



DSI-NRF
Centre of Excellence
in Food Security

ANNUAL REPORT

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Professor Julian May (Director)

Professor Lise Korsten (Co-Director)

Dr Elaine Sinden (Research Manager)

Ms Mologadi Makwela (Communications Manager)

**Ms Elaine Petersen (Co-ordinator: Finance and
Budgeting)**

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ACRONYMS/ABBREVIATIONS

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
GHS	General Household Survey
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-CRAM	National Income Dynamics Study – Coronavirus Rapid Mobile Survey
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
STATS SA	Statistics South 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

The events of 2020 highlighted the importance of the research and capacity development that is undertaken by the Centre of Excellence in Food Security (CoE-FS). The unprecedented measures put in place to slow the pace of new infections of the coronavirus disease 2019 (COVID-19) had an immediate and direct impact on household food security. Soon after the introduction of South Africa's hard-lockdown policies in April 2020, Stats SA used a convenience sample and web-based questionnaire to report a doubling of self-assessed hunger, albeit from a low base due to the biases inherent in their methodology. Using a pre-existing probability sample frame and telephone interviews, the National Income Dynamics Study – Coronavirus Rapid Mobile Survey (NIDS-CRAM) shows an increase in child and adult hunger following the lockdown, and an increase in the share of households who reported running out of money for food. This stood at 47 per cent in April 2020 declining to 37 per cent in June 2020 and can be compared to the General Household Survey (GHS) 2018 in which 25 per cent of households reported that they had run out of money to buy food. Finally, AskAfrika, a private-sector research company, used a telephone interview and quota sample to report that self-assessed adult hunger reached 41 per cent during the hard lockdown. This improved to 32 per cent at the time that most businesses resumed operation in July 2020, but reverted to 37 per cent at the time when most restrictions had been removed in October 2020.

Overall, the access and utilisation dimensions of food and nutrition security may be compromised into the future. Long-lasting structural changes seem likely due to the jobs and livelihoods that have been lost; food price increases arising both from speculation, increased costs and value-chain disruptions; and changes in diet and lifestyles due to mobility and financial constraints.

In this context, scholars such as Dr Gareth Haysom, a CoE-FS-affiliated researcher with the African Centre for Cities at the University of Cape Town, have sought to introduce the concept of 'slow violence' into the discourse on food insecurity. By this is meant a form of violence that is incipient and intergenerational. This theme is picked up by the annual Child Gauge Report that was co-edited in 2020 by Professor Julian May and Dr Chantall Witten, a recent recipient of a CoE-FS PhD bursary. The Child Gauge argues that children are, before even being born, disenfranchised as a result of dietary deficiencies in the first 1000 days. For these children, the food insecurity and deprivation experienced during COVID-19 spell long-term physical, psychological and social development challenges, many of which will haunt them into adulthood.

Researchers and students in the CoE-FS have also experienced direct and sometimes traumatic outcomes. Some have lost family members and colleagues who succumbed to COVID-19, many have experienced ill health themselves or of their family members, and all have experienced delays and disruptions of their research activities. We note with sadness the deaths of Dr Eugene Makgopa Lecturer in Plant Biotechnology and Professor Terry Aveling, both from the Department of Plant and Soil Sciences, at the University of

Pretoria. Both have been involved in CoE research projects, and Professor Aveling was involved in the CoE Farm Save Seed project as well as the Chair of the Seed Pathology Subject Matter Committee of the International Society for Plant Pathology and the Chairman of the Seed Health Committee of the International Seed Testing Association (ISTA) for the periods 2007-2010 and 2010-2013.

Nonetheless, the CoE-FS continued to operate through-out 2020, our sixth year of activity. In some areas, we have been able to increase our activities and impact, taking advantage of new technologies and a renewed interest in food insecurity and hunger. As a virtual centre, the administrative functions immediately moved to working off-campus and on-line. The CoE-FS had already invested in Zoom technology in 2018 and our meetings have been conducted as teleconferences since our inception in 2014. Also, all of our records have been stored on a secure cloud-based platform since 2015.

Despite the closure of both the UWC and UP campuses, the majority of our laboratory-based work could be salvaged, and we were also able to continue with our in-situ trials. Social science projects were also affected, and those involving fieldwork with face-to-face interviews had to be redesigned. Delays have been experienced in almost all student projects, but at the end of 2020, all students were still active.

We have been particularly active in our information brokerage and science communication, networking and community engagement/service rendering Key Performance Areas (KPA's). The CoE-FS has supported two submissions to the government concerning lockdown measures, one concerning informal food traders, and the second concerning school feeding. An additional two smaller projects were funded by UNICEF for COVID-19 which extend the CoE funded food safety project. The UNICEF for One Health funded a project related to hand sanitisers “COVID-19: downstream impact of disinfectants and sanitisers on the environment, food and health care systems: a legal and regulatory framework” and Project 2: “All-inclusive One Health Risk Analysis for Community Health”. These have further supported our One Health Covid programme.

We have also engaged with the national, provincial and municipal government concerning social grants, food parcels, food system stressors, and food safety. We increased our reach through our online Community of Practice meetings and published regularly as op-eds and articles in media platforms such as The Conversation, Business Day and Daily Maverick. We also participated in radio interviews and television, and our outputs were reported on international news services as far afield as Haiti and Argentina.

Our virtual Lekgotla held in July 2020 recommitted the CoE-FS to building the partnership between the host universities, and to the implementation of our management response to the Mid-term Review undertaken in 2018. We also reviewed our core research questions and while we concluded that these remain appropriate, we agreed to

adopt a place-based approach to the analysis of food systems. We will be implementing this approach in two pilot sites, the Breed Valley Municipality in the Western Cape and the Alfred Nzo District in the Eastern Cape. Taken together, the Cape Winelands District and the Alfred Nzo District present the two faces of South African agriculture and the South African food system. Also following the Lekgotla, there has been greater collaboration between the CoE-FS and the ARUA Centre of Excellence in Sustainable Food Systems based at UP, and we welcome the ARUA director, Professor Ludiwe Sibande onto the Management Committee of the CoE-FS.

We can report that we again received a clean audit, as we have done since 2014. The time taken to complete agreements with researchers and to transfer funds has significantly improved. The average time taken to conclude a project agreement in 2020 has been reduced to three weeks even during the disruptions following the lockdown in March 2020.

In 2020, researchers in the CoE-FS published 59 papers in accredited journals and peer-reviewed books, 17 of these publications were in journals with an Impact Factor greater than 3.0. CoE -FS students authored or co-authored 9 of the publications. A total of 95 students were involved in our projects, of which 47 were directly funded by bursaries awarded from the NRF grant. There were also 11 post-doctoral Fellows in the CoE -FS. Women students comprised 65.3%, and black students made 67.4%. Researchers and students presented 15 papers and posters at national and international conferences (these were mostly held virtually).

The CoE-FS has several postgraduate students that are funded through other government or industry sources. Examples of these students include Bursaries awarded by the Water Research Commission, MasterCard or several students are also funded through their respective institutions either as full, part-time or top-up bursaries.

We now have 35 Collaborating Agreements or Memoranda of Understanding with institutions/ entities in place. 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. Currently, the CoE -FS has over one hundred lead investigators/ researchers on its database. Together the grants raised by the CoE-FS amount to R22 852 493.16 in 2020.

We can thus report that we continue to achieve or exceed the majority of our 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 continue to lag with the share of bursary-holders who are South Africans living with disabilities.

Although the CoE-FS is no longer directly funding projects in the Humanities, this work continues through the Critical Food Studies group, a collaboration between UWC, UP

and the University of KwaZulu-Natal. We are proud to be associated with this successful spin-off from the CoE-FS which is establishing an important new field of study in South Africa.

Activities from our Communications and Engagement Strategy increased during 2020. 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 and policy contributions. Our Strategy has borne fruit during 2020, with 404 media activities including radio, television and the national press; 278 website views and 2818 Facebook likes. We bid farewell to our Communications and Engagement Manager, Ms Mologadi Makwela, who left the CoE-FS at the end of 2020 to take up a position in the private sector. In the five years that she held the position, she established the CoE-FS as a leader in science communication.

Professor Julian May, 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 CoE -FS'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 CoE -FS 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 concerning 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. Although this has become a discrete project led by UWC, UP and the University of KwaZulu-Natal, the research undertaken in all of the CoE-FS programmes continues to be informed by a Humanities perspective;
- 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. Increasingly our concern is shifting to local spatially bounded food systems, particularly those in which there are distinct urban/rural flows and dynamics;
- 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 35 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).

The University of Pretoria under the African Research Universities Alliance (ARUA) Centre of Excellence in Food Security, is leading two international collaborative food systems research projects funded by the UK Research and Innovation’s (URKI) Global Challenges Research Fund (GCRF) – Capacity Building in Food Security for Africa (CaBFoodS-Africa) and the Food Systems Research Network for Africa (FSNet-Africa). Both are focused on building research capacities within the African food system. FSNet-Africa is a collaboration between UP, the University of Leeds and the Food, Agriculture and Natural Resources Policy Analysis Network (FANRPAN).

3. STEERING COMMITTEE

In 2020, 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. This committee recommended four new members at the meeting in October 2019 to fill vacant positions, and Professors Sagadevan Mundree and Bocklines Bebe were appointed in 2019, and Professor Christine Foyer and Dr Mickey Chopra were appointed in 2020.

The CoE -FS also established a Scientific Sub – Committee in 2020 who is responsible for reviewing its planned activities, in terms of identifying what the CoE -FS should be doing, and evaluate outputs against what has been proposed in the Business plan. Dr Joan Matji was elected as the Chairperson of this committee and is also a member of the Steering Committee.

Table 1: List of Steering Committee members

Position	Name
Co-Chairperson	Professors Jose Frantz/Burtram Fielding (UWC)

Co-Chairperson	Professors Anton Stroh/Barend Erasmus/ Nthabiseng Taole (UP) - Prof Erasmus has been seconded by Prof Stroh to chair UP meetings.
Director	Professor Julian May (UWC)
Co-Director	Professor Lise Korsten (UP)
DST representative	Ms Rose Msiza (DST)
NRF representative	Dr Makobetsa Khathi/Mr Nathan Sassman (NRF)
Member	Dr Patrick Caron (Cirad)
Member	Ms Bongiwe Njobe (Independent consultant)
Member	Dr Joan Matji (Unicef) -Sci Sub - Committee Chairperson
Member	Prof Sagadevan Mundree (University of Queensland)
Member	Prof Bocklines Bebe (Egerton University)
Member	Dr Mickey Chopra (Worldbank)
Member	Prof Christine Foyer (University of Birmingham)

4. COE – FS DETAILS

4.1 Director and Co-Director

The leadership of the CoE -FS 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

During the first Semester of 2020 (01/01/2020-30/06/2020), the Director, Professor Julian May, was on Sabbatical Leave and Professor Ndomelele Ndidi served as the Acting Director.

4.2 Collaborators

The CoE-FS has concluded formal Collaborating Agreements (CAs) or Memoranda of Understanding (MoUs) with the following 35 institutions/ entities:

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)
28. US Food and Drug Administration (FDA)
29. University of Delaware (UD)
30. University of Maryland (UMD)
31. United States Department of Agriculture (USDA)
32. Bahir Dar University (BDU)
33. University of Ghana (UG)
34. Makerere University (MUK)
35. Evoke Kyne

4.3 CoE -FS details for verification

Host Institution:	University of the Western Cape
Co-Host Institution:	University of Pretoria
Year of current funding cycle:	Seven
Gate Stage:	5

5. OVERVIEW OF ACHIEVEMENTS DURING THE REPORTING PERIOD

5.1 Achievements related to the current stage

Tables 4-7 set out 2020 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 2020 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 NRF and Leverage funded students are provided in Appendix 8 and Appendix 9. Also, the information of NRF and Leverage funded students who graduated in 2020 are provided in Appendices 10 and 11 in the report.

The achievements and deliverables reflected in this report are only applicable to the 2020 reporting period.

Table 4: Activities related to the current stage of deliverables

Output	Achieved
Participate in official events of the DSI-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 CoE -FS.	✓
Make available to the NRF on a quarterly basis “nugget” of information for publication on the CoE -FS 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 2019 and 2020 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 into 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.

The CoE-FS continues to undertake research in all disciplines, including the Humanities. Between 2015 and 2019, funds were contributed towards a programme in Critical Food Studies at UWC using both NRF resources and a grant raised from the Mellon Foundation. In 2019, the Mellon Grant came to an end, and a new multi-institutional grant was raised by the lead researchers in the Critical Food Studies group that expanded the programme to include the University of Pretoria and the University of KwaZulu-Natal. The programme has now spun off from the CoE-FS with its own management structures and administration. Nonetheless, researchers from this group continue to participate in our annual Lekgotla, providing valuable insight which we use to guide our Business Plan. We also collaborate with this group on specific research projects and continue to support research in the disciplines of Law, Human Geography and African Studies.

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

Table 5 provides the 2018-2023 output targets for the current stage, and the 2020 achievements against the Service Level Agreement. This table also provides an overview of the achievements from 2018 -2020 to illustrate the CoE -FS’s progress against its targets.

The evidence for each target is provided as appendices and tables in the report. In 2020, the CoE-FS projects supported 95 students. Of these, 47 students were funded through the NRF and 58 through Leverage funding. In terms of gender, a total of 62 (65.3%) women were supported, which is above the target of 55%. The CoE -FS supported a total of 64 (67.4%) black students, and nine (11.6%) post-doctoral fellows. In terms of equitable distribution of South African students, 84 black students (88.4%) and 53 women (55.8%) were supported.

A total of 47 students graduated in 2020. The CoE -FS produced 59 publications, 17 of which have an impact factor of three and more. The CoE -FS’s website had 278 website views, and 2 818 likes. In addition to this, the CoE-FS had 404 media activities. Lastly, the CoE-FS raised an additional R22 852 493.16 to support its research and students.

As illustrated in Table 5, for the period 2018 – 2020, the CoE -FS supported 353 students with a total of 221 female students and 219 black students. This table also reflects that the CoE -FS supported 33 post-doctoral students during this period. In addition, since 2018 the CoE -FS produced 152 publications, this includes 43 articles with an impact factor greater than three.

Table 5: Service Level Agreement 2020 -2023

Description	Outputs for 2020	Output Targets 2020	Outputs 2018 – 2020	Output Targets 2018 -2023	Source
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Number of students registered in 2020 with CoE-FS / NRF bursaries	47	≥30	172	≥180	Appendices 6,7
Students included in projects funded by the CoE-FS (all students)	95 ¹	≥60	353	≥360	Appendices 6,7,9
Women students supported (all students)	62 (65.3%)	≥ 55% of all students	221	≥ 55% of all students	Appendices 6,7,9
Black students supported (all students)	64 (67.4%)	≥ 70% of all students	219	≥ 70% of all students	Appendices 6,7,9
Equity distribution of South African students (Black, Coloured, Indian, Asian)	84 (88.4%) 53 (55.8%) 0	≥80% black, ≥ 55% women ≥4% disabled	212 171 0	≥80% black, ≥ 55% women ≥4% disabled	Appendices 6,7,9
Citizenship distribution of South African and non-South African students	78 (82.1%) 10 (10.5%) 6 (6.3%)	≥87% South African (incl. permanent residents) ≤5% SADC (excl. SA) ≤4% of rest African continent	191 27 18	≥87% South African (incl. permanent residents) ≤5% SADC (excl. SA) ≤4% of rest African continent	Appendices 6,7,9

¹ This figure includes 47 NRF and 48 Leverage funded students

	1 (1.1%)	≦4% non – African	3	≦4% non – African	
Proportion of students graduating by the next Gate Review	To be determined in 2023	≧ 75% of all students since inception		≧ 75% of all students since inception	n/a
Average duration of submission of Master’s degrees (post-Honours)	24 months	≧ 24 months	24 months	≧ 24 months	n/a
Average duration of submission of PhD degrees	36 months	≧ 40 months	36 months	≧ 40 months	n/a
Average duration of submission of PhD degrees (upgraded from Master’s)	60 months	≧ 60 months	60 months	≧ 60 months	n/a
Post- doctoral fellows	11(11.6%)	≧ 10% of students	33	≧ 10% of students	Annexure 6,7,9
Number of unrated researchers who become rated, or rated researchers who retain or improve their rating	11	≧ 3-4	11	≧ 20	Appendix 4

Number of patents, products & artefacts	1	≥ 2	2	≥ 10	Section 18
Number of articles accredited journals, chapters in peer-reviewed books or books	59 ²	≥ 27	152 ³	≥ 160	Appendix 3
Number of articles with an Impact Factor greater than 3	17	≥ 32	43	≥ 32	Appendix 3
Number of joint venture student training initiatives	7 ⁴	≥ 10	27	≥ 10	Section 7.4
Number of local conferences organised	0	≥ 2	12	≥ 2	n/a
Number of international conferences organised	0	≥ 2	3	≥ 2	n/a
Presentations at local conferences	11 ⁵	≥ 160	153	≥ 160	Appendix 1
Presentations at international conferences	4 ⁶	≥ 40	54	≥ 40	Appendix 1
Food security panels	0	≥ 1	19	≥ 4	

² A total of 9 students authored/ co – authored of the publications.

³ A total of 47 students authored/ co – authored of the publications.

⁴ These initiatives refer to the training provided by a project/ WPs to students.

⁵ Due to COVID -19 no local conferences were held since March 2020, it has changed to webinars/ online meetings.

⁶ Due to COVID -19 no international conferences were held since March 2020, it has changed to webinars/ online meetings.

organised at conferences					
Annual Social media (Facebook, etc.) views	9 765 ⁷	≥37	13 796	≥222	Table 15
Number of face-to-face policy maker engagements	0	≥6-7	27	≥40	n/a
Annual website views	278	≥750	41 360	≥4500	Table 14
Annual media activities (radio, TV, press)	404	≥ 2	832	≥ 12	Appendix 5
Annual Facebook likes	2 818	≥16 - 17	6 731	≥100	Table 15
Number of citations of pooled articles/ book chapters that acknowledge CoE-FS funding (Google scholar)	32	≥6-7	92	≥40	Appendix 3
Additional funds raised	22.8 million	≥ R17 million	52.6 million	≥ R100 million	Table 18/19

Despite notable improvements in various targets set out in the SLA, the CoE -FS fell short in the participation of students with disabilities. The CoE -FS will continue its efforts to bring on board more student and researchers from other HDIs in 2021, especially students with disabilities. Support from the NRF centralised application process will be necessary.

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

⁷This figure includes Facebook group, Facebook page, Twitter page, You tube views and SoundCloud views.

acting director while Professor May was on sabbatical leave. Also, there is a notable improvement in the number of female researchers and students supported through the CoE-FS. Regarding the CoE -FS's management and support structure, we have made excellent progress in appointing staff from previously disadvantaged backgrounds. Additionally, the CoE -FS's full-time staff and the two UWC contract staff comprise 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 CoE -FS'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. This program 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 of presentations as well as drafting research and funding proposals. She registered for a PhD in Media Studies at the start of 2018, and will continue with this in 2021. Ms Elaine Petersen's role over the last few years has developed from 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 in-house Finance and Human Resources training courses, and successfully completed her coursework for her BCom General Degree (Finance stream) in 2020. Ms Robyn Engelbrecht, who has been appointed on a one-year contract as an Administrative assistant has registered for a certificate in Economic Development at UWC and will complete this course in 2021.

Ms Nolutando Didiza is currently enrolled in an Honours program at the Institute for Social Development (ISD) at UWC, and also completed various in-house 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. Further information on some of the core CoE - FS's transformation achievements, gender impact and human resource management initiatives is provided in sections 14 to 16 in this report.

Table 6: Transformation targets

Output	Achieved
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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 (virtual)	✓
One MANCO planning meeting/ Lekgotla has been held (virtual)	✓
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 inquiry 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. Crosscutting 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.

The six areas of research adopted and endorsed by the Steering Committee in 2015, and approved by the NRF in 2016 remain the focus of our work in 2020 but have been re-aligned, as a consequence of the outcomes of the May 2019 Lekgotla to mainly enhance the integration of the research of the CoE-FS but also to take into consideration the mid-term review of the CoE-FS:

The three research questions that inform the scope of work for the CoE-FS's research activities for the second planning cycle (2020-2024) remain unchanged; these are:

- How is the global and national food system changing and how does this affect the sustainability, availability, access, and attributes of food?
- 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 changes in response to the changing food system?
- What policies, technologies, interventions, and products enable access to affordable and nutritious and safe food in ecological, economic, social, and politically sustainable ways?

In 2020, 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.

The CoE-FS supported eighteen NRF-funded projects/ WPs in 2020. Some of this support took the form of bursary and conference funding. CoE-FS's 2020 funded projects are listed in Appendix 12. This list also outlines the contributions to HDIs, marked in orange. From the eighteen NRF projects/WPs funded in 2020, five were administered by an HDI.

6.1 PROGRAMME 1: FOOD SYSTEMS, GOVERNANCE AND POLICY

This programme is led by Professor Bruno Losch (GovInn/ UP).

South Africa's agro-food system is undergoing rapid, corporate-driven restructuring with implications for food security being both direct (via impacts on the nature and availability of foods) and indirect (via the implications for livelihoods, employment and economic activity). In 2020 this programme continued to explore the most urgent and important of these changes to make these dynamics visible to policymakers. Key questions answered include:

1. How is South Africa's agro-food system changing, and what are the prime drivers of change - from production systems, employment in production, through to consumption via informal markets and supermarket retail, and what are the outcomes for consumers in a changing food environment?
2. How is the regional food system changing in Southern Africa - what are the drivers of change, what are the main determinants and outcomes of change?

A second major set of problems related to the ability of South Africa's institutions of government to engage effectively with the dynamics described above. The programme therefore also seeks to understand the institutional arrangements required to make food

security governable and the ability of policy frameworks to link questions of food security and nutrition to broader development priorities. Key research questions here include:

1. What are the institutional arrangements for food system governance at the city level, and to what extent do they make food security problems and vulnerable populations visible to the government?
2. To what extent is there alignment between regional development priorities and the need for food security and right-to-food policy?

Research is undertaken as well as the achievements under this programme are highlighted under the following projects.

6.1.1 Local Food Governance: Project ID - 20101

This project involves Dr Camilla Adelle, (GovInn, UP) and Mr Florian Kroll (PLAAS, UWC). The project adopts an action-research approach, engaging directly with the transformation of local governance by generating knowledge to inform practice, and studying governance practice to expand and deepen knowledge in local food governance. It combines literature review and documentary analysis with stakeholder engagement, through workshops and the development of communities of practice, including participant observation, complete with key stakeholders and elite interviews. Since mid-March 2020 activities have been conducted online while interacting with stakeholders has intensified and expanded to respond to the increased need for information and communication amongst stakeholders to guide the governance of the food system during the lockdown as well as in its immediate aftermath.

The main activities under this project in 2020 were:

- a) A new PhD researcher was embedded in the Western Cape Economic Development Partnership for six weeks (February 2020 – March 2020) to gain insights into the Whole of Government Approach (WOSA) to collaborative governance before commencing her PhD proposal on the subject.
- b) A stakeholder workshop was held on 5 February 2020 to map civil society organisations active in the food space (before COVID-19) in the Western Cape.
- c) A media review and 15 key informant interviews were conducted alongside participant observation of key government/ stakeholder meetings to investigate how civil society organisations mobilised to deliver food relief during the lockdown.
- d) The frequency of meetings of the Food Governance Communities of Practice (FGCoP) (Gauteng and Western Cape) was increased from one a quarter to once a month to help cater for the increased demand from stakeholders to discuss and share information on the acute food security crisis brought on by lockdown measures.

- e) Also, a 'reference group' was established to steer the content and direction of future Community of Practice (CoP) meetings and therefore diversifying the governance of the community.
- f) The CoP also assisted the CoE -FS partner with the Cape Town 'Food Dialogues', an open platform discussing the food system in a way that was accessible to the public and civil society organisations.
- g) A new research focus was established exploring the use of cash vouchers for supporting the local informal economy and investigating the impact of COVID-19 lockdown on food purchasing and consumption behaviour.
- h) A research partnership was established with City University, London to systematically document Cape Town's food policy initiatives and institutional capabilities to govern the metropolitan food economy to improve food access, diet, and health of its constituents, but also how these relate to other governance dimensions such as jobs, the environment, and urban planning. Nine expert interviews have been conducted with state officials and are currently being analysed.

The main achievements of the project in 2020 are as follows:

- The FGCoP (Gauteng and Western Cape) were combined (potentially temporarily) in 2020 and taken online (via Zoom and Facebook) as well as more widely advertised. This change was to hold larger and more frequent meetings to keep abreast of the rapidly changing food security, institutional and stakeholder context of lockdown. While in 2019 the face to face meetings catered for around 30-35 people each, in 2020 the meetings usually included 80-100 people online and on one occasion had well over 200 people participating. The FGCoP also worked more closely with provincial and local government during 2020 as the position of the FGCoP became more firmly intertwined with local food governance.
- The Food Sensitive Planning and Urban Design activities (FSPUD) have been completed following a stakeholder workshop organised in November 2019 in Bellville in collaboration with the African Centre for Cities. FSPUD has emerged as an approach to food planning and one that is gathering traction in other regions, mostly developed countries. FSPUD has been included as a key pillar in the Western Cape Food and Nutrition Security Strategy and as a result, is generating much interest and attention at the local scale. The preparation of the workshop has led to the production of a background paper which has been updated for publication as a CoE working paper in 2020. The workshop report will also be published.

Research under this project will continue in 2021, and further research outputs will be provided in the 2021 Annual Report.

6.1.2 National Food Governance – Towards National Knowledge Brokerage: Project ID - 20102

This project involves Dr Camilla Adele (UP, GovInn), Mr Florian Kroll (UWC), Professor Lise Korsten (UP), Dr Marc Wegerif (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 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 project aims to increase the visibility and societal impact of CoE-FS's research as well as produce new socially robust knowledge on how to better govern South Africa's food system.

The main activities under this project in 2020 were:

- a) Research on food safety: Investigating the management and implementation of food safety policies.
- b) Research on national food governance to analyse the extent to which the prevailing food security governance arrangements in South Africa contribute to the reduction of food security.

The main achievements of the project in 2020 are as follows.

- A series of public seminars on food security have been organized at the University of Pretoria. Entitled #FoodTalks Seminar Series, they were put on hold during lockdown with the first talk subsequently resuming on World Food Day on 13 October 2020: 'Exploring endogenous paths to resilient food systems in South Africa'.
- A systematic review of food governance literature in South Africa focusing on the 1994-2020 period was conducted with a total of 1,237 screened references and 175 used for the synthesis.

The activities have been highly constrained by the lockdown and restrictions of travel related to the COVID-19.

Research under this project will continue in 2021, and further research outputs will be provided in the 2021 Annual Report.

6.1.3 The Right to Food for School Leavers: Project ID - 20103

This project was led by Professor Ebenezer Durojaye (UWC). This project adopts a rights-based approach to the debate on access to food. It combines research, advocacy and litigation to draw the attention of relevant stakeholders to addressing hunger and food insecurity on campuses and for school leavers. It will particularly analyse the obligations of government and non-state actors towards eliminating hunger on campuses.

The objectives of this project are:

1. Addressing food insecurity and hunger among learners in South Africa using a rights-based approach;
2. Addressing social inequality which serves as a fertile ground for several social ills including food insecurity; and
3. 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 in 2020 were:

- a) Fostering the Policy Debate on Food Security for School Leavers through dialogues.
- b) Media Advocacy on Right to Food in Tertiary Institutions through a booklet and infographic.
- c) A research paper on Adopting a Rights-Based Approach to Food Insecurity in South African Universities.

The main achievements of the project in 2020 are as follows:

- Conducted two dialogues on realising access to food for students in South African tertiary institutions. These dialogues brought together government Departments, Chapter Nine institutions and other stakeholders including academics and civil society groups to deliberate on various issues relating to access to food for students in tertiary institutions. These highlighted many pre-existing and emerging challenges concerning physical and economic access to food, as well as the food environment and culture at South African tertiary institutions.
- A booklet on the Right to Food for Students in Tertiary Institutions was produced (400 copies), co-authored by Oluwafunmilola Adeniyi and Ebenezer Durojaye. The booklet is to be disseminated across institutions as it has been developed to assist students, administrators and policymakers in ensuring the realization of the right to food of students in tertiary education institutions across South Africa.
- A two-minute infographic animated video was produced as part of our media advocacy strategy highlighting the challenges of school leavers concerning hunger

and food insecurity. It will serve as a useful tool to engage with policymakers during the planned meetings with relevant government departments.

- A paper titled 'Give us this day our daily bread: Adopting a Rights-based Approach to Food Insecurity amongst Students in South African Universities' was completed and submitted for publication Journal of Human Rights an accredited international journal by E Durojaye and R Nanima.
- The Masters' student has completed her studies in June 2020 with an LLM (Cum Laude).
- The PhD postgraduate student has written up her PhD thesis and has officially sent in an intention to submit to the University, it is envisaged that the formal submission for the examination will be concluded in a few weeks.

6.1.4 Maximising Access to a Balanced, Safe and Healthy Diet for the Poorest Urban Residents: Project ID - 20104

This research is led by Professor Frans Swanepoel (UP).

South Africa is now a majority urban country and faces particular challenges in building a more inclusive economy that brings greater opportunity for black ownership as well as incomes. This need is frequently expressed in calls for far-reaching land reforms and radical economic transformation. Any sustainable food system, as part of the wider economy and a provider of opportunities for new black farmers, will need to contribute to addressing these issues.

In South Africa, urban informal food trade does not operate in isolation but is closely linked to the formal sector with mutual trade and exchanges taking place between them. This unique landscape forms an interesting, but a complex backdrop to what requires context-specific interventions to address its most pressing concerns. Currently, little is known about the wider food system that the informal food market is part of, how it operates, the benefits to food producers and others in the system, and the social and ecological impact it has. This lack of knowledge leads for instance to the development of policies and programs that undermine this food system through the removal of street traders. Access to a variety of fresh fruit and vegetables as well as high protein foods is essential for a balanced and healthy diet. The way these foods are produced and distributed can contribute to increasing or reducing inequality. The functioning of markets, of a variety of kinds, is central to food production and distribution. Much work on food security has focused on core staple food, such as maize, whilst it is inadequate for achieving food and nutrition security in the form of a diverse and balanced diet. This study, therefore, focuses on the supply of commonly consumed fresh produce and high protein foods, such as groundnuts, cabbage and meat to the cities, including the various forms of markets involved. It maps the modes of production and distribution of fresh produce to the urban centres of Johannesburg and Pretoria with a focus on the modes that make a balanced diet most accessible for urban residents in poverty.

The study further analyses the wider social and ecological challenges of these systems with attention to the impact on small-scale and black farmers. It has already been found in preliminary scoping work for this study that street traders, local markets and hawkers (all often referred to as "informal" traders) make these foods accessible to poorer residents through low pricing and other factors, such as their proximity to eaters. Services, such as credit to known customers, also assist people to maintain a balanced diet when living on low and unreliable incomes. As well as being accessible, nutritious food needs to be safe. Even though foodborne diseases are increasingly being recognized as a major public health concern, rigorous and extensive scientific data on the level and nature of food safety hazards (be it microbial, chemical or physical) is lacking. Through this study, the information will be gathered at various stages of two informal urban supply chains (cabbage and peanuts) to determine to what extent different stakeholders are exposed to chemical food contamination (microbial toxins, and pesticide residues). Chemical contaminants cannot be removed through heating (i.e. cooking, roasting, etc.) and have been frequently detected in the informal sector. Furthermore, this scientific data needs to be contextualized in the day-to-day social and physical realities of the informal trade sector if this is to lead to policy recommendations that are both appropriate and feasible to implement.

A better understanding of how the food system functions, including its strengths, weaknesses, health and safety factors, will form the basis for an informed dialogue on how it can be improved to benefit the urban poor.

The WPs under this project are (i) Mapping the Urban Foodscape for a Balanced Basket of Nutrition Foods, (ii) Explore the Food Safety Challenges of the Informal Food Market, and (iii) Do an Exposure Assessment and Risk Characterization of Food Safety Hazards Present in the Informal Food Market.

Research under this project will continue in 2021, and further research outputs will be provided in the 2021 Annual Report.

6.2 PROGRAMME 2: INNOVATION AND TECHNOLOGY

The PIs 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.

Research undertaken as well as the achievements under this programme are highlighted under the following projects/WPs.

6.2.1 SMART Food Processing: Project ID - 20102

This project is led by Professor Naushad Emmambux (UP). Other team members include Professor KG Duodu (UP), Professor MN Amambay (UP), Dr N Mehlomakulu (UP), Dr Danie Jordaan (UP), Professor E Buys (UP), Dr M Mphosi (UL), and Professor R de Kock (UP), Dr N Marx -Pienaar (UP), Dr B. Dlamini (UL), Professor E Amonsou (Durban University of Technology).

The primary question of the project is 'what technological innovation is required for food and nutrition security in the processing of indigenous and local foods. This project works hand in hand with the agricultural production part of the programme. This is a continuity of the previous SMART foods project.

The primary aims/purpose of the proposed project are:

1. The creation and processing of 'SMART' foods and food ingredients from indigenous and local plants to combat malnutrition and diet-related non-communicable diseases. [L]
[SEP]
2. Necessary tools in terms of appropriate food processing technologies for entrepreneurs to produce affordable, safe, convenient, consumer-driven, nutritious foods and food ingredients.
3. Value addition to waste from food processing industry for sustainable food production.

The main activities under this project in 2020 have been:

- a) Technological innovation to reduce the energy density of foods.
- b) Technological innovation to increase the nutrient density of foods with health benefits for infants and adults.
- c) Technological innovation for value addition of food industry waste.
- d) Training, communication and feasibility of research and technologies developed.

The main achievements of the project in 2020 are as follows:

- a) **Technological innovation to reduce the energy density of foods:**
 - PhD student C Mapengo has shown that maize meal and maize starch modified by heat moisture treatment (HMT) and lipid reduced estimated glycaemic index (GI) and this is related to an increase in resistant starch. The study has proposed specific mechanisms as to how heat moisture treatment with stearic acid can change the microstructure, nanostructure and molecular structure of starch and she has related

these changes to the low *in vitro* starch digestibility. This green modification can potentially be used as a low GI food for people suffering from type 2 diabetes.

- PhD student Isaac Asare is also working on HMT treated maize meal and starch with stearic acid. He is focusing on the large intestinal fermentation. With his work done at Purdue University, the team will be the first in the world to report that amylose lipid complexes (ALC) as resistant starch act as a prebiotic and can change the intestinal microflora for health benefits. This study has also shown that the ALC as RS promotes the formation of beneficial short-chain fatty acids, similar to fructo-oligosaccharide as a reference.
- Starch-phenolic complexes with reduced susceptibility to hydrolysis by starch-hydrolysing enzymes and with antioxidant properties were produced from the interaction between maize starch and phenolic extracts from grape pomace and condensed tannin sorghum bran under alkaline conditions, by PhD student K Oladele. These complexes could be applied as ingredients in foods and impart anti-diabetic properties and offer protection against non-communicable diseases induced by oxidative stress. This research also offers opportunities for reduction in environmental pollution by waste beneficiation from the winery and sorghum processing industries to produce functional food ingredients with potential health-promoting properties.
- PhD student H Nekhudzhiga is working on the PCT applied patent 'starch microsphere as fat replacer'. He is investigating the lubricity and the viscoelastic properties of the manufactured starch microsphere. It seems like the microsphere contain both lubricity and elastic properties and this enables the microsphere to escape fragmentation during high shear homogenization. Honours students N Mdiyata and K Vlotman associated with this project have shown that the starch microsphere can replace fat in yoghurt and cheese analogue. This needs further investigation.
- MSc student N Maphumulo is working on increasing the crystallinity and hydrophobicity of isolated amylose lipid nanomaterials. Firstly, he has shown that the unique patented process of producing the nanomaterial can be upscaled, and infrared, as a green technology, can partially increase the crystallinity. Moreover, infrared can also reduce the viscosity of the isolated nanomaterial and this can have a good implication as an encapsulation matrix for flavour compound in the beverage industry.
- MSc student R Kawuma is working on the interaction between cellulose and several starches as this can impact on the functional and nutritional properties. Mr Kawuma has so far shown that nanocellulose can have a better impact compared to cellulose at micro-level.
- DTech student in Food Science from Durban University of Technology, M Khoza is working on processing of bananas. She has so far found that infrared can increase the water absorption and water solubility of bananas, but decrease water solubility. The processing also increases the total phenolic content of the bananas.

b) Technological innovation to increase the nutrient density of foods with health benefits for infants and adults:

- Post-doctoral fellow Dr Peter Bamidele showed that extrusion process to encapsulate ascorbyl palmitate by maize starch has potential and gave better encapsulation yield compared to spray drying and pasting. The encapsulated material also showed slow release during *in vitro* digestibility as well as stability at acidic pH.
- PhD student Mr P Mukwevho has shown that heat-treated Bambara groundnut with microwave and infrared can reduce the cooking time from 3 hours to about 30 minutes. The flour produced from the heat-treated Bambara seeds can be used to replace wheat flours up to 30% without any changes in the dough rheology. This will thus enable to produce a high protein bread. The heat-moisture treated seeds also produce low viscosity flour and the PhD candidate is further investigating the mechanism behind this phenomenon.
- PhD student Sami Ali has started working on fermentation of various sorghum for flatbread. He has so far shown that the tannin sorghum forms a more viscous batter during and after fermentation. He is currently investigating why the fermentation can produce good flatbread.
- MSc student S Kandolo is working on extraction and characterization of a protein from cowpea and Bambara seeds. She has so far managed to produce a protein concentrate. The protein has potential as meat analogues for vegan and vegetarian diets.
- MSc student M Kgonothi is working on the dehydration of orange-fleshed sweet potato by novel technologies such as microwave and infrared. He has so far shown that microwave and infrared reduce the drying time by a quarter compared to oven drying. He is busy analysing the functional and beta-carotene content of the sweet potato.
- Research conducted on enhancing mineral bio accessibility of sorghum-based porridges through food-to-food fortification revealed some interesting findings by PhD student J Lubaale. A combined fortification with ferrous sulphate and organic acids (ascorbic acid and citric acid) increases both the amount and percentage of bio accessible iron in both conventional wet cooked and instant extrusion cooked sorghum porridges. Co-processing (addition of baobab fruit pulp powder) increased the percentage of bio accessible iron but only increased the amount of bio accessible iron when extruded. Conventional wet cooking did not affect the amount of bio accessible iron in the porridges. Fortification with moringa leaf powder whether alone or together with baobab fruit pulp powder decreased the percentage of bio accessible iron. Moringa leaf powder cooked with sorghum did not affect the amount of bio accessible iron. Extrusion of sorghum with moringa decreased the amount of bio accessible iron. Overall, these results show that fortification with baobab fruit pulp enhances mineral bio accessibility much more than with moringa leaf powder.

- MSc Student L Nyathi is working on lactic acid fermentation of finger millet. Lactic acid fermentation improved the *in vitro* protein digestibility of uncooked finger millet flour and cooked finger millet-based beverages except for uncooked finger millet only samples. Most importantly, all fermented and cooked samples had higher *in vitro* protein digestibility than unfermented and cooked samples. This indicates that fermentation seemed to somewhat alleviate the negative effects of cooking on *in vitro* protein digestibility. However, fermentation had no significant effect on reactive lysine content of uncooked finger millet flour and cooked finger millet-based beverages.
- PhD student Y Njowe is working on the properties of edible insects and their protein concentrates. He has found that collected insects have a high protein quality and can be compared with milk or soya protein. In terms of functional properties, the protein has good foaming and emulsifying properties. The characterisation of these insect's protein will pave the way to understand their potential as food and food ingredients.
- The 2020 projects focused on lactic acid fermentation of *Moringa oleifera* leaves with *Lactobacillus plantarum* to study the degradation of phytate and whether the fermentation will have an effect on the bioactive peptides as well as the bioaccessibility of phenolics and antioxidant activity of the leaves. The studies highlighted that indeed fermentation degraded phytate in comparison to the unfermented leaves. The phytase enzyme was not analysed as either from the leaves or the inoculated culture. The culture used has been reported to secrete phytase and has been used in fermenting Moringa leaves. This highlights the contribution of the culture in the removal of antinutrient factors. The role of an inoculated fermentation was further highlighted through the increased protein and bioactive peptide content when compared to fresh and spontaneously fermented leaves.
- Fermented foods consist of complex microbial communities which are referred to as their microbiomes. These microbiomes give a comprehensive look into what microorganisms are responsible for fermentation and the identification of these microorganisms can aid in the development of optimum starter cultures. In this study, the microbiomes of four spontaneous cereal fermentations, two from the lab (sorghum) and two sourced at a Nigerian market (sorghum and maize), were analysed through 16s rRNA sequencing. Cereal fermentations sourced from the market were dominated by *Lactobacillus* while lab fermentations were dominated by *Paenibacillus* and other unknown microorganisms. *Lactobacillus* was found in both lab fermentations and therefore *Lactobacillus* strains will be able to serve as starter cultures for the production of specialised sorghum fermentations.
- MSc student J Baloyi completed her degree with a dissertation: Resting of sorghum-soya biscuit dough: effect on dough and biscuit physicochemical properties and consumer acceptability of the baked biscuits. The objective of this study was to evaluate the effect of dough resting time (15 min and 24 h) on the physical properties, proximate composition, texture, thermal properties, starch and protein digestibility and consumer acceptability of sorghum-soya biscuits. Increasing

sorghum-soya dough resting time to 24 h may have promoted hydration of some starch granules but not starch gelatinization. Longer dough resting did not have the desired positive impact on the biscuit quality.

- PhD student A Venter has started his PhD on phenolic of wild and indigenous flowers. He has recently done his proposal and is busy in the lab.

c) Technological innovation for value addition of food industry waste:

- Post-doctoral fellow Dr Carene Picot-Allian has extracted pectin from citrus waste. Pectin extracted without pre-treatment to remove bioactive compounds has less health benefit in terms of antioxidant. Pectin with pre-treatment also showed some health benefits. The rheology of the extracted pectin in terms of gelling is under investigation.
- MSc student M Masanabo has shown that starch with zein protein (a byproduct) from maize can be processed by extrusion to produce a thermoplastic material for the biodegradable packaging system. He also showed that addition of NaOH in the system improves the compatibility of the starch and zein mixture to produce a homogenous film with better properties.
- S Candiotes MSc studies on "Consumers' understanding of food waste and their attribution of blame" indicates that consumers acknowledge their role/contribution towards food wastage, however, consumers require more support from other stakeholders, in particular, retail and government to address and ultimately mitigate the problem.
- L Mbuza, PhD entitled "A consumer-centric approach to the development and evaluation of biodegradable Bio-mordanted onion (*Allium cepa* L) skin dye for the apparel" has shown some progress including completion of the consumer focus group discussions. Data analysis of this phase is currently underway. The experimental extraction (phase 2 of the methodology) is unfortunately delayed due to the COVID-19 restrictions.
- Z Finxa, MSc study entitled "A case study of mogodu vendors' cultural food expertise in the Sedibeng District, SA to explore valorising the dish amongst urban consumers" progress, includes approval of ethical clearance (NAS134/2019), as well as initial literature review and informal observations of mala mogodu preparation. Development of formal mogodu preparer and vendor one-on-one interview and data collection tools underway.
- V Chakwazira, MSc study entitled "Consumers' sensory and cultural preferences for mala mogodu" progress, includes approval of ethical clearance (NAS134/2019), as well as initial literature review and informal discussion with mala mogodu consumers in the Makhado district. Development of formal mala mogodu consumer sensory data collection instrument underway.

d) Training, communication and feasibility of research and technologies developed:

- Dr Mphosi from the University of Limpopo has trained about 41 small scale and emerging food processor in processing, Good manufacturing practices and HACCP (Hazard analysis critical control points) of mayonnaise, pickled vegetable, carrot juice, chilli sauce, tomato jam, indigenous melon wine and yoghurt. In future, UP will also form part of such training and will include some of the developed products.
- Dr Jordaan from UP Agric economics has also shown that pasta made from sorghum and cowpea composite has potential for commercialization, depending on the scale of production. He will finalise the analyses when the pasta is further developed for commercialisation.
- Professor Dada is busy writing a review paper to show how food security, nutrition and food product developed are important for South African citizens with disabilities. She is halfway through the review and the first draft is expected by end of the year. She is also working on an adapted manual for communication for low literacy consumers for solar dehydration.

Research under this project will continue in 2021, and further research outputs will be provided in the 2021 Annual Report.

6.2.2 Innovation for Environmental Change Resilient Agriculture Drought responses in Cereals and Legumes: Project ID - 20202

Professor Ndiko Ludidi (UWC) is leading this project in collaboration Professor Hon-Ming Lam (Chinese University of Hong Kong, China), Professor Robert Sharp (University of Missouri, USA), Dr Ifeanyi Egbichi (Walter Sisulu University), Professor Marshall Keyster (University of the Western Cape), Dr Eugene Makgopa (the University of Pretoria, *sadly deceased in September 2020*), Dr Mounawer Badri (Centre of Biotechnology of Borj Cedria, Tunisia), Dr Nandipha Ndudane (Tsolo Agricultural and Rural Development Institute, South Africa) and Dr Davison Moyo (UP).

This project consists of various WPs, and the main activities under this project/WPs in 2020 were to:

- a) Evaluate the performance of maize, sorghum, soybean and cowpea lines under both drought and heat stress conditions to ensure that lines of these crops which possess drought tolerance together with heat tolerance can be used in identifying genes that mediate the tolerance of these lines to combined drought and heat stress.
- b) Initiate a breeding programme for soybean to develop new soybean cultivars with enhanced tolerance to drought.
- c) Implement regenerative agriculture practices using crop rotation, intercropping and minimal tillage techniques in a cropping system that uses maize, soybean, sorghum, cowpea, pearl millet, finger millet, teff, safflower, wheat, alfalfa (lucerne), canola, marama, wild sweetpea, common bean barrel medic and black medic. This will result from the determination of the effect of this cropping system on soil

health, crop nutrient content and biodiversity concerning plant beneficial insects and microorganisms.

- d) Evaluate the impact of feed composition on cattle methane production using vegetative and grain components from selected crops grown, while conducting in-depth genetic control of cattle resistance to heat, drought and ticks.

The project identified a maize line with good tolerance not only to drought but to heat stress as well (out of 28 different maize lines that we examined for tolerance to both drought and heat stress). For sorghum, soybean and cowpea, we are still screening the various lines for combined drought and heat stress tolerance, but we have completed the screening of their tolerance to drought.

For maize and cowpea, the research is finalizing proteomic analyses of their drought tolerance and will provide a list of genes that determine their drought tolerance by 20 November 2020. Breeding of soybean for drought tolerance, based on the already identified drought-tolerant line, will begin in December 2020 when the currently growing soybean crop begins flowering. It has been determined that increasing crop diversity has a positive effect on beneficial insect diversity but also introduces detrimental insects in the cropping environment, and thus we will be working to optimize the cropping system to suppress the occurrence of detrimental insect pests. Nonetheless, the study observed increased yields (on a per hectare basis) in a diverse cropping system than in monoculture, when cereals are combined with legumes as part of an intercropping practice that includes oil crops and feed crops such as canola and safflower and we think this is because of the impact of the cropping system on soil health and an increase in the diversity of pollinating insects.

The work on methane emissions is in progress and will be completed in December 2020/January 2021 but the research has nonetheless determined that cattle grazed on natural grass veld have fewer methane emissions than cattle fed with supplementary creeps (sugarcane molasses, urea and methionine hydroxy analog) and have found that skin attributes in cows (hide thickness and hair/fur length/thickness) plays a role in heat stress tolerance and infestation by ticks, but the research is in the process of using the different crops of one of the studies in the absence of the supplementary creeps to evaluate their effects on the methane emissions.

Research under this project will continue in 2021, and further research outputs will be provided in the 2021 Annual Report.

6.2.2.1. Reclamation of Heavy Metal Contamination of Soils: Project ID- 20202 - WP 2.2.2 (1)

Professor Marshall Keyster (UWC) is leading this research with Professor Ndiko Ludidi (UWC) and Dr Donna Brandt (University of Missouri).

The objectives and activities under this project in 2020 were:

1. Soil analysis:

Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES) was used to analyse soil samples collected from a study site in Lukholweni (-30.652314, 28.863464) which is earmarked for field trials. The preliminary, analysis showed that there are variations in nutrient amounts throughout the study site. The sites are mostly Phosphorous and Potassium deficient as well as over-abundant in Iron. Other analysis is underway and will give more insight into the soil health status of the study site in question.

2. Microbial diversity of soil and plants:

Various extreme weeds were identified and GPS tagged on sites around the University of the Western Cape (UWC). Endophytic bacteria were extracted from two weeds namely *Echium plantagineum* and *Lactuca serriola*. Pure cultures were obtained for many candidates and preliminary screening for growth promotion was conducted. We conducted 16S rDNA sequencing and identified one potential bacterial endophyte namely R6 (lab code) from *Lactuca serriola* roots. R6 showed high sequence similarity to *Pantoea agglomerans* which is an industrial and agricultural important bacterial strain. Initial growth experiments on plate-based MS media systems showed that R6 impacts seed germination as well as overall seedling growth when the growth was monitored with a small phenotyping robot in real-time (every 5 hours over 7 days). All bacterial candidates will be subjected to 16S rDNA sequence identification and further characterization for growth promotion capabilities.

Together with a collaboration with the National Zoological Gardens (Pretoria) the research managed to sequence and assemble the whole genome of one of the growth-promoting entophytic bacteria. The whole-genome data suggested that the endophytic bacterium R6 (lab code) belongs to the *Pantoea* genus with the closest species ID being *agglomerans*. *Pantoea agglomerans* has been shown to have huge industrial and agricultural potential by many researchers. The genome data was submitted to National Center for Biotechnology Information (NCBI) for further analysis and acceptance on the server before final submission to the journal Microbiology Resource Announcements. The genome data successfully passed the first tests or steps and is now being processed for publishing on the NCBI site.

3. Plant growth under endophyte inoculation:

Endophytic bacteria were also extracted from wild-grown Peppermint (*Mentha × piperita*) plants. These isolates were characterized in the laboratory to screen for growth-promoting characteristics. Preliminary, these isolates with growth-promoting characteristics were mixed in a consortium and applied to three *Phaseolus vulgaris* (Common bean) genotypes growing in a field in the Eastern Cape (Lukholweni). These plants will be monitored for changes in growth and survival under various stress conditions (e.g. salinity and drought stresses).

It is reported that this is year 1 of the project and therefore none of the objectives has been completed to date. However, the main highlight of the project to date is the identification of the endophytic bacterium R6 from the roots of the weed plant *Lactuca serriola*. The progress made on the genome sequencing and assembly was unexpected because this part of the project is only envisioned to commence much later in the project.

Research under this WP will in 2021, and further research outputs will be provided in the 2021 Annual Report.

6.2.2.2. Crop rotation sequences and soil health in SA: Project ID - 20202 - WP 2.2.5

This work is led by Professor Jacquie van der Waals (UP).

The objectives and activities under this project in 2020 are:

- a) To determine the impacts of selected crop rotation sequences on soil health through specific soil health indicators using a case study in the eastern Free State. This will involve comparison of soil health in four different five-year crop rotation sequences, i.e. (1) maize, maize, teff, fallow, potatoes (2) maize, sugar beans, maize, fallow, potatoes (3) maize, soybeans, maize, fallow, potatoes (4) maize, sunflower, maize, fallow, potatoes.
- b) To develop and optimize a seedling bioassay to measure pathogen status in selected crop rotation sequences to evaluate the soil-borne pathogen build-up in the soil, using the long-term crop rotation trial in the eastern Free State as a case study.
- c) To identify the most sensitive soil health indicators to develop a conceptual soil health protocol, that is, a minimum dataset, for crop rotation practices regarding the eastern Free State long-term crop rotation trial.
- d) To evaluate selected soil health indicators to develop a region-specific rotation sequence. This will involve the computation of soil health scores for each of the five-year crop rotation sequences in the eastern Free State.

The main achievements of the project in 2020 are as follows:

A desktop study has been conducted to select soil health indicators (physical, chemical and biological) to assess in the effect of different crop rotation sequences thereon. Using results from the MSc study conducted by the PhD candidate, certain soil health indicators were identified as ideal sensitive measures to assess under long-term trials. These indicators are subjected to further scrutiny, considering how soil health assessment is advancing and the importance of plant health (great awareness raised in 2020). More soil health indicators may be added to the already existing soil health indicators identified from the desktop study. Therefore, this research can only publish/provide the indicators to be assessed in the crop rotation sequences in due course. Since the actual study will be conducted next year owing to the delay brought about by COVID-19 restrictions and late payment of project funds, identifying more indicators to assess will not have a drastic effect on the project progress.

Research under this WP will continue in 2021, and further research outputs will be provided in the 2021 Annual Report.

6.3 PROGRAMME 3: NUTRITION, HEALTH, SAFETY FOR FOOD SECURITY

The PIs for this programme are Professors Rina Swart (UWC) and Lise Korsten (UP).

Food security exists when all people within a society, at all times, have enough nutritious and safe food for an active, healthy lifestyle. Significant sectors of South African society continue to experience high levels of chronic under-nutrition as well as nutritional deficiencies. At the same time obesity among adults and children is a growing public health problem in the country and is accelerating the burden of food-related non-communicable disease (NCD) in both poor and middle-class populations.

Since the inception of the CoE -FS a key question has been "what is on the plate of South African consumers". This question is central to the work of this programme; the spectrum that is explored in the 2020-2024 cycle includes a continuation of the exploration of food consumption patterns, paying special attention to particularly vulnerable groups where possible, the safety of the food on the plate, possible effects (on nutrition and health) of appropriate, affordable and accessible interventions to improve the amount and quality of food on the plate as well as the interaction between and impact of changing food systems in the country on the content of the "plate", and subsequent consequences for the nutrition and health of the population.

Research undertaken as well as the achievements under this programme are highlighted under the following projects/WPs.

6.3.1 Safe Food: Project ID - 20301

This project is led by Professor Korsten with team members Dr Stacey Duvenage (UP) Dr Chris Marufu (UP), Dr Ishmael Jaja (UFH), Dr Eric Etter (UP), Professor Kalmia Kniel (University of Delaware), Professor Shirley Micallef (University of Maryland) and Dr Manan Sharma (US Department of Agriculture's Agricultural Research Services).

The objectives and activities under this project in 2020 were:

6.3.1.1 All-inclusive One Health Risk Analysis for Community Health - Project ID - 2030 -WP 3.1.1

Based on the previous five year's work done within the Fresh Produce Safety, Animal Produce Safety and Food Hazards CoE project, the main pathogens which were identified included *Salmonella* spp. and *Escherichia coli* as major pathogens prevalent in the environment and informal food system. Microbial hazard characterization and hazard exposure assessments represent the next stages in an effective risk management system and provide a better understanding of the level of risk and to determine the likelihood of the presence of pathogens in the informal food system. Moreover, hazard characterization has been done in the informal taken place over the past five years on fresh produce and animal products in South Africa, funded by the CoE -FS, will allow us to perform the next stage of analysis using the metadata one step further i.e. risk analysis and -assessment. Next-generation tools will allow a deeper understanding of next-generation risk assessment. The data required to execute this analysis include the available food within a community and its associated consumption patterns and processing/ preparation methods, the hazard analysis and hazard's dose-response curve, and the anticipated health effects of the hazard when ingested by humans. Collectively this information will allow the modelling of the final estimate of risk. Additionally, tools such as whole-genome sequencing will allow us to exploit tracking routes of transmission and determining contamination events that take place in the emerging farm-to-fork continuum.

Assessing emerging risks based on previous studies of small-scale farmers include the prevalence of *Cryptosporidium* spp. infection in ruminants, fresh produce and water in South Africa is an essential part of a "One Health" approach. Cryptosporidiosis is a re-emerging zoonotic disease that is increasingly causing morbidity and mortalities in livestock and people in South Africa. The prevalence of *Cryptosporidium* spp. infections in cattle and goats remain largely unknown and additional routes of contamination to humans is largely unknown in specific rural areas of South Africa. An increase in reports of cryptosporidiosis causing diarrhoea in ruminants in Gauteng Province further emphasize the importance to conduct a more detailed and widespread study of the epidemiology of *Cryptosporidium* sp. infection to understand the prevalence and spread.

A study of the risk factors associated with cryptosporidiosis in identified transdisciplinary research sites is required, as this will enable formulation of strategies to counter these risks, reduce the disease burden, and lessen the risk of human infections. The purpose of this study will therefore be to investigate the prevalence and risk factors associated with cryptosporidiosis in ruminants in Gauteng and the Eastern Cape Provinces. Also, the prevalence of *Cryptosporidium* spp. in irrigation water and associated fresh produce determine the continuum from available food in a community and the health burden. Integrating analysis of ruminants, fresh produce, and water quality and community health will enable an all-inclusive approach to "One Health" needed to address this complex problem. The specific objective is to determine the molecular prevalence and associated risk factors of *Cryptosporidium* in these samples from smallholder farms in the transdisciplinary research sites. Based on the "One Health" approach, the data obtained from this study will also enable health professionals to be aware of and map potential outbreaks in humans because of animal and environmental contamination.

6.3.1.2. Risk Reduction through Innovation - Project ID -2030 -WP 3.1.2

Food production is the largest consumer of water globally with the ground-, river- or rain-water commonly used in agriculture. In urban and rural farming sectors, safe water and water of acceptable quality remains a challenge impacting the safety of fresh produce and the health of livestock. Therefore, ensuring safe, affordable and effective water treatment measures for improving water quality in rural settings will contribute to food security. Moreover, municipal water in South Africa is often unreliable in many households and therefore water is often stored in water holding tanks. Also, water is often harvested from rooftops for irrigation and animal watering. Therefore, finding a simplistic means of water treatment for households and small producers is essential to support potable water for crop irrigation and animal watering.

Currently, sand column filters are used to treat household water as well as irrigation water with the reduction of bacterial populations and chemical contaminants. Zero-valent iron bio-sand filters are more effective than sand filters. *Moringa oleifera* is a fast-growing, drought-resistant tree used for food as well as for traditional herbal medicine and has shown promise as an easy water (waste- and grey-water) purification system. *Moringa oleifera* has natural coagulate properties, which have been shown to decrease the turbidity, conductivity, biological chemical demand and remove metals, properties that are favourable for water treatment methods. *Moringa* seeds are non-toxic and are often used for various medicinal purposes. Moreover, there are reports that *Moringa* seeds have anti-bacterial properties. This research investigates *M. oleifera* seeds as part of a filtration system individually and in combination with zero-valent iron sand filters which are effective for water treatment to reduce pathogen loads in water. The filtration system is aimed at small-scale producers to ensure safe water quality as well as producers and households using roof-harvested rainwater and to irrigate crops and for animal watering and household use.

The main achievements of the project in 2020 are as follows:

a) All-inclusive One Health Risk Analysis for Community Health:

Hazard characterization was further undertaken by PhD student Mr Lawrence Zulu (UP) and Post-doctoral researcher Dr Lizyben Chidamba (UP). Additionally, the previous five years' work is being taken further by Dr Stacey Duvenage (UP) in terms of metadata analysis. Moreover, analysis in terms of risk assessment is currently being undertaken by PhD student Ms Thabang Msimango. A new collaborator Mr Victor Ntuli has been included due to his risk assessment expertise and this will be an essential collaboration for this group. Further to this, a collaboration with the National Institute of Communicable Diseases has allowed further hazard characterization using next-generation sequencing technologies on isolates from previous projects.

Cryptosporidium spp. analysis is being optimized within the diagnostic laboratories of Dr Chris Marufu at UP Veterinary Sciences, two new students will continue with this facet of the project in 2021 one from UP Veterinary Sciences and one from UP Department of Plant and Soil Sciences. Work on *Cryptosporidium* spp. is at the cutting edge of One Health research and expanding this to water and fresh produce will further test the limits of One Health Research. Moreover, risk assessment research can now proceed as students from the previous "Safe Food for the Food Insecure" programme is actively publishing their results from their research, as is evident in the outlined publication as well as completion of theses.

b) Risk Reduction through Innovation:

Ms Nombulelo Mbamba (MSc student, UP) under the guidance of Dr Stacey Duvenage (UP) is currently conducting experiments on these filtration systems. Ms Mbamba was delayed by COVID-19 due to the limited access to campus and due to the delay in procuring zero-valent iron internationally. However, filters have been constructed, preliminary trials have been conducted and testing will start in October 2020.

Research under this project will continue in 2021, and further research outputs will be provided in the 2021 Annual Report.

6.3.2 Nutrition and Health: Project ID -20302

This project is led by Professor Rina Swart.

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. Even less information on the dietary intake of the elderly is available. This project thus seeks to address this

fundamental question while it looks into various factors that can improve the nutritional state, and thus health, of the population

Research under this project consists of the following WPs.

6.3.2.1. Food Consumption, Gut-Microbiome and Chronic Disease in Disadvantaged Urban and Rural Communities: Project ID -2030 - WP 3.2.1

The purpose of this study is to explore the relation between the composition of the gut microbiome and lifetime cardio vascular disease risk profile among a subsample of participants in the PURE study. The PURE study is an on-going investigation of the relative contribution of societal influences on individual lifestyle choices and on risk factor of diabetes, obesity and CVD. Participants for the PURE study were selected from two communities of Black South Africans- Mount Frere, a rural community located in the Eastern Cape Province and Langa, an urban settlement close to Cape Town in the Western Cape Province. The PURE cohort is currently being extended to another community in rural Eastern Cape (rural Mthatha) and urban Western Cape (Khayelitsha). Each community started with 1000 participants and the retention rate is around 86% over the past 9 years. The communities were purposively selected based on having a relatively stable (non-migratory) black population for the feasibility of follow-up in a prospective cohort study.

This study will continue in 2021 and research results will be provided in the 2021 Annual report.

6.3.2.2. Food Consumption Patterns: Project ID – 20302 - WP 3.2.2

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 they choose particular food items as well as the food 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 2021. Data collection in Langa was completed, and data analysis will follow in 2021 after completion of the Ikageng fieldwork.

This research will continue in 2021, and research results will be provided in the 2021 Annual Report.

6.3.2.2 Maternal health and nutritional status of mothers: Project ID – 20302 WP 3.2.4

Descriptive and inferential analyses for this research is complete using the General Household Surveys, the Income and Expenditure Surveys, the National Income Dynamic Survey and the South African National Health and Nutrition Examination Survey (SANHANES). The 2016 Demographic and Health Survey data were released during 2019 but too late to commence with the planned post-doctoral fellowship. This analysis is still required and an amount of R200 000 is requested from the CoE-FS to provide a post-doctoral student with the opportunity to do so.

The main achievements of the project in 2020 are as follows:

COVID-19 delayed the appointment of the post-doctoral, but it also created additional opportunities. A collaboration has been established with a researcher from the University of Stellenbosch as well as a PhD student from Wits University on the rapid SMS Maternal and Child Health (MATCH) survey conducted during the lockdown. This was a national survey conducted among pregnant women and mothers registered with the MomConnect health platform in South Africa. It is estimated that this platform has more than half of all women attending the public sector antenatal care services enrolled (Lefevre et al., 2018). Permission for the survey was obtained from the National

Department of Health, and ethics approval was obtained from the University of Stellenbosch's Research Ethics Committee for Social, Behavioural and Education Research [project 14926 on 15 June 2020].

A self-weighted sample of 15 000 pregnant women and mothers with children under 12 months was drawn from the database of MomConnect users. The sample was stratified based on province, gestational age or age of their baby and their type of phone. The women received an invitation to join the SMS (Short Message Service) survey on the afternoon of 24 June 2020. They could respond with "JOIN" to participate, "STOP" to not participate or "MORE" if they needed further information. Those who participated in the survey received R10 in airtime. A response rate of 21% (n=3140) was achieved for the survey, which ended on 30 June 2020. A follow-up survey invitation with further questions was sent on 2 July and this survey ended on 5 July 2020. Of the 3140 individuals that responded to the first survey, 2287 also responded to the follow-up survey.

The post-doctoral played a lead role (with the PhD student from Wits) to produce two papers – one on maternal mental health and food security and the other paper on breastfeeding practices and hunger during the lockdown. The first paper was unsuccessful at the WHO Bulletin and has been submitted to the JAD. The second paper on which the post- doctoral is the first author will be submitted before the end of November to the Maternal and Child Health Journal.

An advertisement by the CoE Human Development for relevant papers linked to climate change prompted another collaboration with existing and new international collaborators to follow on from a study that was reported at 2019 MEDINFO conference. The new collaboration was successful in being commissioned by the CoE Human Development to produce a paper on malnutrition and climate change in Africa. We used DHS data from 22 countries in Eastern, Southern and West Africa and combined it with climate data from the CRU. Data on women focused on the mothers of the children included in the DHS survey. The draft paper has been submitted to the CoE Human Development and will appear in a special edition of Development Southern Africa in 2021.

Collaboration with colleagues in the Breastfeeding fraternity has resulted in publications on aspects of Ethics and Conflict of Interest and Breastfeeding. One paper was published in December 2019 with a response to a Letter to the Editor being submitted in 2021. A further paper on Contraventions of Regulation 991 concerning the Marketing of Breastmilk substitutes have just been accepted for publication by the British Medical Journal and collaboration with a host of national and International A paper dedicated to NATURE has been drafted by role players. There is no direct funding attached to any of these collaborations.

This research will continue in 2021, and research results will be provided in the 2021 Annual Report.

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

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

Food insecurity is a major policy challenge in South Africa. One in four children present stunted growth – an indicator of chronic malnutrition – and this has not changed since the early 1990s. Yet since South Africa's democratic transition in 1994, social protection programmes – including social grants, the National School Nutrition Programme and Expanded Public Works Programme – have increased dramatically. The Child Support Grant, in particular, was introduced in 1998 and now reaches two-thirds of all children – 12 million out of 18 million.

Given this context, this research programme aims to critically interrogate why South Africa's comprehensive social protection system is not making a much more significant contribution to the eradication of food insecurity and hunger and to identify how this contribution can be enhanced. No such systematic investigation has been conducted to date, so this agenda fills a significant and highly relevant gap in academic research and development policy. In the first three years of this SARChI, research and policy engagement were conducted in several areas, including programmatic interventions (social grants, school feeding), cross-cutting themes (the right to food and social protection), and vulnerable groups (student hunger and seasonal food insecurity among farmworkers).

Work is ongoing in all these areas and others such as graduation programmes and agricultural input subsidies. Also, two new WPs were launched in 2020. The activities and achievements in 2020 of these WPs are as follows:

1. Informal social protection in South Africa:

This research project undertakes primary data collection, with three objectives:

- a) To build a comprehensive knowledge base on informal mutual support mechanisms;
- b) To strengthen informal mechanisms in South Africa;
- c) To strengthen policy linkages between formal and informal social protection systems.

This research has been postponed until 2021 because COVID-19 made it impossible to collect primary data through face-to-face interviews. This research has been replaced

with a project 'Lockdown diaries', using telephonic interviews to assess the impacts of COVID-19 on food security and livelihoods.

2. The social protection policy process:

This research project aims to explore the rapid spread of social protection throughout Africa as a policy diffusion process, through in-depth interviews with +/-30 individuals who were centrally involved in this process. This research has made some progress, with several in-depth interviews conducted and transcribed.

This work will continue in 2021, and further research results will be provided in the 2021 Annual Report.

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

This project is led by Professor Julian May and Dr Coretta Jonah (UWC).

This project is organised under the Long-term European Union-Africa Research and Innovation Partnership (Leap-Agri) 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 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 of the 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.

This project is still in progress and will continue in 2021.

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

This project led by Professor Julian May (UWC).

This project is funded by Leap-Agri with a budget of R2.3 million at UWC. The collaborators are Professor Peter Verburg (Project leader, team coordinator) Vrije Universiteit-Amsterdam (VU-A), Netherlands; Professor Anton van Rompaey (Project Leader, Kampala), KU Leuven, Belgium; Dr Jac Davis (VU-A); Dr Nyasha Magadzire (UWC) and Ms Lisa-Marie Hemerijckx (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, wherein 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 were 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 was undertaken in September following approval of the project by the UWC and the VU-A ethics committees, and fieldwork commenced on 10 September 2019 and was completed by 28 January 2020. As the study made use of CAPI, the data were captured and cleaned in real time. A senior Masters student at UWC (Mr. Darryn Durno) was awarded a work study grant to lead the field work, and in 2020, a new PhD student at UWC, Mr. Ashley Haywood, was recruited to the Project.

Ethics approval for the survey design was granted by the KU Leuven Social and Societal Ethics Committee (SMEC) (approval number G - 2019 06 1664) and the Humanities and Social Science Research Ethics Committee of UWC (approval number HS19/6/15). The household surveys are complete in both cities, and enquires about socio-economic data, settlement behaviour (to calibrate the urban growth model) and food consumption. The latter includes questions about dietary diversity (FAO Household dietary diversity), food

security (FAO Food Insecurity Experience Scale), geographic food access and financial food access.

A food vendor survey was designed to be able to trace back the food consumed within the city to its origin. This survey is also complete in both cities. Through the food vendor survey, data are collected on each food type the vendor is selling: where was it grown, how was it transported, who is the supplier, how much does it cost? Moreover, some questions about their customers were included to enable cross-referencing with the food consumption data gathered at the households.

Using these data and geographic data provided by the BVM and the Department of Agriculture, we have modelled city responses to food insecurity during 2020. We can link broader land elements to the household data and create complex datasets that link household, infrastructure, and physical elements at geographic scale. The full model has now been parametrised based on these data, and the results were shared with the managers of both cities at the start of the COVID-19 lockdowns in South Africa and Uganda. We are aware that the BVM manager made use of these data in preparing their response to the food insecurity that emerged during the lockdown.

As an activity of this, Project Professor May was a visiting researcher at VU-A during November 2019. In addition, the intention was to send two UWC students to VU-A and to KU-L, one PhD and one Masters, during the first semester of 2020. Due to COVID-19, this was not possible and it is hoped to send these students in mid 2021.

The Project is still in progress and will be complete in mid 2022. To facilitate this, a request for a no-cost extension has accordingly been submitted. A new proposal was submitted to the Merian Fund in August 2019 to extend this project into a Water-Energy-Food nexus project. This was not successful. A second pre-proposal was submitted to the ERA-NET/FOSC co-fund on food systems and climate change which has been shortlisted and a full proposal has been submitted. A third pre-proposal was submitted to a new Merian Fund call. This has been shortlisted and we have been invited to submit a full proposal. Finally, the Project contributes one site of a new place-based project included into the CoE 2021 Business Plan.

6.7 RESEARCH OUTPUTS

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

Table 8: Research outputs

Output	Output	Appendix
Articles in Refereed/Peer-reviewed Journals	50	3
Books /Chapters in Books	9	3
Refereed/Peer-reviewed Conference Output	15	1

Other Significant Conference Output (seminars, workshops)	19	2
Working Papers/Technical/Policy Reports	0	3
Other recognised research outputs (communication & visibility)	404	5

7. KPA 2: EDUCATION AND TRAINING

7.1 Education and Training highlights

The CoE -FS supported in total 95 students in 2020. Table 9 provides a summary of the 47 bursaries awarded to postgraduate students and post-doctoral fellows from NRF funding for the year under review. Table 10 provides a breakdown of these NRF bursary holders across the collaborating institutions.

In addition, Appendix 6 outlines the continuing students and post-doctoral fellows who were supported through NRF funding, and Appendix 7 outlines the new students and post-doctoral fellows who were supported through NRF funding in 2021. Appendix 8 provides a record of the 172 NRF bursaries provided from 2014 – 2020.

The CoE-FS also supported 48 students through Leverage funding in 2020. Table 11 outlines the bursaries awarded to postgraduate students and post-doctoral fellows from Leverage funding for the year under review. Appendix 9 provides information on students and post-doctoral fellows who were supported through Leverage funding. In total the CoE-FS supported 11 post-doctoral fellows in 2020.

Table 9: Record of NRF-bursary students

Category	Total
Honours students	0
Masters students	27
Doctoral students	14
Post-doctoral fellows	6
Total Post graduate students	47
Total RSA Masters and Doctoral students	37
Total students from African countries (Masters and Doctoral)	3
Total Foreign (not from Africa) Masters and Doctoral students	1
Female Masters and Doctoral students (RSA)	26
Black Masters and Doctoral students (RSA)	35
Honours/ BTech Graduations	6

Masters Graduations	10
Doctoral Graduations	9

7.2 Synthesis of the student training

Table 10 presents the spread of CoE-FS bursaries across the collaborating institutions. This information is drawn from the NRF online system and only reflects those students holding CoE-FS bursaries. Table 11 presents an overview of leverage funded students supported in 2020.

Table 10: NRF bursary holders across the collaborating institutions

2020	Level				
Institution	Doctoral	Honours/ B Tech	Masters – Research Based	Post- Doc	Total
SU	-	-	-	-	-
UCT	-	-	-	-	-
MRC	-	-	-	-	-
UP	2	0	9	2	13
UFH	1	0	0	0	1
UL	-	-	1	-	1
UWC	11	0	17	4	32
WITS	-	-	-	-	-
Total	14	0	27	6	47

Table 11: Record of Leverage funded students supported in 2020

Category	Total
Honours students	13
Masters students	11
Doctoral students	19
Post-doctoral fellows	5
Total Post graduate students	37

7.3 Degrees conferred and post-doctoral fellowships completed

In 2020, a total of 47 students bursary holders graduated/completed, that is 27 NRF funded students and 20 Leveraged funded students, see Tables 12 and 13.

With reference to the NRF funded students, 6 Honours, 10 Masters, 9 Phd and 2 Post-doctoral fellows graduated/ completed. In terms of the Leveraged funded students, 10 Honours, 3 Masters, 6 Phd/ Doctoral, and 1 Post-doctoral fellow graduated/ completed. The full lists of both NRF funded and Leverage funded students who graduated/ completed are per Annexures 9 and 10 in the report.

Table 12: Record of NRF degrees conferred and post-doctoral fellowships completed

Degree	Total
Honours	6
Masters	10
Doctoral	9
Post -doctoral fellows	2
Total	27

Table 13: Record of Leverage funded degrees conferred and post-doctoral fellowships completed

Degree	Total
Honours	10
Masters	3
Doctoral	6
Post -doctoral fellows	1
Total	20

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:

One of the most powerful effects of 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 and knowledge gaps; and 2) understand the various perspectives on specific topics. Similarly, scientists engaging with problems within the messiness of local contexts requires 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. Workshops 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 under the Right to Food project have been given the opportunity to develop their skills being exposed to the academic research environment and actively getting involved in: research on national and international legal and policy intervention; contribution to the assessment of legal strategy and advocacy efforts; and the organization of and presentation in dialogues and webinars.

Three black South Africans at the UP's Department of Consumer and Food Sciences are being trained by Professor Naushad Emmambux. Dr Nwabisa is being mentored as a young scientist, Mr Mukwevho is a lecturer and still working towards his PhD. Mr H Nekhudzhiga, a lab manager, is also working toward his PhD. These three will hopefully be future academics that thrive for excellence and will promote food security and nutrition research.

Mr Ali Elnaeim Elbasheir Ali received a scholarship to attend a three months course in plant molecular biology/plant breeding and statistics at the University of Padova in Italy. This course will have a major contribution in terms of skills set in the project to advance it further. Through leverage funding (GrainSA), Mr. Alex Siebritz (former MSc student) was added to the project as a Research Technician.

The diagnostic platform technician Ms Z. Zulu was trained on the next generation PCR technology that was established in the virtual diagnostic platform created under the CoE-FS. Additionally, continuous skill development is conducted under this project in order to ensure that the diagnostic technician is equipped with the most recent skills and knowledge.

The Food Safety programme train students from various scientific backgrounds and science communication and provide exposure to a collaborative environment. Dr Stacey Duvenage, the Senior Post-doctoral who coordinates 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.

Professor Stephen Devereux co-authored a chapter for the book 'Building Social Protection Systems in the Global South' with a PhD student Samuel Kapingidza, published in 2020 by Palgrave Macmillan.

8. KPA 3: INFORMATION BROKERAGE AND RELATED ACTIVITIES

With COVID-19 occupying the attention of both the South African and global audience, the media attention received focused largely on the impact of the global and national lockdowns on food security and hunger. According to Newsclip Media Monitoring Service, the CoE-FS received more than 400 mentions in the media during 2020. Of these mentions, 279 were online, 88 on print and 37 on broadcast media (Figure 1). Measured in terms of advertising value equivalent (AVE), the coverage received would have come at a cost of a little over R26 million.



Figure 1: Media performance.

All events were held online in the form of weekly webinars hosted largely on Tuesday afternoons. Although attendance was slightly low for the first webinar (25 people), interest grew with registration and attendance growing week on week, peaking at about 150 people in some instances.

8.1 Communication and visibility

The CoE -FS 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 CoE -FS's performance and visibility achieved through the aforementioned channels in 2020.

- Naturally, in 2020 communication outputs were largely centred around the implications of lockdown on food security and nutrition;
- Before the lockdown, researchers were already contributing to the national dialogue, such as during the #SONA2020 address (Figure 2);
- As all interaction moved online, communication efforts focused largely on developing content specifically for online audiences such as increasing video and audio content;
- Through proactive media engagement, a number of researchers were linked with media to provide input on food security, nutrition, safety and social protection within the context of the ongoing lockdown
- The Food Dialogues held between July 2020 and August 2020 generated widespread engagement and some media coverage.



Figure 2: Media communication

8.2 Multimedia communication

In July 2020, there was a breach in security and malware was installed on the CoE-FS' [website](#). The breach was identified early and several steps and safety measures were put in place to secure the site. However, these measures required that the site be 'rolled back' to several weeks before the malware was installed. The implications of this measure have been the need to manually upload previously loaded content, as well as retagging content for SEO and Google analytics. This has had an effect on the site analytics and Google performance. Despite these challenges, there remains a notable year-on-year increase in

web traffic which is further supported by an electronic Newsletter; social media 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 Nuggets: Internal and external communication

In 2020, 10 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. The communication and engagement for 2020 is summarised in Table 14.

Table 14: Comparative overview of Communication and engagement

Output	2014+2015	2016	2017	2018	2019	2020
Nuggets shared	12	9	52	67	73	55
Media Coverage	55	45	129	239	189	404
Website views	N/A	4 218	5 332	14 707	26 375	30 248

Although the number of “nuggets” (55) distributed in 2020 was slightly lower compared to 2019, these received more engagement and coverage (therefore reached more people) compared to 2019. This can be attributed to the variety of ways the content was packaged. Whereas previously the focus was largely on producing written content (i.e., for the website and reposted on social media and emailers) in 2020, content generated included information packaged as video, photo story or audio podcasts. Packaging multi-platform content not only requires more time, it also needs adequate budget for effective publication. Nevertheless, working with what was available, we were able to achieve much more compared to 2019.

8.4 Social Media

The CoE - FS’s followers on the official Facebook Page and Group grew to 2 818 and 736 (respectively). Similar to the growth of our Facebook audience, the Twitter page also grew to 2 451, an increase from 2 099 followers in 2019, and 1 714 in 2018. Considered within the context of the ever-growing use of paid social adverts and post boosting, the CoE -FS’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 CoE -FS’s messages and research outputs are reaching a wide group of people and attracting a steady following. The multimedia communication is summarised in Table 15.

Table 15:: Comparative overview of multimedia communication

PLATFORM	GROWTH BY YEAR		

	2014+2015	2016	2017	2018	2019	2020
Facebook Group	190	258	317	409	526	736
Facebook Page	240	469	936	1 610	2303	2818
Twitter Page	245	640	1134	1 714	2099	2541
YouTube Views	n/a	n/a	430	1 519	1607	3378
SoundCloud	n/a	n/a	4	149	255	292

Similar to the growth of social media platforms; the numbers of views on the CoE -FS's YouTube and Sound Cloud channels showed a steady growth of our visual and audio audience (Figure 3). These platforms are the costliest to maintain, particularly with regards to creating content for regular updates.



Figure 3: Sound Cloud audio performance.

8.5 Events and online communication

With the COVID-19 pandemic bringing into sharp focus; the fragile nature of our public and social security structures, the CoE -FS embarked on a series of webinars presented by diverse groups of stakeholders to strengthen collaborations and play a critical role in driving food security policy, bolstering the capacities of households to weather storms like sudden loss of employment; and to bring about the food systems change needed for sustainable and equitable livelihoods. An example of this can be seen in Figure 4.

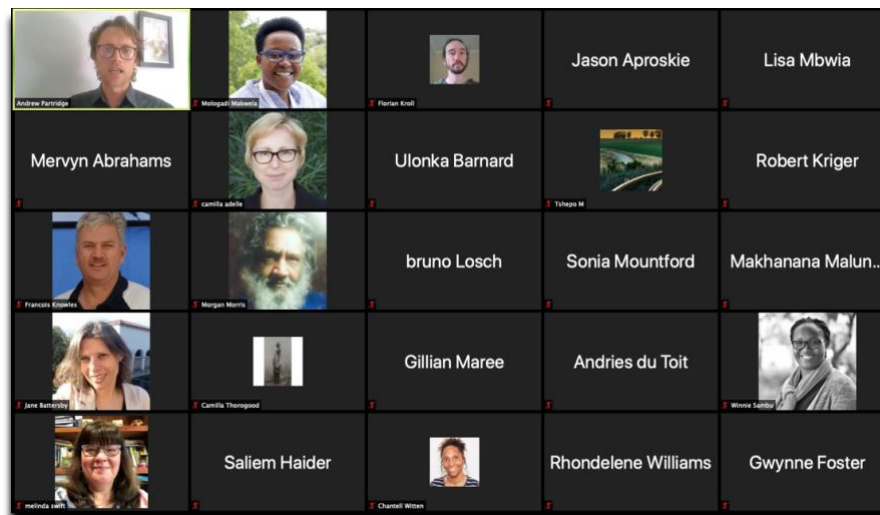


Figure 4: Example from a Community of Practice Webinar on Food Governance & Nutrition.

These webinars were well attended by diverse groups including government officials, researchers, civil society organisations; staff and students across various universities as well as members of the public. The wide-ranging topics covered issues related to the Informal Food Trade, Student Hunger During Lockdown (undertaken in Collaboration with UWC’s Dullah Omar Institute); Safety nets to curb the impact of crisis on vulnerable populations hosted in collaboration with the SA/UK Bilateral Research Chair in Social Protection for Food Security, as well as Food Waste and Loss, to name a few.

Similarly, another major annual event at the CoE-FS is World Food Day on 16 October (Figure 5). In 2020, the event also took place online and was a collaborative effort between the CoE-FS, the Institute for Poverty Land and Agrarian Studies, and C19 People’s Coalition (Food Working Group).

The 4th International Conference on Global Food Security which took place virtually on 7-9 December 2020, addressed the topic of food security at all spatial levels from local to global, and from an interdisciplinary and systemic food systems perspective. It’s aim was to better understand environmental, nutritional, agricultural, demographic, socio-economic, political, technological and institutional drivers, costs and outcomes of current and future food security. Interactions with contextual factors including climate change, urbanisation, greening the economy and data-driven technologies will be central. The conference was attended by 900 delegated, and the 11 mini symposiums were well received.



Figure 5: World Food Day Social Media post example.

These activities were distributed widely to the public and the resulting engagement – as seen through our online platforms and media stats – are indicative of the reach and impact.

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 as follows:

Researchers from different institutions (UCT, UWC, CPUT, SU) are involved in the National Food Governance project. Collaboration with the network of researchers who presented at the 2019 AESOP – SFP Conference in Madrid has led to the ongoing collaboration including the submission of papers for a special issue of the Urban Agriculture and Regional Food Systems journal and the presentation of the CoE-FS FoodGov CoP process at the RAI2020 conference "Anthropology and Geography: Dialogues Past, Present and Future". This has increased the visibility of the CoE -FS and shared insights and learnings from these dialogue processes.

The participation in the Global Food Security conference 2020 contributes to the visibility of the CoE -FS and the consolidation of international collaborations. The international workshop on national experiences of food policy dialogue platforms had to be postponed due to the COVID-19 pandemic.

The Right to Food project collaborated with stakeholders within and outside of the country. This project continues to work with and leverage on 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. It has forged cordial relationships with other partners in sister institutions including the Universities of Pretoria, Fort Hare and Witwatersrand. Researchers working on access to food from these institutions participated in meaningful engagement in our dialogues and have expressed interest in pursuing future collaborative efforts on these issues.

The SMART foods project collaborated with Purdue University (USA), University of Eldoret (Kenya) and ITA Food Technology Institute in a USAID project under the Feed the Future programme. The project entitled "Sustainable Reduction of Post-harvest Losses in Feed the Future Countries through Technologies and Innovations that link Farmers to Markets: Focus on Kenya and Senegal" is within the Food Processing Innovation Lab. This project is based on the concept of food-to-food fortification for enhanced nutritional characteristics of cereal-based foods which is also a core concept in the CoE-FS project. This project has provided leverage funding.

The African Network for Sensory Evaluation Research (ANSWER) was officially launched at the Pangborn Sensory Science Symposium held in Edinburgh 2019. ANSWER aims to engage scientists from cross-disciplinary fields (Food Science, Consumer Science, Nutritional Science, Statistics, Physiology, Genetics, Psychology, Social Sciences etc.) with a mutual research interest in Sensory and Consumer Science to address the challenges and opportunities for food, nutrition and well-being of consumers in Africa. The CSIR's on-going collaboration investigating food wastage across different supply chain members including consumers. Collaboration with CSIR centre for structure nanostructured materials is on-going.

The project led by Professor Ndiko Ludidi collaborated with Walter Sisulu University, the Chinese University of Hong Kong, the University of Missouri, the Centre of Biotechnology of Borj Cedria in Tunisia, the University of Pretoria, the Tsolo Agricultural & Rural Development Institute (part of the Eastern Cape Department of Minister of Agriculture, Land Reform and Rural Development) and the University of Mauritius are ongoing. Furthermore, our collaboration with the Chinese University of Hong Kong and the Walter Sisulu University has resulted in the establishment of the SA Agriculture Small-Scale Farmer Support Group that aims to provide innovation and sustainability support in small-scale farmer development in the Alfred Nzo district and OR Tambo district to resource-poor small-scale farmers in villages of these municipalities. As a result of collaboration with Walter Sisulu University and the University of Missouri on marama bean, we have established a new collaboration with the University of Zurich to initiate a study on marama bean seed biology and genomics that would positively impact domestication efforts for marama bean. Our collaboration with the Chinese University of

Hong Kong has resulted in collaboration with Professor Gyuhwa Chung at Chonnam National University in South Korea on wild soybean and Dr Faheem Shehzad Baloch at Bolu Abant Izzet Baysal University in Turkey on soybean and safflower.

The research led by Professor Marshall Keyster's current national collaborations includes collaborations with Walter Sisulu University (Dr Egbichi [biochemical assays]), the National Zoological Gardens (Dr Du Plessis [transcriptomic and bioinformatic analysis]), and University of Fort Hare (Mr Mpayipheli [field trials]). Current international collaborations include the main partner university (University of Missouri) with Dr Brandt and ongoing collaborations with previous University of Missouri CoE collaborators Professor Mendoza-Cozatl and Professor Heese.

The research led by Professor Jacque van der Waals has strengthened the ties between the UP and Potatoes South Africa, and Grain South Africa. Through this project, a new collaboration between the UP and the University of the Free State has been established. Engagement with the CoE-FS and subsequent funding of this project will also facilitate further collaborations with researchers from other academic and research institutions. The project management team is currently pursuing these.

The group of researchers within this Safe Food project include researchers from University of Pretoria Department of Plant and Soil Sciences, Department of Food Science and Department of Consumer Sciences and Department of the Animal Sciences University of Fort Hare, the Department of Rural Development and Agrarian Reform (DrDAR). Collaboration with DrDAR enable researchers in the project to use the modern state art veterinary laboratories in the Eastern Cape Province. The department also provides with retrospective data on a microbial survey of meat from abattoirs in the province. This team has established collaboration with the National Institute of Communicable Disease's Sequencing Core Facility to begin exploring the genome of selected isolates through the supply chains. Collaborations have been established with Professor Kalmia Kniel (University of Delaware), Professor Shirley Micallef (University of Maryland) and Dr Manan Sharma (US Department of Agriculture's Agricultural Research Services) who are experts in the field of water filtration with zero-valent iron.

A collaboration between the US Food and Drug Administration Centre for Food Safety and Applied Nutrition and the UP-food safety team through the Genome Trakr has been created to conduct further characterization isolates in the CoE-FS Virtual Microbial Database, researchers include Dr Marc Allard, Dr Yi Chen and Dr Dumitru Macarisin. Moreover, a collaboration with Dr Victor Ntuli (University of Lesotho) has been established to harness his expertise in risk assessment. Researchers at the University of Fort Hare have an established collaboration with the French South African Institute of Agriculture (FSAGRI), hosted by the department and Livestock and Pasture Science at UFH and was awarded an Erasmus+ International Credit Mobility programme with UniLaSalle (France). The partnership will facilitate the mobility of students and staff

between UFH and UniLaSalle for selected programmes in the field of Agriculture, Food Science, Water and Environmental Management.

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.

The FoodGov Community of Practice continued to offer policymakers access to the current research findings informing policy deliberations. In response to the food systems arising from the lockdown, the programme led by Professor Bruno Losch established an online Slack platform and conducted online dialogues to discuss and clarify the implications of the lockdown regulations. Members of this programme offered informal advice to provincial and local authorities on the interpretation and contestation of lockdown regulations, particularly for informal traders. Programme members were invited to participate in regular gatherings of the City of Cape Town Food Security Working Group. The award of a Cape Higher Education Consortium grant for the development of policy briefs on food systems governance has led to ongoing consultation of relevant stakeholders to represent the interests and concerns of marginalised groups, especially the informal traders and urban farmers.

The #FoodTalks seminars are a way to raise awareness on food-related issues to a large audience. The systematic review of the food governance literature in South Africa will contribute to the policy debate and help stakeholders and policymakers to identify and address the major bottlenecks which prevent food security and progress towards sustainable food systems.

The Right to Food Project has been able to engage with different stakeholders and share its expertise on several issues relating to the right to food. Through the development of key advocacy and educational materials on the right to food, many stakeholders within the university system and civil society groups have benefited from the project.

The project led by Professor Ndiko Ludidi has given regenerative agriculture training to a small-scale farming cooperative (DI Farms) that operates in the Alfred Nzo and OR Tambo District in the Eastern Cape (<https://business.facebook.com/pg/DI-Farms-249332532086754/posts/>), and Seeds Gardening Services, and continue to collaborate with them in using their land for our research purposes while providing climate-smart regenerative agriculture support for their operations.

The project led by Professor Marshall Keyster will disseminate our ICP results with the farming community in the Eastern Cape which could aid in better soil management and planning for the 2021 growing season.

In the project led by Professor Jacquie van der Waals, an important collaboration has been developed between the University of Pretoria and potato farmers of the Eastern Free State, facilitated by Potatoes South Africa, to develop a region-specific crop rotation program for the area. A long-term crop rotation study has been established (managed by Mr Gert Bester) on which various soil and crop health indices will be assessed in the different crop rotation sequences. The results obtained from the study will provide preliminary insights into the changes in soil and crop health that may have occurred due to the different crop rotation sequences. It will then be possible to make predictions which rotation sequence will provide the most benefits for soil and crop health. Also, the findings will sensitise farmers to the importance of soil health and crop rotation programs in the drive towards sustainable agriculture.

The Safe Food project has established a Food Safety Science Platform for South Africa and will be able to share information around food safety-critical matters and methodology. The platform will be open resource for government and industry and will be used to drive policy change in terms of food safety test methods and regulations.

Finally, in 2019, the CoE-FS finalised its “Child Malnutrition” research programme. As a service rendering activity, Professor May has co-edited the Child Gauge 2020 Report that focuses on child malnutrition and food insecurity. This nine-chapter report was published in December 2020, with a foreword from Professor Lawrence Haddad, the director of the Global Alliance Initiative for Nutrition (GAIN) and a former Steering Committee member of the CoE-FS. The report is a high-profile and high impact publication that targets government and civil society.

11. FINANCIAL INFORMATION

Table 16: Funding received and spent from NRF in the reporting period

Commitment	Expenditure
R15 315 378.75	R13 993 836.73

The committed funds to the value of R1 321 542.02 remaining as at 31 December 2020, consists of 20% project balances and running expenditure and will be fully expended during the first half of 2021.

Table 17: Breakdown of NRF funding expenditure

Commitment	Amount	% Expenditure
Running costs (Research)	R4 409 558.98	29
Running costs (20% roll-forward)	R1 321 542.02	8
Bursaries	R5 610 000.00	37

Salaries	R3 338 610.00	22
Running costs (Operational)	R306 872.75	2
Conferences, webinars and media	R328 795.00	2
Equipment	0	0
Total income	R15 315 378,75	100

Table 18: Direct⁸ funds (funding received by PIs/ project leaders)

Collaborating Partner	Funder	Description	Year of funding	Amount (Rand)
UWC	CS Mott Foundation	Governance project_ E Durojaye	2020	R450 000,00
UP	WUR	Governance project_ F Swanepoel	2020	R1 060 000,00
UP	UP	Governance project Post-doctoral funding_ F Swanepoel	2020	R400 000,00
UP	City University of London	Governance project_B Losch	2020	R84 470,88
UP	GovInn	Governance project_B Losch	2020	R90 000,00
UP	GovInn	Governance project_B Losch	2020	R130 000,00
UP	CIRAD	Governance project_B Losch	2020	R675 000,00
UP	SALGA	Governance project_B Losch	2020	R50 000,00
UWC	CHEC	Governance project_B Losch	2020	R90 000,00
UWC	CIRAD	TAFS Project_B Losch	2020	R178 345,55
UP	EU Innofood	SMART Foods project_Bursaries N Emmambux	2020	R200 000,00
UP	EU Innofood	SMART Foods project_Running costs N Emmambux	2020	R600 000,00

⁸ Any financial contribution other than the funding received from the CoE-FS to the project, which is auditable and managed by the project leader and the collaborating institution.

UP	Carnegie Foundation	SMART Foods project_Bursaries_N Emmambux	2020	R200 000,00
UP	Carnegie Foundation	SMART Foods project_Running costs_N Emmambux	2020	R120 000,00
UP	EUSAID	SMART Foods project_Bursaries_KG Duoda	2020	R150 000,00
UP	EUSAID	SMART Foods project_Running costs_KG Duoda	2020	R750 000,00
UP	NRF-LEAP Agri	SMART Foods project_NUTRIFOODS – Running costs_R de Kok	2020	R322 295,73
UWC	NRF	Climate – CPRR_Soybean_ Running costs_N Ludidi	2020	R87 880,00
UWC	NRF	SA&Tunisia Collab_ Running costs_N Ludidi	2020	R230 000,00
UWC	NRF	Researcher Incentive fund_ N Ludidi	2020	R30 000,00
UWC	NRF	SA&China_Joint Research on maize_Running costs_ N Ludidi	2020	R200 000,00
UWC	NRF	Bursary funds_Eden Keyster_ N Ludidi	2020	R30 000,00
UWC	NRF	Bursary funds_PhD Mandilakhe Naku_ N Ludidi	2020	R200 000,00
UWC	NRF	Bursary funds_PhD Gerhard Basson_ N Ludidi	2020	R200 000,00
UWC	UWC	DVC Capacity development fund_ N Ludidi	2020	R50 000,00

UWC	GrainSA	Climate – Project running costs_M Keyster	2020	R429 067,00
UWC	GrainSA	Climate – Human resource costs_M Keyster	2020	R120 000,00
UWC	UWC	Climate – Publication Income_M Keyster	2020	R39 000,00
UWC	NIDS	Food Consumption patterns_R Swart	2020	R695 220,00
UWC	ZEF	Food Consumption patterns_PhD_R Swart	2020	R290 000,00
UP	WRC	Food Safety_L Korsten	2020	R1 700 000,00
UP	CoP SPS	Food Safety_L Korsten	2020	R110 000,00
UP	ddPCR	Food Safety_L Korsten	2020	R3 500 000,00
UP	UP	Food Safety_Publication Income L Korsten	2020	R53 966,00
UP	UNICEF	Food Safety_L Korsten	2020	R65 000,00
UP	IAP Science Health Policy	Food Safety_L Korsten	2020	R82 000,00
UP	UNICEF	Food Safety_L Korsten	2020	R66 100,00
UWC	NRF	LEAP-Agri_J May	2020	R695 220,00
UWC	NRF	Food4Cities_J May	2020	R916 000,00
UWC	NRF	SARChI_S Devereux	2020	R1 496 000,00
UP	UP	10% Salary Contribution	2020	R715 928,00
UWC	UWC	10% Contribution	2020	R750 000,00
Total Direct funds				R18 301 493,16

Table 19: Leverage funding (funding received by collaborators)

Collaborating Partner	Funder	Description	Year of funding	Amount (Rand)
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UP	CIRAD	Governance project Salaries_B Losch	2020	R900 000,00
UWC	PLAAS	Governance project_PhD funding B Losch	2020	R100 000,00
UP	UP	Smartfoods_Project resources_ N Emmambux	2020	R550 000,00
UWC	University of Hong Kong	Soybean research in China_N Ludidi	2020	R645 000,00
UWC	International University of Korea	Soybean research in Korea_N Ludidi	2020	R100 000,00
UWC	British Council	SARChI_S Devereux	2020	R1 496 000,00
UWC	ZEF	LEAP-Agri_J May	2020	R290 000,00
UWC	VU-A	Food4Cities_Postdoc_ J May	2020	R400 000,00
UWC	Self-funded	Food4Cities_Masters_ J May	2020	R70 000,00
Total leverage funds⁹				R4 551 000,00

11.3 Return on investment

The CoE-FS publication list and students registered for 2020 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-FS published over 300 journal articles, book chapters, and books, with the highest cumulative citation of 55. It has also supported more than 350 students, which is viewed as a long-term economic and societal investment.

The establishment of the CoE -FS has also resulted in considerable additional funding in 2020, amounting to R22 852 493.16.

⁹ Leveraged funds are, any contribution to a project. These contributions are often not managed by the collaborating researcher or his/her institution, but the CoE-FS project leveraged from receiving some form of financial support.

However, the greatest return on investment is the networking and collaborations that have taken place within the projects supported by the CoE -FS and the findings that are emerging. As mentioned above the CoE-FS currently has 35 Collaborative agreements in place with more than 100 international and national collaborators since 2014.

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, 62 of the 95 students (65.3%) are women. The CoE-FS management and administrative teams; currently, the Co-Director, Research Manager, Finance Manager, Administrator, Communications Manager, and two 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.

One of the three project team members and five out of six of students under the Local Governance project are female. Also, several of the collaborating academics are female including Jane Battersby (UCT-ACC), Gillian Black (SLF); Robyn Park Ross (UCT); Mercy Brown (UCT). Also, a significant proportion of the participants in the food governance COP workshops are female.

The two postgraduate students involved in the Right to Food project are women. They have been active in the various outputs of the Project during this period as well as taking lead on the two dialogues held. Also, the project has adopted a gender-sensitive approach to its research and engagements with stakeholders by highlighting female school leavers as a vulnerable group.

The SMART Food project includes 4 women as partners and collaborators. Also, there were 10 female graduates in 2020 and there are 20 current female students for 2020. Two

of the five members of DI Farms and two of the five members of Seeds Gardening Services (the small-scale farmer cooperatives that we collaborate with, see above) are females.

The project led by Professor Marshall listed a white female (international) at management level who is based at the University of Missouri as well as 9 black female students who are based at the University of the Western Cape.

Under the SARChI in Social Protection project, 8 of the 13 postgraduate students are women (62%). 2 of 5 students working as researchers on the Lockdown Diaries project were women (40%).

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 20. The lead researchers, researchers and project leaders who were part of the CoE-FS in 2020 are listed in Appendix 4.

Table 20: 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 (Contract)	100
Dr Elaine Sinden	UWC	F	C	South African	Research 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
Ms Robyn Engelbrecht	UWC	F	C	South African	Administrative Assistant (Contract)	100

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:

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 and 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, informal workers, refugees) 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) but also participants from outside of science (various state and civil society institutions). The approach of co-production lends itself to transdisciplinary research. This can be seen in the participatory approaches used in the data collection methods of Michelle Beeslaar and Ntombizethu Mkhwanazi.

The Right to Food project has positioned itself as the first of its kind in the region (Africa), gaining insight into the issue of student hunger at the national level. With the growth potential, it could attract potential international collaborators going forward.

The research team led by Professor Ndiko Ludidi is formed from institutions of diverse groups and countries (Walter Sisulu University is an HDI and the Tsolo Agricultural & Rural Development Institute is a provincial institution in a poor rural setting, the University of Missouri and the Chinese University of Hong Kong are world-class institutions recognized for their international academic leadership). The project is multidisciplinary, bringing together plant science, soil science and entomology while using these diverse disciplines for social impact by collaborating directly with small-holder farmers.

Multiple institutions have been involved in the research project led by Professor Marshall Keyster. In South Africa, Walter Sisulu University (Dr Egbichi), the National Zoological Gardens (Dr du Plessis) and University of Fort Hare (Mr Mpayipheli) have all contributed to the advancement of the project under the review period. All the 13 students listed in this project are from previously disadvantage communities. Also, all the students fall in the black designated group. In addition to the strong network between the PI's of the project which links the University of the Western Cape to the University of Missouri

(Columbia), some of the research was performed at the University of Missouri in the laboratory of Professor Mendoza-Cozatl as well as in the laboratory of Professor Antje Heese.

The Safe Food project involved various disciplines such as microbiology, veterinary public health, social sciences, food science, epidemiology, consumer science and bioinformatics. Also, UP's Department of Plant and Soil Sciences, Food Safety team, Animal Sciences, Veterinary Sciences, University of Fort Hare's Animal Sciences, University of Delaware, University of Maryland, US Department of Agriculture's Agricultural Research Services and the US Food and Drug Administration Centre for Food Safety and Applied Nutrition were involved in this research. Various black South African students are funded through this programme, additionally, further African collaborators have been included and will form part of the future projects. Several international experts are collaborating on research in this progress report.

15 SOCIAL IMPACT

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

The social impact of the Local Governance project led by Professor Bruno Losch has strongly increased during 2020 due to the engagement with the Food Governance Community of Practice with a wider group of stakeholders including in civil society but also local government. More frequent meetings, higher numbers of participants and also live screenings of the meetings on Facebook has dramatically increased the reach of the FGCoP (up to 100 online participants and more 300 followers on social media).

Some of the activities under the Right to Food project were reported in the media and led to many organizations and other stakeholders reaching out to us.

The project led by Professor Marshall Keyster started a new community engagement project with a community in Matatiele. This project will explore possibilities to convert the land into farming land for subsistence farming. A new community engagement project with a community in Mthatha started. 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. Professor Keyster and his team visited a community in the Westbank area (Cape Town) to assist the community with farming vegetables. They will conduct an ICP analysis on the surrounding soils in order to assess the appropriateness of the soil for vegetable farming.

At the end of 2019, the University of Pretoria's Department of Plant and Soil Science's Food Safety Group under the leadership of Professor Lise Korsten, Intelseeds, Syngenta and Starke Ayres sponsored seed and shadow netting to schools who participated in a

National School Nutritional Programme project which formed part of the Safe Food for the Food Insecure Programme, on the safety of fresh produce grown and served in the schools. During December 2019, the UP's Department of Plant and Soil Science's Food Safety Group and Plant Pathology Division within the Faculty of Natural and Agricultural Sciences visited schools in areas of Limpopo Province to represent the UP and present career options within Science. The group of postgraduate students and staff (Tintswalo Baloyi, Thabang Msimango, Malick Bill, Mandla Sibiyi, Zinhle Nxumalo, Zamazulu Zulu and Ntombizethu Mkwanazi) from Professor Korsten's research group handed overprinting paper, pens and pencils and microscopes. Schools who benefited from this drive included Thapane Primary School, Sara Primary School and Fobeni High School. Also, the House of Prayer Crèche received printing paper, colouring crayons, puzzles and other materials. (These activities were not reported in the 2019 Annual Report).

16 SCIENTIFIC CONTRIBUTIONS

A study by a student has shown that maize meal and maize starch modified by heat moisture treatment (HMT) and lipid reduced estimated GI and this is related to an increase in resistant starch. The study proposes specific mechanisms as to how heat, moisture treatment with citric acid can change the microstructure, nanostructure and molecular structure of starch and she has related these changes to the low in vitro starch digestibility. This green modification can potentially be used as a low GI food for people suffering from type 2 diabetes.

Another study by a student also shown that the ALC as RS promotes the formation of beneficial short-chain fatty acids similar to fructo-oligosaccharide as a reference. Starch-phenolic complexes with reduced susceptibility to hydrolysis by starch-hydrolysing enzymes and with antioxidant properties were produced from the interaction between maize starch and phenolic extracts from grape pomace and condensed tannin sorghum bran under alkaline conditions.

Research by a student on crystallinity and hydrophobicity of isolated amylose lipid nanomaterials has shown that the unique patented process of producing the nanomaterial can be upscaled, and infrared as a green technology can partially increase the crystallinity. Moreover, infrared can also reduce the viscosity of the isolated nanomaterial and this can have a good implication as an encapsulation matrix for flavour compound in the beverage industry. Research has shown that heat-treated Bambara groundnut with microwave and infrared can reduce the cooking time from 3 hours to about 30 minutes. The flour produced from the heat-treated Bambara seeds can be used to replace wheat flours up to 30% without any changes in the dough rheology. This will thus enable to produce a high protein bread.

Research has shown combined fortification with ferrous sulphate and organic acids (ascorbic acid and citric acid) increases both the amount and percentage of bio accessible iron in both conventional wet cooked and instant extrusion cooked sorghum porridges. Co-processing (addition of baobab fruit pulp powder) increased the percentage of bio accessible iron but only increased the amount of bio accessible iron when extruded. conventional wet cooking did not affect the amount of bio accessible iron in the porridges. Fortification with moringa leaf powder whether alone or together with baobab fruit pulp powder decreased the percentage of bio accessible iron. Moringa leaf powder cooked with sorghum did not affect the amount of bio accessible iron. Extrusion of sorghum with moringa decreased the amount of bio accessible iron. Overall, these results show that fortification with baobab fruit pulp enhances mineral bio accessibility much more than with moringa leaf powder.

Research has shown that edible insects have a high protein quality and can be compared with milk or soya protein. In terms of functional properties, the protein has good foaming and emulsifying properties.

Research determined that increasing crop diversity has a positive effect on beneficial insect diversity, but also introduces detrimental insects in the cropping environment. A study revealed that cattle grazed on natural grass veld have fewer methane emissions than cattle fed with supplementary creeps (sugarcane molasses, urea and methionine hydroxy analog) and have found that skin attributes in cows (hide thickness and hair/fur length/thickness) plays a role in heat stress tolerance and infestation by ticks.

Through the food vendor survey, data are collected for each food type the vendor is selling: where was it grown, how was it transported, who is the supplier, how much does it cost? Moreover, some questions about their customers were included to enable cross-referencing with the food consumption data gathered at the households. Using these data and geographic data provided by the BVM and the Department of Agriculture, we have modelled city responses to food insecurity during 2020. We can link broader land elements to the household data and create complex datasets that link household, infrastructure, and physical elements on a geographic scale. The full model has now been parametrised based on these data, and the results were shared with the managers of both cities at the start of the COVID-19 lockdowns in South Africa and Uganda.

The work of the Governance programme conducted dialogues on realising access to food for students in South African tertiary institutions. These dialogues brought together government Departments, Chapter Nine institutions and other stakeholders including academics and civil society groups to deliberate on various issues relating to access to food for students in tertiary institutions. These highlighted many pre-existing and emerging challenges concerning physical and economic access to food, as well as the food environment and culture at South African tertiary institutions.

The booklet Right to Food for Students in Tertiary Institutions has been developed to assist students, administrators and policymakers in ensuring the realization of the right to food of students in tertiary education institutions across South Africa. A two-minute infographic animated video was produced as part of our media advocacy strategy highlighting the challenges of school leavers concerning hunger and food insecurity. It will serve as a useful tool to engage with policymakers during the planned meetings with relevant government departments.

In addition, the CoE -FS produced 59 papers in accredited journals and peer-reviewed books – publishing results research projects in peer-reviewed journals enables the scientific community to evaluate the findings themselves. These publications are of vital importance as it provides instructions so that other researchers can repeat the experiment or build on it to verify and confirm the results.

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

Starch microsphere as fat replacer’ (Emmambux MN and Nekhudzhiga HE). SA patent (2019) and PCT applied in 2020. The patent describes the novel way of manufacturing starch microspheres that can be used to replace fat globules in food system for example mayonnaise, cheese and yogurt. The production of the starch microspheres is based on green chemistry principle and can be considered clean label.

19 CHALLENGES AND CONSTRAINTS

The global COVID-19 pandemic presented institutions and individuals with unprecedented challenges in 2020. Universities and research centres such as the CoE-FS were not exempt from this global disruption. UWC and UP faced similar challenges, but also some that were unique to the host and co-host institutions. In the case of UWC, the remote location of the university requires that the majority of students travel long distances by public transport, facing heightened levels of risk. In the case of UP, considerable numbers of students live on campus. The Level 5 lockdown meant that all campus activities were suspended, and that non-South African students needed to return to their home countries. Many South Africans also needed to relocate to their homes,

some of which are in provinces other than the Western Cape and Gauteng. Most research projects were suspended during this period, during which access to laboratories was severely constrained, and studies involving the participation human subjects was impossible unless mobile phones or the internet was used. In many cases, expedited approval from ethics review committees had to be sought.

Both universities responded well to the limits placed on mobility and access. Prior experience and contingency plans set up to manage the periodic student protests played an important role in this regard. In addition, the CoE-FS has always operated as a virtual office, and the dual hosting arrangement has meant that all of the necessary audio-visual and e-conferencing equipment and skills were in place. This meant that the transition to an entirely off-campus enterprise was quickly undertaken, and remains our method of work until the present.

Nonetheless there have been specific challenges. Of greatest importance has been the impact on researchers and students who have been directly affected by COVID-19, either by falling ill themselves, or by the emotional and physical burden of dealing with the ill-health of family members. Furthermore, woman researchers and students have been particularly affected by increased burdens of unpaid work, home schooling and the care of those who are sick. As noted in the introduction, two members of our research community have died, and almost all have experienced loss and illness of their family and colleagues. Although the CoE-FS itself is unable to provide counselling or other support, we are mindful of this, and have attempted to ensure that the research team affiliated to us are able to take up such support which is offered by their university.

A second challenge has been the expectation that the CoE -FS engage with the communities that have been worst affected, as well as with civil society and government responses to COVID-19. Although the pandemic and the responses of government could not have been anticipated, the CoE-FS has been engaging with local responses to food insecurity for some time, as well as with issues of food safety along value chains. We have also focused on child malnutrition which has been of particular importance during 2020. We were unable and sometimes unwilling to engage with all of the requests that were submitted to us. In some case we lacked the expertise, and used our Communities of Practice networks to refer the request. In other instances, we felt that the available science did not support the request being made, and we were unwilling to be drawn into an activist role. Nonetheless we did support the campaign to permit informal food trading, as well as the campaigns to increase the Child Support Grant and resume school feeding. We were active in the publication of articles in non-academic media sources, as well as participating in radio and television discussions.

A final challenge has been to manage the constraints on mobility. During Level 5, this involved finding ways to keep experiments from failing in our laboratories and test sites. In most cases, we were more successful with this during COVID-19 than during the

Campus lockdowns of 2015-17. The university authorities quickly provided secure access to campus, as well as support for the necessary permission to travel to field sites. In other cases, restrictions on air travel meant that entire projects came to a halt, and in the case of the 4th Global Food Security Conference, the meeting was postponed for eight months, and eventually converted to a virtual event. We have thus experienced delays across all activities, and several of our externally funded projects have had to seek no-cost extensions. In particular, projects that involved mobility grants to international universities have not been able to meet their capacity building targets, and new forms of doing such capacity building and networking will need to be investigated in 2021.

20 WAY FORWARD & DIRECTORS' NOTES

Despite repeated commitment to the reduction of poverty, South Africa remains one of the most unequal countries in the world in terms of income distribution. These inequities extend to food and nutrition security outcomes such as childhood stunting and the malnutrition experienced by adults. This puzzle of 'poverty amidst plenty' has its roots in South Africa's political economy of colonial dispossession and the poverty producing actions of the Apartheid era. Food and nutrition insecurity continue to act as a form of 'slow violence' against the most vulnerable in South Africa.

The economic costs of hunger and malnutrition are often overlooked and the benefits of interventions are under-estimated or neglected. Food and nutrition security should feature more prominently in all spheres of South Africa's government, especially in this time of a global pandemic. People uncertain of whether they will be able to meet their food energy needs are unlikely to take risks with the resources that they do have available, recognising the consequences if the investment does not yield a return. This will constrain entrepreneurship in the informal sector and small-holder agricultural sector. Hungry children are unlikely to perform well at school, limiting their opportunities when they enter the labour market. Malnourished children and adults are likely to be susceptible to other forms of illness, driving up the costs of health care, and the risk of catastrophic health expenditures.

Achieving food security in South Africa will require more than changing how food is produced or consumed. Instead a range of publicly funded, coordinated interventions will be needed that cover health, economic, social, agricultural and innovation policies, as well as measures that regulate the activities of the private sector and the guide the behaviour of consumers. Finally, provincial and municipal food and nutrition strategies point to the role that must be played by local government. This is both in terms of spatial planning for food and nutrition security, as well as in the implementation of complimentary actions that support better diets and safer food consumption. Issues of policy and product implementation and the functioning of local food systems will thus be a focus area of the CoE-FS in the future. We hope that these projects will enhance our transdisciplinary work, and grow our partnerships with civil society and government.

