system to assess the microbial dynamics and activity in soils for future rapid-profiling of healthy soils for optimal yield.

The activities and achievements in 2019 are as follows:

The pilot study: DNA extraction, Illumina sequencing, data analysis, and interpretation. The main study involved: soil sampling, DNA extractions, Illumina sequencing, RNA extractions, data analysis, interpretation and article writing, and design and optimise primers for routine soil health testing.

A pilot study was conducted in November 2017 to assess microbial abundance and diversity (metagenomics approach) in order to assess previous biological soil health indicators (Biologs) collected from selected cropping systems. Soil samples collected in May 2017 from the test site situated at the Nelson Mandela Metropolitan University, George campus at Saasveld, in the Western Cape were used for DNA extractions. DNA samples were sent for sequencing (Illumina sequencing) in the USA at the beginning of 2018. Subsequently, soil samples were collected in March 2018 from nine different treatments representing different cropping systems. In 2019, the microbial composition (diversity, richness and abundance), functional potential and activity have been determined. Data analysis on microbial (bacterial and fungal) composition and related metabolic function and activity were completed and two publications were finalized and submitted for publication in December 2019. Subsequently, primers are being designed for specific taxa and optimized for routine soil health tests, for the detection of microbes noted as pathogenic and beneficial.

Organic cropping systems positively impacted on microbial soil health indicators i.e. significantly higher microbial richness and diversities. The enrichment of specific bacterial and fungal phyla of agricultural importance was also observed in most of the organic cropping systems. Greater microbial variability was found in conventional cropping systems compared to organic cropping systems. In addition, the abundance of pathogenic microbes including *Fusarium oxysporum* and *Alternaria alternata* was higher in most of the conventional cropping systems. Metabolic functions and activity of the microbes were also determined. The functional pathways involved in the soil changed with microbial structure variations, many of which were related to transportation and metabolism. Whether or not these observed differences translate into an extended capacity to adapt to climate change, both at small and commercial scale farming, still needs to be investigated. Primer design and validation was finalised in December 2019. The validated primers will be used in future to check for the presence of pathogenic fungi including *Fusarium oxysporum* and *Alternaria alternata*. Due to the complexity of RNA sequencing data, processing and analysis to confirm microbial activity in the selected treatments is also still in progress. This task was concluded in January 2019.

Once the analysis is finalized a paper will be prepared for publication by February 2020. In conclusion, this study provides a very important framework to study healthy soils in organic production systems. It clearly shows the biological enrichment with traditional production systems and the negative effect intensive agriculture can have on microbial diversity, richness and functional potential. In one example it was clearly demonstrated that high throughput soil tillage systems can have a direct negative effect on soil richness and diversity (important indicators for soil health) and functional potential. These systems were also characterized by higher abundances of pathogenic genera including *Fusarium oxysporum* and *Alternaria alternata*.

Conventional soil health tests will be conducted by checking the presence of the above pathogenic groups amongst other microbes of interest.

#### 6.2.2.4 Climate Change Resilient Livestock – 170205

Professor Kennedy Dzama (SU) was the project leader for this research.

The objectives of this research were to:

- Determine the expression of methyl coenzyme M reductase A (mcrA gene for methanogenic archaea) in Nguni, Boran and Bonsmara cattle;
- Determine relationships between morphometric, thermo-tolerance and tick resistance traits, in extensively reared Boran, Nguni and Bonsmara Cattle;
- Determine relationships among thermo-tolerance traits and expression of HSP70A1A and HSP90AB1 in Boran, Nguni and Bonsmara cattle;
- Determine relationships among thermo-tolerance traits, expression of HSP70 and HSP90, methane production, growth performance and meat quality attributes between Boran and Nguni male weaners;
- Determine the effects of commercial and communal grazing systems on volatile fatty acid production, pH, ammonia and lactic acid concentration in the rumen of Nguni, Boran and Bonsmara cows;
- Determine the effect of communal and commercial grazing systems on enteric methane production, expression of methanogens and microbial population in the rumen of Nguni, Boran and Bonsmara cows; and
- Provide a literature review on the sustainability of meat production.

Ms. Melody Dzviti's collection of data on determining the relationships between morphometric, thermo-tolerance and tick resistance traits, in extensively reared Boran, Nguni and Bonsmara cattle will be completed in 2020. Data (tick counts, hair samples, morphometric measurements) has been collected for the winter, autumn, spring and part of summer season from extensively reared Boran, Nguni and Bonsmara cattle. Ms. Melody successfully collected rumen fluid samples required for one of the chapters and is scheduled to commence lab work this month. She will however continue collecting blood samples for some of the chapters until February 2020. Some of the findings include: Hair length differs by breeds and Boran cattle have sleeker coats than the Nguni and their hair sheds less than that of the other two breeds - this could be due to sebum. In some months, the Nguni had hair similar in length to that of the Bonsmara, however, the latter breed had higher tick counts. Generally, the *R. decoloratus* and *R. microplus* as well as the Amblyomma spp are the common ticks in the areas of interest. Mr. Denis Kayima has succeeded in collecting all rumen fluid samples and methane-related data required for his work and commenced laboratory work on 10 September 2019. Both students have done progress reports on some of their chapters to the supervisory team.

## 6.3 PROGRAMME 3: FOOD SAFETY HAZARDS (SAFETY)

The PI for this programme is Professor Lise Korsten (UP). Other team members were the late Professor Voster Muchenje (UFH), Professor Gerrie Du Rand, Professor Elna Buys, Dr Stacey Duvenage, Dr Erika Du Plessis, Dr Ishmael Jaja, Dr Nadene Marx-Pienaar, Dr Thobela Nkukwana and Dr Chris Marufu (All from UP).

This programme investigated:

- The current food safety status quo of selected foods which are regularly consumed by the food insecure;
- The effect of 'food safety insecurity' on the rural and urban communities and whether, and how, the lack of basic technologies such as refrigeration and lack of awareness and knowledge impact on their ability to obtain and provide safe, nutritious, wholesome food for the family; and
- The food safety status of food existing in the informal markets (i.e. spaza shops, farmer markets), as well as that of food from school feeding programmes.

The research objectives were to:

- Determine the level of food safety in informal markets in informal settlements of South Africa;
- Determine the level of food safety in the informal food service industry;
- Determine the level of food safety in a typical food insecure household;
- Develop a virtual CoE-FS microbial database; and
- Take part in scientific communication.

The research undertaken, as well as the achievements under this programme are organised under the following projects and WP's.

### 6.3.1 Building the Knowledge Platform: Information collection and Dissemination

#### 6.3.1.1 CoE-FS Virtual Microbial Database

Research shows that the microbial database has grown between 2016 and 2019. As at 2019, a total of 2969 isolates, which is a summary of selected, purified, preserved and characterised foodborne pathogens isolated from the plant and animal supply chains, were collected.

#### 6.3.1.2 Food safety knowledge, attitudes, and practices of Tshwane street vendors when managing fresh produce

Street vending as a livelihood has increasingly provided for many families in recent years. Urbanisation and migration remain the biggest factors which lead towards street vending in South Africa. Over the years, street vending has gained acceptance as an economy booster although stringent restrictions to curb the increasing numbers of street vendors have been put in place to maintain the image and aesthetic values of the inner cities in developing countries. Millions of rands are reported to have been collected from street-sold fresh produce and cooked foods in South Africa. A great number of consumers, especially the lower income

consumers often enjoy the services provided by street vendors due to the convenience and affordability of food products such as fresh produce. It is unfortunate however that street vendors are seldom properly educated in terms of food safety protocols and therefore expose consumers unnecessarily to foodborne illnesses.

This study thus, empirical in nature, investigated food safety knowledge of street vendors in Tshwane when managing fresh produce. A total of 183 street vendors were interviewed around Pretoria on their knowledge pertaining to food handling, food preparation and food storage. Results indicated that most street vendors had below average knowledge regarding food safety in general. In terms of specific food safety dimensions, the findings presented that most street vendors had better knowledge regarding food handling compared to food storage. In terms of food preparation, results were dismal and indicate that serious attention is needed. In conclusion the results from this study demonstrate that more research is needed to address the food safety aspects amongst street vendors because of the potential risks that consumers are subjected to due to poor knowledge pertaining to food safety.

#### 6.3.1.3 Consumers' perceptions and experiences of food safety and how this contributes towards waste in the QSR industry

The foodservice industry has been described as pervasive, touching the lives of many on a daily basis. Changes in consumption patterns (i.e. people having less time to prepare food at home) have led to an increased dependency on establishments such as quick service restaurants (QSR). Additional key drivers attributed to the increase of consumption include a growing ethnic diversity and the increase in dual income families as well as single person households. In the South African context, it is reported that many dine out as much as 1-4 times a week (Van Zyl, Steyn and Marais, 2010). In turn, this has also impacted the consumers' vulnerability to the establishments in which they dine. With this being said, food handlers in this industry move in and out between informal and commercialized kitchens and it is noted that they often face improper hygiene conditions as well as a lack of sanitary facilities, despite the requirements of operation under a certificate of acceptability (Holy and Makhoane, 2006). Failure to follow food safety protocols in QSR has raised alarm due to statistics indicating that 60% of all foodborne illness is often due to non-compliance with food safety protocols. Due to the recent Listeriosis outbreak in South Africa that occurred during January 2017 to May 2018, the topic of food safety in the industry has become a priority (thelancet.com, 2018). Additionally, recent studies have indicated that food safety practices in South African QSR tend to be dismal. The aim of this study, therefore, was to explore consumers' perceived importance pertaining to food safety attributes in QSR and to compare it to actual perceived performance in the same QSR's in order to identify areas of possible concern. –

The Importance-Performance Analysis tool (IPA), originally developed by Martilla and James, (1977), was used. In its application, a two-dimensional grid is used. It contains four quadrants and includes an analysis matrix for the plotting of attributes

based on their relative importance and performance to a customer (Janes and Wisnom, 2003). The same set of attributes for importance and performance are used as they will be directly compared within the IPA grid (Oh, 2001). In the construction of the IPA grid, the mean values of the importance and performance scores are used as the crossing point. For the sake of this study, food safety attributes were chosen in line with existing literature, common food safety practices and protocols. No attributes should be considered unimportant, but through the application of this tool, insight from the consumers' perceptions is gained. The use of this tool will assist in the investigation and describing of consumers' perceptions and experiences of food safety at quick service restaurants. It is motivated that consumers keenly search for attributes of food safety when faced with purchase decisions (Oh, 2000). The measuring tool was pre-tested with a sample of 20 respondents. Additionally, it was reviewed by experts in the food safety industry and by the foodservice industry, prior to data collection.

Data collection commenced with phase 1, which was store visits in order to observe current SOP's and to interview managers. Phase 2 involved an online and a paper-based consumer survey targeting respondents residing in Gauteng, SA's smallest, but most populous province. The paper-based questionnaire was collected to counter excluding respondents who might not have had access to the internet, and allow for capturing data from a wider, inclusive sample. The pre-requisites for participation in the study were that respondents had to reside in the Gauteng area and have recently (i.e. within the past 3 months) dined or purchased food from a quick service restaurant. Respondents also had to be above the age of 18. Screening questions were asked in the questionnaire to ensure the respondents met these requirements.

Descriptive statistics were used to interpret the findings i.e. the means of perceived importance and perceived performance, in order to plot on the IPA matrix. Results indicated that there is much need for addressing food safety concerns in QSRs. This however, will not only require practical changes i.e. addressing negligent food safety behaviours, but will involve a knowledge component which will require industry stakeholders to consider implementing stern education campaigns. With this being said, SA, as the "rainbow nation", poses a unique challenge in that education on the topic of food safety is not as simple as it may initially sound like. It is important to acknowledge the differences among its citizens and industry stakeholders and to structure education campaigns accordingly.

In conclusion, food safety assurance is considered fundamental in foodservice because of the high volume of meals served on a daily basis (Rebouças et al., 2017). Consumers are therefore vulnerable to these establishments to keep them protected from falling ill due to the consumption of contaminated food. However, if consumers misperceive the nature and source of foodborne illness, it would imply that they misjudge the frequency and it would thus be less motivated to change behaviours related to food safety, according to Unusan (2007).

#### 6.3.1.4 Listeriosis project

The outbreak of listeriosis in South Africa during 2017 – 2018 resulted in the food industry being placed under intense scrutiny. Food safety procedures implemented throughout the food supply chain became the focus of government, industry, media and concerned consumers. The industry was justifiably held responsible for the occurrence of this outbreak but the role and responsibility of the consumer was somewhat negated. Consumers' implementation of recommended food safety practices, specifically relating to storage and handling of processed meat products, can help reduce the risk of listeriosis. A national web-based survey was conducted to explore consumers' overall consumption of processed meat products, their awareness of listeriosis and their knowledge pertaining to safe food handling, preparation and storage. A sample of 731 respondents representing a middle to higher household income completed the questionnaire. Results reflecting the purchasing preferences and knowledge of listeriosis of the study group indicated that most of the respondents knew what listeriosis was. They also heard about it from social media (57%) and television (77%). Knowledge regarding safe food handling was high (93%), with 76% having a good knowledge of safe food preparation, whilst only 52% of the respondents were knowledgeable regarding correct and safe storage procedures for food. These results confirm the fact that consumers need to be educated regarding the correct and safe food handling practices in the home environment. This study identified the need to develop targeted educational initiatives of listeriosis prevention. Understanding consumer consumption, awareness of listeriosis and food safety cognition is essential for developing targeted food safety education.

### 6.3.2 Food safety hazard detection and diagnosis

#### 6.3.2.1 National school nutritional programme

The National School Nutrition Programme provides meals to over nine million schoolgoing children nationwide. Incidences of food poisoning have been reported at schools, therefore food safety within schools is a concern. This study aimed to determine the safety of fresh produce served and grown in Ekurhuleni (area 1) and Pretoria West District (area 2) in the Gauteng Province as well as schools in the Delmas (area 3) and Bethal (area 4) of the Mpumalanga province. Fresh produce, water, soil, contact surface swabs and hands swabs were collected from 12 schools during two site visits. In addition, questionnaires from different food handlers were included to determine their food safety knowledge, attitudes and practices.

Microbiological analysis

Roof top rain, harvested water and municipal water used for irrigating fresh produce at schools were found to be of acceptable quality for irrigation, according to the SA water guidelines. High levels of indicator organisms were enumerated from irrigation water used in Ekurhuleni school 3, causing the water to not be of acceptable quality. This was as a result of the water being stored in open refuse bins outside in the garden. The wash water from all the schools was of good quality. Of the total 161 fresh produce samples, the majority of fresh produce samples (77.6% from the garden and 91.7% from the store room) at Ekurhuleni and Pretoria West District

schools exceeded the coliform acceptable limit. Of a total of 85 fresh produce samples collected from Gauteng Province, area 1 21 exceeded the *E. coli* limit and 36 fresh produce samples out of 76 exceeded the acceptable *E. coli* limit for fresh produce in Gauteng, area 2. Coliform, Enterobacteriaceae, *E. coli* and *S. aureus* counts ranging from 0 to 6.13 cfu/g, 0-6.97 cfu/g, 0-4.26 cfu/g and 0-5.02 cfu/g, respectively were recorded from fresh produce from Gauteng province from both the garden and the storeroom. *Escherichia coli* was isolated from spinach (12/50 samples; 24%), carrots (2/17 samples; 11.8%), floor (2/80 samples; 2.5%) and hand swabs (4/35 samples; 11.4%) in the Gauteng Province. All the schools in Mpumalanga province from which samples were collected used municipal water for irrigating the fresh produce in the gardens.

The irrigation and wash water from the schools were of good microbiological quality, except for the wash water at School 9 located in Delmas from which *E. coli* was detected. Out of the 160 fresh produce samples obtained from the school gardens and storerooms, the majority exceeded the acceptable coliform (82.3% in the garden and 93.8% in the store room) and 11.4% of fresh produce from the garden and 43.2% of fresh produce from the store room exceeded the *E. coli* limit for fresh produce consumed raw. Coliform, *Enterobacteriaceae*, *E. coli* and *S. aureus* counts ranging from 0 to 6.14 cfu/g, 1.79-6.99 cfu/g, 0-4.57 cfu/g and 0-4.51 cfu/g, respectively were recorded on fresh produce from Mpumalanga from the garden and storeroom. Although most of the fresh produce is not consumed raw, apples served at some of the schools were consumed raw and were contaminated with between 0 and 4.72 log cfu/g of coliforms. *Escherichia coli* was detected from spinach (15/59 samples; 25.4%), tomatoes (2/12 samples; 16.7%), cabbage (2/25 samples; 8%), onion samples (2/39 samples; 5.2%) and floor (2/70 samples; 2.9%) in Mpumalanga.

A total of 49 hand swabs were obtained from the food handlers at all the schools. Presumptive foodborne pathogens detected on the hands include *S. aureus* (4.08%), *E. coli* (8.16%), ESBL producing *E. coli* (2.04%), *Enterobacter* spp. (6.12%) and *Klebsiella* spp. (16.33%). The three *S. aureus* isolated from Area 1 in Gauteng from water at school 3 which was stored in a dustbin and from food handlers' hands from Area 1 and Area 2 in Gauteng were screened for antibiotic resistance against 12 antibiotics. The *S. aureus* isolate detected in irrigation water that was stored in open refuse bins outside in the school garden was not resistant to any of the antibiotics tested. One *S. aureus* strain detected on the hand of a food handler was resistant to penicillin whereas the other *S. aureus* strain also detected on the hand of a food handler was resistant to nine of the antibiotics used, namely penicillin, oxacillin, gentamicin, erythromycin, clindamycin, chloramphenicol, rifampin, quinupristin /dalfopristin, ciprofloxacin and cefoxitin.

Extended Spectrum Beta-Lactamase (ESBL) producing *E. coli* were detected from 5.6% of Chinese spinach, 6% of spinach, 7.7% of carrot, 8.3% of tomato and 5.8% of onion samples. ESBL *Klebsiella* spp. were detected from 5.6% of Chinese spinach, 7% of spinach samples, 1.7% of cabbage, 7.7% of carrot and 11.6% of onion samples. ESBL *Enterobacter* spp. were detected from 2.90% of onion, 7% of spinach, 16.7% of tomato, 3.7% of apple, 11.1% of Chinese spinach and 10.16% of cabbage samples. ESBL *Enterobacter* spp. were mostly detected from 4% of floor

and 2.7% of counter swabs obtained from the kitchen. ESBL producing *E. coli* were also detected in soil samples (4.08%). The majority of ESBL-producing *E. coli* isolates (80%) were detected on samples from Mpumalanga and were mostly resistant to more than five antibiotic classes.

#### 6.3.2.2 Informal supply chain and point of sale (Morogo)

Eight farms were identified and visited in Gauteng (1), North-West (4) and Mpumalanga (3) provinces. All farms in Gauteng, Mpumalanga and two farms in North–West used borehole water sources for irrigation while one farm from North–West used the Hartebeespoort dam water as a source for irrigation. Formal retailers, informal retailers and street vendors were identified for the selected farms so that we can source track the microbial quality of Morogo from farm to fork. A total of 454 samples were processed and evaluated for microbial quality indicators as well as the detection of foodborne pathogens. *Escherichia coli*, *Salmonella* spp. and presumptive ESBL-producing organisms were isolated, identified, preserved and stored forming part of the CoE-FS Virtual Microbial database.

a) Fresh produce

Whilst 97.2% of spinach samples exceeded the previous guideline. Coliform counts on 98.1% of Chinesis exceeded the guidelines (log 2,3 CFU/g) (Department of Health, 2000) and ranged from 0.80 to 6.55 cfu/g, whilst 97.9% of spinach samples exceed the coliform limit and ranged from log 1.15 cfu/g to 6.10 cfu/g. *Enterobacteriaceae* levels on 65.1% of Chinesis sampled from all eight farms exceeded the recommended concentration (log 4 CFU/g) (New South Wales Food Authority, 2009). Borderline concentrations of *Enterobacteriaceae* were determined on field Chinesis from Farm A, B and C and retailer Chinesis from Farm B and C. No acceptable *Enterobacteriaceae* levels on Chinesis were observed across all farms. While on rape 43.1% of samples exhibited acceptable *Enterobacteriaceae* levels and 56.9% of samples exceeded the log 4 CFU/g guideline (NSW Food Authority 2009). Overall, *Enterobacteriaceae* levels on rape samples ranged from log 0.00 cfu/g to 6.98 cfu/g. Moreover, *Enterobacteriaceae* levels on spinach ranged from log 2.00 cfu/g to 6.37 cfu/g, with 66% exceeding the recommended concentration (New South Wales Food Authority, 2009).

*Escherichia coli* concentrations on the Chinensis ranged from 0.00 to 3.00 log cfu/g, with 3% of samples exceeding the acceptable amounts according to the New South Wales Food Authority (New South Wales Food Authority, 2009). Enterobacteriaceae counts on rape samples were ranged from 0.00 to 2.35 log cfu/g, with only one sample exceeding the New South Wales guidelines (out of 50 samples). *Escherichia coli* levels on spinach sampled ranged from log 0.00 cfu/g to 3.54 cfu/g with 5% of the samples exceeding the acceptable guideline (New South Wales Food Authority, 2009). No *Listeria* spp. were detected across all fresh produce samples assessed. *Escherichia coli* was detected from field Chinensis on Farm A during both trips as well as from Chinensis from Farm C in the field and at the retailer, with Farm D's retailer Chinensis contaminated with *E. coli*. In addition, *E. coli* was prevalent in rape samples originating from Farm A, B, C and H, with *Salmonella* spp. prevalent from Farm C and F in rape samples at points of sale. *Salmonella* spp. was detected on

one spinach sample from Farm F. On spinach, *E. coli* isolates were detected from all farms except from farms E and F in spinach samples.

Three ESBL-producing *Serratia* spp. were detected from field Chinensis from Farm A during trip 2, which was also detected in water from the farm. Presumptive ESBL-producing *Rhanella aquatilis* was prevalent on rape samples from Farm A and E, while presumptive ESBL-producing *Klebsiella* spp. were prevalent from Farm E on retailer samples and Farm F and H from field samples. Presumptive ESBL-producing *Serratia* and *Citrobacter* spp. were prevalent on rape samples from Farm F and H. Presumptive ESBL-producing *Serratia* spp. were detected from Farm C, while presumptive ESBL-producing *Rahnella aquatilis* was detected from spinach in Farm D and presumptive ESBL-producing *Citrobacter* spp. were detected from spinach samples from Farm H.

b) Water

Coliform counts for all water sampled ranged from 0.00 to 5.38 cfu/100ml, with 45% of the water samples exceeding the log 3 cfu/100ml level, as defined by the World Health Organization guidelines for the use of wastewater in agriculture (World Health Organization, 1989). In terms of the level of *E. coli* present in all water sources, the ranges were 0.00 to 3.38 log cfu/100ml- 16% of the water samples were considered unacceptable when compared to the limits set by the US Food and Drug Administration (FDA) (< 410cfu/100ml) (FDA, 2014).

Moreover, *Enterobacteriaceae* levels in all water sources ranged from 0.00 to 5.04 cfu/ml. Source water is often of good quality. However it was observed to become contaminated as the water flows further down the irrigation systems. *Escherichia coli* was prevalent in all water sources across all farms (26% contaminated), with *Salmonella* spp. prevalent only in water collected from Farm C and F. No *Listeria monocytogenes* was isolated from water collected, however, *L. seeligerii* was detected in Farm B and F. Moreover, presumptive ESBL-producing *Serratia* spp. were prevalent in water collected from Farms A, B and C and presumptive ESBL-producing *Klebsiella* spp. and *Enterobacter* spp. Were only detected in water from Farm C.

Therefore, these results highlight typical levels of indicator organisms in small-scale farms, retailers and street vendors in South Africa. The presence of *E. coli*, *Salmonella* and presumptive ESBL-producing organisms on fresh produce indicates a potential risk to consumer health and additionally highlights the food safety knowledge gap of small-scale farms and street vendors. Therefore, a need to raise awareness of food safety and educate farmers and retailers of good hygiene practices is a requirement.

#### 6.3.2.3 Informal point of sale (fruit and vegetables)

Five kinds of fresh produce, namely spinach, cabbage, tomatoes, apples and carrots were sampled from five greengrocers in Ekurhuleni, Atteridgeville and Mamelodi. From each greengrocer five replicates of the fresh produce were sampled, giving a subtotal of 25 samples. A total of 375 samples were taken. The coliform counts from

all fresh produce samples collected from Ekurhuleni were higher than the acceptable limit of 2.3 log cfu/g for ready-to-eat products according to the suspended guidelines for ready-to-eat products [South African Department of Health (DoH), 2000]. Ninety-eight percent of the fresh produce was positive for coliforms. Only spinach and tomatoes were analysed for Enterobacteriaceae and 100% of samples had this family present. Only 5.6% of the samples had *E. coli* that could be enumerated. Apples had lower counts of coliforms and *E. coli* when compared to the other four fresh produce types. Moreover, *E. coli* was isolated from 17.6% of the samples (n=22). Over 60% *E. coli* were multidrug resistant. A total of 96.67% of the *E. coli* isolates were susceptible to gentamicin, 70% were susceptible to cefotaxime and ciprofloxacin. Moreover, over 60% of the isolates were resistant to Cotrimoxazole (Trimethoprim / Sulfamethoxazole), Amoxicillin, Ampicillin and Tetracycline.

The coliform counts from all fresh produce samples collected from Atteridgeville were higher than the acceptable limit of 2.3 log cfu/g for ready-to-eat products according to the previous guidelines for ready-to-eat products (DoH, 2000). Ninety-four percent of the fresh produce samples were positive for coliforms, 90% were positive for *Enterobacteriaceae* while only 8.8% of the samples had *E. coli* that could be enumerated. Apples had lower concentration of quality indicator organisms than the other four sample types. *Escherichia coli* was isolated from 32.0% (n=40) of samples. Over 85% of the *E. coli* isolated in the study were found to be multidrug resistant, with resistance to more than three antibiotics classes. Sixty percent of the isolates were resistant to cefotaxime, 75% were resistant to both cotrimoxazole and amoxicillin, 82% were resistant to ampicillin. A total of 96.87% of isolates were susceptible to gentamicin, 71% were susceptible to nitrofurantoin, and 64% were susceptible to streptomycin. Eighty-seven percent of the isolates were resistant to tetracycline. *Salmonella* spp. and *Listeria* spp. were not detected on any samples (n=125).

From Mamelodi, 125 fresh produce samples were taken (spinach, cabbage, tomato, carrots and apples). No *Salmonella* spp. and *Listeria* spp. were detected from any fresh produce sampled, with *E. coli* detected from only four samples (2 spinach, 1 apple and 1 carrot). Coliforms of all samples exceeded the acceptable level as set out by the Department of Health's previous guidelines. Coliforms were detected from 89.6% of the fresh produce samples, *Enterobacteriaceae* was detected from 90.4% and *E. coli* was enumerated from 20.8%. Spinach had higher concentration of quality indicators as compared to apples, cabbage, carrots and tomatoes. The *E. coli* isolated from spinach was multidrug resistant while the one isolated from apple and carrots were resistant to only one or two antibiotics. All *E. coli* isolates were resistant to tetracycline.

#### 6.3.2.4 Informal at home study (fruit and vegetables)

Two kinds of fresh produce (spinach and tomatoes) were sampled from 25 houses and five greengrocers in Ekurhuleni and Atteridgeville municipalities. From each greengrocer, nine replicates of each fresh produce type were sampled, giving a subtotal of 18 samples per fresh produce type, three samples of each fresh produce

type from the markets were analysed within 24 hours. The remaining samples were stored in five houses, with one house storing three replicates of each fresh produce type. A total of 360 samples were sampled by the end of the study. This work included the use of questionnaires to gather information about the local people in Ekurhuleni in order to help locate the households to be included in the study. 262 consumer questionnaires have been done and are currently being analysed.

The coliform counts from all fresh produce samples from Tshwane and Ekurhuleni were higher than the accepted limit of 2.3 log cfu/g for ready-to-eat products (DoH, 2000). All fresh produce samples were positive for coliforms, 97.8% were positive for *Enterobacteriaceae* while only 44 samples had *E. coli* at levels that could be enumerated. *Escherichia coli* was isolated from 9.17% (n=33) samples. Five *Salmonella* spp. and no *Listeria monocytogenes* isolated were from this set of samples (n=360). No enterohemorrhagic *E. coli* virulence genes were detected in any of the *E. coli* isolates (n=62). However, over 75% of the isolates were multidrug resistant. Over 87% of the *E. coli* isolates were susceptible to gentamicin, over 80% were susceptible to tetracycline and ampicillin.

**6.3.2.5 Informal point of sale (fruit and vegetables)-** (This research was co-funded by the Water Research Commission and the US AID Partnership for Enhanced Engagement in Research).

A total number of 545 vegetable samples were collected from ten formal retailers, ten street trading greengrocers, ten mobile trolley vendors, and 13 vendors at two farmers' markets in Gauteng, South Africa, from May 2016 to May 2018. The vegetable samples included, depending on availability, spinach (bunches, baby leaves, or minimally processed ready-to-eat (RTE) pillow packs) (n=200), tomatoes (n=200), cucumbers (n=45), lettuce (Iceberg lettuce heads or mixed salad leaf RTE pillow packs) (n=50), and green beans (n=50 samples). Overall, coliforms enumerated from cucumbers differed significantly from the coliforms enumerated from the leafy green vegetables (spinach and lettuce). All 200 spinach, 200 tomato, 50 lettuce, 50 green beans and 43 (96%) of the cucumber samples were positive for coliforms. Coliform counts on green beans, cucumbers, lettuce, spinach and tomatoes were considered at unacceptable numbers according to the previous Department of Health's guidelines. The *E. coli* enumerated from tomatoes from the retailers and street traders were significantly lower than *E. coli* enumerated from the retailer and farmers' market spinach samples. Although, interestingly, overall more tomato samples were positive for *E. coli* than the total spinach, lettuce, cucumber or green bean samples respectively. According to the commission regulation on microbiological criteria for ready-to-eat pre-cut fruit and vegetables (EC, 2007), six of the spinach sampling sites, four tomato sampling sites, two lettuce sampling sites, two green bean sampling sites and one cucumber sample site had unsatisfactory *E. coli* counts. *Enterobacteriaceae* counts on all farmers' market products except for cucumber exceeded the Health Protection Agency's guidelines of 2009. *Escherichia coli* enumerated from all farmers' market products were considered at unacceptable levels.

A total of 122 presumptive extended-spectrum/ AmpC β-lactamase-producing Enterobacteriaceae were isolated, all these organisms are included in the CoE-FS Virtual Microbial Database. Only 77 were selected for further screening, all the 77 isolates showed resistance to more than one antimicrobial agent, with 96.1 % being MDR (resistant to ≥ 3 antimicrobial classes). The results obtained from this research indicate that further investigation of different fresh produce types in Gauteng and other provinces in SA is necessary. Future studies should focus on surveillance of fresh produce production systems from farm to retail to identify the potential sources of contamination which contribute to the presence and dissemination of antimicrobial resistant microorganisms and their genetic determinants. Since antimicrobial resistance is a worldwide problem, a global solution is required that integrates the contributions from governmental departments as well as from the scientific community.

**6.3.2.6 Formal supply chain (fruit and vegetables) -** (This research was co-funded by the Water Research Commission and the US AID Partnership for Enhanced Engagement in Research).

The microbiological quality of leafy greens was investigated from commercial farms to retailers. A total of 239 samples were collected comprising spinach (n=68), lettuce (n=68), water samples (n=63) and soil samples (n=40) from two commercial farms (in the field followed through to the packhouses and associated major retail outlets) in Gauteng Province and North West Province. Fresh produce sampled (spinach and lettuce) recorded high levels of *Enterobacteriaceae* counts ranging between log 2.2 and 4.6 CFU/g. Total coliform counts of all fresh produce sampled during the study ranged between log 2.7 and 4.6 CFU/g, which exceeds the previous Department of Health guidelines for ready-to-eat foods. Among the leafy greens (spinach and lettuce) from Farm A and Farm B, neither *Salmonella* spp. nor *Listeria monocytogenes* were detected. However, *Salmonella* spp. was only detected on irrigation water on Farm A, with *Listeria monocytogenes* detected on processing water in Farm A.

In this study, a total of 83 ESBL-producing bacteria were isolated and *Klebsiella* spp. was detected in irrigation water from both Farm A and Farm B and on lettuce at harvest at Farm B. ESBL-producing *Serratia* spp. was found to be more prevalent in spinach samples in the field, packhouse and retail samples at Farm A but none was detected in Farm B samples. ESBL-producing *E. coli* was found to be most prevalent in irrigation water sources and lowest in spinach and lettuce sourced from commercial farms.

Only 11% (16/136) of fresh produce was found to be contaminated with ESBL-producing *Enterobacteriaceae*. In addition, of the 23 ESBL- producing *E. coli* isolates, 95.7% were found to be multidrug resistant. Moreover, of the 30 generic *E. coli* isolates tested, 80% were found to be multidrug resistant.

#### 6.3.2.7 Antibiotic resistance in the informal supply chain (fruit and vegetables)

(This research was co- funded by the US AID Partnership for Enhanced Engagement in Research).

A total of 111 ESBL-producing bacteria were detected and isolated from water 80% (n=89) and cucumber 20% (n=22) of the 28 samples (16 water samples and 12 cucumber composite samples). The 111 ESBL-producing bacteria were further screened to determine the presence of antimicrobial resistance conferring genes; 60% (n=67) were positive for *blaTEM*, 77% (n=85) for *blaSHV*, 31% (n=34) for *blaOXA*, 30% (n=33) for *blaCTX-M*$_{G1}$, 0% (n=0) for *blaCTX-M*$_{G8/25}$ and 6% (n=7) for *blaCTX-M*$_{G9}$. In addition to ESBL-producing organisms 56 *E. coli*, 4 *Salmonella* spp. and 4 *Listeria* spp. isolates were detected and isolated from water and cucumber samples. Moreover, 92,86% of water samples and 7,14% of cucumber samples were contaminated with *E. coli.* All these isolates form part of the CoE-FS Virtual Microbial Database and characterization of these isolates in order to determine the South African genomic signal and indepth antimicrobial resistance gene will be conducted.

#### 6.3.2.8 Microbial profiles of red meat at different stages of the abattoir to retail outlets distribution chain

A total of 216 swab samples from beef, pork and mutton carcasses were collected during the loading process of carcasses into trucks at the abattoir, when off-loading carcasses at the supply points and during marketing. The samples were immediately transported to the laboratory and subjected to total bacterial count, coliform count, *E. coli* count and *Staphylococcus aureus* detection. The results indicated that the microbial counts were significantly ($p < 0.05$) higher in samples from the commercial abattoir than in those from the communal abattoir. The results further showed significant microbial contamination of carcasses with all bacterial groups in all the stages except for *S. aureus* which was not detected at all from the samples from the commercial abattoir. However, *E. coli* was the predominant microbial contaminant in the samples from both abattoirs.

#### 6.3.2.9 Vacuum packing and overwrapping effects during marketing on shelf-life and microbiological quality of red meat

The study investigated the effect of vacuum packing and overwrapping on the physico-chemical and microbiological shelf life of red meat during marketing. Two types of packaging systems commonly used by the retailers were selected and used in this study: vacuum packaging and overwrapping. A total of 108 fresh loin meat samples of beef (n= 36), pork (n= 36) and mutton (n= 36) were purchased from a local butchery. Samples were immediately transported to the laboratory in cooler boxes with ice and stored in a refrigerator at 4 °C for storage duration of 15 days. To monitor shelf life, physico-chemical traits such as colour (CIE-L*, lightness; a*, redness; and b*, yellowness) and pH measurements were taken on days 0, 3, 6, 9, 12, and 15 with three replicates (n =18) per each meat type. Microbial analysis of the meat samples was carried out on the respective days of sampling. The samples were subjected to total bacterial count, coliform count, *E. coli* and *Staphylococcus aureus* detection. Packaging had a significant effect ($p < 0.05$) on colour (L*, a* and b*)

among different meat types. Vacuum packed mutton and pork loin samples were observed with low L* values (34.5 ± 1.05) and (45.9 ±1.05) which were significantly different ($p < 0.05$) in comparison to overwrapped samples. Total bacteria count, coliform count and *E. coli* increased significantly ($p < 0.05$) with storage duration. In conclusion, both packaging systems could not sustain a high quality in meat.

#### 6.3.2.10 Assessment of aerobic plate counts, *staphylococcus aureus, escherichia coli* and *salmonella* in meat sold by street vendors in the Eastern Cape Province

The study was carried out to determine the aerobic plate counts (APC), *Staphylococcus aureus, Escherichia coli* and *Salmonella* contamination levels in cooked (n=24) and raw (n=24) beef, pork and mutton samples, surface contact plates (n=48) and water samples (n= 40) from street vendors. A total of eight street vendors who were willing to participate in the study were randomly selected. After biochemical tests, no significant differences were found in the microbial counts of meat sold by street vendors in Alice and King Williams town. Furthermore, no significant differences were found in the mean scores of raw beef, mutton and pork where APC (4.8, 3.7 and 2.8 Log CFU/g), *Staphylococcus aureus* (3.3, 3.7 and 2.8 Log CFU/g) and *E. coli* (1.0, 0.6 and 0.3 Log CFU/g) respectively. *Salmonella* tested negative in all the samples tested in the study.

#### 6.3.2.11 Microbiological quality of street-vended chicken meat under the rural set-up in Alice, Eastern Cape Province

The aim of this study was to evaluate the microbiological quality of street-vended chicken meat under the rural set-up of Eastern Cape Province. A total of 30 street vended chicken meat samples were randomly collected from 15 street food vendors. Each vendor offered one raw and one cooked chicken meat sample at a cost. The samples were aseptically received with plastic gloves, sealed and transported in an ice-filled cooler box to the laboratory for microbial analysis. *Escherichia coli, Staphylococcus aureus* and aerobic plate counts were performed on both meat samples. The test for *Escherichia coli, Staphylococcus aureus* and aerobic plate counts were within approved range.

#### 6.3.2.12 Two-year survey of aerobic plate count and *enterobacteriaceae* count, *escherichia coli* and *salmonella* in meat from abattoirs in the Eastern Cape Province

This study was conducted to evaluate the *Enterobacteriaceae* and aerobic plate count (APC), as well as the detection of *Escherichia coli*, and *Salmonella* spp in meat from selected slaughter facilities. A retrospective data (n = 100) of microbial survey from 2017 was obtained from the Grahamstown veterinary laboratory. A prospective study (n = 50) was conducted in 2018 across the Eastern Cape abattoirs where samples of mutton (n = 10), beef (n = 10), pork (n = 10), avian (n = 10), and water (n = 10) were collected and transported to the Grahamstown veterinary laboratory microbiology section for further analyses.

For APC all samples were found to be between 2 to 4.50 log CFU/g, with *Enterobacteriaceae* between 2 to 4.00 log CFU/g. In this study, the results show that there were no significant differences across all meat except for pork where the significant difference was observed (P≤0.05) on aerobic plate count. For *Enterobacteriaceae* across all meat types, there was no significant difference (P≤0.05). *Salmonella* and *Escherichia coli* was detected in 50% beef and pork There was no *E. coli* detected on mutton, but 66.7% of *Salmonella* were detection of mutton. *Salmonella* was detected in all chicken samples but *E.coli* was found in 80% No *Salmonella* was detected in water samples but 91.7% of *E. coli* was recovered from water.

#### 6.3.2.13 Pesticide analysis of dark green leafy vegetables and other fresh produce sourced from provinces of South Africa

To date, 33 fresh produce samples have been collected from seven provinces in South Africa. Fresh produce included cabbage, leafy greens (morogo, rape, covo, mustard spinach, pumpkin leaves, kale, spinach and Chinese spinach), peppers, herbs, chillies and spring onion. Fresh produce was selected based on availability. Six products were found to exceed the maximum residue levels (MRLs). A residue of 0.01 mg/kg *Lambda-Cyalothrin*, a D-class carcinogen, was found on cabbage from the Northern Cape which exceeded the MRL. In addition a residue of 4.411 mg/kg *Profenofos*, a chemical that can overstimulate the nervous system causing nausea, dizziness, confusion, and at very high exposures, was found on cabbage from Gauteng which also exceeded the MRL. Chillies from KwaZulu Natal exceeded the *chlorpyrifos* MRLs.

*Chlorpyrifos* is considered moderately hazardous to humans by the World Health Organization. *Chlorpyrifos* itself is not toxic, however when the body breaks it down a toxic form is created. Exposure to *chlorpyrifos* has been linked to neurological effects, persistent developmental disorders and autoimmune disorders. Spinach from KwaZulu Natal exceeded the MRL set for *Lambda-Cyhalothrin*, while spinach from Gauteng exceeded the MRLs for *cypermethrin*. Lastly, *Tebuconazole*, a possible human carcinogen, was found at levels (0.01mg/kg) on peppers from the Free State and this value exceeded the MRLs. It is perhaps important to note that the national set MRL levels are based on minimal CODEX *Alimentarius* standards and is also calibrated against equivalence to export requirements. Fresh produce being sold to consumers in the market should not be adulterated by any chemical residues. The results in this study to date have indicated the need for better screening of fresh produce in the informal sector.

#### 6.3.2.14 Formal and informal spinach safety from farm to fork: A South Africa case study

*Coliforms* and *Enterobacteriaceae* enumerated from spinach (at harvest and at retail), water (source and irrigation) or soil did not differ significantly (*coliforms* p=0,1665; p= 0,8236; p=0,0801; p=0,9465; p=0,0136 and Enterobacteriaceae p=0,2864; p=0,3592; p=0,6337; p=0,0904; p=0,6135, respectively) (Figure 3 and 4). *Escherichia coli* enumerated from source and irrigation water from the formal and informal sector was not significantly different (p=0,1757; p=0,2979), nor were the *E.*

*coli* enumerated for the soil (p=0,5107) (Figure 3 and 4). However, only 67% of formal irrigation water and 62% of informal irrigation water were within international and national guidelines (1000 cfu/100 ml; World Health Organisation 1989; South African Department of Water Affairs and Forestry 1996). Source water (46% in the informal and 68% in the formal sector) did not comply with these guidelines for agricultural water. In the informal sector, *E. coli* count ranges did not differ between the source and the point of irrigation. However, in the formal sector, the *E. coli* counts from source water were higher than those obtained for irrigation water. The source water in the informal sector is often in close proximity to where irrigation takes place, whereas in the formal sector water requires piping from the source in black PVC pipes being mostly exposed to high day temperatures. Often informal farmers use flood irrigation as a means to decrease the microbiological risk by not wetting the edible portion of the crop, whereas in the formal sector overhead irrigation is commonly used. *Escherichia coli* enumerated from spinach collected at the point of harvest was significantly higher in the formal sector when compared to the informal sector (p=0,0263). This was similarly found at the point of sale for both supply chains (p=0,0328) (Figure 4).

The majority (93%) of spinach samples at the retailer in the formal and informal sector had *E. coli* counts less than 1000cfu/g. The remaining 7% of samples in the formal sector ranged between log 5 and 6 cfu/g, while in the informal sector counts ranged between log 3 and 6 cfu/g. Du Plessis et al. (2017), found lower *E. coli* counts on spinach at the point of sale in the informal (log 0,79 cfu/g) and formal sector (log 0,37 cfu/g) when compared to this study. Interestingly, at the point of harvest, 99% of informal spinach samples and 91% of formal spinach samples were below 1000 cfu/g. In the informal sector the *E. coli* populations on spinach increased from the point of harvest to the point of sale. Spinach in the informal sector is transported and sold on the back of open vehicles and humidity maintained by sprinkling of water obtained from communal water storage sources, which was of questionable quality. *Salmonella* spp. were detected from 23,3% of formal irrigation water and only in 13,6% of informal irrigation water.

In the informal sector *Salmonella* spp. were isolated from only 1,5% of spinach samples at harvest and from 14,8% of spinach at the point of retail, indicating a postharvest contamination source. In the formal sector 2,4% of spinach at the point of retail was found to be contaminated by *Salmonella* spp. Du Plessis *et al.* (2017) found no viable *Salmonella* spp. or *Listeria* spp. from the 90 spinach samples tested in the formal and informal sectors at the point of sale. No *Listeria monocytogenes* was isolated from any water or spinach samples in this study. A total of 189 *ESBL-Enterobacteriaceae* were isolated throughout this study, with 44 from formal water sources, 46 from formal spinach, 42 from informal water sources and 57 from formal spinach sources. Emerging bacterial threats, with $\beta$*-lactams* and aminoglycosides as problematic resistances, include amongst others *E. coli*, *Klebsiella pneumoniae* and *Enterobacter* species (Fair and Tor, 2014). The main *ESBL-Enterobacteriaceae* isolated in this study included *E. coli* (31%), *Serratia* spp. (17%), *Enterobacter* spp. (16%) and *Klebsiella* spp. (13%). Interestingly all three the emerging bacterial threats as well as *Serratia* spp. were predominantly detected in water and fresh produce

samples, which is similar to results reported by Blaak *et al.* (2014) and Zurfluh *et al.* (2015).

The enumeration of coliforms, *Enterobacteriaceae* and *E. coli* as well as presence of foodborne pathogens and *ESBL-Enterobacteriaceae* on spinach in the formal and informal sectors indicates that spinach sold in the South African informal sector is not less safe than the spinach sold in the formal sector. However, the higher levels of *E. coli* in the formal sector indicates need for water treatment and/or alteration of farming practices in order to minimize the risk associated with overhead irrigation (Allende & Managhan, 2015). In addition, the presence of foodborne pathogens as well as *ESBL-Enterobacteriaceae* indicates the need for improved food safety management practices on farms, during transport and distribution as well as during retail sale in order to mitigate these risks in the formal and informal spinach sector of South Africa. In addition, proper food safety training and mitigation practices in the informal sector could lead to prevent the increase in *E. coli* populations from the point of harvest to retail sale.

## 6.4 PROGRAMME 4: PLATES, BASKETS AND SHELVES (PLATES)

The PI of this programme is Professor Rina Swart (UWC).

Since the inception of the CoE-FS, a key question has been "what is on the plate of different groups of South African consumers". A project to review existing data was supported in the first year of the CoE-FS and it was concluded that inadequate information is available. For children, the previous national food consumption survey was done twenty years ago. As a result, a Child Malnutrition programme was set up by the CoE-FS in 2015 to investigate alternative data sources, undertake exploratory primary research using qualitative and quantitative methods, and undertaken limited laboratory research to identify keys issues in product safety, authenticity, and development. This programme driven by Professor Julian May has largely completed its research and merged into the Plates programme in 2019.

The research undertaken and achievements in 2019 under this programme are organised under the following projects and WP's.

### 6.4.1 Food Consumption Patterns -180401

This research is led by Professor Rina Swart (UWC).

The purpose of this study is to explore the food and nutrition security of young adults (aged 18-25), their dietary intake, as well as the nature of their food acquisition practices and engagement with their local food environments.

Specific objectives of this research are to:

- Assess the socio-economic status of young adults;
- Assess the dietary intake of young adults;
- Determine the anthropometric status of young adults;
- Assess the food security status of young adults;

- Determine the food acquisition patterns of young adults, i.e. where do they obtain food, when and why do they choose particular food items as well as the providers; and
- Explore perceptions of young adults on enablers and constraints for healthy food choices in their environment.

The study population includes young adults (18-25 years) residing in two geographical areas, i.e. Langa in the Western Cape, and Ikageng in the North-West province. These two sites are part of the PURE study of adults aged 50-70 and information on the health profile of these communities will thus be available. For the study, 300 participants will be selected randomly from each geographical area, and the number of households within each geographical area will be counted to determine the interval to be applied within each area. Respondents will include one person aged 18-25 years per household. If the household does not have a member in this age range, field workers will approach the next household as per the interval sampling to request participation if eligible participants reside in the household.

The study design is in the form of a quantitative cross-sectional survey. Fieldworkers will employ a standardised survey instrument developed specifically for this study. The socio-demographic questionnaire, 24 hr dietary intake, anthropometric measurements, and food acquisition questionnaire will be completed with one adult aged 18-25 years per household after obtaining informed consent. During quantitative data collection, individual young adults will be identified to take part in focus group discussions to explore their perceptions of food environments. A minimum of two focus group discussions per set will be carried out in which a semi-structured interview guide will be employed. Ethics approval at North-West University took very long, but this institution will start with data collection in 2019. Data collection in Langa was completed, and data analysis will follow in 2019 after completion of the Ikageng fieldwork.

This research is continuing in 2020, and research results will be provided in the 2020 Annual Report.

### 6.4.2 Gender in Household Food (in) Security- 180402

This study explores specific challenges experienced by women in their endeavours to contribute to food security and ensure food security for their households. This study links with the Farmworker project of the SARChI in Social Protection for Food Security. This research continued in 2019 and is being conducted by a master's student, Ms. Thulile Ngwexana. The title of Ms. Ngwexana's thesis is: *Access to land and productive resources among female farmers Stellenbosch: Implications for women's empowerment and household food security.*

This research will continue in 2020, and research results will be provided in the 2020 Annual Report.

### 6.4.3 Gender, Sex, Power and Food – 170402

The main aim of this project led by Professor Yanga Zembe (UWC), was to explore the interconnections between gender power inequities, sexual risk-taking and food insecurity among unemployed women in rural and peri-urban settings in KwaZulu-Natal and the Western Cape.

Despite clear interconnections between gender, hunger, and poverty, the gendered dimensions of food security remain under-explored in South Africa. Most studies focus on food availability, access, and use, without disaggregating for nutrition status or food security data by gender, and without considering the influence of key issues affecting women in South Africa – including gender power inequities and sexual risk-taking – on women's roles as providers, utilisers and consumers of food.

The study i) assessed the socio-economic and gendered dimensions of food insecurity in KwaZulu-Natal and Western Cape, using existing national databases; ii) explored the food security strategies of unemployed women in rural and peri-urban settings in KwaZulu-Natal and Western Cape; iii) examined the context within which particular food security strategies are selected by these women and the extent to which the selected strategies are framed by agency, and gendered vulnerabilities and opportunities; iv) explored the extent to which gender power inequities (relational and economical) in the sexual partnerships of unemployed women shape their access to and provision, preparation, and consumption of food; v) explored the gendered identities of the women, including how they perceive themselves as women, caregivers and sexual beings about food security; and vi) explored the women's perceptions of how their gender roles influence the provision of food in their households.

The study sample was made up of 20 women, who had an average age of 34. The majority were unemployed (85%), just over half (55%) were living with a sexual partner, and all of them had children who were recipients of the Child Support Grant (CSG). The lowest-earning participant reported a monthly household income of R400, whilst the highest-earning reported a household income of R7200 and the average monthly income per household was R3589. All of the women had children; nearly half had three or more children (45%), whilst 30% reported having one child. In terms of food insecurity, most of the women reported a diet largely consisting of foods that are high in carbohydrates such as rice and maize meal, with very little vegetables and almost no high protein foods like meat, poultry and dairy (except for sour milk). Most also reported regularly struggling to obtain food for their families, especially towards the end of the month.

The findings indicated clear gendered patterns in the buying, sourcing, preparation and, to a lesser extent, consumption of food in the households of the women interviewed in this study. Most women reported that the buying of food, including decision making on what was bought, was considered a mother's domain in most households and that these ideas had to do with gender socialization on women's roles in the household, and the fact that they were usually the ones who were in

charge of preparing/cooking the food and thus best informed on what the family had or did not have in their grocery cupboards.

Most women had no problem with having the role of buying, sourcing and preparing food for their households because they considered it their duty. However, most also complained that this arrangement meant that they were the ones who had the burden of figuring out what was to be eaten and how it was obtained, which was stressful especially since most households regularly struggled to afford groceries for the whole month. The strategies that women used to manage household food shortages included asking for food from relatives and friends, borrowing money, taking up low paying on-the-spot jobs like doing laundry for R20, going to a local fruit and vegetable market that was known to give away free rotten vegetables, changing what they normally ate to the most basic foods (usually maize/rice with just fats seasoned with stock cube) and rationing food. Another strategy worth noting was that women deprived themselves of food to ensure there was enough for their children and husband/male partner; this they did because they considered themselves responsible for ensuring that their families did not sleep on empty stomachs.

Since the women in this study were the ones who dished out food in their households, by not dishing out food for themselves during lean times, they avoided having to be the bearer of the news that there was not enough food to go around. Women also reported knowledge of other women in the community who managed food insecurity in their households by stealing money or food from others in the neighbourhood, shoplifting and engaging in transactional sex. The women in our study considered it a mother's duty and responsibility to ensure that their children did not go to bed hungry, and as such carried a lot of guilt and pressure whenever they experienced food shortages. In a context where absent fathers were said to be the norm, it was not surprising that women considered themselves the only people responsible for feeding their children. They were used to having noone to share the burden of feeding their families. Importantly, not all of the women in our study reported singular responsibility for feeding and taking care of their children and households; a few women had male partners who were present fathers in their children's lives, and who took as much responsibility for ensuring there was food to eat in their households as their female partners.

These men were also said to share the responsibility of cooking and preparing food. When we inquired about the reasons for the women's sense of responsibility for their household's food security, the responses we received indicated gender socialization that emphasized the centrality of a mother's role in ensuring the welfare of her offspring. They also indicated cultural notions of lazy men, and men socialized to believe themselves incapable of attending to the 'kitchen' affairs of their households. The take-home message from these findings is that poor Black women suffer high levels of stress and pressure to manage regular experiences of food insecurity, due to gender socialization. The gendered demarcations of roles in patriarchal households mean that, for many, that stress is not shared or carried with others, it is a lonesome burden that women carry alone.

### 6.4.4 Enhancing Food Security through Disaster Risk Reduction - 150802

This study is led by Professor Dawid van Niekerk (NWU) and aims to determine how a sustainable food system can be achieved to realise food security for poor, vulnerable and marginal populations in South Africa.

The objectives of the study were to:

- Review all food security disaster risk reduction and climate change adaptation legislation, policies, strategies, programmes and budgets (including all aspects relating to food production, processing, markets and livelihoods, value chains, health and nutrition, consumer behaviour and choice, food safety, and food rights);
- Determine interactions, overlap, deficiencies, complementarity, conflicts, and gaps in current and linked policies for food security;
- Map all current statutory and regulatory issues across multi-sectors.
- Influence policy change and/or adaptation within sectors and levels of government;
- Facilitate and initiate integration/linkages of food security, disaster risk reduction and climate change adaptation policies across all government sectors and spheres; and
- Monitor such policy and legislation implementation.

A significant amount of time on this project has been aimed at the capacity development of Masters and PhD students focusing their research on the topics related to the objectives of the project. The progress of the students is as follows:

- Ms. Lulu Chauke: *Enhancing food security through the integration of DRR and the food chain value: The case of Listeriosis outbreak: South Africa.*
  The student has made significant progress and she is in the final stages of data collection. Due to unforeseen personal circumstances, she was not able to submit in 2019 but will do so in 2020.
- Mr. Tshepo Nkolanyane: *Enhancing food security through disaster risk reduction and climate change adaptation policies and legislation: South African context.*
  The study is in the finalisation phase. Field research has been completed and the student is busy with the final write up. The key informants which were chosen to be appropriate for the study include senior officials in different departments and industries i.e. Department of Agriculture, Forestry and Fisheries (DAFF), National, Provincial and Local Disaster Management Centre and South African Agriculture Industry (e.g. AgriSA and farmers' unions). The student experienced some difficulty in conducting interviews with the target group and much of 2019 was used for this purpose.

  Besides the direct study, the student identified a gap within the disaster risk reduction/food security domain concerning the involvement of the youth. To this end, he and three of his fellow students created the South African Youth Centre for Disaster Risk Reduction (SAYCDRR). The SAYCDRR aims to advocate the prioritisation of youth and children in DRR. Its objectives are a) Enabling inclusive youth and children engagement and empowerment in DRR;

b) Education and research; c) Serving as the officially recognized spokesperson for youth and children in the disaster management community in South Africa; and d) Enabling and empowering young woman in disaster risk areas. Through this initiative, he and his fellow students were able to attend two international conferences where he presented the initiative. Furthermore, the SAYCDRR launched an online channel called "Disaster Talk" which covers issues of DRR and food security. Currently, three universities are involved in this initiative.

- Mr. PW Bredenkamp**:** *Agricultural adaptation to intensifying El Niño and La Niña periods within North West, South Africa. (*North-West University).
  The student is currently in the finalisation phase of his thesis and will hand it in in early 2020. The research focussed on agricultural adaptation to enhance food security in light of changing climatic conditions in North West province.
- Ms. Annegrace Zemb: *A framework for policy coherence between food security, climate change adaptation and disaster risk reduction in South Africa.*
  The student has completed her data collection phase. She has made significant progress and is in the process of completing her first article which will be submitted for publication in early 2020. It is envisaged that she will submit her thesis by the end of 2020.
- Ms. Sizwile Khoza: *A gendered approach to climate-smart agriculture adoption by smallholder farmers in Malawi and Zambia.*
  The student will submit her thesis by articles towards 2020. She conducted fieldwork in two disaster-prone regions in Southern Africa (Chikwawa district in Malawi and Gwembe district in Zambia). A total of 16 key informant interviews, six focus group discussions and 102 household interviews were conducted in Chikwawa and Gwembe districts. Through the bursary support, a total of 172 individuals in different capacities (government officials, NGO staff and farmers) were reached through the data collection exercise.
  Findings specific to this study were that the adoption of climate-smart agriculture (CSA) is being promoted in the context of pre-existing gender inequalities which focus on traditional male/female gender binaries. The study established that current gender mainstreaming efforts in CSA are blind to the heterogeneity of smallholder farmers, with different social groups of women facing various constraints to adopting CSA. The constraints include: a lack of decision-making in intra-household decision-making, lack of access to, and control of, productive assets required for CSA. Furthermore, poor access to information and basic education are among other socio-cultural factors that skew CSA adoption in favour of better-resourced male farmers. From the study, several accredited articles were produced.
- Mr. Clement Kalonga: Regional policy coherence for resilience and sustainable development frameworks in the SADC Region.
  The student is currently in the data collection phase and aims to have this first article ready for publication towards the middle of 2020.

### 6.4.5 Child Malnutrition – 190401 (Linked to 160502)

The PI for this project is Professor Julian May. Other team members include Professor NM Emmambux (UP), Professor Shanaaz Mathews (UCT), Dr. Jaya Josie (HSRC), Professor Hettie Schonfieldt (UP), Professor Maria Eugenia D'Amato (UWC),

Dr. Rihlat Said Mohamed (WITS), Dr. Coretta Jonah (UWC) and Professor Lise Korsten (UP).

The Persistence of Child Malnutrition Programme started in 2016, with the intention of describing child malnutrition in South Africa, examining its trends, determining its causes and identifying possible policy and product solutions. Most activities in the Programme were due to end in 2018. However, due to delays in the kick-off, some activities remained and were incorporated into the Plates Programme which was motivated by the critical need to focus research on the nature and causes of nutritional status and outcomes of children, who remain one of the most vulnerable groups in the country. Even though household-reported hunger of children continues to reduce in South Africa, chronic child malnutrition rates remain high at 27% and mostly unchanged since 1993. South Africa is thus an outlier as a middle-income country when compared to countries such as Brazil and Peru, where chronic child malnutrition has been reduced. The programme aimed to examine trends and causes of child malnutrition in South Africa and to provide recommendations for policy. Work Packages in two out of the three planned projects are still in progress but are due to be completed by the beginning of 2020. Dissemination work is on-going on the third project, the secondary data analysis, in the form of research outputs and publications.

#### 6.4.5.1 Maternal Health and Nutritional status of women

The final work package under the secondary data analysis component is ongoing as a PhD registered at the University of the Western Cape; *An analysis of maternal and child nutritional status in South Africa and its impact on maternal labour supply* undertaken by Fru Wanka, seeks to establish the relationship between maternal and child malnutrition and maternal labour supply. The study assesses the state of maternal and child malnutrition and its effect on maternal labour supply. The results indicate a decrease in overweight children aged below five in South Africa. Also, mothers with stunted children are less likely to participate in the labour force. These findings were presented at the 4th International Congress Hidden Hunger, Stuttgart, Germany held from 27 February to 1 March, 2019 and the Economic Society of South Africa Conference in Johannesburg, South Africa from 3-5 September 2019. This thesis is expected to be submitted for examination in the first semester of 2020.

#### 6.4.5.2 Determinants of an early transition from breastfeeding

This research focuses on breastfeeding of infants of six months and younger. Two PhD studies (one each at UWC and NWU) were funded in 2016.

a) Freda Philander's PhD is titled *An Appraisal of food security of women during the prenatal and postpartum period in Delft, Western Cape in South Africa with the focus on exclusive breastfeeding*. The study assessed the impact that food security has on exclusive breastfeeding (EBF) intention, outcome, and duration. Outcomes indicate that household food insecurity and maternal confidence influence EBF intention and outcomes in a low-income/no-income urban community in the Western Cape. EBF intention is associated with EBF outcome. The results point to the need for interventions aimed at improving household food security during the prenatal period

as this will impact the health of the unborn child until adulthood as well as the health of the mother, and improve the prevalence of EBF for the full duration of six months. These findings were presented at the 1st National ISD PhD Conference at the University of the Western Cape on 15th Oct 2019. The thesis will be submitted for examination in the first semester of 2020.

b) Chantell Whitten's PhD is titled *Mothers' breastfeeding experiences and practices: An explorative mixed methods study in the sub-district of Tlokwe, North West Province.* Research work and data analysis in the first ever infant feeding cohort study of mothers with infants aged 0-24 weeks for the North West province was completed during 2019. Findings show that, similar to the initial findings from the 2016 SA-DHS, the prevalence of early infant complementary feeding before six months is lower than rates previously reported for infants aged between four and eight weeks, and exclusive breastfeeding is strongly associated with the mother's self-confidence as measured by the BSES-SF. These findings have been disseminated to policymakers and the general public through media publications and engagements. The thesis will be submitted for examination in the first semester of 2020.

#### 6.4.5.3 Consequences of an early transition from breastfeeding

The consequences of an early transition from breastfeeding are addressed by answering the question; What is in the child's food bowl? This previously quantitative study was designed as a qualitative inquiry and awarded as a PhD to Nazeeia Sayed. The qualitative case study is conducted in KwaZulu Natal. The study is making steady progress, and the following questions have been addressed; What are infants in KwaMashu, KZN consuming? Is a food-based approach to complementary feeding in South Africa enough?; and what are the factors that affect the infant feeding decisions of mums and caregivers in Ethekwini, KZN?

The results indicate that 58 (43.3%) of mothers/caregivers used a purchased product as the first food given to infants. The most popular choice purchased was infant cereal (84.5%), followed by ready-to-eat fruit or vegetables (15.5%). Besides these two product categories, there was reported consumption of processed food items including sweetened tub yoghurts, polony/Viennas, instant noodles, chips/crisps, cordial juices, sweets/chocolates, biscuits and sugar added to foods. Additionally, almost a third of infants (30.6%) had started solid foods before three months of age. Cereals were the main first foods given, with 56.7% preparing foods at home and 43.3% using commercial products. Soft maize meal porridge and commercial infant cereals were the most popular foods eaten daily, followed by sugar, margarine and peanut butter. Of the mothers, 80.6% had ever breastfed, with 63.5% reporting breastfeeding initiation in the first hour. Only 25.4% reported exclusively breastfeeding to six months. Almost a third of infants (30.6%) had started solid foods before three months of age. A total of 36.6% were breastfeeding, 47.0% formula feeding and 14.4 % mixed feeding at the time of data collection. It is concerning that just over half of the infants (52.2%) were getting biscuits, two-thirds (66.4%) chips,

and close to a third (32.8%), sweets or chocolates. This thesis will be submitted for examination in 2020.

#### 6.4.5.4 School gardens for pre-adolescent food security

The school gardens study is being conducted as a PhD registered at the University of the Western Cape and is currently in the finalisation stages. Focus groups have been conducted with children in 11 groups in two school settings. Both of these schools are in areas designated for people who were classified in racial groups other than White during apartheid. The one area was for people classified as Black Africans and the other for people classified as Coloured. Both schools are in areas recognised as having high levels of food insecurity. Further interviews to understand the role and purpose of the SFGs in the lives of children were conducted with parents, headmasters, teachers and school community stakeholders. In the focus groups, initial discussions were held and exercises conducted with the children to understand the food literacy of the children about fruit and vegetables. This was done to ascertain the relationship that the children had with fruit and vegetables, as the literature cites SFGs as potentially playing a role in increasing the knowledge and preference of children for fruit and vegetables. Children in both sites demonstrated good food literacy, notably a good knowledge of different fruit and vegetables and enjoyment of them. This is despite not being involved in their SFGs.

In both sites, some children had the experience of food gardening through home gardening. This contributed to their love and enjoyment of food. The children stressed that they thought to have an SFG was important. The reasons for this were so that food could be provided for those who didn't have, as well as for learning purposes to learn how to grow food in the short and the long term. All children indicated that they would like to participate in the SFGs at their schools. Parents demonstrated good knowledge and love of food growing and understood the importance of eating fresh produce and tried to instil this in their children. This was often a result of involvement in familial food growing. Many parents indicated that they would like their children to be involved in the SFGs. This was for a variety of reasons that often referred to a hope that their children would have lives that they were not allowed to have, as they had grown up under the apartheid government and not being classified as White. Ms. Nkoma participated in two conferences and the thesis will be submitted for examination during the first semester of 2020.

#### 6.4.5.5 Impact of social grants on the cost of adequate child nutrition

The Social Protection and diet component of the children programme is being conducted as a PhD at UCT's economics department by Winnie Sambu through the Children's Institute and in collaboration with the SARChI in Social Protection for Food Security. It examines the role of social protection – specifically, the child support grant – on the food security of poor households with children. A total amount of R150 000 was allocated for 2019 as follows; R100,000 as bursary and an additional R50 000 for running costs. The candidate is making steady progress and, during this reporting period, a first paper that looks at measurement issues in

monitoring child malnutrition in South Africa using household survey data has been drafted. This paper shows that there are significant data quality issues in anthropometric data collected through household surveys and malnutrition rates may be under or over-estimated in South Africa. This paper was presented at the biannual conference of the Economics Society of South Africa. The full PhD study is envisioned to be completed by December 2020.

#### 6.5.4.6 Water, Sanitation and Hygiene (WASH) and Child Malnutrition

The CoE-FS focuses on the governance landscape of WASH and the links between WASH and nutrition. The governance landscape will be contextualized through examining the sub-Saharan African (SSA) and South African settings while the links between WASH and nutritional status in urban SA will be explored using the afore-mentioned project. The research findings show that there is a relatively limited body of scientific knowledge on the nexus between governance, water, sanitation, hygiene, and nutritional status in children in the (SSA) context. Other studies further suggest that sanitation is a significant risk factor for undernutrition in children living in SSA countries. However, publications on the topic suggest that this is an emerging and growing field of interest. Further, the research results show that no scientific studies are focusing on the link between the governance of WASH and nutritional status in children. Although epidemiological studies acknowledge the policy implications of their results, they do not provide indications as to how to operationalize their recommendations. Also, most SSA governments have water and sanitation policies in place regarding the importance of water, sanitation, and hygiene on the health and nutritional status of children. However, there are no specific child health or nutrition outcomes against which these policies could be evaluated. Findings also revealed that the individual WASH components occur in different governmental spheres. Hence, the relationship between water, sanitation, and/or hygiene is seldom elaborated upon. This is because the various departments are primarily concerned with their core mandates and are therefore restricted in addressing cross-cutting issues.

Apart from the lack of a guiding framework to operationalise and address the link between nutrition and WASH; and to guide and inform implementation at national, provincial or local levels, the research findings also established that there is a lack of clarity about roles and responsibilities of the various sectors and departments that need to be involved and how the link between WASH and nutrition should be monitored.

## 6.6 PROGRAMME 5: CRITICAL FOOD STUDIES (HUMANITIES)

### 6.6.1 Expansion of Food Politics and Cultures Project towards an intra-institutional project - 190501

The PI for this programme was Professor Desiree Lewis (UWC).

The subject of food in South Africa both indexes academic work focused on narrow conceptualisations of the forms and purpose of knowledge and presents unique

opportunities for critical humanities-driven scholarship. In the context of development discourses from the mid-1900s, the field of food security has steadily garnered donor support through government funding, North-to-South Aid, UN mechanisms, and foreign policy. Mounting specialisation in agro-food and scientific scholarship and practice (especially in the global South) has accompanied dwindling resources and scholarship for understanding human action, experiences, and subjectivities about food. From the mid-1900s, scholars who have had a major impact on humanities disciplines, such as Claude Levi Strauss (1978) and Roland Barthes (1961) demonstrated that food may be a quotidian and frivolous subject.

But its centrality to all societies makes it a crucial focus for transdisciplinary study. With the growth of feminist humanities scholarship on food since the late twentieth century, theoretical, conceptual and methodological research has increased tremendously. Drawing on early work associated with scholars such as Levi Strauss and Barthes, and the recent work pioneered by feminist interdisciplinary scholars in the humanities (for example Bennett, 2007 and 2009; Bradley, 2016; Phillopov, 2017), this programme demonstrates that food is at the centre of numerous cognitive, cultural and human experiences. In driving a new field, the programme will involve planning, the hosting of events and cohort supervision with UP and UKZN.

By developing a research trajectory of humanities-driven food studies, the programme will generate a new field in southern African scholarship by establishing active partnerships with UP and UKZN academics and postgraduates. While research projects involving the natural sciences and social sciences have steadily increased, it is mainly in Northern contexts that humanities-driven food studies are currently being consolidated.

The development of this as a vibrant community-building research project with regional implications include:

- Recruiting, supervising and mentoring postgraduates as well as postdoctoral and emerging researchers to facilitate their active participation in research cultures and public debate;
- Producing knowledge through established scholarly and new digital or non-academic platforms;
- Building networks for generating transdisciplinary and transnational knowledge;
- Fostering conversations among scholars nationally, within the southern African region and internationally; and
- facilitating public intellectual activities that stimulate debate about and critical understanding of food as a public issue.

The project developed a postgraduate student cohort across institutions by establishing connections between UP and UWC. Students undertook work in one or more of the following research areas and actively contributed to building a research community in the following research areas:

1. Gender, Feminism and Food Studies;
2. Food Knowledge, Ecofeminism and Indigenous Knowledge Systems;
3. Consumer Identities, Foodscapes and Foodways in Urban Context; and
4. Foodways in relation to Literary, Visual and Popular Cultural/The Materiality of Food and its Visual Representation.

The activities to date entail supervision by respective supervisors from various departments as well as continuous mentorship and support. The supervision and support are coupled with intense and rich monthly post-graduate seminars and discussions at both UP and UWC where students present their work and receive substantial feedback prepared by a respondent. The seminars provide invaluable space for engagement with fellow students from various departments. A mini-postgraduate conference, held from 21-22 November, brought together participants of the seminars from the three universities to deepen their work as well as strengthen and consolidate the Critical Food Studies student cohort. Much time and effort have been directed to establishing the UP and UWC connection. This work is paying off and there is good collaboration and engagement. The virtual seminars are an important component to facilitate the connection between the universities. Furthermore, as part of this project, UWC and UP are working together to produce a special issue of Gender Questions for 2020. The student article and essay submission from both institutions as well as from others are in the process of being peer-reviewed. The inclusion of students' work aims at building a confident research cohort as well as strengthen this new field of inquiry.

Between April 2019 and November 2019 this project held seven postgraduate seminars. These were well attended and facilitated the growth of the Critical Food Studies project. Seminar one focussed on Following the body. Visceral experiences of food sovereignty in the city of Cape Town. Seminar two focussed on Foodscapes as Identity Expression: Food Choices and Tastes among Middle-Class Blacks Post-Apartheid South Africa. Seminar three focussed on Public Eating, Food Spaces and Social Identities in South Africa's Spur Family Restaurants and Defiant Seed: tracing narratives of seed within the context of indenture in South Africa. Seminar four focussed on The South African Milk tart - Origins and Originality and Farmer's markets, elites and 'consuming local': some explorations. Seminar five focussed on A closer look at the health behaviour and food consumption choices of Black South African women in light of the globalized, urbanized climate we live in and An exploration of Halal food branding semiotics and positioning in selected foodscapes in Cape Town. Seminar six focussed on A social semiotic analysis of the linguistic landscape of tuckshops in Eersteriver, Western Cape and South African Culinary tourism: what is on the menu? Seminar seven focussed on The history of food in perspective - Reimagining Jane Austen's rake figures through metaphors of food. Six of these honours presenters are expected to submit their thesis and graduate in 2019. Three of the masters students will submit their theses in 2020. One of the three PhD students will submit in 2020.

This project is developing an emerging field of research and is consolidating work in several disciplines across and within universities. Two project activities were undertaken in February 2019 and October 2019. There is a forthcoming event, the

UKZN indaba, on the 18 November 2019. At the start of 2019, we held a successful inception workshop at UP with participants from UWC, UP and UKZN. This was an important process to ascertain what various researchers were working on and to establish new connections and areas for work. This project used the process to profile itself and generated work-in-progress articles to launch the Critical Food Studies project and its website. Participants from various disciplines (women and gender studies; linguistics; history; anthropology; sociology and education, to mention a few) were brought together from all three universities to highlight and generate a transdisciplinary approach to food and inspire new thinking and examinations of food. In October 2019 this project co-hosted, with ASRI, a public seminar *Food, pleasure, and poison in Cape Town: A response to World Food Day* which was well attended. The panel discussion of four speakers, which was streamed,explored complex negative, positive and ambivalent meanings attached to food and eating. This was followed by the play My Daily Bread by the students of the UWC Gender Equity Unity. This play was performed at the Grahamstown Festival in July 2019, drawing large crowds and positive reviews. The collaboration with Auwal Socio-Economic Research Institute (a socio-economic policy unit) is an important step towards developing Critical Food Studies reach and engagement beyond the academy.

New knowledge and research on the meanings of food were generated through the building of a new inter-institutional Critical Food Studies post-graduate cohort. Specific places and areas are being explored through a food lens in South Africa. Places such as Eerste River, Woodstock, Upington in the Northern Cape as well as numerous foodscapes in different malls in Cape Town, leisure-style farmers' markets such as Oranjezicht City Farm Market in Cape Town and various restaurants in Khayelitsha are sites of exploration. Research being undertaken by students can be broadly categorised under the following foci: consumer culture and food branding; foodways and social identities; humanising food movements and activism.

A strong Critical Food Studies cohort and collaboration between UWC and UP has been built with a clear sense of what a humanities-centered focus on food has to contribute. The past few months have underscored how invaluable a transdisciplinary approach is and that the energy and potential are enormous. Asking new and different questions about the cultural, social, ecological and political meanings of food not only expands our understanding of food's location, provisioning, consuming, tasting, production, etc., but unearths gendered, raced and classed stereotypes and problematic assumptions about the producers, makers, and eaters of food in South Africa. More so, these new examinations of food enable considerations of the various relationships embedded within food at multiple levels. This helps to explore the social construction of the household, local and national, concerning food and the impact of globalised food systems. Neat development policymaker formulations of the one-size-fits-all nature are being unravelled, thus broadening the scope and underscoring the significance of the Critical Food Studies contribution. More so it brings to the fore that issues about food ought not to narrowly be about hunger, climate adaptation, and nutrition but instead need to explored as part of larger, complex questions of social identities,

belonging, social histories, deep ecology and various interconnected networks, emancipatory visions that see pleasure, freedom, embodiment and the visceral as central components. The Critical Food Studies' work is highlighted by the numerous invitations the programme receives, many of which are declined due to capacity.

## 6.7 LEVERAGE PROJECT: SA – UK BILATERAL RESEARCH CHAIR IN SOCIAL PROTECTION FOR FOOD SECURITY IN SOUTH AFRICA (SARCHI)

This programme is led by Professor Stephen Devereux (UWC).

The overarching question for this programme can be framed as follows: Why is South Africa's comprehensive social protection system not making a much more significant contribution to the eradication of food insecurity and hunger, and how can this contribution be enhanced?

The primary focus in 2019 was a study on food insecurity among farmworkers, while a secondary focus was on extending social protection to informal workers. The Farm Worker study builds on earlier research commissioned by the NGO Women on Farms Project on the working conditions of women farmworkers in the Western Cape and Northern Cape, which was lead-authored by the SARChI Chair. The final research report for the farmworker study has been drafted but not yet published. Two articles were published: one on seasonal food insecurity among farmworkers in the Northern Cape was published in the journal Nutrients (impact factor 4.2), and one on farmworker labour rights violations in the journal Development Southern Africa (impact factor 0.6). Online articles were published in the Mail & Guardian and The Conversation. The first national conference on the future of farmworkers in South Africa was held at UWC on 16-18 October 2019. A book of the conference is now being compiled.

The food security survey found that seasonal hunger is widespread among farmworkers in the Northern Cape and Western Cape during the winter months of April to August when there is no employment and often no other source of income except social grants. One policy recommendation is to institute seasonal unemployment insurance for seasonal farmworkers. This programme has published six journal articles, two book chapters, and two online articles. It has also presented at eight conferences, three workshops and has done one webinar and three live radio conferences. Details regarding these are reflected in the report.

This programme is ongoing and further research outputs will be provided in the 2020 Annual Report.

## 6.8 LEVERAGE PROJECT: PARTNERSHIPS FOR HEALTHY DIETS AND NUTRITION IN URBAN AFRICAN FOOD SYSTEMS – EVIDENCE AND STRATEGIES (NOURICITY)

This project is led by Dr. Coretta Jonah (UWC) and is organised under the Long-term EU-Africa Research and Innovation Partnership on Food and Nutrition Security and Sustainable Agriculture.

The project brings together partners from academia and research institutions and private organisations from three African and two European countries who have already successfully collaborated bilaterally on several food and nutrition security projects. These institutions are the Institute of Statistical, Social and Economic Research (ISSER), the University of Ghana, the DST-NRF Centre of Excellence in Food Security (CoE-FS), the Uganda National Academy of Sciences (UNAS), the Centre for Development Research (ZEF) at the University of Bonn in Germany, and Wageningen Economic Research (WEcR) at the Wageningen University in The Netherlands. The final partner, the Base of the Pyramid (BoP), is a company that has extensive experience in the field of food and health in informal settlements and works on the ground in both Ghana and Uganda. This project offers a chance to capitalise on the sum of these experiences and bring it to fruition in the analysis of and against urban malnutrition in Africa.

The South Africa National Research Foundation (NRF) funds the local component project. The research investigates a) urban food sources, characteristics and rural-urban linkages as "systemic" drivers of food choices and nutrition; b) people's access to nutrition-related knowledge (formal and informal, indigenous and Western), income, food tastes, habits, and culture, as "individual" drivers of food choices; and c) how systemic and individual drivers combine to determine people's food consumption and nutrition status.

Research undertaken as well as the achievements under this programme are highlighted under the following WP's.

### 6.8.1 Langa Food Environment Mapping and food value chains

The work is a component of the wider NouriCity project. The primary research to be conducted is a mapping of the food retail environment in Langa, with a particular focus on the interaction of food retail with critical infrastructure and other urban functions. The mapping will, therefore, focus on housing typologies, services, amenities and transport, inter alia. Following the mapping process, the researcher will conduct three community meetings to discuss foodways in Langa, paying particular attention to personal mobilities and how food purchasing behaviour is shaped by the interaction of food retail with critical infrastructure. Following the completion of this work, a team member will travel to Ghana to conduct a workshop on methods associated with the food environment mapping.

The UCT team will also conduct a reverse value chain analysis on key food items. The purpose of this work is to identify the flows of food into the local food retail sector and to demonstrate the complex interaction between formal and informal

components of the food system. The aim is to document the physical, economic and social components of these value chains, informed by Cook's "Follow the Thing" methodology and Hulme's discussion on “unfollowable”. For 2019 the proposal and Business Plan for this research were approved, research instruments were designed, and ethical approval was obtained. Food Mapping in Langa was initiated and the production of the maps has begun. The Work package also collaborated closely with the Ghanaian/German consortium partners in developing a methodology for food environment mapping which is ongoing in Ghana.

### 6.8.2 Safe and nutritious food for Africa’s cities

The LEAP-Agri project aims to map the redistribution chain of the Cape Town fresh produce market to the Food Bank and to determine the microbiological quality and safety of the fresh produce. Subsequently, it will be easier to identify the points of contamination and the introduction of potential human pathogenic bacteria in the distribution chain. Several food samples will be taken from the fresh products that will be redistributed to the non-profit organization. Additionally, swabs of the knives, counters, and floors will be collected as well as from the hands of the people handling fresh produce. The fresh produce and contact surface samples will be sampled to determine if *Listeria monocytogenes*, *Salmonella* spp. and *Escherichia coli* are present. The enumeration of *E. coli*, coliforms, *Salmonella* spp. and *Listeria monocytogenes* will also be done.

The objective is to determine the organization and logistics of the redistribution of fresh produce to food banks, to collect data on the actual status of the quality and food safety of the fresh produce being donated and to identify the need to optimize or change current practices to enhance food safety while ensuring food security and preventing food wastage. Thus, the research objectives can be summarized as 1) to describe what is happening in food redistribution (by observation and interview); 2) to determine the status of food safety and the extent of the food safety problem (if present) (by food analysis); 3) to put forward recommendations to optimize current practices based on the results obtained. Research proposal and project agreement have been submitted and signed, ethics approval has been granted, and work has been initiated on this work package.

Three field trips were conducted in 2019 to determine the previously described objectives. To date, we have been able to visit the market twice. The purpose of the first visit, which took place on 17 September 2019, was mostly focused on observing how the food was handled before redistribution (cooked, cut or otherwise) and the detection of *L. monocytogenes*, *Salmonella* spp. and *E. coli* was done as well as the enumeration of *E. coli*, coliforms and *Salmonella* spp. During the second (15 October 2019) and third (17/18 November) sampling trip the microbiological analysis was repeated as was described for the first field trip.

### 6.8.3 Transitions into obesity in Africa’s emerging big cities

The work package aims to determine the impact of urbanisation on health and nutritional outcomes by addressing the following research questions.

- What is the level of chronic health conditions, undernutrition, and overnutrition in countries across geographical areas?
- What is the extent of the coexistence of undernutrition and overnutrition in households across rural and urban areas?
- What can cross-sectional and panel data tell us about the effects of migration on nutritional outcomes of adults?
- What are the socioeconomic determinants of these changes in nutritional outcomes if any?

In 2019, the objectives of this WP were to acquire all data for analysis and initiate the data analysis for both countries. However, because the Ghana panel data was not readily available, analysis was conducted for the South Africa data pending the release of the Ghanaian data. Additionally, while collaboration with the Ugandan team has been ongoing during the research visit in Bonn, it was agreed that no primary research be conducted in Uganda by the Ghana and South Africa team. However, analysis in Uganda will be coordinated with ongoing work in Ghana and South Africa.

The analysis reveals that there was an increase in overweight and obesity over time from wave 1 to wave 5 of the National Income Dynamics Study. For both waves, urban rates of overweight and obesity were higher than rural rates. While there was an overall upward growth in BMIs, analysis of the balanced panel for South Africa revealed that, overall, individuals who moved from rural areas to urban areas recorded increases in their BMI categories compared to those who stayed behind. For the total population compared to 10% of people who did not migrate, 19% of people who moved from rural to urban areas recorded increases in their BMI. The increases in BMI were greater for women compared to men as approximately 21% of women migrants recorded increases in BMI compared with 17% of male migrants. A closer look at the BMI indicates that income was associated with BMI increases. The wealthiest individuals recorded the lowest increases in BMI (7%) compared to 17% for the middle quintile and 10% for the poorest quintile.

In September and October 2019, Dr. Coretta Jonah and Ms. Winnie Sambu undertook an exchange visit to the Centre for Development Research (ZEF) at the University of Bonn. The visit was hosted by Dr. Nicolas Gerber, Senior Researcher at ZEF and the Principal Investigator of the Nouricity project.

The main objectives of the research visit were:
- To undertake a review of literature on the effects of migration on dietary intake in South Africa and Ghana, and conduct preliminary analysis using South African panel data.
- To share the research methodology and preliminary findings for input and critique from the Nouricity team (at ZEF) as well as other ZEF researchers working on migration, food security, and dietary transitions.

The research visit took place over three weeks from 8 September to 2 October 2019. The team began the visit by attending the Poverty Reduction, Equity, and Growth Network 2019 conference whose theme was Promoting social, economic and socio-

political development through social protection and which took place on 9-10 September 2019 in Bonn. Professor Julian May and Dr. Coretta Jonah presented a research paper on child malnutrition and social protection in South Africa. After the conference, Dr. Jonah and Ms. Sambu officially began their visit at ZEF with a meeting on 11 September 2019 with Dr. Gerber and Professor Felix Asante, another member of the Nouricity team working on Ghana case studies, who was also visiting at ZEF at the time. All three researchers held several meetings to finalise the comparative county study on Ghana and South Africa. The researchers participated in ZEF seminars and organised a presentation of their initial findings to ZEF colleagues. Critical input has been fed into the draft paper. The masters student awarded a bursary on the work package is making steady progress, and an additional student has been identified to work on the project.

This research is continuing in 2020, and further research outputs will be provided in the 2020 Annual Report.

## 6.9 LEVERAGE PROJECT: EXPLORING FOOD SYSTEM TRANSFORMATIONS IN RAPIDLY CHANGING AFRICAN CITIES (FOOD 4CITIES)

This project led by Prof Julian May (UWC) is funded by Leap-Agri with a budget of R2.3 million at UWC. The collaborators are Prof. Peter Verburg (Project leader, team coordinator) Vrije Universiteit-Amsterdam (VU-A), Netherlands; Prof. Anton van Rompaey (Project Leader, Kampala), KU Leuven, Belgium; Dr. Jac Davis (VU-A); Dr. Nyasha Magadzire (UWC) and Ms. Lisa-Marie Hemerijickx (KU-Leuven). VU-A is funding Dr. Magadzira's Fellowship at UWC, representing additional leverage funding of R400 000.

The goal of the project is to develop a spatial model of food availability, food access, and food utilisation across a city and the surrounding area. We will create city maps that predict what locations within the city are likely to experience different types of food-related challenges, for example, where in the city will there be a shortage of food (food deserts), or where will there be plenty of food but with low nutritional value (food swamps)? We plan to develop this model with a predictive component, so that city and municipal planners can anticipate where issues might arise in the future as the city grows. Two cities have been selected: Worcester in the Breede Valley Municipality of the Western Cape as an example of a secondary city, and; Kampala in Uganda as an example of a metropolitan city.

Planning and engagement meetings were undertaken with the Breede Valley Municipality in July and August 2019. These included a preparatory meeting with the municipal directors for strategic planning, community development, and the Integrated Development Plan. Two subsequent meetings were held with Ward Advisory Committees to inform them of the household survey. Questionnaire design and the pilot survey were undertaken in September following approval of the project by the UWC and the VU-A ethics committees, and fieldwork commenced on 10 October 2019 and was completed by 28 October. As the study made use of CAPI, the data was captured and cleaned in real-time. A proposal was submitted to the

Merian Fund in August 2019 to extend this project into a Water-Energy-Food nexus project. The collaborators are the Institute for Environmental Studies (IVM), VU-A, the South African Institute for Advanced Material Chemistry (SAIAMC) at UWC, and the IHE Delft Institute for Water Education.

This research is continuing in 2020, and further research outputs will be provided in the 2020 Annual Report.

## 6.10 SPECIAL PROJECTS

### 6.10.1 International Food Day - 190701

This project led by Ms. Natalie Seymour (UWC) started as the International Food Fair and is geared towards encouraging staff and students from UWC's Institute for Social Development (ISD) and School of Government (SoG), as well as the CoE-FS, to share cultural information and food.

The CoE-FS provided a small grant to support the activities of the 2019 International Food Fair. The UWC campus community has grown exponentially year on year, with large numbers of International students exceeding the numbers of the previous year. Most students are young and inexperienced in how to cook for themselves and how to interact with each other socially. International Food Fair allowed students and staff to engage with each other informally. 2019 saw an increase in Xenophobic attacks across the length and breadth of South Africa, but particularly in KZN and Gauteng. The International Food Fair offered an opportunity to embrace and celebrate diversity rather than exclude people because of perceived differences. The original purpose of the International Food Fair was to encourage ISD, SoG and CoE-FS, students and staff in the swapping of cultural information, through sharing in the diverse cuisine from their countries of origin.

However, the year 2019, demonstrated why it should become a necessary part of UWC's cultural outreach calendar beyond the confines of campus life. Already we have seen this venture evolve beyond the School of Government building. Through the power of word of mouth, we now have a following across all faculties and among all UWC students. Once the word is out, everyone congregates at the SoG building in vast numbers, often exceeding our capacity to host them. The 2019 International Food Fair, therefore, lent itself to more robust sharing beyond the confines of food and socializing. A new dimension was added to the usual cross-cultural debate - the introduction of the Belhar branch of an indigenous South African community, the Khoisan. The Khoisan are currently engaged in debates where they seek recognition for their forgotten culture, so South Africans and international students were able to discuss their constraints informally.

### 6.10.2 Agriculture Transformation in Africa (ATA) – 180710

This project was led by Professor Frans Swanepoel (UP) and is funded by Cornell University in the USA. Other members on the project included Dr. Willeke de Bruin (UP), Dr. Farai Kapfudzaruwa (UP) and Prof Alice Pell (Cornell University). The main

purpose of the ATA programme is to support and strengthen the innovation capacity of Africa's science and technology institutions, specifically in the implementation of the Science Agenda for Agriculture in Africa.

The main objectives of the project were to:

- Establish an Agricultural Innovation System (AIS) intellectual core competence within Future Africa, augmented by a technical guidance team, to design and populate the capacity-building programmes of ATA, ensuring that the initiative is well integrated in UP and able to draw synergies from other UP entities, especially the CoE-FS, as well as other South African universities, and organizations including provincial and national government;
- Identify and enter into partnership agreements with local and regional partners across the major regions of Africa;
- Engage key African stakeholders on the AIS to craft broader partnerships for policy practice and programme implementation at regional and country levels;
- Develop the suitable capacity of selected African university partners and learning institutes to support the emerging capacity needs of the AIS at all levels;
- Facilitate the sharing and utilisation of knowledge generated through the initiative; and
- Build capacities and competencies in AIS at all levels on the continent.

ATA's establishment involves two Phases. Phase 1 focuses on the inception and establishment of the ATA programme (including the establishment of key partnership and network linkages), while Phase 2 will roll out comprehensive programmes. Funding for this project was provided to support the activities of Phase 1, although significant progress has already been achieved towards addressing Phase 2.

Satisfactory progress has been achieved and is demonstrated by the following activities:

- Professor Alice Pell, former Vice-Provost for International Affairs and current Advisor to both the Deans of the Colleges of Agriculture & Life Sciences (CALS), and Veterinary Medicine (CVM) at Cornell University visited UP during December 2018, March 2019 and October 2019. The purpose of the visits was to provide a basis for longer-term engagement between UP, including members of the CoE-FS, and Cornell University who are focused on food security issues. Cornell is the only private university in the USA with a College of Agriculture and Life Sciences and a College of Veterinary Medicine.
- The university's Atkinson Centre for Sustainable Future functions as a multidisciplinary development-oriented research center with six focus areas of which “sustainable agriculture and food systems”, “one-health” and “sustainable communities” are of particular interest to the CoE- FS.
- A draft discussion document that aligns activities of the three-food security-related entities at UP, namely the Institute for Food, Nutrition and Well-being Leadership, the CoE -FS and the ARUA CoE in Food Security was completed. It is envisaged that Future Africa will serve as a hub for the establishment of one food security platform

- The University of Pretoria in partnership with the University of Leeds (ULeeds) and the Food Agriculture and Natural Resources Policy Analysis Network (FANRPAN), recently submitted an outline proposal to the ARUA-UKRI GCRF Partnership Programme for Research Excellence for a project entitled "Food Systems Research Network for Africa" (FSNet-Africa). Following the approval of the outline proposal, a delegation from ULeeds and FANRPAN visited UP from 30 September to 2 October 2019 for a write shop to develop a full proposal. The full proposal was submitted on 13 November 2019 and should it be awarded, the project will receive £2 million over three years.
  The project will aim to collaboratively produce context-relevant, interdisciplinary research through creating two-year-long structured opportunities for 30 African early career research fellows (who obtained their PhD's less than 10 years ago) to (i) conduct impact-focused interdisciplinary research related to African food systems, (ii) build lasting research networks, and (iii) develop their skills to translate their research significantly. UP will host FSNet-Africa and will leverage the facilities at the Future Africa campus as a platform for the ongoing engagement between researchers and food system stakeholders.
- On 18 July 2018, Prof Alice Pell attended a Book launch "*A Feast from Nature"*, organized by the Faculty of Natural and Agricultural Sciences at UP in collaboration with the CoE-FS. Fundraising opportunities and a more consolidated food security platform were discussed between Professors Pell, and Professors Lise Korsten and Julian May.

### 6.11 RESEARCH OUTPUTS

Table 8 provides the cumulative total of peer reviewed and other recognised research outputs.

**Table 8: Research outputs for 2019**

| Output | Output | Appendix |
|---|---|---|
| Articles in Refereed/Peer-reviewed Journals | 49 | 3 |
| Books /Chapters in Books | 7 | 3 |
| Refereed/Peer-reviewed Conference Output | 98 | 1 |
| Other Significant Conference Output (seminars, workshops) | 189 | 2 |
| Working Papers/Technical/Policy Reports | 3 | 3 |
| Other recognised research outputs (communication & visibility) | 189 | 5 |

## 7. KPA 2: EDUCATION AND TRAINING

### 7.1 Education and Training highlights

The Centre supported in total 128 students in 2019 and the table below outlines the 58 bursaries awarded to postgraduate students and postdoctoral fellows from NRF funding for the year under review. The CoE-FS also supported 70 students through Leverage funding in 2019. The details of Leverage-funded students are per Annexure 8 to the report. In total the CoE -FS supported 9 postdoctoral fellows in 2019.

**Table 9: Record of NRF-bursary students**

| Category | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | Total |
|---|---|---|---|---|---|---|---|
| Honours students | 4 | 4 | 7 | 3 | 11 | 7 | **36** |
| Masters students | 15 | 19 | 27 | 24 | 31 | 31 | **147** |
| Doctoral students | 7 | 8 | 18 | 20 | 18 | 15 | **86** |
| Post-Doc Fellows | 2 | 3 | 6 | 10 | 7 | 5 | **33** |
| **Total Post graduate students** | **28** | **34** | **58** | **57** | **67** | **58** | **302** |
| Total RSA Masters and Doctoral students | 17 | 16 | 29 | 34 | 36 | 35 | **167** |
| Total students from African countries (Masters and Doctoral) | 5 | 11 | 16 | 9 | 12 | 11 | **64** |
| Total Foreign (not from Africa) Masters and Doctoral students | 0 | 0 | 0 | 1 | 1 | 0 | **2** |
| Female Masters and Doctoral students (RSA) | 11 | 9 | 21 | 22 | 23 | 23 | **109** |
| Black Masters and Doctoral students (RSA) | 7 | 7 | 6 | 17 | 34 | 32 | **103** |
| Honours/ BTech Graduations | 4 | 3 | 7 | 1 | 3 | 10 | **28** |
| Masters Graduations | 5 | 2 | 5 | 11 | 7 | 9 | **39** |
| Doctoral Graduations | 0 | 0 | 1 | 2 | 5 | 5 | **13** |

## 7.2 Synthesis of the student training

The table below presents the spread of CoE-bursaries across the collaborating institutions. This information is drawn from the NRF online system and only reflects those students holding CoE -FS bursaries.

**Table 10: Bursary holders across the collaborating institutions**

| 2018 | Level | | | | |
|---|---|---|---|---|---|
| **Institution** | **Doctoral** | **Honours/ B Tech** | **Masters – Research Based** | **Post-Doc** | **Total** |
| SU | 1 | - | - | - | 1 |
| UCT | 1 | - | - | - | 1 |
| MRC | - | - | - | 1 | 1 |
| UP | 4 | 6 | 10 | 2 | 22 |
| UFH | 2 | 0 | 1 | 0 | 3 |
| UL | - | - | - | - | - |
| UWC | 6 | 1 | 20 | 2 | 29 |
| WITS | 1 | - | - | - | 1 |
| **Total** | **15** | **7** | **31** | **5** | **58** |

### 7.3 Degrees conferred and post-doctoral fellowships completed

The table below reflects information about students and fellows – funded or benefitted by CoE projects who graduated in 2019. The information illustrates that in 2019 a total of 54 students graduated, this include 27 NRF funded and 27 leverage funded students.

**Table 11: NRF-bursary students funded through the CoE who graduated/ completed in 2019**

| Surname & initials | Institution | Programme | Degree | Gender | Race | Citizen ship |
|---|---|---|---|---|---|---|
| Adarkwah-Yiadom, M | UP | Innovation & Technology | PhD | M | B | Ghana |
| Adeboye, A | UP | Innovation & Technology | PhD | M | B | Nigeria |
| Aijuka, MEO | UP | Innovation & Technology | PhD | M | B | Uganda |
| Ali, AE | UWC | Innovation & Technology | Masters | M | B | Sudan |

| | | | | | | |
|---|---|---|---|---|---|---|
| Bamidele, OP | UP | Innovation & Technology | Post-Doctoral | M | B | Nigeria |
| De Bruin, W* | UP | Systems | Post-Doctoral | F | W | SA |
| Dlabatshana, Z | UWC | Systems | Hons | F | B | SA |
| Dladla, L | UP | Innovation & Technology | Hons | F | B | SA |
| Damon, L | UWC | Systems | Masters | F | C | SA |
| Dyantyi, N | UWC | ISD | Hons | F | B | SA |
| Eckert, C | NMMU | Innovation & Technology | Masters | F | W | SA |
| Lekhoba, H | UWC | Innovation & Technology | Hons | M | B | SA |
| Lubisi, N | UWC | ISD | Hons | F | B | SA |
| Mfaku, A | UWC | Systems | Masters | F | B | SA |
| Mkwananzi, S | MRF | Plates | Post-Doctoral | F | B | SA |
| Mlangeni, IA | UP | Innovation & Technology | Hons | F | B | SA |
| Ngwexana, T | UWC | Systems | Masters | F | B | SA |
| Notini, X | UFH | Safety | Masters | M | B | SA |
| Nzonzo, S | UFH | Innovation & Technology | Masters | M | B | SA |
| Owuso-Darko, R | UP | Children | PhD | M | B | Ghana |
| Pote, C | UWC | Plates | Masters | F | B | Zimbabwe |
| Rhodes, H | UWC | Plates | Hons | M | C | SA |
| Sibanda, T | UP | Safety | PhD | M | B | Zimbabwe |
| Sindi, B | UWC | ISD | Hons | F | B | SA |
| Solomon, M | UWC | Plates | Hons | F | C | SA |

| | | | | | | |
|---|---|---|---|---|---|---|
| Williams, R | UWC | Systems | Hons | F | C | SA |
| Van Niekerk, AJ | NMMU | Innovation and Technology | Masters | M | W | SA |

**Table 10: Leverage-funded students who graduated / completed in 2019**

| Surname & initials | Institution | Programme | Degree | Gender | Race | Citizenship |
|---|---|---|---|---|---|---|
| Adeboye, A | UP | Innovation & Technology | Doctoral | M | B | Nigeria |
| Adeyemi, A | UP | Innovation & Technology | Doctoral | M | B | Nigeria |
| Basson, GL | UWC | Innovation & Technology | Masters | M | C | SA |
| Breet, LM | UP | Innovation & Technology | Hons | F | W | SA |
| Davids, RN | UWC | Contestation | Post-Doctoral | F | C | SA |
| Frisby, S | UP | Innovation & Technology | Hons | F | W | SA |
| Hassan, S | UWC | Contestation | Masters | F | B | Refugee |
| Heneck, A | UP | Innovation & Technology | Hons | F | W | SA |
| Hlatswayo, SG | UWC | Innovation & Technology | Masters | F | B | SA |
| Hlophe, N | UP | Innovation & Technology | Masters | F | B | Swaziland |
| Joubert, N | UP | Innovation & Technology | Hons | F | W | SA |
| Kapingidza, J | UWC | SARChI | Doctoral | M | B | Zimbabwe |
| Khubisa, TO | UWC | Contestation | Doctoral | F | B | SA |
| Lewies, R | UP | Innovation & Technology | Hons | F | W | SA |

| | | | | | | |
|---|---|---|---|---|---|---|
| Lubaale, J | UP | Innovation & Technology | Masters | M | B | Uganda |
| Maneya, R | UP | Innovation & Technology | Masters | F | B | Zimbabwe |
| Marwick, A | UP | Innovation & Technology | Hons | M | W | SA |
| Matenda, J | UWC | Contestation | Masters | M | B | Zimbabwe |
| Moiloe, L | UP | Innovation & Technology | Hons | F | B | SA |
| Mokone, K | UP | Innovation & Technology | Hons | M | B | SA |
| Motloutsi, K | UP | Innovation & Technology | Hons | M | B | SA |
| Naicker, LW | UWC | Contestation | Doctoral | F | I | SA |
| Nekhudzhiga, E | UP | Innovation & Technology | Masters | M | B | SA |
| Ngqeza, Z | UWC | Contestation | Masters | M | B | SA |
| Sanousi, M | UWC | SARChI | Masters | M | B | Sudan |
| Sibandze, A | UP | Innovation & Technology | Masters | F | B | Swaziland |
| Steyl, A | UP | Innovation & Technology | Hons | F | W | SA |

### 7.4 Education and training highlights

The education and training of students and fellows are core activities through which the CoE-FS works towards systematically developing a creative research training environment that is internationally competitive. Most of the research undertaken by the CoE-FS takes place via student research training at the postgraduate level. It thus creates a conducive and collaborative environment in which students are exposed to experts from various fields of research under the food security umbrella. Opportunities for training and education are through various workshops, conferences, and meetings, which are forums for student development. Not only has the CoE-FS provided opportunities and incentives for academics based at various institutions (locally and internationally) to work together, but, additionally, students associated with the projects have also been exposed to a range of experts from other institutions, as well as other disciplines through participation in research meetings, conference presentations, and seminars.

Some of the education and training initiatives include:

Ms. Elaine Petersen is making good progress with her Bachelor of Commerce degree and will graduate in 2020. Ms. Mologadi Makwela is registered for a PhD in Media Studies, and the administrative assistant, Ms. Nolutando Didiza, began an Honours degree in Development Studies in 2019. Under the Drought Responses in Cereals and legumes project Mr. Ali Ali, Mr. Gerhard Basson, and Miss Gift Hlatshwayo graduated *cum laude* for their MSc degrees in April 2019. Mr. Andile Lilelo's thesis was completed and passed. Mr. Musa Akanbi and Miss Aphiwe Gule submitted their MSc theses in November 2019. Additionally, Mr. Anelisa Majola, Ms. Athini Ntloko, and Ms. Nompumelelo Nyembe submitted their PhD theses in November 2019. One MSc and one Post-doctoral student completed their theses under the Reclamation of Heavy Metal Contamination of Soils project in 2019.

Within the Local Food Governance project, one master's student Ms. Lucille Damon graduated in 2019, and Master's students Mr. Ashley Haywood and Ms. Jenny Willis submitted their thesis for examination in 2019 but their degrees have yet to be awarded. Ms. Neo Madime and Ms. Zandile Mentjies submitted their honours theses in 2019 for consideration and are awaiting feedback. Ms. Thulile Ngwexana, who received a Master's degree bursary under the Gender, sex, power and food project, graduated in April 2019. Postdoctoral fellow, Dr. Willeke de Bruin, completed her two-year fellowship on 30 June 2019. She is currently continuing her research as a postdoctoral in the CoE-FS funded by UP. Dr. S. Duvenage and Dr. G Villamizar-Rodrigues completed their postdoctoral fellowship within this programme.

# 8. KPA 3: INFORMATION BROKERAGE AND RELATED ACTIVITIES

## 8.1 Communication and visibility 2019

The Centre makes available its research, events and activities through various communication channels, namely the website, social media channels (Facebook and Twitter), video and audio platforms (YouTube and SoundCloud), as well as email lists whose content is distributed to a diverse group of stakeholders including students, researchers, host and affiliate institutions; government, funding agencies and the national media through whom, the public is exposed to the work undertaken by the CoE-FS.

Below follow highlights of the Centre's performance and visibility achieved through the aforementioned channels in 2019.

- Communication outputs and the coverage thereof maintained a steady increase through the course of the year;
- The strategic focus on increasing online audiences resulted in increased numbers of followers on both of the Centre's social media pages;
- The number of 'research nuggets' shared with the public increased;
- People-centred articles/communication items generated the most engagement on social media pages; while research and events linked to the issue of Student Hunger received widespread media and public attention;

- The farm worker conference held on World Food Day received widespread coverage from traditional media; with some media attending the conference on all three days.

### 8.2 Digital communication

The refurbished website was finalised in July 2018. July 2019 marked one year since the re-launch of the new site. Google Analytics indicated that, since then, web traffic has jumped from 14 957 page views to over 24 500 page views. The number of users also increased to 8 688; up from 3 657 at the end of 2018 and only 1 965 in 2017. This shows that the Centre's website is gaining traction and is seen by an even wider audience compared to previous years. The current site, built on WordPress offers a more dynamic content management system to host content produced by the CoE-FS. The notable increase in web traffic is evidence of the improvement in functionality of the website. Together with the website, the Centre's digital footprint is further supported by an electronic Newsletter; presence on social media through accounts on Facebook and Twitter, as well as audio-visual communication through YouTube and SoundCloud platforms. Our research nuggets are regularly published and disseminated through these platforms.

### 8.3 "Research Nuggets": Internal and external communication

In 2019, nine electronic newsletters – containing a mix of content ranging from reports, publications, event notices, articles and audio-visual material – were distributed to an ever-growing list of subscribers drawn from local & international researchers, affiliate institutions, civil society organisations, NGOs, students and members of the public sector and government institutions.

**Table 13: Comparative overview of Communication and engagement**

| Output | 2014+2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|
| Nuggets shared | 12 | 9 | 52 | 67 | 73 |
| Media Coverage | 55 | 45 | 129 | 239 | 189 |
| Website views | N/A | 4 218 | 5 332 | 14 707 | 26 375 |

In total, 73 "nuggets" were produced and distributed through the various digital communications channels. This is higher than the planned 36 nuggets as per the communications SLA of producing three nuggets per month. These nuggets are shared with national and international mass media organisations in the form of news releases and opinion editorials.

CoE-FS content that received wide news coverage for the period under review includes:

- SONA, budget 'suggest food security is low on national agenda' (UWC, UCT, UP). This is an example of reactive media engagement. The Centre's PIs were invited to respond to the President's State of the Nation Address in February, which made little mention of food security. The comments of researchers from different institutions were drafted into a single opinion editorial piece which was subsequently published by several media outlets across the country.

- Student hunger colloquia (DOI and CoE-FS – This story received wide coverage, including international coverage through Aljazeera. The story continued to gain traction throughout the year with several major national broadcasters (e.g. Radio 702, SAFM and Metro FM) conducting interviews late into the year.
- Effect of Sugar Tax on obesity in SA (Professor Rina Swart) – Professor Swart's comment was incorporated into an article published by WHO (Africa region) web portal. The Future of Farm Workers Conference was widely covered by national media. Hosted by the CoE-FS in collaboration with PLAAS and Women on Farms Project, the event was also attended by several media, including SABC (TV and radio); GroundUp, Daily Maverick, EWN and others.




*Figure 1: Example of 'nuggets' published on the Centre's online platforms*

As a result of wide dissemination and science engagement activities, the Centre and its affiliates amassed 165 media mentions in 2019, down from 239 mentions the previous year. It should be noted the number of clippings reflected here is not the total number of media mentions achieved for 2019. Some mentions were missed due to the lack of a dedicated monitoring agency, others due to the media omitting the Centre's name in the published articles and others. A series of articles published by Africa Check, provides an example of media using their discretion to include or exclude affiliation. The articles, fact checking various statements made by members of government, cited Professor Julian May. In one piece he was linked to his role on the board of Stats SA, in another, he was cited as director of the CoE-FS.

In some instances, researchers also did not make explicit link/reference to the Centre as the affiliated institution during interviews. Therefore, the decline in media mentions should be understood within this context. Additionally, the strategic focus of communication activities in 2019 was on boosting our online reach and increasing engagement with the online community, particularly through social media. To this end, there were notable increases in the number of followers, reach and engagement across the Centre's official pages on social networking platforms.

### 8.4 Social Media

People centred posts – as was the case with posts about student research – were the most effective in generating engagement from our online audience. These posts stemmed from feature articles first published on the Centre's website and later

developed into social media image posts. This type of content is more relatable to audiences as the focus of the article is on both the researcher and the research.

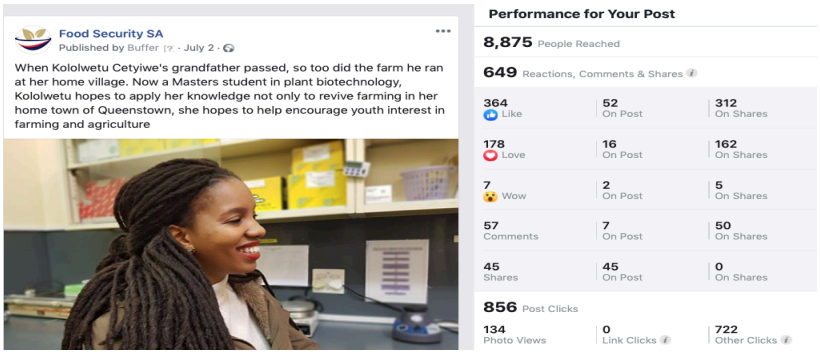



*Figure 2: Example of the reach and engagement on social media*




*Figure 3: Example of student focused social media image content*

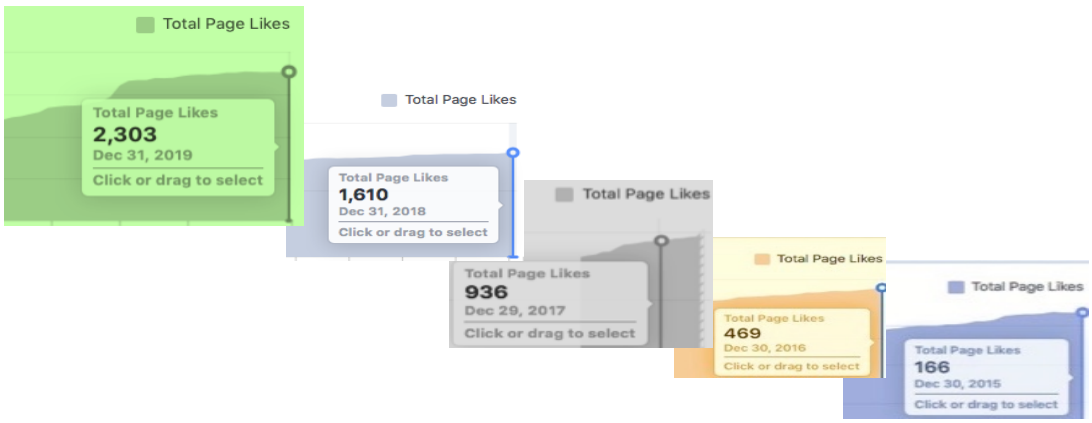



*Figure 4: Comparative overview of Facebook followers*

The Centre's followers on the official Facebook Page and Group grew to 2 303 and 535 (respectively) in 2019. This is an increase of more than 600 compared to 1 610 the previous year. Posting live from events such as the International Food Safety Conference, as well as the increasing use of multimedia content from the website, YouTube and SoundCloud accounted for the increase in the numbers of people and organisations following our page.

Similar to the evident growth of our Facebook audience, the Twitter page also surpassed the 2 000 follower mark, growing to 2 099 followers in 2019, up from 1 714 in 2018. Considered within the context of the ever-growing use of paid social adverts and post boosting, the Centre's social media growth is significant as all activities and posts are organic. This means that despite operating with no budget for social media ads, the Centre's messages and research outputs are reaching a wide group of people and attracting a steady following

**Table 14: Comparative overview of multimedia communication**

| PLATFORM | GROWTH BY YEAR | | | | |
|---|---|---|---|---|---|
| | 2014+2015 | 2016 | 2017 | 2018 | 2019 |
| Facebook Group | 190 | 258 | 317 | 409 | 526 |
| Facebook Page | 240 | 469 | 936 | 1 610 | 2303 |
| Twitter Page | 245 | 640 | 1134 | 1 714 | 2099 |
| YouTube Views | n/a | n/a | 430 | 1 519 | 1607 |
| SoundCloud Plays | n/a | n/a | 4 | 149 | 255 |

Similar to the growth of social media platforms; the numbers of views on the Centre's YouTube and Sound Cloud channels showed a steady growth of our visual and audio audience. These platforms are the costliest to maintain, particularly with regards to creating content for regular updates.

## 8.5 Events and online communication

Events helped to enhance the CoE-FS's visibility through increased media coverage and stakeholder participation (See overview on the next page). Key events hosted or co-hosted by the Centre and its affiliates in 2019, kicked off with the first food systems CoP meeting in January 2019, where the team undertook a practical exploration of Cape Town's complex food system. The exploration was captured on camera and packaged as a video photo album with deep captions to tell the story. It was widely shared on media, and audio was recorded for podcast on SoundCloud. The #FoodTalks Seminar Series was launched in June 2019. The series is an initiative of the Centre for the Advancement of Scholarship in conjunction with the Centre for the Study of Governance Innovation, and the Centre of Excellence in Food Security. The series brings together leading thinkers and practitioners in the sector to share knowledge and creates a space to talk about the current food system and how we can move to a socially and ecologically regenerative, just and nourishing food system in South Africa and the region. CoE -FS affiliated researchers and students participated in the SAAFoST Congress which took place in Johannesburg in September 2019. Snippets of presentations were shared on social media, including image graphics of student research focus areas to profile the work of students.

Continuing on the momentum of the national Colloquium on student hunger, organized in partnership with the Dullah Omar Institute in 2018, the group went on to submit a petition to the SAHRC at two other events held first in Johannesburg and then in Cape Town. These events brought together a cross-section of key stakeholders including policy makers, food security experts, private sector and government department representatives, academics and student representatives, to discuss access to food for students in South African tertiary institutions. In collaboration with the SARChI in Social Protection for Food Security, the Centre hosted a national Conference on the Future of Farm Workers in South Africa.

The conference brought together academics, activists, farm workers, farmers and policy makers to discuss the challenges faced by farmworkers in South Africa; including how, despite producing the food we eat, many farmworkers experience hunger. The conference generated discussions online about labour violations on farms, food insecurity among farm workers as well as issues of transformation and land reform.

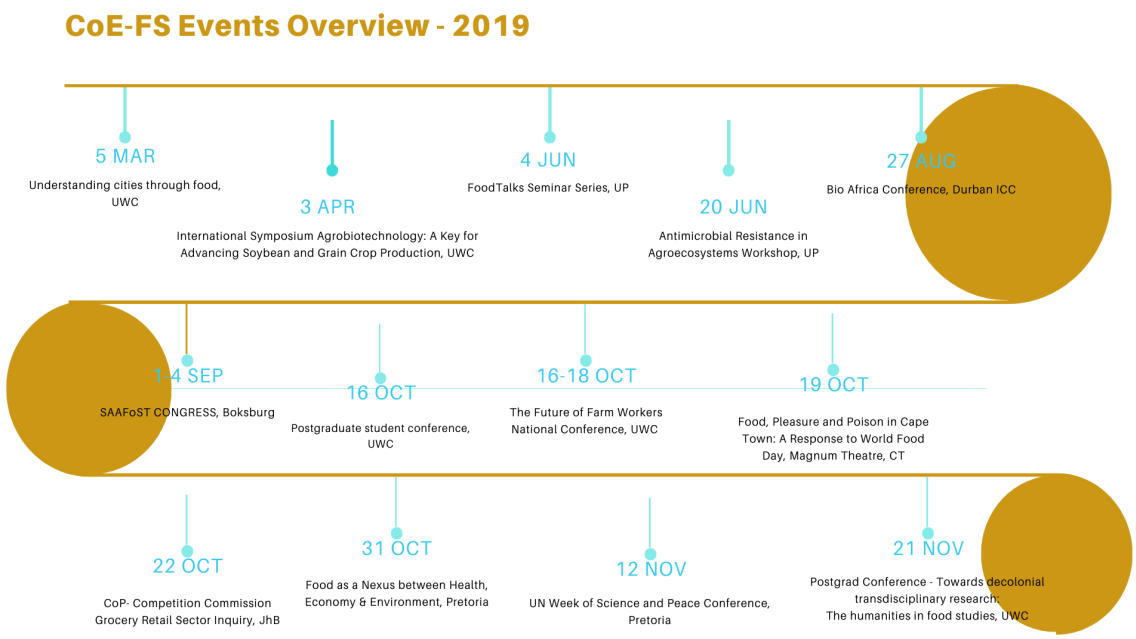



*Figure 5: Overview of key events that attracted media attention, hosted by the Centre*

# 9 KPA 4: NETWORKING

Since its inception, the CoE-FS has established various national and international collaborations and/or partnerships as a result of research activity and/or affiliations. Collaboration is fundamental to the work of a virtual centre such as the CoE-FS. Connecting with diverse stakeholders in this regard is critical to our success and relevance. In addition to the formal agreements that the CoE-FS has reached with 26 collaborating institutions, it has nurtured research and networking collaborations with scholars and institutions across South Africa and internationally.

A few networking examples for 2019 are as follows:

The project led by Professor Emmambux collaborates with Professor B Hamaker (Whistler Carbohydrate Centre, Purdue University, USA); Professor F Van Bockstaele (Gent University, Belgium); Professor M Stading and L Macakova, (RISE, Sweden); European Sensory Network (ESN); Professor T Beta (University of Mannitoba, Canada) and Professor SS Ray, CSIR centre for nanostructured materials in 2019. Professor Ndiko Ludidi and his team have established collaborations with the University of Kwazulu-Natal (African Centre for Crop Improvement, Pietermaritzburg campus) for initiation of work on pigeon pea, finger millet, and pearl millet. This collaboration is important for the future work of the CoE-FS on crop breeding for drought and heat stress tolerance, and improvement of Sub-Saharan African nutrition and links with our collaboration with the University of Mauritius. Recently his team developed a collaboration with Kenyatta University in Nairobi, aimed at cooperation in characterization of marama populations in South Africa and Kenya in terms of their responses to drought and heat stress and efforts

towards domestication of marama. This cooperation also aims at characterization of finger millet accessions held by Kenyatta University about their responses to drought and heat stress. Dr. Marshall Keyster's current national collaborations include collaborations with Walter Sisulu University (Dr. Egbichi [biochemical assays]), University of Pretoria (Dr. Makgopa [plant transformations]), the National Zoological Gardens (Dr. du Plessis [transcriptomic and bioinformatic analysis]), University of Fort Hare (Mr. Mpayipheli [field trials]). International collaborations include the main partner university (University of Missouri) with Professors David Mendoza-Cozatl and Antje Heese.

The Southern African Farm Animal Genetics Resources (SADC AnGR) colloquium, hosted by the project at the Faculty of AgriSciences, Stellenbosch University in collaboration with the CoE-FS, AU-IBAR, and SADC was well attended by researchers from Botswana, Malawi, Zimbabwe, and South Africa. This colloquium enabled engagements of students with researchers from various universities, research institutions, and countries. The French South African Institute of Agriculture (FSAGRI), hosted by the department and Livestock and Pasture Science at UFH, was awarded an Erasmus+ International Credit Mobility programme with UniLaSalle (France). This partnership will facilitate the mobility of students and staff between UFH and UniLaSalle for selected programs in the field of Agriculture, Food Science, Water, and Environmental Management.

The project “Towards national-level knowledge brokerage” continues to strengthen its collaboration with the South African Food Lab and the Public Affairs Research Institute with regard to the national food governance debate. It also reached out to new collaborators though the #Food Talks Seminar Series at the University of Pretoria. In addition to national stakeholders from the government, civil society and academia, the workshop on The state of food governance had representatives from UK, France, Kenya, Mozambique, Zimbabwe, and Burkina Faso. In the academia and in addition to UP and UWC, researchers from several different institutions (universities and research centres) are involved in the Local Food Governance project, including UCT, CPUT, SU, Wits, and UJ in South Africa, as well as Cirad in France, the City University London in UK, and the university E. Mondane in Mozambique. Collaboration with CSOs and government has been further developed and strengthen and 2019. For government, it includes the Presidency (Department of Planning, Monitoring, and Evaluation), the National Department of Health, the National Department for Rural Development and Land Reform, the Western Cape and Gauteng provincial governments, metros (City of Cape Town and City of Johannesburg), municipalities (Witzenberg in the Western Cape) and the South African Local Government Association SALGA. CSOs and think tanks, it includes: The Southern Africa Food Lab, the Sustainable Livelihoods Foundation, the Gauteng City-Region Observatory, the African Centre for Biodiversity, WWF, the Public Affairs Research Institute, Umthunzi Farming Community, South African Faith Communities Environment Institute, Women on Farms, Abalimi Bezekhaya, People's Health Movement, Ikhaya Gardens, Philippi Economic Development Partnership, Goedgedacht Care for the Earth and the Healthy Living Alliance. All these national and international collaborations have strongly improved the scientific partnership of the CoE-FS, its engagement and its visibility.

The project led by Professor Durojaye collaborated with stakeholders within and outside of the country. For instance, the project forges cordial relationships with other partners in sister institutions such as the Universities of Pretoria, Fort Hare, and Witwatersrand. Researchers working on access to food from these institutions were invited to participate in policy dialogues. The team travelled to participate in developing an institutional food security policy for the University of Fort Hare. The team was in conversation with the Department of Higher Education (DHET), to use some of the research outputs to influence policy directions of the DHET and a meeting was held in 2019 with DHET. Additionally, a joint piece was published in the Conversation. This project continues to work with and leverage established relationships with civil society organizations, government departments, private actors and Chapter 9 institutions to realize its main objective of realizing access to food for students in tertiary institutions.

On 23 October 2019, UP and FANRPAN signed an MoU at its Future Africa campus to explore and prioritize opportunities for synergy between the two institutions for greater impact in the food, agriculture and natural resources sectors on the African continent. Following the October 2019 workshop, a framework was developed to guide partnership and collaboration activities between Cornell University and UP, including members of the CoE-FS. UP will sign an institutional MoU with Cornell University during early May 2020. A full proposal for a project entitled Food Systems Research Network for Africa, co-led by UP, ULeeds, and FANRPAN was submitted to UK Research and Innovation (UKRI) on 13 November 2019. The proposed project on food system transformation will involve participation from different members of the CoE- FS. Postdoctoral fellow, Dr. De Bruin, and Dr. Kayode Adepoju from UFS are engaged in a groundnut research project that applies systems dynamics methodology. The collaboration will culminate in a poster, presented at the Systems Analysis and Africa workshop on 3 December 2019, and a peer-reviewed paper is being prepared for submission in 2020. Dr. De Bruin and Dr. Adepoju will also continue working in 2020 on a project in the informal food market. The research that is conducted by Ms. Sithembile Mwamakamba (PhD student funded by the British Council, and based at UP/FANRPAN) draws from the work of the Agricultural and Food-System Resilience: Increasing Capacity and Advising Policy (GCRF-AFRICAP) programme. Working with local organisations and governments in Malawi, South Africa, Tanzania and Zambia, the GCRF-AFRICAP programme focusses on creating an evidence base to underpin new country-specific policies in agriculture and food production. The progamme is led by FANRPAN in collaboration with the University of Leeds (ULeeds).

Professor Alice Pell (former Vice Provost for International Relations at the University of Cornell, animal scientist and researcher in agriculture, nutrition, and agricultural education) plays an advisory role to Dr. De Bruin and Dr. Adepoju in applying systems dynamics methodology to the groundnut research project. This contributes to the preparation of a peer-reviewed paper that will be submitted for publication 2020. Dr. De Bruin, together with colleagues from WUR and UP, co-developed a proposal for an envisioned five-year collaborative project on applying systems thinking to improve the food safety of informal food supply chains. This project will

commence in January 2020 and will involve participation from different disciplines in the CoE -FS. On 3 December 2019, IIASA in collaboration with the CoE-FS hosted a workshop on Systems Analysis and Africa. This collaboration with IIASA positions the CoE-FS to become a preferred partner for long-term food systems research on the continent.

The “Cropping systems and soil health in South Africa” project has strengthened collaboration between UP and NMU. This collaboration also resulted in strengthening capacity at one of the previously disadvantaged institutions. Mr. Nkolanyana and fellow students through the South African Youth Centre for Disaster Risk Reduction/SAYCDRR launched several Disaster Talks in which they address pertinent disaster risk reduction and food security issues. Linkages with UFS and DUT has been established. The network, the Southern Africa Society for Disaster Reduction, is an ongoing initiative that addresses DRR and food security issues. The next biennial conference will be held in Malawi in 2020. One of the sub-themes is Food Security in SADC.

Critical Food Studies participated in a symposium at the University of Minnesota. This was a significant networking process at numerous levels. The symposium was an intimate process that brought together established key scholars across the US, working on critical food studies. The ultimate nature of the symposium facilitates new linkages and connections with important scholars to enhance the profile of Critical Food Studies as well as introduce the research being undertaken in South Africa. These linkages have subsequently been taken forward in critical ways: new collaborations and potential partnerships are being explored - development of a book, contribution of articles to the website 2020, cross-continental virtual seminars 2021, exchange visits 2020-21 and participation in the Critical Food Studies international conference in 2022. The emerging scholar attended the 19th Food Studies Conference in Taiwan and showcase her work and Critical Food Studies.

A link between Sustainable Livelihoods has been established to allow informal settlement microenterprise data to feed into the Food Safety programme. Also, fresh produce samples from around South Africa were collected and sent to the UP for pesticide analysis. Polony samples collected for UWC were used to test for the presence of *Listeria monocytogenes* before, during and after the outbreak. Researchers are also investigating linkage with Professor Jannie Hugo of the UP’s Family Medicine Department to include areas linking the household food security and community health with food safety and disease burden. The group of researchers within the Food Safety programme included researchers from the UP’s Department of Plant and Soil Sciences, Department of Food Science and Department of Consumer Sciences, and Department of Animal Sciences University of Fort Hare. The collaboration with the Department of Rural Development and Agrarian Reform (DrDAR) enables researchers in the programme to use the modern state art veterinary laboratories in the Eastern Cape Province. Collaboration has also been established with the National Institute of Communicable Disease’s Sequencing Core Facility to begin exploring the genome of selected isolates through the supply chains.

The ongoing work of SARChI with the United Nations Development Programme (UNDP) African regional bureau in Ethiopia resulted in a flagship publication in 2019. Further collaboration is planned in 2020 on informal social protection in Africa, with a case study of SA involving local researchers and students. Professor Devereux has been appointed Extern Examiner, MSc in Food Security Policy and Management, at the School of Development Studies, University College Cork in Ireland. He has also been awarded a 3-year Mercator Fellowship by the University of Bremen and will engage with academics at Bremen's Research Centre on Inequality and Social Policy (SOCIUM) while researching and writing my book on the role of transnational agents in propagating social protection in Africa.

From its conception, the Child Malnutrition programme included researchers and students from several institutions by design. These researchers have in effect become multipliers and resulted in additional collaborations. Researchers from the following local and international institutions have collaborated on the programme in 2019: UCT, UKZN, UP, WITS, UWC, Stellenbosch University, HSRC, MRC, University of Bonn, University of Montpellier, UNICEF, World Banks. A new collaborative project on Water, Sanitation and Hygiene in Soweto entitled: A software platform to improve safety and utilization of sanitation and water source facilities among women in South African informal settlements started in 2019. This new project has been successful in securing funding through the Grand Challenge Africa WASH Call Round 5 granted by the African Academy of Science, the Bill and Melinda Gates Foundation, the UNICEF, ARM, and Sida. The new project is a collaboration between the principal investigators and collaborators of the present project, namely: Dr. Rihlat Said Mohamed, Mr. Douglas Momberg, Prof. Shane Norris, Prof. Julian May, and new collaborators, including Dr. Lee Voth-Gaeddert (Centers for Disease Control and Prevention, CDC), Ms. Lauren Tavener-Smith (the Institute for Social Development, University of the Western Cape) and Professor Alastair Van Heerden (the Human Sciences Research Council, HSRC). Therefore, the new project strengthens and will ensure the continuity of existing but also new collaborations between the CoE-FS and other national and international institutions, including the CoE in Human Development, the SAMRC/Wits Developmental Pathways for Health Research Unit, the HSRC, the Institute for Social Development (UWC), the CDC, the African Academy of Sciences, and the Bill and Melinda Gates Foundation.

Ms. Sambu accompanied Dr. Coretta Jonah to Bonn (Germany) for a research visit at the Centre for Development Research (ZEF) in September and October 2019 to strengthen links with these institutions. During 2019, Professor May had meetings to discuss on-going and possible collaborations with Professor Rod Uphoff, Dr. Henk van den Heuvel (VU-A); Professor Will Hout (ISS, Den Haag); Professor Wilhelm Lowenstein (RUB); Dr. Darian Pearce (Ghent University); Dr. Philippe Petithuguenin (CIRAD), Professor Joachim von Braun (ZEF/University of Bonn), Professor Steve Wiggens (Overseas Development Institute), Ms. Chantell Whitten (NWU); Ms. Truida Prekel; Mr. Justin Bonello (Neighbourhood Farm) and Ms. Jenny Stiptech (McGregor Food Gardens); Ms. Jennifer Johnson (MACProject); Professor Lues Ryk and Mr Leolyn Jackson (Central University of Technology); Dr. Masoud Vaezghasemi (Uppsala University); Dr. Nathanial Dlamini (Stats SA); Dr. Michael

Davies-Venn (VU-A); Professor Anton van Rompaey (KU-Leuven) and Professor Barbara Regeer (VU-A).

The meetings with Professors Uphoff and President Choi contributed towards an invitation Ms. Mologai Makwele at MU in 2019 representing leverage funding of R100 000. The meeting with Dr. Petithuguenin contributed towards the renewal of the secondment of Dr. Bruno Losch at UWC for two years. The meeting with Professor von Braun resulted in an additional PhD bursary of R400 000 being made available to UWC. The meeting between Mr. Bonello and Ms. Stiptich resulted in knowledge transfer for the design of the McGregor Food Garden programme. The meeting with Dr. Vaexghasemi resulted in the award of a seed grant of R80 800 to UWC and Wits for travel and internationalisation from the South Africa Sweden University Forum. On 7 February 2019, a delegation of two members of the German Parliament visited the CoE-FS at UWC. Mrs. Dagmar Freitag has been an MP since 1994 and is a member of several parliamentary working groups and committees that determine DAAD's funding policies. Mrs. Ulla Schmidt has been a Member of Parliament since 1990 and served as the German Health Minister for 8 years. The German Consul General, Dr. Matthias Hansen accompanied the visitors. Staff and students provided a presentation on the activities of the CoE-FS.

# 10 KPA 5: SERVICE RENDERING

All the principal investigators are involved in service rendering, which includes an input to policy debates, keynote presentations and facilitating workshops.

A few examples are as follows:

Professor Ndiko Ludidi and his team interacted with smallholder farmers in rural villages of the Eastern Cape (Lukholweni village in the Matatiele Local Municipality of the Alfred Nzo District near Mount Frere through the chairperson of the local agricultural co-operative called Seeds Gardening Services; and Ngqandulo village near Flagstaff in Ingquza Hill Local Municipality and Mqhekezweni village near Mthatha in the King Sabata Dalindyebo Municipality both of which are in the OR Tambo District through the chairperson of a local agricultural co-operative called D.I. Farms) and the Northern Cape (Leliefontein, Kamiesberg Local Municipality, Namakwa District through a member of the local farmers association named Mr Les Adams).

The interaction in the Eastern Cape is to transfer knowledge and skills to these farmers to assist them with their cropping systems towards using regenerative agriculture to maximize crop yield while improving the health of the soil. In the Northern Cape, our interaction is to assist with identifying animal feed crops that can withstand the dry conditions of the area. Dr. Marshall Keyster disseminated the ICP results with the farming community in the Eastern Cape which could aid in better soil management and planning for the 2020 growing season. Professor Dzama hosted a SADC colloquium in July 2019 which deliberated on various topics under the theme: Intersecting Innovation, Food Security and Livelihoods. The team

developed a framework for sustainable utilization of animal genetic resources in Southern Africa and hosted an Agricultural Sustainability colloquium at Stellenbosch University in August 2019.

The workshop on The state of food governance in Pretoria held on 25th September 2019 included many government officials from national, provincial and local government, as well as representatives from CSOs. The #FoodTalks seminars are a way to raise awareness of food-related issues to a large audience. The development of a research agenda based on the interests and concerns raised by civil society and state representatives constitutes a service rendered in the sense of identifying research needs and opportunities and formulating research proposals based on these. Furthermore, the workshops and Community of Practice meetings have raised awareness of key food governance matters and sensitised stakeholders to the various issues and positions (including research from the COE). The activities have been a significant avenue for connecting research and academia with government and civil society.

During this 2019 the “Right to food security for school leavers” project prepared and presented a petition on access to food for students in South African tertiary institutions to the South African Human Rights Commission. This petition was presented on behalf of thousands of South African University students who daily grapple with the challenge of hunger and food insecurity. It is believed that this petition can go a long way in ensuring that the government responds to the needs of students in higher institutions in the country. This project also participated in meetings for involving different stakeholders including civil society groups, government departments, and others.

Dr. Willeke de Bruin represented the CoE-FS at the first FAO/WHO/AU International Conference on Food Safety, in February 2019 in Addis Ababa, Ethiopia. The PhD Student, Mr Ginindza, collected data and created an online fisheries profile during January 2019 on the Too Big to Ignore (TBTI's) Information Systems on Small-Scale Fisheries entitled *Ocean View's small-scale fishing in the West Coast rock lobster fishery*. He presented his research findings entitled *Technology in the small-scale fishery* as part of a lecture on Social and Ecological Dimensions of Ecosystem Management to PLAAS students on 1 August 2019. The focus of the presentation was on the consequences of technology on livelihoods and food security within the South African small-scale fisheries. Four projects on the continent were engaged in which included the Food security/Disaster risk reduction interface. A Food Safety Science Platform for South Africa has been established and will be able to share information around food safety-critical matters and methodology. The platform will be an open resource for government and industry and will be used to drive policy change in terms of food safety test methods and regulations.

Professor Stephen Devereux was the co-convenor, of the Social Policy for Developing Countries Honours and Master’s course, Institute for Social Development, University of the Western Cape. He was also the convenor of the PhD Forum, Institute for Social Development, UWC, and the Academic Convenor and co-sponsor, of the 1st National PhD Conference in Development Studies: Social and

demographic transformation in a time of rising inequality, hosted by the Institute for Social Development, UWC.

Professor Julian May was a member of a panel discussion titled “What works to eradicate stunting” at the Grow Great Campaign seminar in Johannesburg. Grow Great is a civil society organisation working to eradicate stunting in South Africa. Dr. Rihlat Said Mohamed, Mr. Douglas Momberg and Dr. Christian Bwangandu Ngandu were invited in October 2019 to be part of the Grow Great Summit, Zero Stunting by 2030 - An opportunity for greatness. This is an initiative of the DG Murray Trust. Dr. Precious Motsepe, representatives from Mexico National Institute of Public health, the University of Santiago in Chile, Brazil’s Bolsa Familia program, Delhi’s Development Authority in India and Senegal’s nutrition campaign as well as from local academics and policymakers attended the summit.

# 11 FINANCIAL INFORMATION

**Table 15: Funding received and spent from NRF in the reporting period**

| Commitment | Expenditure |
|---|---|
| R15 315 379 | R15 315 379 |

The breakdown of the funds received from the NRF for 2019, are provided in Table 16.

**Table 16: Breakdown of NRF funding expenditure**

| Commitment | Amount | % of Expenditure |
|---|---|---|
| Running costs (Research) | R5 760 671.80 | 37.61 |
| Bursaries | R5 133 345.00 | 33.52 |
| Salaries | R3 661 236.36 | 23.91 |
| Running costs (Operational) | R 700 125.84 | 4.57 |
| Equipment | R0.00 | 0 |
| Conferences | R 60 000.00 | 0.26 |
| Total | R15 315 379 | 100 |

### 11.1 Other sources of funding

**Table 17: Funding received from other sources**

| Collaborator | Funder | Description | Amount (R) |
|---|---|---|---|
| UWC | NRF | Bilateral SARChI Grant from NRF | 1 700 000 |
| UWC | NRF | Leap Agri Project | 941 930 |
| UWC | NRF | Food4Cities Project | 720 000 |
| UP | UP | Postdoc, W de Bruin | 200 000 |
| UP | British Council | PhD bursary with running costs, F Swanepoel | 456 700 |
| UWC | Cornell University | UNESCO Chair, J May | 67 500 |
| UP | NRF | India-SA bilateral Chair, Running costs, N Emmambux | 100 000 |
| UP | NRF | India-SA bilateral Chair, Bursaries, N Emmambux | 170 000 |
| UP | NRF | Incentive Fund Bursaries and Patent for fat replacer, N Emmambux | 670 000 |
| UP | NRF | Incentive fund, USAID Collaboration, N Emmambux | 610 000 |
| UP | NRF | Incentive fund, Smart Foods, N Emmambux | 50 000 |
| UWC | NRF | Competitive programme for rated researchers, SA-Tunisia Bilateral, KIC , (Running costs), N Ludidi | 1 138 000 |
| UWC | NRF | Competitive programme for rated researchers and Free-standing student bursaries, Bursaries, N Ludidi | 675 000 |
| UWC | NRF | Competitive programme for rated researchers, Running costs, M Keyster | 368 000 |

| | | | |
|---|---|---|---|
| UWC | NRF | Competitive programme for rated researchers, Bursaries, M Keyster | 185 000 |
| UP | UP | Research Grant, N Labuschagne | 50 000 |
| UP | UP | Food Safety, L Korsten | 2 150 000 |
| UWC | ROFE | Obesogenic food environments, R Swart | 1 073 050 |
| UWC | Bloomberg Philanthropies | Global Obesity Advocacy Incubator, PhD, R Swart | 100 000 |
| UWC | NRF | Rated Research Grant, R Swart | 250 000 |
| UWC | UCT | Child Malnutrition, J May | 75 000 |
| UWC | CoE-FS Human Development | Child Malnutrition, J May | 300 000 |
| **Total** | | | **12 94 598** |

### 11.2 Financial leverage

**Table 18: Leverage funding received**

| Collaborator | Funder | Description | Amount (R) |
|---|---|---|---|
| UP | WUR, Netherlands | Postdoc Development, F Swanepoel_W De Bruin | 70 000 |
| UP | IISA | Running Costs, F Swanepoel | 100 000 |
| UWC | UNESCO Chair in Global Food Systems | Inception Workshop, J May | 45 795 |
| UP | CIRAD | Governance programme, B Losch | 675 000 |
| UP | SALGA | Governance programme, B Losch | 100 000 |
| UP | CIRAD | PhD, Governance programme, B Losch | 100 000 |

| | | | |
|---|---|---|---|
| UP | CIRAD | Senior Researcher costs, Establishing a community of practice in Gauteng, Governance programme, B Losch | 75 000 |
| UWC | Ford Foundation | Dullah Omar Institute, E Durojaye | 450 000 |
| UP | CIRAD | Senior Researcher costs, Governance programme, B Losch | 450 000 |
| UP | SALGA | Senior Researcher costs, Governance programme, B Losch | 50 000 |
| UWC | British Council | SA-UK Bilateral SARChI | 4 494 000 |
| **Total** | | | **6 609 795** |

### 11.3 Return on investment

The CoE-FS publication list and students registered for 2019 as outlined in Table 5 of this report, represents a significant return on investments, and once the published output has been verified and converted into subsidy income, this will represent a considerable income for the universities at which research is taking place. It is difficult to accurately estimate the value of the expenditure in terms of subsidy income since this varies year on year and is affected by the number and location of co-authors. Since its inception in 2014, the CoE published ovder 250 journals, book chapters, and books, with the highest cumulative citation of 55. It has also supported more than 300 students, which is viewed as a long-term economic and societal investment.

The establishment of the Centre has also resulted in considerable additional funding in 2019, amounting to R18.7 million. Particularly noteworthy was the award of a five-year UK-SA Bilateral South African Research Chair in Social Protection for Food Security. The incumbent, Professor Stephen Devereux, assumed his position at UWC in 2016. This initiative presents another opportunity to further widen network opportunities. Additionally, following an agreement reached with CIRAD, two senior researchers are stationed at UWC.

However, the greatest return on investment is the networking and collaborations that have taken place within the projects supported by the Centre and the findings that are emerging. As mentioned above the CoE-FS currently has 27 Collaborative agreements in place with more than 100 international and national collaborators.

Findings that are already emerging have been provided in this report and represent new directions in the natural and social sciences as well as a unique engagement with the humanities through the Mellon Foundation initiative and the SARChI, and LEAP-Agri programmes.

# 12 GENDER IMPACT

The CoE-FS has made a concerted effort to include women in its research teams and as recipients of student bursaries; currently, 78 of the 128 students (60.9%) are women. The CoE-FS management and administrative teams; currently, the Co-Director, Research Manager, Finance Manager, Administrator, Communications Manager, and Administrative Assistant positions are filled by women.

Gender inequality both leads to and is a result of food insecurity. According to estimates, women and girls make up 60% of the world's chronically hungry and little progress has been made in ensuring the equal right to food for women enshrined in the United Nations' Convention on the Elimination of All Forms of Discrimination against Women. Women face discrimination both in education and employment opportunities and within the household, where their bargaining power is lower. On the other hand, gender equality is described as instrumental to ending malnutrition and hunger. Women tend to be responsible for food preparation and childcare within the family and more likely to spend their income on food and their children's needs. The gendered aspects of food security are visible along the four pillars of food security: availability, access, utilisation, and stability, as defined by the FAO.

The CoE-FS provided opportunity and capacity development for women and equal opportunities are encouraged through its projects. Most of the scientists and students under the SMART foods project are women. The "Drought Responses in Cereals and legumes" project has 50% of its students as women and one researcher at the ARC (Dr. Alina Mofokeng) as a collaborator. The project led by Dr. Marshall Keyster has listed a female (international) at the management level who is based at the University of Missouri as well as five female students who are based at UWC. Two black female students joined the team in 2019. Women are well represented in the research team led by Professor Kennedy Dzama - of the two students at UFH one is female and she is at the forefront of driving the research objectives of the project.

The majority of the students under the project led by Professor Dewald van Niekerk are female as well as one of the supervisors. In all instances, women have been used as part of the locally recruited research teams. Given the gender focus of the study of Ms. Sizwile Khoza, women were also included as study participants and key informants in the focus group discussions of which one at each site was specifically for women only, and in the household survey. The approach used in this study ensured that there was meaningful inclusion of women as their real-life experiences in climate-smart adoption dynamics were captured. In Ms. Lulu Chauke's study, gender mainstreaming of women is one of the key issues that is

included in the study since women (especially in rural areas) are more vulnerable to food insecurity.

The majority of the research activities in the Food Safety programme are led by women, who are also included as students. The “International Food Fair” project was gender-neutral. Each individual regardless of gender was given an equal opportunity to participate. For the farmworker survey, all respondents, all interviewers and some data entry clerks and data analysts (including students under my supervision at UWC) were female. Three of the four presentations at The Future of Farm Workers in SA conference were co-authored with female students or colleagues, and all three were presented by them.

The persistence of malnutrition in children continues to at the household level predominantly affect women. This is because, in developing countries, especially the health, nutrition, and wellbeing of children continue to remain the responsibility of women. Thus, in researching the challenge of persisting child malnutrition, making policy recommendations and engaging with policy-making on means to improve the health and nutritional status of children greatly enhances the position and role of children.

All the components of the Child Malnutrition programme include and engages with women at various level; women are participants, the beneficiary of research outcomes, researchers and students on the programme. Currently, out of fourteen students working on the programme eight bursary holders are women. However, if we include other female students engaged in the programme but not directly receiving a bursary, this brings the total number of women to fourteen female students either engaged directly or indirectly in the children programme. Also, the twenty-three-person research team is comprised of fifteen women and eight men.

Additionally, the team continuously identifies young, dedicated and committed female candidates interested in furthering their education and pursuing academic careers for; academic support, supervision and mentoring from Honours through to PhD. The opportunities offered to women on the children programme include; research training, proposal writing and funding application skills, development of project management skills, opportunities for further studies and some direct employment.

# 13 HUMAN RESOURCES

The CoE-FS operates as a virtual centre with a small number of permanent staff. The universities and departments to which funds are directed to provide additional administrative support. The core team of the CoE-FS is listed in Table 19. The lead researchers, researchers and project leaders who were part of the CoE-FS in 2019 are listed in Appendix 4.

**Table 19: Management and administrative staff**

| Name and Surname | Institution | Sex | Race | Citizenship | Role | % Time |
|---|---|---|---|---|---|---|
| Prof Julian May | UWC | M | W | South African | Director | 100 |
| Prof Lise Korsten | UP | F | W | South African | Co-Director | 20 |
| Ms Nolutando Didiza | UWC | F | B | South African | Administrative Assistant | 100 |
| Dr Elaine Sinden | UWC | F | C | South African | Centre Manager | 100 |
| Ms Mologadi Makwela | UWC | F | B | South African | Communications Manager | 100 |
| Ms Elaine Petersen | UWC | F | C | South African | Co Ordinator: Finance and Budgeting | 100 |
| Ms Daleen Muller | UP | F | W | South African | Administrator | 60 |

Mr. Peter Mukwevho from the University of Limpopo has worked in UP lab due to limited resources. He has now enrolled for a PhD in Food Science. Mr. Ali Ali and Mr. Musa Akanbi were supported to attend further courses (in France for Mr. Akanbi and in Italy for Mr. Ali) in plant science that are essential for their research work. Mrs. Ziyanda Mmangio-Kaseke was supported to attend a conference in Hungary in 2019; Mr. Ali Ali and Mr. Gerhard Basson were supported to attend a conference in Spain in 2019. The conferences enabled the students to present their work but also to network with leading researchers internationally and to acquire diverse knowledge of relevance to plant science. All thirteen students under the "Reclamation of Heavy Metal Contamination of Soils" project received the following training at UWC: ICP Ionomic training, Gel-based proteomics training, and HPLC training as well as plant growth and development.

One of the most powerful effects of the co-production process is the capacity building of its participants. Interaction of civil society and government officials with researchers and each other increases their capacity to: 1) have open debates about the difficult issues concerning uncertainty, complexity, knowledge gaps; 2) understand the various perspectives on specific topics. Similarly, scientists engaging with problems within the messiness of local contexts require their learning to move beyond the theoretical into the practical. They can also help all participants to build relationships and networks with which to collaborate and coordinate in the future. The workshops, therefore, created awareness of food security as a policy problem and also introduced the stakeholders to each other as a collective group, many for the first time. The participatory deliberation processes operationalized by the scientists also created learning opportunities for the stakeholders to listen to (and begin to understand) perspectives different from their own. In time this could lead to an evolution of values of the participants (i.e. second loop or conceptual learning).

The postgraduate students on the project led by Professor Ebenezer Durojaye have been exposed to participate in meetings and other engagements relating to the right to food to give them the needed exposure. Dr. Farai Kapfudzaruwa, a postdoctoral fellow at UP's involvement in the mapping of the research strengths of current and prospective UP partners is important because these mechanisms go beyond the usual academic exchange agreements by taking advantage of the strengths of the institutions partnering. Ms. Loandi Richter, a PhD student at UP, has developed wider skills in research project management. Dr. Willeke de Bruin, spent six weeks in the Netherlands to participate in a preparatory learning experience about applying food systems thinking. Mr. Joseph Ginindza, a PhD student at UWC, has developed broader knowledge and application of political economy and research skills that are applied in social science. All of the students under the “Enhancing food security through disaster risk reduction and climate change adaptation policy and legislation” project is intricately linked to the broader objectives of the project. Regular briefings with the students are held and their inputs are valued and included. They are also given the freedom to initiate initiatives. The students are also involved in all of the regional research initiatives which have a direct bearing on their studies.

The diagnostic platform technician Ms. Zulu was trained on the next generation PCR technology that was established in the virtual diagnostic platform. The Food Safety Programme trains students from various scientific background and science communication workshops as well as exposure to a collaborative environment in addition to the day to day development of an MSc or PhD student.

Dr. Stacey Duvenage, the Senior Postdoctoral fellow funded by this project has received invaluable mentorship and development through this programme. Through this forum, she has been able to develop her scientific engagement, influence, and impact as a result of conducted research. She has been exposed to and will further be exposed to develop excellence in teaching, scientific communication, and collaboration as well as mentorship. She has provided cutting edge technology and guidance to students in the field of food safety diagnostics and trace-back systems. Dr. German Villamizar-Rodriguez, the postdoctoral fellow funded by this project has received invaluable mentorship and development through this programme. Through this programme he has been exposed to method development and diagnostics as well as to student mentorship. Research assistants Ms. Lesego Marule and Ms. Phephi Zwane - Development of their abilities to assist with questionnaire development, data collection, data analysis [qualtrix and SPSS) and project management of the final year research projects.

SARChI funded the exchange visit PhD student Mr. Samuel Kapingidza to IDS Sussex in the UK, where he participated in the short course: 'Social Protection: Policies, Programmes, and Evidence'. He co-presented a session on politics of social protection on the short course at IDS; co-authored a paper for the UK Development Studies Association annual conference, and co-authored a chapter for the book ‘Building Social Protection Systems in the Global South’ to be published in 2020 by Palgrave Macmillan. SARChI also funded an exchange visit to IDS Sussex in the UK for Ms. Mologadi Makwela, CoE-FS Communication,

Marketing, and Engagement Manager, where she participated in the short course: 'Social Protection: Policies, Programmes, and Evidence' and had meetings with the Communications team at IDS.

Consistently the Child Malnutrition programme focused on the intergenerational transfer of knowledge and skills through human resource development focusing on women and previously disadvantaged groups. Students and research assistants have been encouraged to participate in publications, conference attendance, and presentations at both local and intranational conferences. Female research assistants with Matric qualifications have been trained in; project management, anthropometry, deuterium dilution technique and conducting interviews. Other researcher assistants have assisted in developing specific capacities for inclusion in the publications emanating from this study, these include statistical/quantitative as well as qualitative analysis.

## 14 TRANSFORMATION GOALS

The CoE-FS has made a concerted effort to promote its transformation goals (transdisciplinary, multi-institutional research, promotion of designated groups, internationalisation), and a few examples are listed below:

SMART foods research involves food chemists, food sensory scientists, food engineers, polymer scientists, economists, and financial analysts. All students in the project led by Professor Ndiko Ludidi are Black. The involvement with communities in villages has resulted in cultivation fields of some of these communities being fenced in preparation for crop production and we have started providing much needed regenerative agriculture knowledge to these communities. Importantly, we have started to provide seeds of our drought-tolerant lines to the subsistence and smallholder farmers in these communities at no charge. Collaboration with Walter Sisulu University has started to transform the participation of WSU in cutting-edge crop science for food security and has enabled us to link our natural science work with socially relevant interactions with resource-poor farmers in the Eastern Cape.

All thirteen students listed in the Reclamation of Heavy Metal Contamination of Soils project are from previously disadvantaged communities. Also, all the students fall in the Black designated group.

The approach of co-production that underpins the Knowledge brokerage and Local governance projects lends itself to transdisciplinary research. This can be seen in the participatory approaches used in the data collection methods of Ms. Michelle Beeslaar and Ms. Ntombizethu Mkhwanazi, respectively Masters and PhD students at UP. In our pursuit of a more equitable, just and sustainable society, we must examine not only who gets to make decisions, but also on whose evidence these decisions are made: The question of whose knowledge is to be recognized, translated and incorporated into action is particularly important in South Africa in the context of decolonizing knowledge in our universities. The approach of knowledge co-production through Communities of Practice, workshops and co-

elaborative scenarios adopted is inherently transformative as it facilitates groups otherwise marginalised in knowledge production (women, small farmers, and traders, informal workers, migrants, and refugees) who were not only considered but helped inform the overarching research agenda and had their knowledge integrated into the co-production process. The approach of knowledge co-production is also inherently transdisciplinary as it includes researchers from multiple academic disciplines (geography, sociology, political science, public health) as well as participants from outside of science (various government and civil society institutions).

Professor Pell's visit to UP in March 2019 was preceded by her participating in the Strengthening Agricultural Higher Education for Agri-Food Transformation in Africa (SHAEA) Steering Committee meeting, held in Nairobi, Kenya. Seven countries were identified to host anchor universities - Mozambique, Malawi, Côte d'Ivoire, Uganda, Kenya, Senegal, and Cameroon. Although SA does not qualify to host anchor universities, the CoE-FS is very well positioned to provide support and play an important role in working with the anchor universities. The Food Safety research group has transformed the food safety arena by challenging the formal regulated system based on Western food safety management systems (Eurepgap now GlobalGap and British Retail Consortium (BRC) standards). They have developed an African food safety system based on our local legislation and will use the current data. All projects engaged in several research projects were involved with various disciplines such as microbiology, veterinary public health, social sciences, food science, epidemiology, consumer science, and bioinformatics. The meat section of the project collaborated with Dr. Gabriel Marufu from the Veterinary laboratory in Makhanda, and Prof Ezekiel Green from the Department of Food Science and Biotechnology, University of Johannesburg. The food safety knowledge attitudes and practices group partner with industry partners included the leading international supply chain logistics company and Iowa State University.

The Child Malnutrition programme was conceptualised to involve researchers from both local and international institutions, and this has resulted in joint publications. Local collaborations have occurred between historically deprived academic institutions, more established ones and public research entities such as the MRC and the HSRC. The academic background of researchers on the programme was equally varied, with social scientists, natural scientists and engineers collaborating in various components of the programme.

## 15 SOCIAL IMPACT

The CoE-FS has made a concerted effort to advance social impact. A few examples of such interactions are below:

Community engagement activities under the project led by Dr. Marshall Keyster include: Continuing the research activities with the Tsolo Agriculture and Rural Development Institute (TARDI) as well as starting a new community engagement project with a community in Matatiele. This project will explore possibilities to

convert land into farming land for subsistence farming. This project also started a new community engagement project with a community in Mthatha. This project aims to provide vegetables (food) for the community with a possibility to convert the excess produce into cash through selling at local markets.

Dr. Marshall Keyster and his team visited a community in the Westbank area of Cape Town to assist the community with farming vegetables. We will be conducting ICP analysis on the surrounding soils in order the assess the appropriateness of the soil for vegetable farming.

Social impact was achieved through the involvement of civil society in the CoP meetings. Close collaboration and extensive consultation with Western Cape representatives of the South African Local Government Association (SALGA) have taken place, not only by involving them in the Western Cape Food Governance Community of Practice gatherings, but by convening a series of meetings where SALGA officials were sensitized to key issues of local food systems governance, invited to provide feedback on the draft food governance posters (in collaboration with the Food System Governance Programme), and consulted to identify small-town municipalities with whom to conduct co-elaborative scenario processes concerning plausible food futures and how these relate to wider local government concerns (including local economic development and provision of basic services such as roads, water, power, and waste). These consultations resulted in the identification of Witzenberg municipality as a pilot municipality in the Western Cape and discussion is underway for extending the collaboration with other municipalities in the Breede river valley. As a result of the meeting convened by The right to food security for school leavers project and based on the petition submitted to the South African Human Rights Commission, the project has received attention of national and international media such as ETV and Al Jazeera both of whom have interviewed Ms. Olufunmilola Adeniyi about the hunger and food insecurity in South African tertiary institutions.

Food Safety students at UP shared Food Safety awareness on campus on 7 June 2019, World Food Safety Day. Ms. Loandi Richter and Ms. Degracious Kgoale have been sponsored through the Food Safety for the Food Insecure for their WRC Green Matters project in which they are developing a mobile growing and selling chamber for fresh produce. Ms. Thabang Msimango is currently rolling out her NSNP Thank You Road Trip, visiting the schools in her research project to deliver seed, shadow netting, and other scientific supplies to the schools.

The farmworker project has been conducted in close collaboration with the NGO Women on Farms Project, which was represented on the farmworker conference organising committee and mobilised civil society participation and farmworker representation at the conference. Students and researchers on the Child Malnutrition programme have engaged with several quasi-governmental originations and civil society. The researcher provided input into the NRF magazine and participated in the celebration of children's rights by highlighting the critical importance of children's right to nutritious food.

Researchers participated in the Zero Stunting/Grow Great campaign organized by the DG Murray Trust in October 2019. A student in the programme also participated in a panel discussion organized by Grow Great Campaign, a civil society organization that is working to eradicate stunting in South Africa. Ms. Samba participated in discussions on measures that can eradicate stunting.

# 16 SCIENTIFIC CONTRIBUTIONS

A few of the scientific contributions of the CoE-FS programmes are as follows:

The research led by Professor Naushad Emmambux on "The effects of amylose lipid complexes as resistant starch on the microbiomes in the large intestine" is the first to be reported in the literature. The reduction of heat moisture treatment time as a physical modification of starch by infrared to two hours from 24 hours will show the commercial potential of such a processing technology. The production of starch microsphere novel smart food ingredients to be used as a fat replacer. Fermentation especially the addition of *L. Plantarium* and *L. Fermentum* a viable way to process and preserve indigenous foods

The project led by Dr. Marshall Keyster identified a gene (*ves3*) which is important in regulating heavy metal stress tolerance in plants. At the University of Missouri (Columbia), Ms Lee-Ann Niekerk confirmed our hypothesis that the *ves3* mutant cannot endocytose the iron transporters (IRT1) from the plasma membrane and therefore making *ves3* over-accumulates toxic Cadmium (Cd). However, *ves3* does not actively transport the Cd from roots to leaves and therefore this mechanism must be further investigated. This finding is currently prepared for publication in a high impact factor journal. *Ves3* mutants (other plants) can become the gold standard for phytoremediation technologies. We thus used the expertise of Professor David Braun at the University of Missouri, to make vesicle trafficking mutants (especially *ves3*) in Maize. The first generation of the mutants has been created and the screening process is underway in the growth room. Preliminary data shows that we do get viable mutants that could grow to produce a possible fourth generation. We will then screen the F4 generation to confirm the genetic mutation. This is a major step towards making food crops more tolerant to heavy metal stress.

The CoE- FS is bringing its results on local food governance to the national level and raising the importance of an integrated and transdisciplinary approach about the South African food system, beyond the sectorial approaches which are the common way of thinking in the government. Publications on this approach are under preparation.

Transformation of agriculture on the continent is a fundamental entry point for impact on sustainability in Africa, and a key opportunity to contribute to Africa's development and the global development agenda as articulated above. The ATA programme facilitates and strengthens collaboration with African and global role-players towards finding science-based transformational and equitable pathways

and solutions for sustainable development of one of the continent's most pressing challenges. Members from different disciplines of the CoE-FS are exposed to system thinking methodologies in this project, thereby enabling them to shift their thinking from a silo approach (discipline-specific) towards thinking more broadly and sharing data. This enriches the work that is carried out, resulting in a greater impact and an ideal platform for emerging scholars to contribute to the key objectives of the CoE -FS.

## 17 DATA STORAGE, UTILISATION, AND ACCESSIBILITY

Administrative data on students, grants, projects, financial information and all other information relevant to the management of the Coe-FS is kept on cloud storage and is backed-up manually onto external hard-drives. The Coe-FS is also using the Data First facility at UCT to access large social survey data sets and will deposit its datasets and Stata Do files on this service in future.

## 18 PATENT, PRODUCTS OR INTELLECTUAL PROPERTY

One SA patent has been filed entitled 'Starch microsphere as fat replacer' by Professors Emmambux and Nekhudzhiga.

## 19 CHALLENGES AND CONSTRAINTS

The CoE-FS continues to experience challenges and constraints arising from the decision to bring together two spatially and cognitively distant research teams. Although in theory, this decision can foster innovative practices and unusual collaborations, in practice these innovations remained elusive in the already challenging environment of higher education in South Africa. By and large, research teams continue to work in silos typically comprised of a supervisor and one or more postgraduate students. As a result, and as observed in the 2018 report, synthesis and inter-institutional collaboration remain a concern specifically concerning the host and co-host institution.

In response to these challenges, we have continued to reduce the number of funded projects, and to accept that the CoE-FS will not be able to deal with all aspects of the complex global food system. This process will continue in 2020, to consolidate the functioning of the CoE-FS so that greater efficiency and impact is achieved, as part of our May 2020 Lekgotla.

As noted in 2018, the production of trans-disciplinary research remains limited, and this is further constrained by the different epistemological positions of the researchers in the Centre. Axiological differences are also apparent, following follow the usual lines of natural science and social science/humanities. The Director and Co-director continue to take the lead in this respect by establishing projects that will break out of these silos. In 2019, the CoE-FS continued to use the expertise of

Mr. Robert Kriger in its 2019 week-long Lekgotla. This has moved the reconfiguration of the CoE-FS programmes forward but this still has to be continued. However, an outcome of this exercise has positively impacted the CoE-FS by producing a Sustainability Framework to ensure efficient, better and impactful operation of the CoE-FS beyond the NRF funding period. We have previously noted that the international funding environment has been affected by political developments in Europe and the USA, and that funding programmes have become very competitive. For this reason, we have intensified our efforts and strategies to seek funding from national and international bodies as reflected in our Sustainability Framework.

Project reporting has improved, but some Project Leaders still submit incomplete reports or submit the reports late, affecting the preparation of the annual report and record-keeping, and for communicating research outputs. We also identified some changes to project terms of references and student appointments that were made without approval. We no longer re-fund Project Leaders who do not comply with these and other government obligations without explanation. As previously noted, econometric modelling, statistical and programming capacity in South Africa is limited. As a result, a considerable amount of research time was spent on mastering the methods required to conduct the research. We continue to use our international collaborators to strengthen our capacity in this regard.

A concern that continues to be raised at UP has been the lack of any full-time support staff. This has limited the presence of the CoE-FS on the campus. This matter was raised again with SteerCom in the November 2019 meeting, and we need this and other operational matters to be concluded with credible solutions as part of the March 2020 Steering Committee meeting since the December 2019 meeting meant to address these issues did not materialize.

## 20 WAY FORWARD & DIRECTORS' NOTES

The Mid-Term Review Report concludes that:

(i) The CoE-FS has laid the foundation for food security issues in South Africa to be dealt with more coherently;
(ii) UWC and UP complement each other in their research and this was a good approach;
(iii) Some programmes are doing well in terms of research and addressing the food security issue;
(iv) The CoE-FS has made progress in laying the foundation for transdisciplinary projects;
(v) The CoE-FS is training citizens from the rest of Africa;
(vi) There is a strong representation of women among researchers and students;
(vii) The CoE-FS should continue to receive funding from the NRF.

The Review Panel correctly identified that some ongoing issues are arising from the merging of the bids separately prepared by UP and UWC, and the co-hosting of a Centre of Excellence led by an HDI and a Historically Advantaged Institution. Both

SteerCom and MANCO have worked hard to address these issues since 2014 as well as other matters arising from differing procedures, practices, and institutional cultures. We have requested a high-level meeting between the host universities and the NRF, which was meant to take place in December 2019 but which did not take place, to discuss those that still need addressing. These remain unaddressed and as such we have agreed to include these issues in our March 2020 Steering Committee Meeting as part of dealing with the NRF Management Response to the Review and the Response of the CoE-FS to it.

These include:

(i) Increasing the funding support to increase the time available for the Co-Director at UP from 20% to 50%;
(ii) Increasing the funding support to increase the time available for an administrator at UP from 50% to 100%;
(iii) Clarifying the financial contribution being made by the hosts to the CoE-FS and how this support is provided;
(iv) Improving access to laboratory and other facilities available to the research group based at UWC and the other HDIs involved in the CoE-FS; and
(v) Addressing the privilege gap experienced by researchers at the HDIs involved in the CoE-FS in terms of networks, exposure, funding opportunities, and resources.

We will continue to use our SteerCom as the independent body that assesses the strategic and scientific merit of the projects submitted for their consideration, and the NRF as the final authority approving. This model is derived from the approaches of credible funding agencies such as the Canadian International Development Research Centre (IDRC) and the Mellon Foundation. We will continue to accept unsolicited proposals and make the process of application and review clearer on our website and social media platforms. Although this is not required as a practice for many agencies, including the NRF, we have decided to provide feedback to unsuccessful applicants.

A concern raised by the SteerCom since 2014 and echoed by the Review Panel, concerns the range and spread of projects undertaken by the CoE-FS. Accordingly, we have undertaken a process of reducing our programmes to three, as reflected in this Annual Report. The question of what constitutes “excellence” is always a lively subject of debate, and especially so in the current context in which the decolonisation of the academic process itself is receiving renewed attention. While excellence could be reduced to counting the number of publications in high-impact journals, we contend that alternative views exist that include societal impact and community outreach; the demographic representivity of the students supported and the researchers involved; the transformative role in terms of promoting trans-disciplinarity; curricula reform and new ways of working; the amount of leverage funding and internationalisation; and the merit and soundness of the work being undertaken.

While these roles are not mutually exclusive, the trade-offs have to be acknowledged and managed. As an example, trans-disciplinary journals do not

necessarily have high-impact factors; achieving societal impact takes time away from research, and financially needy students often require additional support. We believe that "excellence" in food security must include societal impact and relevance.