VISION
Excellence in Agricultural Research and Development.

MISSION
The Agricultural Research Council is a premier science institution that conducts research with partners, develops human capital and fosters innovation to support and develop the agricultural sector.

THE ORGANISATIONAL VALUES OF THE ARC

Truth:
Incorporates honesty and integrity. The ARC shall conduct its business in a transparent and ethical way towards its employees, stakeholders and shareholders;

Accountability:
Incorporates responsibility. The ARC shall accept responsibility and accountability with respect to employee well-being, occupational health and safety (OHS), environmental sustainability and agriculture;

Respect:
Includes equity, diversity and dignity. The ARC shall conduct its business with respect for our colleagues, clients and stakeholders;

Growth:
Includes equality, rewards and recognition. The ARC shall ensure equity in terms of race, gender, creed, fair treatment, training and development to all its employees, stakeholders and shareholders;

Excellence:
Incorporates empowerment and innovation. The ARC strives to conduct research and development (R&D) in an efficient, effective, professional and accountable manner; and

Trust:
Includes ethics and transparency. The ARC shall ensure and foster trust among its employees, stakeholders and shareholders.
The ARC conducts its business at various campuses, including its administrative office, situated at different locations within the country (Bethlehem, Nelspruit, Potchefstroom, Pretoria, Rustenburg and Stellenbosch) and at a number of laboratories, office buildings and research farms throughout the country. Most of the research facilities of the ARC are distributed in accordance with agro-ecological zones, which enables specific focus on particular commodities.
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The Agricultural Research Council is led at the top by a Council (Board) of 16 capable and competent members who oversee governance and performance of the organisation. Under the Council is the Executive Management led by the Chief Executive Officer. The Executive Management is responsible for the overall operations and management of the Agricultural Research Council including but not limited, and in consultation with the ARC Council, to crafting the strategic direction to deliver on the mandate of the organisation as derived from the Agricultural Research Act, 1990 (Act No. 86 of 1990, as amended by Act 27 of 2001).
ARC 2018/2019 BOARD MEMBERS

Prof. Sibusiso Vilikomo - Chairperson
Dr. Joyce Chitja - Deputy Chairperson
Dr. Saskia van Oosterhout - Member
Dr. Aldo Stroebe\nMr. Allan Bishop - Member
Mr. Michael Brinkhuis - Member
Mr. Bongwe Kali - Member
Mr. Mulani Mahasana - Member
Mr. Andrew Maseate - Member
Dr. Moraka Makheka - Member
Prof. Phatu Mashela - Member
Ms. Joyce Machitoeng - Member
Adr. Edwin Mphahlele - Member
Mr. Sipho Mthombeni - Member
Dr. Mqebi Ngidi - Member
Dr. Mokgadi Ngoepe - Member
Dr. Shadrack Mxophuli - CEO & President
ORGANOGRAM
A properly established and well financed institution that focuses on agricultural research is bound to contribute to the scientific endeavours, economic growth, development, self-reliance and the competitiveness of the nation. Such an institution attracts the best minds, continues to develop its human capital and places an emphasis on a conducive environment for its staff to be productive and respected nationally and globally. These have been the objectives of the Agricultural Research Council (ARC) in the year under review. Agriculture remains a commanding height for South Africa’s existence. A strong agricultural sector plays a crucial role in the development of a stable country and will continue to create direct and indirect job opportunities for all South Africans. While the country’s economy continues to struggle, the ARC must play its important strategic role by consistently providing research that enables the country to be resilient and ultimately stable.

As Chairperson of the ARC, let me emphasize the fact that conducting business under the current circumstances has been challenging. As a Council, we continued to drive the ARC to be an exceptional organisation, free from corruption and usage of its best brainpower to be a leader in the agricultural scientific world. In 2018-2019 we made sure that our international collaborations were also meaningful to the ARC and agricultural science in South Africa.

The ARC has in the past years been affected by dwindling funding to perform its core research mandate. Also, the difficulty of the Department of Agriculture Forestry and Fisheries (DAFF) to pay the debt owed to the ARC must never be underestimated. However, this did not discourage the organisation in performing to its optimal best. Regardless of the financial challenges faced by the organisation, the ARC has worked well with our stakeholders and commodity industries. This has been exemplified by the continuous development of new cultivars, together with other partners, which have made the ARC a premium and global player as a research organisation in the agricultural sector.

The ARC provided scientific solutions to support rural development and agrarian reform as priority programmes of the South African government, primarily through DAFF and the Department of Rural Development and Land Reform (DRDLR). The ARC made contributions to related issues that are facing South African agriculture, in particular, the debates around land expropriation without compensation. The emphasis by the ARC was on bringing about equity in agricultural participation by all South Africans, the prevention of privatising social goods, reducing the cost of research so that emerging farmers must also benefit, etc.

The popular discussions on the 4th Industrial Revolution (4IR) were discussed by the ARC. Of relevance, the ARC has technologies that could provide targeted producer support to achieve the vision of agrarian transformation and vibrant, equitable and sustainable rural communities. Such technologies create a competitive advantage for the ARC as well as South Africa in the developing and emerging market economies. In brief, entering the space of the 4IR demands inventions and innovations by the ARC.

The following are general but important other developments within the ARC. Firstly, the organization has entered into partnerships for the assessment of Proactive Land Acquisition Strategy (PLAS) farms, and recommendations are that the farms should be rehabilitated for sustainable agriculture. Secondly, the ARC scientists developed a new vaccine for heartwater. This vaccine is unique as it doesn’t require use of antibiotics subsequent to administration and provides significant protection based on animal clinical trials. Thirdly, researchers at the Animal Production Campus used whole genome sequencing (WGS) for analyses of samples of animals from three indigenous cattle breeds (Afrikaner, Drakensberger and Nguni) to identify distinguishing and unique
characteristics. Fourthly, one of the objectives of the ARC is to grow and develop the agricultural sector that creates new markets, employment, business opportunities and positively contributes to South Africa’s National Developmental Plan. Finally, the ARC plays an important role in the process of economic development and contributes significantly to household food security and must be strengthened in order to play its meaningful role on a continuous basis. These are some of the developments that our society should be seized with and we hope the media world will help to expose such achievements by the ARC.

During the year under review the ARC has developed a Sustainable Turnaround Plan (STP) and Vision 2050 (V50) in order to make this organization more effective and efficient from all respects. These identify the impediments to make the organization to be a major success. The identified challenges pose a major risk to South Africa’s food security, meeting local demand for the delivery of safe as well as nutritious food and the production of competitive agricultural goods. In the year under discussion, the Council also approved a Sustainable Funding Plan (SFP) which will turn the organization around. The STP, V50 and SFP were considered and debated in order to take the ARC out of its current difficulties. It is imperative that the ARC take short-term, medium-term and long-term views to make this organisation a premium and sustainable research organisation.

To achieve success with the above requires cooperation by all responsible participants in the agriculture sector. The issue of union strikes and the peddling of misinformation do not contribute to the existence of a flourishing ARC. These challenges were observed via print media, social media and television. Innocent citizens, business owners, students, citizens of Hatfield as well as surrounding areas, other ARC campuses etc. were terrified by the strike. The responsible intervention of the SAPS must be applauded by responsible citizens of South Africa. What has happened to the Albert Luthuli, Desmond Tutu, Nelson Mandela and FW De Klerk tradition of solving difficult issues through peaceful and fruitful negotiations/discussions? Building a successful organisation like the ARC (in a fledgling democracy) requires calmness, focus and obtaining as well as using measurable factual data/information.

Before I express my gratitude, let me articulate my observations on matters of governance, going beyond this year. With the economic meltdown and the concerted effort to expose corruption in state institutions (where they collaborate with the private sector and private individuals) this year we marked a call for a new beginning to reposition agriculture as a whole. Hence the ARC Turnaround Strategy and Vision 2050. Therefore, it is incumbent for the Ministry, Department and the Portfolio Committee in Parliament to be driven by one common purpose; that is agricultural success, scientific achievements in this sector and a contribution to the economic competitiveness of the country. This is long overdue and was apparent in our conversations with all the organs of state.

In terms of corporate governance, the Council and Council Committees met as per required legislation and the Council Charter does provide the terms of reference in terms of how the Council and Committees should perform its functions. My thanks go to all Council and Audit & Risk Committee members, Executive Management of the ARC for their dedication in fulfilling their fiduciary duties and responsibilities as well as the entire ARC staff for their contributions to sustain a financially struggling organisation.

Let me thank our former Honourable Minister Senzeni Zokwana for trying to steer the ARC in the right direction during our historic turbulent times. We welcome our new Honourable Minister Angela Thokozile Didiza and her deputies, Honourable Sdumo Dlamini and Honourable Mcebisi Skwatsha of the now combined Department of Agriculture, Land Reform and Rural Development. We are convinced that the new consolidation of the three is a step in the right direction. As a knowledge and scientific institution we are convinced that the Department is in solid leadership and this will help the ARC to become a magnet of excellence in the science of agriculture.

In conclusion, as a Council we congratulate His Excellency, President Matamela Cyril Ramaphosa on the ascendency to the highest office. We are happy about his efforts on the “War on corruption and crime” in government and the related entities. The Council takes note of the gazetted Proclamation No R 36 of 2019 Special Investigating Units and Special Tribunals Act No. 74 of 1996 (Referral of Matters to Existing Special Investigating Unit) in respect to the former DAFF and possibly its entities. We wish the President, Cabinet and government well in making South Africa a well governed and a respected country.

Prof Sibusiso Vil-Nkomo
Chairperson of the ARC Council
MESSAGE FROM THE PRESIDENT AND CEO OF ARC

The primary objectives of the Agricultural Research Council are to conduct research and development, technology development and dissemination in order to:

- Promote the development of scientific solutions and technologies to ensure national food security;
- Promote the sustainability, development and growth of the agricultural sector;
- Facilitate sector skills development and knowledge management;
- Facilitate and ensure natural resource conservation; and,
- Contribute to a better quality of life.

As outlined above, the ARC mandate is critical for sustainable agricultural production; that in turn, enables food and nutrition security for a healthy, peaceful, developmental society that contributes to economic growth and good governance.

In accordance with the requirements of the Agricultural Research Act, 1990 (Act No. 86 of 1990 as amended by Act no. 27 of 2001) and the Public Finance Management Act, 1999 (Act no. 1 of 1999 as amended by Act 29 of 1999) (PFMA) we hereby present the annual report of the ARC containing audited financial statements and performance information for the year ending 31 March 2019.

On behalf of all of us, the employees of the ARC together with Council we hereby submit this Annual Report to South Africa’s Parliament, through the Executive Authority, the Minister of Agriculture, Forestry and Fisheries: Honourable Ms. Thoko Didiza.

The outputs in this Annual Report were in accordance with the pre-determined objectives that are contained in the Business Plan for financial year 2018/19 as approved by Council, and tabled in Parliament by the Honourable Minister of Agriculture, Forestry and Fisheries: Mr. Senzeni Zokwana. Further, this Annual Report provides information on organisational performance for the fourth year of the five (5) year Strategic Plan for the period 2015/16 to 2019/20.

On behalf of all at the ARC, we hereby express our gratitude for good governance, oversight, strategic advice provided by Council (Board), the Council Committees, especially the Audit and Risk Committee.

The ARC hereby expresses appreciation for the support and efforts of the Honourable Minister: Mr. Senzeni Zokwana and Deputy Minister: Mr. Sifiso Buthelezi, as well as the administrative support of the Department of Agriculture, Forestry and Fisheries.

During the financial year the ARC received science policy and other support from the Department of Science and Technology (DST) and accordingly, the ARC hereby expresses appreciation to the DST for its support during the financial year.

As contained in this Annual Report, our analysis indicates that during the financial year 2018/19, the ARC successfully delivered on its predetermined outputs as reflected in the performance information report. The ARC’s predetermined goals, outputs and targets were duly outlined in the Business Plan for the said financial year. In many instances, the ARC generally exceeded the set targets for the strategic goals.

Briefly, the ARC achieved good performance as per strategic goals with limited resources, particularly people (skills and capacity), ageing infrastructure (buildings and laboratories), and equipment, primarily through effective utilization of partnerships and collaboration. Financial constraints and escalating costs further limited the ARC’s ability to entirely fulfil its mandate.
During the reporting period, there was need for the ARC to reflect on the organisation’s contributions, through research and development, technology transfer and dissemination towards the national priorities as outlined in the Medium Term Strategic Framework (MTSF):

- Outcome 4: Decent employment through inclusive economic growth;
- Outcome 7: Vibrant, equitable, sustainable rural communities contributing towards food security for all; and,
- Outcome 10: Protect and enhance our environmental assets and natural resources.

These were aligned to the United Nations Sustainable Development Goals (SDG) in the following manner:

1. Contributing towards the attainment of agricultural yields through improved agricultural production, productivity and biosecurity;
2. Enabling the country to respond and adapt to climate change concerns (water, land, energy, biotic and abiotic stresses), including through sustainable natural resource utilisation;
3. Contributing towards agricultural development, particularly smallholder farmer development;
4. Employment and job creation across the full agricultural and agro-processing value chain; and,
5. Information, knowledge generation and skills development for improved productivity.

Accordingly, the following strategic goals enabled the ARC to conduct research and development as well as dissemination of scientific solutions as a response to agriculture sector needs:

1. To generate knowledge and technologies that will enhance the efficiencies in crop based agriculture;
2. To generate knowledge and technologies that will enhance the efficiencies in livestock, wildlife and aquaculture based agriculture;
3. To generate knowledge and technologies for conservation and utilization of natural resources;
4. To generate knowledge, solutions and technologies for food safety, quality and improved efficiencies in the agriculture value chain;
5. To generate and disseminate knowledge and technologies for decision-making and transformation of the agricultural sector; and,
6. Apply best resource management practices towards a high performing and visible organisation.

RESEARCH AND INNOVATION:
CONTRIBUTING SCIENTIFIC SOLUTIONS FOR A DEVELOPMENTAL ECONOMY

In the year under review, the ARC continued to increase its contribution to the scientific knowledge base of our economy through peer-reviewed publications emanating from research and development. The ARC has excelled in scientific output as measured through significant increase in the number of peer-reviewed scientific publications. In the ten year (10) period between 2008/09 and 2017/18 the number of peer reviewed scientific publications significantly increased from 155 to 499. However, during financial year 2018/19 the ARC’s scientific publications declined by 11 percent to 442.
Further, research collaboration across the spectrum of strategic objectives has increased and diversified, as demonstrated by the greater number of peer reviewed scientific journals with external authors that exceeded targets.

Further analysis of performance for the 5-year Strategic Plan period (2015/16 to 2019/20) indicates that the number of peer reviewed journal articles published increased by 33 percent over the period 2015/16 to 2018/19. This includes the increased number of publications with ISI rating (impact factor) higher than 2.0 suggesting improved quality of science and knowledge generated.

These outcomes are particularly significant as the knowledge generated and scientific information are in turn, disseminated to users who are predominantly in the agricultural sector. Although not necessarily linear, learnings arising from scientific publications enable researchers to translate the information into applications in the agricultural sector. Such applications could lead to development of new technologies such as cultivars, diagnostic tools, digital software, vaccines, to name a few.

Climate change is a serious threat to South Africa’s primary objective of food security, sustainable agricultural production, rural development and economic growth. It is imperative for South Africa’s agriculture to be resilient to adverse impacts of climate change. Agriculture’s resilience to climate change requires application of scientific solutions and innovation. Accordingly, the ARC has been engaged in a range of scientific research and development initiatives aimed at enabling resilience of agriculture to adverse impacts of climate change.

Scientific solutions for resilient agricultural production include, among others, development of drought-tolerant maize varieties containing the transgene for Bt (MON89034) and are also resistant to infestation by the Fall armyworm. Biological and biochemical analysis of the mechanism of resistance remain the focus of research within the ARC. Field research results suggest the use of these maize hybrids enables the attainment of required yields for food security.

Agriculture is also vulnerable to climate variability as it presents risks for attaining required yields and productivity. To mitigate the effects of climate variability, the ARC conducts research and development to generate knowledge and scientific solutions that could assist farmers in their decision making for effective and efficient production. During the reporting period the ARC conducted studies on climate smart agriculture production methods and technologies of conservation agriculture at various sites in Limpopo, Mpumalanga, Free State and North West provinces. Results demonstrated the use of climate smart methods for conservation agriculture improved soybean productivity, particularly among smallholder farmers when compared to conventional tillage.

Plant pests and diseases have in many instances resulted in poor crop yields, with consequences of threats to national and household food security, particularly for grain crops. In light of this threat, the ARC conducts research and development for solutions towards ensuring resilience of crop production to pest and disease infestation. This has included research on identification and development of solutions for resilience to pests such as root-knot nematodes (e.g. *Meloidogyne javanica*) in maize, Russian wheat aphids (e.g. *Diuraphis noxia*), banana bunchy top virus, fruit flies (e.g. *Bactrocera dorsalis*) and blueberry bud mites (e.g. *Acalitus vaccinia*) to mention a few.

Livestock production and productivity is an important component of South African agri-food systems, particularly as an important source of protein that is essential for food and nutrition security among the population. For example, in the reporting period, the ARC focused on research applications of genomic tools, whole genome sequencing to obtain detailed scientific understanding of the differences and similarities between South African indigenous cattle breeds such as Nguni, Afrikaner and Drakensberger. Although the research continues, results to date suggest insightful information about genes associated with phenotypes, fertility and susceptibility to certain diseases. Genetic markers specific to each breed were identified, which could be useful in breeding and animal production programmes. Further analysis could elicit understanding of growth performance and meat quality of the different cattle breed populations under different production systems.

Public health is an important component of a functional society, particularly for sustainable livelihoods and economic development. Food safety is a critical element towards ensuring good public health. The ARC conducted research to profile, quantify and characterize bacterial foodborne pathogens isolated from local and imported meat and meat products in South Africa. More than 2000 samples were tested for various pathogens, including for *Listeria* species. Results indicated that 15% of samples from domestic markets tested and 12.4% of samples from ports of entry contained *L. monocytogenes*. The metadata and isolates were shared with the National Institute of Communicable Diseases to identify the cause of infection among the population in the recent outbreak of listeriosis disease. Genetic characterization of the various samples continues.

The outbreak of animal diseases in many cases have resulted in major losses to livestock production, with sometimes devastating consequences to livelihoods and income for farmers; and, in some instances disease spread has posed risks to public health. Research and development for use of the best biosecurity measures is critical towards sustainable
increased animal production. Accordingly, the ARC has continued to develop new technologies for diagnostic services, vaccines and other scientific solutions for effective animal health management.

For example, innovations based on the knowledge and understanding of immune responses and antibody development, have enabled the ARC develop diagnostic tools for various important animal diseases causing viruses such as African Horse Sickness (AHS), bluetongue (BT), Wesselsbron, Foot-and-Mouth Disease (FMD), bovine tuberculosis and the horse parasite *Babesia*. These diagnostic tools have since been trademarked as Nkuku® and Inshi® antibody libraries.

The ARC continues to provide technical advice, data and information for the National Cultivar Evaluation Programme, a partnership with all stakeholders in the grain industry (farmers, seed producers, millers, agro-processors, researchers, commodity organizations and funding agencies) that involves evaluation of the most suitable crop cultivars for specific agro-ecological zone in grain production. As a public entity with good scientific expertise and other resources (land, laboratories etc), the ARC is central to generating all data and information required for decision making in grain production.

During the reporting period, the ARC conducted more than 200 field trials which was inclusive of 70 cultivar evaluation trials for wheat and maize throughout South Africa. The data and associated information was published as production guidelines for maize and wheat. In addition, the guidelines were presented at cultivar evaluation workshops, printed and distributed to more than 1000 farmers, as well as made accessible through various media (website, study groups, exhibitions, farmers’ days etc).

**DISSEMINATING SCIENTIFIC SOLUTIONS FOR AGRICULTURAL DEVELOPMENT**

Income generation among agricultural enterprises is important for food and nutrition security, economic growth, sustainable agricultural development and job creation. Accordingly, the ARC conducts research on plant improvement through various breeding programmes aimed at enhancing genetic traits for increased yield, productivity, resilience to stress (drought, pests, diseases, salinity, climate change etc.), nutritional quality and post-harvest handling among others.

In the last ten years, the ARC’s efforts at crop improvement have resulted in the development of more than 180 cultivars of critical importance for sustainable agriculture. The figure below shows the trend in cultivars developed by the ARC with Plant Breeders’ Rights. It’s important to note that there has been a significant decline in the number of cultivars with Plant Breeders Rights in the last 3 years. This has been primarily due to reductions in funding allocations from government over the MTEF period 2016/17 to 2018/19.

The significance of developing and transferring for use new cultivars is to enable farmers to increase yields, improve nutrition and resilience to pests, diseases as well as adverse impacts of climate change (e.g. drought tolerance, heat tolerance, floods etc). The net effect to society is food and nutrition security as well as increased incomes in the agricultural sector. In addition, Plant Breeders’ Rights provide...
Research on plant improvement for cultivar development at the ARC has been constrained by various factors, such as resources (people, infrastructure, finance etc.) and climate change. Resource constraints on the ARC have limited the ability of the organisation to invest in new equipment that could significantly accelerate the introduction of new technologies for research on cultivar development. The effects of resource constraints have become evident during the financial years 2016/17 to 2018/19 as there were fewer cultivars evaluated for plant breeders’ rights. Budget cuts in the MTEF period 2016/17 to 2018/19 constrained the ARC’s ability to generate sufficient data for evaluation of new cultivars, hence a significant reduction in the number of cultivars with Plant Breeders’ Rights were released in the said period.

The impact of fewer cultivars will likely result in reduced yields, less competitiveness and sustainability of South African agriculture enterprises - further impacts could be increased food prices due to lower yields and productivity.

In order to enable effective transfer of technology the ARC provided training to no less than 1500 farmers through more than 30 courses. Such training is aimed at improving skills of farmers, thus improving productivity. Courses range from grain crops, to vegetable and wine production, meat and dairy processing, sustainable water use, poultry and pig production, animal reproduction (artificial insemination) and animal health care.

Digital transformation is essential for improved agricultural productivity, information and technology dissemination as well as enabling producers to access markets. During the reporting period, the ARC, in partnership with the South African Weather Services (SAWS) and other international non-profit organizations, introduced and successfully transferred the use of digital smart tools, “Rain 4 Africa” application (R4A app), primarily through the use of cell phones. The R4A app provides the users, primarily farmers, to obtain real-time information on weather, planting conditions and pesticide use on farm among others. This R4A app was disseminated to more than 6000 farmers and extension officers, and is expected to enable improvements in crop yields, water use efficiency and greenhouse gas emissions.

**DEVELOPING OUR PEOPLE, THE MOST IMPORTANT ASSET FOR EFFECTIVE DELIVERY**

Human resources capacity (skills and appropriate numbers) are the most critical resources for ARC’s success and sustainable impact on the agricultural sector to fulfil its mandate. For this and other reasons, the ARC continuously engages employees and students, including prospective students, for skills development and careers in the sector.

The ARC has continued to maintain good relationships between management and employees, with turnover below 5 percent for the reporting period. Indeed, the ARC’s employee turnover since financial year 2007/08 to 2018/19 has been below 10 percent on average. Low turnover is an important element for the effectiveness of multi-year research and development projects as it enables the attainment of required outputs, such as cultivars and vaccines.

Although employee turnover remains low within the ARC, the country lacks a critical mass of highly skilled scientists, engineers and technicians. Therefore, any resignation of highly skilled scientists negatively affects the continuity of research projects, which in turn, delays the delivery of outputs. It’s therefore imperative for the ARC to explore a variety of mechanisms to improve on talent management, retention and recruitment, including skills development.

**ARC developing skills for sustainable agriculture research and innovation**

To mitigate the lack of critical mass of skills in South Africa, the ARC continued to invest substantially in the training and development of employees. Such training and development includes formal training at higher education institutions that includes the use of funds obtained through the National Research Foundation, Technology for Human Resources Industry Programme (THRIP), Agri-SETA and other support.
Brief analysis indicates that interventions implemented in the last ten years for capacity building, particularly the Professional Development Programme (PDP) and employee development have significantly contributed to the changes within the ARC. During this period, the PDP has increased from less than 50 postgraduate students in 2007/08 to more than 190 in 2018/19.

Similar analysis indicates that employees enrolled for post-graduate degrees beyond bachelor of honours has increased from less than 60 to more than 250 in 2018/19. For the financial year 2018/19, at least 54 students obtained Master of Science degrees, while another 24 obtained Doctoral degrees; all through education and training provided by ARC scientists. The effect has been that ARC has contributed to attainment of more than 100 MSc and PhD degrees awarded during the same period. These achievements represent significant contribution of the ARC towards skills development, especially as more than 80 percent of the graduates were black (per South African demographic classification) African, and no less than 60 percent were female.

MANAGING OUR FINANCES FOR EFFECTIVE AND SUSTAINABLE SUCCESS

The ARC has been operating within declining funding levels in both the amount and level of funding it receives from the Parliamentary Grant and its ability to generate external income which in turn has had the following consequences to the organization.

- The ARC consistently finds itself in a deficit arising from the need to deliver world class research services in accordance with its mandate, whilst receiving increasing less in terms of adjusting to inflationary increases.
- The cash reserves have been on a consistent decline since the 2014/15 financial year and is facing short term liquidity crisis.

The current economic downturn and increasing expectations for the ARC to demonstrate its relevance and the effectiveness of its programs and services have exacerbated the challenges faced by the ARC to establish and define sustainability over the long term.

As a key provider of solutions for the management of pests and diseases and the mitigation and adaption to climate change, a non-functional ARC would present a significant threat to food security, agriculture and economic growth, peace and sustainable development. Consequences of a dysfunctional or liquidated ARC would be too ghastly to contemplate for South Africa.

During the MTEF period ending 31 March 2018, the ARC Parliamentary Grant was reduced by R246 million; which was inclusive of the grant allocation from the Department of Science and Technology (DST) for the maintenance and operation of national genebanks (National Public Good Assets), being reduced by R60 million. Further, reductions in budget allocations severely impacted upon the ARC’s ability to generate external income from co-funding arrangements with commodity organisations and other funders.

Reductions in budget allocations by government have severely impacted upon the ability of the ARC to fulfil its mandate. This is evident in the reductions in the number of cultivars released to the agriculture sector during the same and subsequent MTEF period of 2016/17 to 2018/19. Consequently, this will likely reduce agriculture yields, productivity and competitiveness of the sector, that in turn could result in threats to food security and higher food prices.

Further analysis indicates that in the period 2012 to 2015 income exceeded expenditure; however, since 2015, this trend has reversed and projections are it will remain as such (e.g. expenditure exceeding income up to 2019). This scenario has a direct impact on the cash reserves of the ARC, hence the depletion by end of the financial year 2018/19. Although the working capital of the ARC showed a positive ratio in 2016, whereby current assets exceeded liabilities, the opposite was true in 2017/18 and 2018/19, when current liabilities exceeded current assets, indicating liquidity challenges.

Although the ARC reduced expenditure through various cost containment measures, difficult economic conditions resulted in a deficit for the financial year 2018/19. This was largely due to personnel and other fixed costs such as electricity, municipal services and security that could not be sufficiently curtailed timeously.

The recoverability of long outstanding debtors with significant amounts, mainly government departments, in turn presented difficulty for the ARC as the organisation had not made provision for such situation. In addition, poor economic conditions, including a persistent drought in the Western Cape and in other parts of the country limited the ability of the agriculture sector to provide funding (external income) for key projects at the ARC.

On behalf of management, the ARC concurs with the observations of the Audit and Risk Committee relating to the going concern status of the organisation as contained in the Annual Financial Statements. It’s imperative that the ARC engages with the Shareholder, through the Minister for Agriculture, Forestry and Fisheries to provide necessary financial resources that will ensure the organisation is a going concern.
It is clear that the current and future performance of the ARC depends on appropriate, consistent and sustainable resource allocation. Sustainable funding resource allocation is a critical element to enable the ARC to fulfil its mandate; which in turn, would support, inform and enable sustainable agriculture.

Management has accepted with disappointment the outcome of the external audit from the Auditor General of South Africa and resolved to immediately implement measures to eliminate adverse audit findings for 2019. This includes, among others the following:

i) An Audit Improvement Plan targeted at eliminating root causes of adverse findings, including consequence management;
ii) Review and development of business processes, including associated delegations of authority;
iii) Review and implementation of improved Information Technology (IT) system support;
iv) Review of skills (competencies and appropriate placements), including required training among all relevant personnel; and,
v) Accelerating the implementation of a business turnaround plan approved by Council for financial year 2019/20 and beyond.

Management and employees of ARC hereby express appreciation for the oversight and leadership of Council and the stewardship of the Audit and Risk Committee supported by Internal Audit service providers, particularly aimed at improving internal controls.

The ARC hereby thanks the Auditor General for providing an external audit service of good quality in a professional manner. Management undertakes to implement effective and timeous interventions through the Audit Improvement Plan.

TO OUR CLIENTS AND STAKEHOLDERS

To our most valued customers, partners, beneficiaries, suppliers and stakeholders, we the people at ARC hereby extend our utmost gratitude for your support and assistance during the last financial year. We trust and hope you will continue to partner and work with us in various ways to ensure that we meet the expectations and developmental needs of the South African communities.

A special message of thanks for support, advice and commitment for the success of the ARC is extended to the government, mainly through the Departments of Science and Technology and Department of Agriculture, Forestry and Fisheries. Further thanks and appreciation are extended to our partners in the private sector, particularly the commodity organizations of commercial agriculture that have continued to place trust in the scientific capability of ARC through funding allocations; and, in some instances joint partnerships in executing projects.

On behalf of the ARC management hereby thanks all members of Council for their dedication to ensure effective oversight of ARC governance. Further, the ARC thanks the Audit Committee for exercising their fiduciary duties with utmost care and vision for excellence. In particular, management appreciates the support, guidance and effort you have all devoted to the ARC.

Dr Shadrack Ralekeno Moephuli
President and CEO
EXECUTIVE REPORT

STATUTORY BASIS

The Agricultural Research Council is a public entity established under the Agricultural Research Act, 1990 (Act No. 86 of 1990, as amended). It is a schedule 3A public entity in terms of the Public Finance Management Act, 1999 (Act No. 1 of 1999, as amended by Act No. 29 of 1999).

PRIMARY MANDATE

In terms of the Agricultural Research Act, the objectives of the ARC are to conduct research, drive research and development, drive technology development and transfer (dissemination), in order to:

- Promote sustainability and equitable economic participation in the agricultural sector;
- Promote agricultural development and growth in related industries;
- Facilitate sector skills development and knowledge management;
- Facilitate or ensure natural resource conservation;
- Promote national food security; and,
- Contribute to better quality of life.

MAIN FUNCTIONS

The ARC’s main functions, as provided for in the Act, are to:

- Undertake and promote research, technology development and technology transfer;
- Utilise the technological expertise in its possession and make it generally available;
- Publish information concerning its objectives and functions, and establish facilities for the collection and dissemination of information in connection with research and development;
- Publish the results of research;
- Establish and control facilities in the fields of research, technology development and technology transfer that the Council may determine from time to time;
- Cooperate with departments of state, institutions, persons and other authorities for the promotion and conduct of research, technology development and technology transfer;
- Promote the training of research workers by means of bursaries or grants-in-aid for research, technology development and technology transfer, and contribute financially to research, development and technology transfer Programmes;
- Hire or let facilities; and,
- Cooperate with persons and authorities in other countries conducting or promoting research, technology development and technology transfer in agriculture.

AGENCY MANDATES

The Government of South Africa, through the DAFF and the DST, has mandated the ARC to manage and maintain National Public Goods Assets. The National Public Goods Assets (NPGA) comprising of national collections (genebanks) of animals, bacteria, animal databases, range and forage gene banks, fungi, genetic material, insects, plants, yeasts and viruses, to mention a few.

These provide important sources of genetic material for research and development, scientific reference (especially for pest risk assessment), future use, as well as rehabilitation of planting and breeding stock for national recovery from natural disasters. The collections serve as a basis for the ARC research, technology development and technology transfer, which contributes to a better life for all and the conservation of natural resources. The ARC maintains and manages a combination of the collections in alignment with its mandate as indicated below.
**Animal Production, Improvement and Health**

*This includes the full value chain of animal production and animal health.*

<table>
<thead>
<tr>
<th>DNA Databank for Stock Identification</th>
<th>Transboundary Animal Diseases, Onderstepoort</th>
</tr>
</thead>
<tbody>
<tr>
<td>The maintenance and expansion of a national DNA database that is utilised for DNA fingerprinting, biochemical genetic typing and species identification with the purpose of animal identification, the prevention of stock theft, forensic investigations, and species and population characterisation.</td>
<td>This division is responsible for the diagnosis of Foot and Mouth Disease (FMD) and African Swine Fever (ASF) and the manufacture of FMD vaccines. It is a Biosafety Level 3 high-containment facility that operates under special quarantine restrictions within a specially-designed building. It used to operate as an institute on its own. DAFF and Provincial Departments of Agriculture take full responsibility for the control of FMD and ASF in the country.</td>
</tr>
</tbody>
</table>

**Conservation of Adapted Indigenous Livestock Breeds**

The conservation, maintenance and evaluation of indigenous and adapted South African cattle, small stock, poultry and pig breeds. This activity is in line with the Green Paper on the Conservation and Sustainable Use of South Africa’s Biological Diversity.

**Animal Recording Facility**

The maintenance of a domestic animal genetic resources information system to organise information regarding indigenous breeds so that it is easily accessible.

**National Forage Gene Bank**

The National Forage Genebank was founded in the early 1980s and incorporates the valuable National Forage Collection from Rietondale, which already incorporated previous collections from Prinshof, Stellenbosch and Cedara dating back to 1900.

**National Culture Collection of Beneficial Gastrointestinal and Food Fermentation Organisms**

The maintenance, conservation, utilisation and development of the bacterial culture collection. This indigenous culture collection is unique in Africa and has existed since 1950.

**Rabies Laboratory, Onderstepoort**

This laboratory is responsible for diagnosing rabies in animal brain tissue submitted for analysis. DAFF and Provincial Departments of Agriculture take full responsibility for the control of rabies in animals in South Africa. It is a zoonosis (an animal disease that can be transferred to humans), and is therefore significant to public health.

**Blood Vaccines Production Unit**

This unit produces blood that contains the parasites for use as vaccines against redwater, heartwater and gall sickness. All these diseases severely limit production.

**National Science Collections**

- National Tick Collection (Gertrud Theiler Tick Museum).
- Insect collection (Vectors of animal diseases).
- Participating institution in the South African Natural Science Collections Facility.

**Diagnostic services**

- Reference laboratories for Rift Valley Fever, Bluetongue, African Horse Sickness, Foot and Mouth Disease, Lumpy Skin Disease and African Swine Fever.
- Serum bank (Surveillance of animal diseases).
Natural Resources Management, Mechanisation and Engineering

Activities focus on biosystematics and integrated pest and weed management, soil, climate and water, as well as engineering.

<table>
<thead>
<tr>
<th>Agricultural Engineering</th>
<th>Soil, Climate and Water</th>
<th>Plant Protection</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Agricultural equipment and maintenance of test facility.</td>
<td>• Agro-meteorological network, databanks and information systems.</td>
<td>• National collection of insects.</td>
</tr>
<tr>
<td>• Renewable energy demonstration centre.</td>
<td>• Land type and other surveys with associated databases and sample collections.</td>
<td>• National collection of arachnids.</td>
</tr>
<tr>
<td></td>
<td>• National Oceanic and Atmospheric Administration (NOAA) satellite image database for natural resource and disaster management.</td>
<td>• National collection of nematodes.</td>
</tr>
</tbody>
</table>

Plant Voucher Specimen Collection and Vegetation Database

This is an Integrated National Vegetation Resource database. The databases currently being used by the Vegetation Ecology Section are:

- Phytotab, which contains site records of species with estimates of abundance.
- The Roodeplaat herbarium specimen database.
- National weeds list.
- Ecology literature index.
- Autecological database containing miscellaneous information about plant species.
- Agricultural Research Council/INFO database, which contains map coverage and Acoks’ sampling site localities. The Acocks maps database has been made available to SA-IGIS and includes information from other floristic data sets.

Crop Production, Improvement and Protection

This includes work on citrus and subtropical crops, deciduous fruits and grapes, as well as vegetable, medicinal and ornamental plants, summer grains and oil and protein crops, small grains, and industrial crops

<table>
<thead>
<tr>
<th>Germplasm Collection</th>
</tr>
</thead>
<tbody>
<tr>
<td>The collection has a large number of inbred lines and cultivars well-adapted to local and sub-Saharan biotic and abiotic stress factors. Some germplasm collections have been maintained for more than 50 years. If this asset is lost or not maintained properly, all breeding projects of mandated crops will suffer and become entirely dependent on foreign, often non-adapted material.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Deciduous Fruits, Vines and Wine</th>
<th>Tropical and Subtropical Crops</th>
<th>Vegetable and Ornamental Plants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grapevine, deciduous fruit, yeast and alternative crops genebank.</td>
<td>Tropical crops genebanks, indigenous plants and vegetable genebanks.</td>
<td>Indigenous plants and vegetable genebanks.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Grain Crops</th>
<th>Small Grain</th>
<th>Industrial Crops</th>
</tr>
</thead>
</table>
Custodianship of the National Assets
It is important and in the national public interest to maintain a national reference collection. The concept of the “public good” is defined as “that good, the benefit (including financial) of which does not entirely accrue to an individual or group, but to the public at large and where the government acts on behalf of the country”.

It also relates to ongoing research and the delivery of essential services. They provide a wide range of functions, among which are:

- To support public functions of government and obligations under international agreements.

Regulatory decision support systems include:
- International obligations such as the Convention on Biological Diversity (CBD), and the International Plant Protection Convention (IPPC), which compels it to keep reference collections of all agricultural specimens with respect to the import and export of agricultural produce;
- Providing critical diagnostic support to the government phytosanitary services;
- Strategic national and international diagnostic and animal disease control capacity; and
- Strategic national and international diagnostic and plant disease control capacity.

Research.
- Natural resource inventories such as soil, water, climate and vegetation data banks, as well as weather stations for climate inventories and collection of data;
- A significant amount of the germplasm contained in the genebanks forms the basis for further research and development (plant breeding, cultivar development, new product development, etc.);
- Provide a resource for training; and
- They make an important contribution to scientific studies, biodiversity replenishment, sustainable development and production, food security and pest invader identification.

Emergency systems.
Genebanks serve as the basis for resuscitating agricultural production following natural disasters and are important for biodiversity and food security.

Organisation and Facilities.
- The ARC conducts its business at various campuses, including its administrative office, situated at different locations within the country (Bethlehem, Nelspruit, Potchefstroom, Pretoria, Rustenburg and Stellenbosch) and at a number of laboratories, office buildings and research farms throughout the country. Many of the research facilities of the ARC are distributed in accordance with agro-ecological zones, which enables specific focus on particular commodities. The ARC’s research and development capability is organised as follows:
  - Crop Production, consisting of Citrus and Subtropical Crops, Deciduous Fruits and Grapes; Vegetable, Medicinal and Ornamental Plants, Summer Grain and Oil and Protein Crops, Small Grain and Industrial Crops;
  - Animal Production, consisting of Animal Production, Animal Health and Aquaculture;
  - Natural Resources Management, consisting of Soil, Climate and Water; Biosystematics and Integrated Pest and Weed Management;
  - Mechanisation and Engineering consisting of Engineering;
  - Agro-processing, Food Technology and Safety; and,
  - Biotechnology

Additionally, the ARC has an Agricultural Economics and Capacity Development division that focuses on transferring research output to stakeholders such as farmers, both smallholder and commercial, as well as communities. Supporting core business divisions, the ARC has functional divisions, namely human resources; marketing and communications; finance; information technology and communication; facilities management; risk management; and internal audit, and all of these groups operate from its main office in Pretoria.
FINANCIAL RESULTS OVERVIEW

The ARC, has reported a deficit of R22 million for the financial year under review, which is slightly better than the deficit reported for the 2017/18 financial year. The organization has continued with its cost saving initiatives, however, it has experience a decline in external income which was mainly influenced by an unfavorable economic environment.

Ms Maureen Manyama
Chief Financial Officer

STATEMENT OF FINANCIAL PERFORMANCE OVERVIEW

<table>
<thead>
<tr>
<th>Amounts in Rand thousand</th>
<th>2019</th>
<th>2018</th>
<th>% Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revenue</td>
<td>1 314 305</td>
<td>1 308 220</td>
<td>0,47%</td>
</tr>
<tr>
<td>Expenditure</td>
<td>1 336 928</td>
<td>1 344 287</td>
<td>0,55%</td>
</tr>
<tr>
<td>Operating Deficit</td>
<td>-22 622</td>
<td>-36 066</td>
<td>-37,28%</td>
</tr>
<tr>
<td>Deficit for the year</td>
<td>-22 063</td>
<td>-38 066</td>
<td>-42,04%</td>
</tr>
</tbody>
</table>

Sources of Funding:
The ARC’s revenue streams consist of Parliamentary Grants (government transfers) and external income. Parliamentary Grants consists of baseline operational and capital grants whilst external income relates to revenue from contracts for services rendered and produce sold.

Parliamentary Grants:
The Parliamentary Grants reported under the period under review has shown a 4% year-on-year increase: R929 million (2018/19) vs R895.5 million (2017/18); and is derived from DAFF as well as DST.

The ring fenced projects includes, *inter alia*, the following: Climate monitoring; SADC activities; National public good assets; Intergis; Crop forecasting; Diagnostic services and DST.

External Income:
The ARC has experienced a 7% year-on-year decline on external income during the period under review. The external income realized or achieved was R385 million as compared to the R413 million reported for 2017/18 financial year. The revenue from services rendered continued to be the main driver of external income, and as such contributes 72.2%.
The 7% unfavorable variance has been largely influenced by the following revenue streams which performed at levels lower than the previous financial year: Sale of goods (-28%); Rendering of Services (-13%); Other Income (-2%). This has however mitigated by the following revenue streams which shown a year on year growth: Royalty Income (101%); Rental of Facilities and Equipment (14%) and Interest & Dividends (86%).

**Expenditure:**
The Operating Expenditure has largely remained flat year-on-year with R1,337 million incurred during the period under review. The Employees costs remain the leading cost driver for the ARC, which contributes 61% towards the total expenditure; followed by Operating and Administrative expenses (28%) and Non-cash expenditure (6%) which consists of Depreciation and Amortization as well as Impairment loss/Reversal of Impairments. The organisation has increased the provision for impairment loss on its Accounts Receivables book by R40.9 million to reflect its ageing which is dominated by long-outstanding accounts.

**The composition of the total operating expenditure is as follows:**
The year-on-year movement has been influenced negatively by the growth in the following costs drivers: Employee related costs (-2%); Non-cash expenditure (-23%) and Lease rentals (-10%). There has been an underspending experienced year-on-year of 11% and 8% on the Operating and Administrative Expenses; and Repairs and Maintenance respectively.

### STATEMENT OF FINANCIAL POSITION

<table>
<thead>
<tr>
<th>Amounts in Rand thousand</th>
<th>2019</th>
<th>2018</th>
<th>% Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Assets</td>
<td>264 405</td>
<td>287 974</td>
<td>-8,18%</td>
</tr>
<tr>
<td>Non-Current Assets</td>
<td>1 085 801</td>
<td>1 064 164</td>
<td>2,03%</td>
</tr>
<tr>
<td>Current Liabilities</td>
<td>403 156</td>
<td>381 051</td>
<td>-5,48%</td>
</tr>
<tr>
<td>Non-Current Liabilities</td>
<td>139 645</td>
<td>142 142</td>
<td>1,79%</td>
</tr>
<tr>
<td>Net Assets</td>
<td>807 405</td>
<td>828 945</td>
<td>-2,60%</td>
</tr>
</tbody>
</table>

**Current Assets:**
The current assets have declined year-on-year by 8% which has been largely influenced by Inventories and Receivables from exchange transactions:
- The Inventories balance has been influenced by an increase in Livestock year-on-year whilst the following categories have all declined year-on-year: Finished goods, Forage and Consumable stores.
- The performance on the net trade receivables/(debtors) reported of R144 million, were influenced largely by the collections realized during the period under review as well as an increased provision on doubtful debt (R40.9 million) which the organization has prudently processed. The total balance for the Provision of Impairment of trade and receivables at year-end was R75 million. Out of the R157 million Trade Debtors’ balance within the 150+ days; 76% of the balance is largely driven by the three major customers who are government departments. The organization had R5.3 million written off as uncollectible, during the period under review.
- The organisation ended the year with cash and cash equivalents of R76 million, which has improved slightly as compared to the R68 million of the FY 2017/18.

**Non-Current Assets:**
The non-current assets have grown to R1,085 million as compared to the R1,064 million (FY 2017/18), which has been significantly influenced by the additions on Property, Plant and Equipment (PPE) to the value of R65 million.

**Current Liabilities:**
The liabilities grew by 5% to R403 million and has been largely influenced by year-on-year growth in the following accounts namely: Payments received in advance-contract in process; Other Payables and Accrued Leave. This has, however, been mitigated by the Trade Payables which declined by R7 million to R53.8 million. It is pleasing that the significant portion of the trade payables were within the current and up to 60 days’ categories.

**Non-Current Liabilities:**
The non-current liabilities has remained flat year-on-year, with a closing balance of R126 million. The Foot and Mouth Disease (FMD) vaccines facility accounts for just over 95% of the R126.1 million balance for Unspent conditional grants and receipts.

### CASH FLOW STATEMENT OVERVIEW

<table>
<thead>
<tr>
<th>Amounts in Rand thousand</th>
<th>2019</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net Cash flows from operating activities</td>
<td>72 278</td>
<td>44 414</td>
</tr>
<tr>
<td>Net cash flows used in investing activities</td>
<td>-64 224</td>
<td>-73 484</td>
</tr>
<tr>
<td>Net increase / (decrease) in cash and cash equivalents</td>
<td>8 045</td>
<td>-29 069</td>
</tr>
<tr>
<td>Cash and Cash equivalents at the end of the year</td>
<td>76 348</td>
<td>68 303</td>
</tr>
</tbody>
</table>
It is pleasing to report that the ARC had a positive Net cash flow from Operating activities of R72 million, which has improved by 63% as compared to prior year. The organisation has invested R65 million in CAPEX, through the Purchase of Property, Plant and Equipment. The cash and cash equivalents improved year-on-year by 12%.

OUTLOOK

The ARC has continued to operate in a challenging environment that is characterized by: Declining funding environment; sluggish growth on external income; liquidity challenges/cash constraints and high fixed costs. As thus, a Financial and Sustainability Turnaround Plan has been developed, and will be executed throughout the MTEF period FY 2019/20 to FY 2021/22.

The sources of funding remain the same as follows:

The baseline parliamentary grants constitute 70% towards the total funding, which is followed by External (contract) income at 25%. The ARC has been allocated funding towards the construction of the Foot and Mouth Disease (FMD) vaccine facility.

The costs structure:

The personnel costs continue to be a critical cost driver of the ARC, and currently consumes over 90% of the Operational Parliamentary Grant. The Operating Expenditure is critical to the core functions of the ARC, and is linked to an organisation’s ability to generate contract income.
## AGRICULTURAL RESEARCH COUNCIL - TEN YEAR REVIEW

### STATEMENT OF FINANCIAL PERFORMANCE

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Income</th>
<th>Parliamentary Grant</th>
<th>Baseline Operational - DAFF</th>
<th>Baseline Operational - DST</th>
<th>Ring fenced Projects</th>
<th>Ring fenced Projects</th>
<th>Baseline Capital - DAFF</th>
<th>External Income</th>
<th>Other Income</th>
<th>Total Expenditure</th>
<th>Personnel Costs</th>
<th>Operating Costs</th>
<th>Depreciation &amp; Amortisation</th>
<th>Net Surplus/(Deficit)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>R'000</td>
<td>831</td>
<td>393</td>
<td>432</td>
<td>42</td>
<td>19</td>
<td>57</td>
<td>293</td>
<td>6</td>
<td>773</td>
<td>480</td>
<td>265</td>
<td>18</td>
<td>58</td>
</tr>
<tr>
<td>2011</td>
<td>R'000</td>
<td>871</td>
<td>393</td>
<td>432</td>
<td>42</td>
<td>19</td>
<td>57</td>
<td>293</td>
<td>6</td>
<td>773</td>
<td>480</td>
<td>265</td>
<td>18</td>
<td>58</td>
</tr>
<tr>
<td>2012</td>
<td>R'000</td>
<td>978</td>
<td>416</td>
<td>454</td>
<td>47</td>
<td>19</td>
<td>67</td>
<td>293</td>
<td>6</td>
<td>854</td>
<td>511</td>
<td>282</td>
<td>19</td>
<td>59</td>
</tr>
<tr>
<td>2013</td>
<td>R'000</td>
<td>1,104</td>
<td>442</td>
<td>485</td>
<td>49</td>
<td>22</td>
<td>71</td>
<td>293</td>
<td>6</td>
<td>1,015</td>
<td>518</td>
<td>312</td>
<td>23</td>
<td>124</td>
</tr>
<tr>
<td>2014</td>
<td>R'000</td>
<td>1,364</td>
<td>485</td>
<td>520</td>
<td>52</td>
<td>26</td>
<td>97</td>
<td>293</td>
<td>6</td>
<td>1,227</td>
<td>685</td>
<td>350</td>
<td>51</td>
<td>89</td>
</tr>
<tr>
<td>2015</td>
<td>R'000</td>
<td>1,358</td>
<td>485</td>
<td>520</td>
<td>52</td>
<td>26</td>
<td>97</td>
<td>293</td>
<td>6</td>
<td>1,227</td>
<td>779</td>
<td>491</td>
<td>51</td>
<td>137</td>
</tr>
<tr>
<td>2016</td>
<td>R'000</td>
<td>1,249</td>
<td>485</td>
<td>520</td>
<td>52</td>
<td>26</td>
<td>97</td>
<td>293</td>
<td>6</td>
<td>1,194</td>
<td>768</td>
<td>509</td>
<td>48</td>
<td>14</td>
</tr>
<tr>
<td>2017</td>
<td>R'000</td>
<td>1,203</td>
<td>485</td>
<td>520</td>
<td>52</td>
<td>26</td>
<td>97</td>
<td>293</td>
<td>6</td>
<td>1,194</td>
<td>768</td>
<td>509</td>
<td>48</td>
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<td>2018</td>
<td>R'000</td>
<td>1,308</td>
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<td>1,227</td>
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<td>137</td>
</tr>
<tr>
<td>2019</td>
<td>R'000</td>
<td>1,314</td>
<td>485</td>
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<td>52</td>
<td>26</td>
<td>97</td>
<td>293</td>
<td>6</td>
<td>1,227</td>
<td>779</td>
<td>509</td>
<td>48</td>
<td>137</td>
</tr>
</tbody>
</table>

### STATEMENT OF FINANCIAL POSITION

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Assets</th>
<th>Capital and Reserves</th>
<th>Non Current Liabilities</th>
<th>Current Liabilities</th>
<th>Total Equity and Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>R'000</td>
<td>818</td>
<td>618</td>
<td>72</td>
<td>818</td>
</tr>
<tr>
<td>2011</td>
<td>R'000</td>
<td>908</td>
<td>618</td>
<td>72</td>
<td>908</td>
</tr>
<tr>
<td>2012</td>
<td>R'000</td>
<td>1,273</td>
<td>742</td>
<td>84</td>
<td>1,273</td>
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<tr>
<td>2013</td>
<td>R'000</td>
<td>1,372</td>
<td>822</td>
<td>87</td>
<td>1,372</td>
</tr>
<tr>
<td>2014</td>
<td>R'000</td>
<td>1,506</td>
<td>956</td>
<td>87</td>
<td>1,506</td>
</tr>
<tr>
<td>2015</td>
<td>R'000</td>
<td>1,592</td>
<td>956</td>
<td>87</td>
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<tr>
<td>2016</td>
<td>R'000</td>
<td>1,592</td>
<td>956</td>
<td>87</td>
<td>1,592</td>
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<tr>
<td>2017</td>
<td>R'000</td>
<td>1,592</td>
<td>956</td>
<td>87</td>
<td>1,592</td>
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<tr>
<td>2018</td>
<td>R'000</td>
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### CASH FLOWS

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<tr>
<th>Year</th>
<th>Cash Flow from Operating Activities</th>
<th>Net Cash Flow from Investing Activities</th>
<th>Cash and cash equivalents at beginning of year</th>
<th>Cash and cash equivalents at end of year</th>
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<td>118</td>
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### RATIO ANALYSIS

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<tr>
<th>Year</th>
<th>Asset Turnover</th>
<th>Return on net assets (%)</th>
<th>Current Ratio</th>
<th>Operating margin (%)</th>
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<td>2019</td>
<td>1.1</td>
<td>10.3%</td>
<td>1.4</td>
<td>7.1%</td>
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</tbody>
</table>

### Performance

- **Asset turnover**: Revenue divided by net assets including cash resources
- **Return on net assets**: Net profit as a percentage of net assets excluding cash resources
- **Current ratio**: Current assets (excluding cash resources) to current liabilities
- **Operating margin %**: Net surplus/(deficit) as a percentage of turnover

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**Note**: The table provides a comprehensive overview of the Agricultural Research Council's financial performance and cash flows from 2010 to 2019. It includes statements of income, expenditure, assets, liabilities, and cash flows, as well as ratios for asset turnover, return on net assets, current ratio, and operating margin.
STRATEGIC GOALS AND ORGANISATIONAL ACHIEVEMENTS

With the mandate and statutory basis in mind, six strategic goals were crafted in order to enable the ARC to effectively focus and prioritise its options in delivering on its mandate. The strategic goals are framed as statements that describe the outcome expected in the agricultural sector as a result of the ARC intervention. They align fully with the National Outcomes, but also align with the relevant sectoral policy and strategy frameworks. The six strategic goals have been crafted in order to enable the ARC to effectively focus and prioritise its options in delivering on its mandate and so respond to the above strategic frameworks; as follows:

1. To generate knowledge and technologies that will enhance the efficiencies in crop based agriculture;
2. To generate knowledge and technologies that will enhance the efficiencies in livestock, wildlife and aquaculture based agriculture;
3. To generate knowledge and technologies for the conservation and utilisation of natural resources;
4. To generate knowledge, solutions and technologies for food safety, quality and improved efficiencies in the agriculture value chain;
5. To generate and disseminate knowledge and technologies for decision making and transformation of the agricultural sector; and
6. Apply best resource management practices, towards a high performing and visible organisation.

These strategic goals served to inform the ARC’s research focus, programme orientation and performance data. The ARC was also structured in a way that would support these strategic goals by clustering its divisions under Crop Sciences, Animal Sciences, Research and Innovation Systems, Impact and Partnerships as well as Administration and Corporate Affairs. The ARC also identified nine programmes through which these goals would be achieved. The programmes are Crop Production, Improvement and Protection; Animal Health, Production and Improvement; Natural Resources Management; Mechanisation and Engineering; Agro-processing, Food Technology and Safety; Smallholder Agricultural Development; Agricultural Economics and commercialisation; Training and Extension; and Administration and Corporate Affairs.

The following sections outline the overview and highlights of each division as achieved under the various programmes in the Financial Year 2018/19.
The Crop Sciences Division of the ARC primarily supports four of the organisation’s strategic goals:

- **Strategic Goal 1**: To generate knowledge and technologies that will enhance the efficiencies in crop based agriculture;
- **Strategic Goal 3**: To generate knowledge and technologies for the conservation and utilisation of natural resources;
- **Strategic Goal 4**: To generate knowledge, solutions and technologies for food safety, quality and improved efficiencies in the agriculture value chain; and
- **Strategic Goal 5**: To generate and disseminate knowledge and technologies for decision making and transformation of the agricultural sector.

Research is carried out on citrus and subtropical crops, deciduous fruits and grapes, as well as vegetables, medicinal and ornamental plants, summer grains, oil and protein crops, small grain and industrial crops.

The Crop Sciences Division has research facilities in Stellenbosch, Rustenburg, Potchefstroom, Bethlehem, Nelspruit and Pretoria (Roodeplaat). The division also has satellite stations strategically positioned in almost all of the nine provinces of South Africa. Achievements attained by this division under various ARC programmes for the 2018/19 financial year are highlighted below.

The research that supports Strategic Goal 1 can be categorized into three distinct disciplines, namely breeding, crop production systems and crop protection.
GERMLASM DEVELOPMENT RESEARCH

The Germplasm Development Research Team invited stakeholders and decision makers within the South African wheat industry, to an open day held in Bethlehem, to showcase the annual pre-breeding trials.

This, the first Germplasm Development (pre-breeding) open day, displayed the excellent germplasm developed to date with the aim to directly benefit farmers and the wheat industry in the future. This engagement was critically important, by bringing all industry stakeholders together, to view ARC germplasm, to better understand the potential research gaps, to clear up any misperceptions and address research needs of both farmers and industry partners.

The National yield improvement trial, the Fusarium Head Blight (FHB) phenotyping trial, the FHB resistance nursery, the rust resistance trials, the Russian wheat aphid resistance nursery, 20 international nurseries and the National Small Grain Collection rejuvenation block were showcased. The FHB phenotyping trial received significant attention, in which 2 000 entries are screened annually to determine the FHB resistance levels of each entry. Additionally, resistant lines are screened with molecular markers to confirm resistance against FHB, before being incorporated in the pre-breeding programme.

The open day was a huge success with many positive comments and compliments received. This event will now become an annual occurrence, with the administrator of the Winter Cereal Trust (WCT) recommending that attendance be a compulsory engagement for all WCT trustees.

EVALUATING THE PERFORMANCE OF COMMERCIALLY AVAILABLE SUNFLOWER CULTIVARS

The national sunflower trials, which have been conducted since the early 1970s, aim to enable farmers to optimise sunflower production through sound cultivar selection. To do this, multi-environmental trials were conducted to evaluate performance and adaptation of sunflower cultivars entered by different seed companies, taking into consideration yield performance and stability. Such trials often show genotype x environment interaction (GE), which complicates the process of selection of genotypes with superior performance across diverse environments. The information generated from the trials helps the farmers and other stakeholders with similar growing conditions to identify and select high-yielding sunflower cultivars with specific or broad adaptation to their conditions. Commercially available cultivars are evaluated in order to predict their future yield performances and to assess their seed composition (oil and protein content).
Results from cultivar evaluations showed that the mean yield of the five best cultivars was 0.2 t/ha higher than the overall mean yield of all cultivars. This relates to R800 per hectare at a grain price of R4 000 per tonne. If only 10% of the national crop of 525 000 ha could come from the five best cultivars as opposed to a random selection of cultivars, the increased yield will earn R42 000 000 per annum. Up to 30% of cultivars are replaced annually, and when a new cultivar, with an extreme grain yield and/or quality is introduced, it will be identified through this project.

**DNA FINGERPRINTING ENSURES TRUE-TO-TYPE VEGETABLE CULTIVARS**

The ARC DNA fingerprinting laboratory provides a critical service to the vegetable industry. Molecular marker fingerprints have been developed for all the important potato and sweet potato cultivars, which enables the ARC to routinely verify the integrity and trueness-to-type of stock plants of varieties maintained in the ARC genebank. This material is used in the ARC breeding programmes and by private breeders. The laboratory also tests other vegetables such as cauliflower and broccoli for private clients. An important part of the service is to detect when plants of different varieties were labelled incorrectly. Early detection of such mistakes helps our clients to prevent unnecessary losses.

**ONION BREEDING**

Male sterility is important to prevent self-pollination of onion flowers and loss of the onion hybrid genotypes in the production of onion seed. Research conducted by the ARC identified molecular markers and genotyping assays that significantly reduced the time required to identify the correct genotype of male sterility and maintainer lines in onion parent lines. It also further provides accurate genotypic information, which is useful for large scale screening. These molecular marker methods will facilitate the production of correct seed for commercialization of onion lines worldwide.

**NEMATODE RESISTANT SWEET POTATOES**

Many sweet potato cultivars are attacked by root-knot nematodes, especially *Meloidogyne incognita* races 2 and 4 and *M. javanica*, and in South Africa crop losses due to root-knot nematodes have been estimated at 6%. Screening trials showed that only two out of 12 sweet potato cultivars tested, namely ‘Mvhuvhelo’ and ‘Bosbok’, were resistant to these *Meloidogyne* root-knot nematodes. Neither of these are orange-fleshed cultivars, which are in demand locally and globally to help fight malnutrition, especially vitamin A deficiency. Further research showed that both ‘Mvhuvhelo’ and ‘Bosbok’ have the type of resistance mechanism that can be used in a breeding programme to transfer root-knot resistance to orange-fleshed cultivars. These cultivars can also be used in a crop rotation or intercropping system by farmers to suppress high populations of root-knot nematodes in their soil. However, the well-known commercially grown cultivar ‘Blesbok’ was found to be a tolerant host to *M. incognita* races 2 and 4. Tolerant plants do not suffer yield losses, but they allow nematodes to reproduce, which then attack the next crop planted in the soil. The cultivar ‘Blesbok’ can therefore not be used in crop rotation systems in regions with high populations of *M. incognita* races 2 and 4 root-knot nematodes.

**MANGO CULTIVARS AND SELECTIONS SHOW ENORMOUS POTENTIAL FOR FRUIT NECTAR DEVELOPMENT**

The export of fresh mangoes has dropped in recent years, however, value-adding through processing of a variety of mango products (canned mango, blended juices containing mango pulp, dried mango and atchar) has increased significantly. The development of high-value processed products would significantly reduce wastage when production volumes are high since fresh mango is a highly perishable product. Furthermore, processing also increases the availability of mango products during the off season. Fruit nectars developed from several of the ARC cultivars...
and promising new selections were evaluated for shelf-life, nutritional value and consumer preference studies focused on taste, colour, texture and overall impression. Shelf-life was evaluated over a six month period and parameters such as total soluble solids, titratable acids, pH, Vitamin C, carotenoid content, 2,2-Diphenyl-1-picrylhydrazyl (DPPH) activity and phenolic compounds were determined. From the sensory evaluation studies, ‘Crimson Pride’ met extremely well with consumer approval. The cultivar also had the most promising characteristics required for nectar production and Vitamin C content remained stable over time at room temperature, indicating a long shelf-life. ‘Crimson Pride’ was also extremely high in Vitamin A and ‘Joa’, also one of the ARC cultivars, was extremely high in antioxidant properties, even after a storage period of six months. Nectar developed from a new selection from the ARC breeding programme, ‘B26’, maintained colour during cold and room temperature storage. Overall, ‘Crimson Pride’ was highly suitable for nectar production in terms of its nutritional value and consumer preference. With the ARC advanced mango breeding programme, new cultivars with highly promising agro-processing potential could be identified in the future.

One of the ARC’s cultivars, ‘Crimson Pride’, is high in Vitamins A and C.

VARIEGATED MACADAMIA PROTECTED BY PLANT BREEDERS’ RIGHTS

Variegated plants are in high demand across the world, particularly in the ornamental industry, however, many of these variegated mutations are unstable and revert to a normal green colour. A stable, variegated ‘Beaumont’ seedling was identified for its potential in the ornamental market where it affords the public and home gardener the opportunity to plant a decorative fruit tree in their garden, and at the same time benefit from the highly nutritious nuts. Macadamia is one of the most nutritious nut types having a multitude of healthy attributes including vitamins, minerals, as well as healthy mono-unsaturated fats which reduce the accumulation of cholesterol.

The new macadamia cultivar has extremely attractive variegated foliage.

Even the husks of the new macadamia cultivar are variegated.

SCREENING FOR FLAVONOID CONTENT AS A PRE-BREEDING TOOL FOR THE DEVELOPMENT OF IMPROVED GRAPEFRUIT CULTIVARS

The citrus industry forms a major part of the agronomic and economic sector of South Africa, and supports the livelihoods of an estimated 1 million Southern Africans. The citrus industry has a long history in South Africa with the first exports of fruit dating back to 1907. Presently the South African industry consists of 120 commercial citrus varieties, of which grapefruit accounts for 11% of the total citrus orchards planted in the 2015/16 production season. Grapefruit are naturally rich in flavonoids, with naringin as the major flavonoid, best known for its distinct bitterness and anti-oxidant, anti-carcinogenic and cholesterol-lowering activities. To keep up with global demands (increased yields, pest and disease resistance, increased nutritional...
content etc.), breeding and selection programmes for new cultivars and varieties are needed. However, citrus fruit quality is influenced by several genetic and environmental factors and therefore a high performance liquid chromatography (HPLC) screening technique was developed so that grapefruit germplasm accessions could be screened for naringin content.

Varietal, seasonal and canopy position differences on the fruit characteristics and flavonoid composition were evaluated and it was found that the interactions between the physical and chemical characteristics were constant over two seasons, with genotype and climate playing the largest role rather than position on the tree.

This study demonstrated that the sampling of fruit for determining naringin/naringenin content in grapefruit can be simplified thereby facilitating the screening of a large number of accessions for use as possible parents in the breeding programme.

**NEW LITCHI CULTIVAR YIELDS VERY LARGE FRUIT OF HIGH QUALITY**

The ARC Litchi Breeding Programme was initiated in the early 1990s. Since then, over 30 selections with improved tree and fruit characteristics have been identified. One of these, a natural branch mutation, was recently awarded Plant Breeders’ Rights.

While the selection bears fruit at the same time as the current industry standard, ‘Mauritius’, which has oval-shaped, reddish-brown fruit, the selection’s fruit are much larger, more heart-shaped and bright red in colour.

Very few cultivars available on the market match the size of this new selection and it therefore has the potential to ensure a much better return on investment for the grower since larger fruit fetch a premium price.

**NEW RED PLUM CULTIVAR**

Plant Breeder’s Rights were recently granted to ‘Flavour Star’, a Japanese plum cultivar developed by the ARC. It is a very attractive red plum with crimson flesh and excellent sweet, aromatic taste. It also offers outstanding storage ability, which is crucial for export.
RESEARCH FOCUSING ON PRODUCTION SYSTEMS

IMPROVING YIELD OF HYDROPONICALLY-GROWN MUSTARD SPINACH

Bolting (pre-mature flowering and seed setting) seriously affects optimal yield in mustard spinach (Brassica juncea) and non-heading Chinese cabbage (Brassica rapa L. subsp. chinensis). The ARC conducted research to investigate the effects of leaf harvesting and flower removal frequency on the yield of hydroponically grown mustard spinach and non-heading Chinese cabbage. Results showed that non-heading Chinese cabbage plants had a higher tendency to bolt than mustard spinach plants. Cultivation of mustard spinach is recommended, with no flower removal and a leaf harvesting frequency of 14 days to improve leaf yield.

IMPROVING PROPAGATION OF AFRICAN POTATO AND AFRICAN GINGER

Wild populations of African potato, Hypoxis hemerocallidea, are declining rapidly due to large-scale, unsustainable harvesting for use in traditional medicine. The ARC developed a simple and affordable method that can be used by resource poor farmers to propagate African potato, whereby the corm is cut lengthwise into four sections or the growth tip is scooped out from the tip of the corm to stimulate the development of two or more buds. To improve the propagation results, plant hormones were added to stimulate bud initiation. By using these methods resource poor farmers can use some sections of the corm for propagation, while other sections can be used for traditional medicine or product development. This will help to minimize the pressure on wild African potato plants.

African ginger, Siphonochilus aethiopicus, is almost extinct in nature because seed can take up to a year to germinate, which is too slow to replace plants harvested for the use of the rhizomes. Propagation by tissue culture is too expensive for small scale farmers. Dividing the rhizomes when plants are dormant in winter is an easy way to propagate ginger, but because the rhizomes are also the parts used and marketed, it limits the number of rhizomes available for cultivation. ARC research found that cutting the rhizomes into pieces and adding arbuscular mycorrhiza to the growth medium is a simple and economically viable method that can be used by smallholder and commercial farmers to propagate African ginger.

NEMATODES AS BIO-INDICATORS OF IRRIGATED SOIL HEALTH IN THE CROCODILE (WEST) AND MARICO CATCHMENTS

Globally, irrigated crop production accounts for 40% of produce. However, crop yield and quality is threatened by the deterioration of freshwater resources because of anthropogenically-induced pollution. Furthermore, the threat of irrigating with low quality water extends to soil health/quality, which plays an important role in sustainable crop production. In South Africa, the Hartbeespoort and Crocodile (West) irrigation schemes (Crocodile [West] Catchment), representing the experimental sites for this study, are supplied with water from the Crocodile (West) river system. This river system has historically been subjected to pollution (e.g. metals, nutrients, and salts) that originates from urban, industrial, and agricultural landscapes. Conversely, water utilized by the Marico-Bosveld Irrigation Scheme (Marico Catchment; reference system) is regarded as minimally impacted.

Although the threat posed to crop production can be evaluated using region-specific irrigation water quality guidelines (e.g. South African Water Quality Guidelines for Agricultural Use: Irrigation), such guidelines only consider soil health from an abiotic (physico-chemical properties) perspective and disregards biotic attributes. This, even though soil fauna plays a fundamental role in fulfilling important soil ecosystem functions (e.g. nutrient cycling and pest control). Assessing and monitoring soil health thus requires a holistic approach, including the use of nematodes as bio-indicators. The study took into account terrestrial, non-parasitic (beneficial) nematodes as bio-indicators of soil quality, soil chemistry and ecotoxicology and the outcomes of this study ultimately highlighted the impact of anthropogenic activities on irrigation water quality in the Crocodile (West) Catchment. Nonetheless, it remained difficult to elucidate the subsequent effects on irrigated soil health, likely as a result of agricultural activities (e.g. tillage and fertilizer ap-
A single application of ethephon can be used as a means to mitigate climate change effects to improve flowering and fruit set in litchi. control (left) and treated (right).
RESEARCH FOCUSING ON PROTECTION AGAINST PESTS AND DISEASES

MANAGEMENT OF ROOT-KNOT NEMATODES IN MAIZE

A recent maize survey conducted by ARC-Grain Crops and North-West University indicated that *M. javanica* and *M. incognita* remain the predominant plant-parasitic nematodes and that the root-knot nematode population in any maize field mostly consists of a mix of these two species. If a producer has to include a nematode-resistant cultivar into his management programme, this cultivar must be resistant to both of these nematode species because the ratio in which these two root-knot nematode species occur in individual fields, are unknown.

Research to date indicated that currently only a few maize cultivars are resistant to both these root-knot nematode species and that only a small number of these cultivars contain the Bt gene. If the application of a nematicide is not sufficient in keeping the root-knot nematode numbers below the economic threshold level in a particular maize field, the producer can only prevent yield losses by including nematode-resistant maize cultivars into his integrated pest management programme. These root-knot nematode resistant cultivars are recommended to producers with known root-knot nematode infestations in their fields. However, most maize cultivars are better adapted to certain areas and the scenario might arise where the producer may not be able to include a nematode resistant cultivar containing the Bt gene.

Two additional pilot trials were planted in microplots to determine whether the African stemborer (*Busseola fusca*) will affect the nematode population already present in the field. Samples were often also infected with *Fusarium graminearum* (Gibberella) and/or *Macrophomina phaseolina* (Charcoal rot), two economically important crown and root rot pathogens of maize, therefore, these pathogens were also included in the pilot trials, to investigate possible interactions between nematodes and these pathogens. Results from the microplot trials indicated that stemborer damage increased in the presence of nematodes. These results warrant extensive research to better understand this interaction to enable researchers and the industry to make informed recommendations to producers.

ON-FARM DEMONSTRATIONS OF TELA MAIZE HYBRIDS FOR THE CONTROL OF FALL ARMYWORM IN SMALLHOLDER FARMING AREAS

The TELA project is an international public-private partnership aimed at enhancing food security and improving rural livelihoods among smallholder farmers in sub-Saharan Africa through development, deregulation and deployment of drought-tolerant and insect-protected GM maize hybrids. The TELA project is the transgenic (GM) component of the Water Efficient Maize for Africa (WEMA) project. Conventional maize hybrids developed under the WEMA project are marketed under the trade name DroughtTEGO™ and GM hybrids are marketed under the trade name DroughtTELA™. To date, the ARC has released and registered five TELA hybrids with the Bt (MON89034) gene for stalk borer and fall armyworm protection.

The five TELA hybrids (WE6206B, WE62017B, WE6208B, WE6209B and WE6210B) were planted in on-farm demonstration plots in collaboration with smallholder farmers in the Free State, Gauteng, KwaZulu-Natal, Limpopo and Mpumalanga provinces. The purpose was to demonstrate the varieties to the farmers and to provide information to farmers during information days. Farmers in Matibidi, Mpumalanga experienced very serious fall armyworm damage to their crops despite applying pesticides three to five times. Most farmers in the area abandoned their crops as they failed to control the fall armyworm.

Serious fall armyworm damage in conventional maize hybrid in Matibidi, Mpumalanga.

However, there was complete control of fall armyworm by Bt (MON89034), with no noticeable damage in each of the five TELA hybrids in the demo planted by one of the farmers in Matibidi (see picture on next page). An information day was held at the on-farm demo in Matibidi and all participants were impressed by the control of fall armyworm by the Bt (MON89034) in the five TELA hybrids, and subsequently requested seed.
MONITORING DISTRIBUTION OF RUSSIAN WHEAT APHID BIOTYPES IN SOUTH AFRICA

Russian wheat aphid (RWA), Diuraphis noxia (Kurdjumov), is an invasive aphid species that originates from central Asia from where it spread to other major wheat producing countries in the world.

RWA was first recorded in South Africa in 1978. Cultivation of resistant wheat cultivars is an effective management option, saving insecticide application costs and reducing environmental risks associated with pesticide use.

Following the first release of a RWA-resistant cultivar by ARC in 1992, several resistant cultivars have been released by private and public breeding programmes. However, this insect has adapted through the development of so-called biotypes, unique strains of the aphid capable of overcoming host plant resistance. Since the first biotype (designated RWASA1), reported in 1978, four additional biotypes (RWA-SA2 - RWASA5) have emerged.

ARC has been actively monitoring the development and spread of these biotypes, annually. Amidst climate change, a pro-active approach has become exceedingly important. Detecting new biotypes is fundamental in the development and deployment of durable sources of resistance in wheat.

During 2018, the latest biotype (RWASA5) was detected by ARC in the Free State and clone colonies of the aphid established. Following screening of resistance-donor material, this biotype is now considered the most virulent recorded to date. Farmers were alerted to this discovery through the popular press (SA Grain) and requested to be vigilant during the 2019 season. ARC continues to monitor the distribution of these biotypes in both the summer and winter rainfall regions, facilitating a rapid resistance-breeding response by the wheat breeding companies in South Africa.
Wheat rusts are one of the major wheat production constraints in South Africa. Three types of rust diseases commonly infect bread wheat in South Africa, namely stem rust, leaf rust and stripe rust.

Resistant cultivars provide effective and environmentally safe rust control. However, genetic resistance is often challenged with frequent development of new strains/races, which could render existing resistant cultivars susceptible. Such virulent races commonly develop through genetic mutation occurring in local races or through introduction from other countries. Monitoring of the rust population helps to quickly detect and control (with cultivar breeding) new races, thereby preventing potential epidemics and losses to the wheat industry. The National Rust Survey programme of the ARC (in collaboration with the University of the Free State) has been conducting annual surveys over the past three decades and more than 25 different races of leaf and stem rust and four races of stripe rust, have been identified.

During the 2017/2018 season, three stem rust isolates (collected in the Free State Province near Bethlehem) differed in their virulence profile from known South African stem rust races. Following screening, all three isolates were identified as a new race and coded to race PTKSK (North American notation) (Photo Dr W Boshoff, UFS). This race was previously reported as one of Ug99 variants from Ethiopia, Kenya and Yemen. However, this was the first report of race PTKSK in South Africa and brings the number of Ug99 variants detected in South Africa to five.

If the Zimbabwean stripe rust survives in the summer and causes infection in 2019, windborne spores could spread to South Africa from infected fields in Zimbabwe. It is therefore important for South African wheat producers and researchers to be more alert during the 2019 season for signs of stripe rust particularly on previously resistant cultivars. To assist in creating awareness locally, the information about the Zimbabwean stripe rust was published in the popular press (Wheat Focus and Landbouweekblad). ARC continues to monitor the situation for possible spread to South Africa.

Another new development in Southern Africa last year was the detection of stripe rust for the first time in Zimbabwe during September 2018. Our collaborators, Seed-Co International, provided samples for analysis in South Africa that were collected from irrigation wheat (Photo Dr T. Soko, Seed-Co Int.).

Garlic is affected by many virus diseases, therefore establishing a certification scheme to supply farmers with virus-free plant material is crucial to improve the quality of garlic grown in South Africa. A prerequisite for such a scheme is a diagnostic screening method to detect viruses in garlic. The ARC developed a DNA-based diagnostic test that can detect single viruses or a mixture of viruses in garlic samples. This has prepared the way for registering a garlic certification scheme in South Africa.

METHOD TO TEST FOR VIRUSES IN GARLIC

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FAST AND RELIABLE DETECTION OF FISSURE SCAB ON POTATO

Fissure scab on potato is considered a serious cosmetic disease in all 16 potato production regions in South Africa. The disease affects the appearance and quality of tubers, resulting in losses in the seed potato, ware potato and processing industries.

Fissure scab causes star-like fissures filled with corky tissue on the surface area of tubers of several potato cultivars. Seed growers have to conform to the local certification regulations and a diagnostic test was needed to rapidly and accurately identify the Streptomyces species involved in disease symptoms. The ARC used sophisticated DNA-based techniques to develop a rapid diagnostic test for fissure scab.

SOYBEAN HOST STATUS TO MELOIDOGYNE INCognita AND NEMATODE BIODIVERSITY IN LOCAL SOYBEAN CROPPING SYSTEMS

Root-knot nematodes (Meloidogyne spp.) are the major nematode pests of local soybean crops, resulting in up to 100% yield losses. The host response of locally-adapted soybean genotypes to the predominant Meloidogyne incognita was determined, while nematode (plant-parasitic and non-parasitic) abundance, diversity and occurrence in local soybean cropping systems and especially in glyphosate-treated versus non-treated (conventional soybean and natural vegetation) soils, were also assessed.

The investigations showed that substantial variation existed between the cultivars for all nematode parameters and that only two of the genotypes tested retained their resistance even at the higher temperature regimes when pot trials were conducted.

The highest plant-parasitic nematode diversity was associated with conventional soybean cultivars followed by natural vegetation and the glyphosate-tolerant soybean cultivars. A total of 72 non-parasitic nematode genera were also listed for the three ecosystems. Faunal analyses showed that soils from glyphosate-treated plots were degraded, less enriched and fungal-mediated.

Conversely, soils from non-treated plots were disturbed and enriched, and bacterial-mediated. However, this study re-emphasised the challenges posed by plant-parasitic nematodes, in particular Meloidogyne and Pratylenchus, to local conventional and genetically-modified soybean crops.

It also gave an insight regarding the importance of non-parasitic nematodes as bio-indicators of soil quality in soybean cropping agro-ecosystems and ultimately, it showed that nematode assemblages generally did not differ among glyphosate-treated and non-treated plots.

INCREASE YIELD WITH INTEGRATED CONTROL OF MANGO BLOSSOM MALFORMATION

Mango malformation disease (MMD) is a serious disease worldwide, causing severe economic losses annually.

Despite current recommendations for control, which includes removing clearly-visible malformed inflorescences, the incidence of mango blossom malformation continues to rise, significantly impacting on grower income.

Research showed that by incorporating an optimised integrated control strategy using both chemical sprays (Prochloraz) and regular removal of malformed inflorescences, fruit yield was consistently better over the long term than without the integrated control strategy - with an almost 30 ton/ha increase in yield over three seasons.
It is critical that growers combine a ‘break out and spray’ strategy for integrated control of mango blossom malformation to ensure healthy inflorescences.

Proper control results in higher quality fruit and increased yields.

NEW PEST IDENTIFIED ON LUCRATIVE BLUEBERRY CROPS

Plant quarantine measures prevent the introduction of many new pests and diseases on imported agricultural produce into South Africa. However, harmful species can and do move here from neighbouring countries, or they may be introduced through illicit trade in plants.

The ARC is often the first line of defence against new and invasive pests and diseases, as this is where potential pest and disease organisms are identified by taxonomic experts.

South Africa is a signatory to the International Plant Protection Convention, which sets phytosanitary standards and plant quarantine measures for trade (import and export) between countries in agricultural and other produce. It is therefore important to verify the presence of newly-introduced species scientifically.

Blueberry bud mite (Acallitus vaccinii) (Acari: Eriophyidae) was recently discovered in Mpumalanga, and for the first time in South Africa. This mite is an economically important pest of cultivated and wild blueberries, up to now only known from North America. Infestation levels found in South Africa so far were high, reducing flower and berry formation by up to 90%. These mites are microscopically small and identifying them is notoriously difficult. Knowing the identity of the pest allows finding available information on it and facilitates investigation and the use of appropriate control strategies.

The pest has not yet been found in the Western Cape, the main area of blueberry cultivation. Information about the mite was disseminated to blueberry farmers and industry organizations to equip producers with the knowledge to detect the presence of the bud mite early and prevent local build up and spread of infestations, which may result in increased damage and economic losses.

IMPROVED GRASS WEEDS CONTROL SYSTEMS IN MAIZE

The lack of effective control of grass weeds as well as the observed shifts to predominantly grass weed species under conservation agriculture emphasised the need to investigate the biology of problematic grass weeds in South Africa and to compare the degree of weed control achieved by various commercially available herbicides.

A field trial was conducted to study the emergence of seven grasses, namely common couch (Cynodon dactylon), naked crab grass (Digitaria nuda), crab finger grass (D. sanguinalis), goose grass (Eleusine coracana), sweet buffalo grass (Panicum maximum), bushveld herringbone grass (Urochloa mosambicensis) and herringbone grass (U. panicoides), and tropical spiderwort or wandering Jew (Commelina benghalensis) under various temperature and moisture regimes created by various planting dates. Preliminary findings suggest that the grass species were not all equally well adapted to germinate under the various conditions created. When water was not a limiting factor, *U. panicoides* was able to germinate and emerge to a greater extent at sub-optimal temperature conditions, compared with the other grass species. *Eleusine coracana*, *D. sanguinalis* and *D. nuda* dominated in the later planting dates, although general reduced emergence was observed compared with earlier in the season. Another field trial to establish the yield loss associated with weed crop competition showed that two grass species, *Rottboellia cochinchinensis* (Guinea fowl grass) and *Brachiaria eruciformis*...
(Sweet signal-grass), were dominant in the Potchefstroom trial. *Rottboellia cochinchinensis* resulted in 11 kg/ha yield loss for every 10g weed biomass increase per square metre. *Cynodon dactylon* and *U. panicoides* were dominant in the Bethlehem trial and resulted in a 28 kg/ha and 52 kg/ha yield loss for every 10g biomass increase per square metre, respectively. Field trials were conducted at Potchefstroom and Bethlehem with 15 herbicides: three acetochlor (700 a.i. g/ℓ), a dimethenamid-P (720 a.i. g/ℓ), an acetochlor (768 a.i. g/ℓ), two acetochlor (840 a.i. g/ℓ), a metolachlor (840 a.i. g/ℓ), three s-metolachlor (915 a.i. g/ℓ), a metolachlor (960 a.i. g/ℓ) and a s-metolachlor (960 a.i. g/ℓ). In order to control broad leaf weeds and nutsedge, bendioxide (3 ℓ/ha) as well as bromoxynil (1.5 ℓ/ha) for Amaranthus control and halosulfuron-methyl (50 g/ha), were applied six weeks after the pre-emergence applications. Weed control extending for six weeks was obtained with all products tested at both sites and control with products with similar active ingredients did not differ significantly from each other.

A glasshouse experiment using two soil types, sandy loam soil (16% clay) and a sandy clay-loam (35% clay) showed that *Urochloa mosambicensis* competed best in wet environments with 16% clay, whilst *U. panicoides* performed best in dry environments with 35% clay. *Urochloa mosambicensis* (bushveld herringbone grass) is thus considered the more successful and competitive of the two species because of its superior ability to adapt its root-to-shoot ratio in unfavourable environments.

**NEW DISEASE IDENTIFIED ON IMPORTANT VEGETABLE CROP**

A new and damaging disease of squash was observed in several commercial plantations in the Northern Cape Province. Fruits were covered by dark, brown to black, soft and water soaked lesions of about 3-6 cm diameter. Molecular methods identified the causal organism as the bacterium *Pseudomonas syringae* pv. *syringae*. This is the first report of soft rot in squash caused by *P. syringae* pv. *syringae*. Squash is amongst the most important crops grown in South Africa by both commercial and emerging farmers. On some farms up to 90% of fruits were spoiled, making them unfit for marketing and causing great financial losses. Further studies are needed to determine the spread and alternative hosts of the pathogen.

**Aggressivity of Urochloa panicoides and Urochloa mosambicensis was evaluated under four different soil environments.**

**Competitive ability of maize to various grass weeds was investigated under both glasshouse (A) and field trials (B).**

**ARC IMPACT ON FARMING SUCCESS**

Stilhoek Boerdery is a family-owned enterprise near Bela-Bela where the first passion fruit (granadilla) trials were planted in October 1996 to determine suitability of the climate and conditions. In 1998, Stilhoek Boerdery started farming with 100 granadilla plants. Assistance from the ARC
in terms of research on fungicides for application on granadillas, cultivar development, diagnosis of granadilla viruses and advice on the prevention of future viral infections, played a crucial role in the success of this venture. Stilhoek Boerdery continues to work closely with the ARC to register fungicides for use on passion fruit in South Africa and is also funding trials. The enterprise is also doing ground-breaking work on using foliar feeds as anti-fungal agents on passion fruit.

In 2018, an unknown viral infection devastated granadilla production on Stilhoek farms. The ARC identified it as Cowpea Aphid Borne Mosaic virus (CABMV), which is transmitted by an aphid. This knowledge allowed Stilhoek Boerdery to implement appropriate control strategies to reduce crop losses. The ARC additionally assisted in identifying potential alternative hosts to CABMV on the farm, thus enabling the farm to secure funds for planting of virus-free plant material to rejuvenate the farm after the losses experienced. Today Stilhoek Boerdery is the largest granadilla producer and exporter in South Africa, employing over 600 people, which contributes significantly to the local economy.

**PHYTOPHTHORA CINNAMOMI IN SOUTH AFRICAN MACADAMIA**

Macadamia is one of the most important horticultural export crops in South Africa. The industry is expanding at a rapid rate with increasing hectarage being planted year on year. However, there have been increasing observations of macadamia decline throughout the country.

Macadamia is highly susceptible to root rot and trunk canker caused by the soil pathogen *Phythophthora cinnamomi*, with yield losses of up to 60% and an estimated 10% loss in the annual gross value of macadamia.

By developing a highly sensitive molecular method, the pathogen was identified in soil samples collected from a range of macadamia production areas.

The study showed that the disease is widespread throughout these areas, with more than half of the samples collected being infected. The highest disease incidence was found in the Mpumalanga Province, which is one of the major growing regions.

Laboratory studies showed that several biocontrol agents could potentially be used in the integrated management of root rot and stem canker in macadamia and further evaluations are needed to ensure that the South African macadamia industry remains at the forefront of global production.

**AVOCADO SUNBLOTCH DISEASE IN SOUTH AFRICA**

Avocado (*Persia americana* Mill.) is an economically important subtropical fruit worldwide, and in South Africa avocado contributes approximately 29% to the total gross value of subtropical fruits. Avocado sunblotch disease (ASBV), caused by Avocado sunblotch viroid (ASBVd), is one of the most important diseases that affects yield and quality in avocado production worldwide. Typical symptoms are found on leaves, fruit and bark of the tree, however, some trees do not display any visible symptoms, and these are termed symptomless carrier trees. The most important control measure for ASBV is careful selection of pathogen-free bud wood and seed that are used for propagation. These materials are identified as pathogen-free through indexing.
Validation of the sensitivity and reliability of a large scale indexing method for ASBVd, which is critical for high through-out indexing of samples from both avocado nurseries, as well as grower orchards, was undertaken by the ARC. It was found that distribution of the pathogen was uneven in symptom-bearing trees, which means the accuracy of indexing can be affected by where samples are taken from a tree. This information allowed for the sampling method to be improved, which increased the reliability of ASBVd indexing. Reliable indexing, together with information dissemination on good farm management practices to prevent the spread of the disease, are crucial for improved management of ASBV in South Africa.

PROTECTING THE OLIVE INDUSTRY

ARC research over the past five years, in collaboration with the University of Palermo in Italy and Stellenbosch University, has shown that the indigenous seed wasp, *Eupelmus spermophilus*, attacks cultivated olives, but that it is only of economic importance where olives grow in close proximity to wild olive trees, because the seed wasp requires wild olives to overwinter. Other indigenous pests that can survive in cultivated olives year round pose a greater threat to the industry and require further research.

GETTING A HANDLE ON CROWN GALL

Crown gall is a serious bacterial disease of grapevines, causing galls on roots or on the base of the vine, leading to yield loss and stunted growth. The bacterium can survive in soil, in live and dead grapevine tissue, as well as on the surface of roots (rhizoplane) for years.

The bacterium, *Agrobacterium vitis*, is a complex organism, which includes pathogenic and non-pathogenic forms. To prevent the spread of crown gall, it is crucial to determine if established, ailing grapevines (even before typical galls develop) and nursery material are free from the disease. Collaborative research between the ARC and Stellenbosch University resulted in the development of a molecular diag-
nostic protocol for the routine detection of the grapevine crown gall pathogen, A. vitis, in plant material. This now forms part of the ARC diagnostic service available to growers and nurseries. To prevent the disease from spreading, farms and nurseries where the disease is identified, must adhere to strict phytosanitary measures and any infected material must be removed and destroyed.

Crown gall causes serious stunting and yield loss in grapevines.

TRANSMISSION OF BANANA BUNCHY TOP VIRUS BY THE BANANA APHID, PENTALONIA NIGRONERVOSA

DNA barcoding is often used for rapid identification of insect species that look so alike that conventional identification is difficult. Maceration of small insects like aphids to obtain enough DNA for barcoding means that important voucher specimens are destroyed.

ARC optimised a non-destructive method of extracting DNA from aphids, which allowed the specimens to remain intact. Sufficient DNA concentrations were obtained to identify the aphids and to detect Banana Bunchy Top Virus (BBTV) in the vector, Pentalonia nigronervosa.

Approximately 78% of aphids collected directly from symptomatic plants in infected plantations, as well as some aphids collected in other African countries, tested positive for BBTV. The BBTV viral strain identified from South Africa grouped with the “South Pacific” clade.

This non-destructive DNA extraction method can be used in an early detection management strategy, especially in epidemiology and virus-vector studies of Banana bunchy top disease (BBTD), to prevent the spread of the disease throughout the southern African region.

The banana aphid, Pentalonia nigronervosa, is the vector of BBTV disease which causes devastating damage to banana plantations.

BBTV-infected banana plants show stunted growth.
GLUTEN-FREE BREAD MADE FROM UNRIPE BANANA FLOUR

Banana is the most important subtropical fruit in South Africa. However, approximately 20-50% of all harvested bananas are wasted due to post-harvest losses.

The production of unripe banana flour is one of the ways to reduce wastage and produce a value-added product at the same time thus promoting sustainable agriculture.

Studies on the development and characterization of gluten free bread made with unripe banana flour using sourdough fermentation revealed that the flour was suitable for bread production.

Bread loaves had a greater volume and there was no cracking of the bread compared with control bread loaves.

Furthermore, breads made from unripe banana flour had a better crumb structure. Consumer preference studies indicated that this bread was highly acceptable.

Not only is the product healthy from a nutritional perspective, but banana fruit wastage is significantly reduced through the development of a value-added product.

POTENTIAL OF MORINGA SEED EXTRACT TO PREVENT NON-ALCOHOLIC FATTY LIVER DISEASE

The increased consumption of unhealthy diets that are rich in fructose has been identified as a key contributor to the high prevalence of non-alcoholic fatty liver disease (NAFLD). Fructose is the sweetest naturally occurring carbohydrate, therefore it is the preferred sweetener for various foods and beverages. It is estimated that fructose consumption has increased by 16% per capita globally. The metabolism of fructose occurs mainly in the liver and unlike that of glucose, its bypasses the normal rate-limiting steps in the breakdown of sugars. By virtue of this bypass, the consumption of fructose and its metabolism leads to increased accumulation of lipids (fats) in the liver, thereby causing NAFLD. The ARC conducted a study to investigate whether crude *Moringa oleifera* seed extract can protect growing rats against high-fructose diet-induced NAFLD and its associated complications. The crude *M. oleifera* seed extract significantly protected both female and male rats against NAFLD and reduced cholesterol concentration in male rats only. *Moringa* seed extract can potentially be used as an intervention for diet-induced NAFLD and hypercholesteremia in human adults and children.

KEI APPLE IS SUITABLE FOR AGRO-PROCESSING AND VALUE-ADDING

The fruit of wild indigenous trees in Africa has been enjoyed by local communities without any thought to develop and cultivate them as crops. Furthermore, worldwide there is increasing focus on food security, resulting in a greater interest in the development of unknown, under-utilised fruits and other indigenous foods. Increasingly, the natural habitat of the trees is being lost, due to population growth,
over-exploitation as firewood and the growth of commercial agriculture. The survival of indigenous fruit trees, which are well adapted to local environmental conditions, has become a priority. It is well known that a healthy diet includes an adequate intake of fruit. Africa has an extensive range of indigenous fruits that serve as an important source of vitamins, minerals, amino acids, and trace elements to rural populations. Limited scientific research has been carried out on the nutritional value and potential for development of indigenous fruits and nuts. However, ARC in collaboration with Tshwane University of Technology, investigated the nutritional value and characteristics of the Kei apple (*Dovyalis caffra*) and it was found that the fruit is a rich source of amino acids with excellent antioxidant properties. The chemical characteristics of the fruit and pulp of Kei-apple selections vary significantly, however, with relatively high concentrations of Vitamin C, total phenolics and 2,2-diphenyl-1-picrylhydrazyl (DPPH) and high total soluble solids: total titratable acidity (TSS: TA), this indigenous fruit is extremely suitable for agro-processing and the development of value-added products. Further studies will include investigations on harvesting methods, transport and storage to prevent post-harvest losses.

**Kei apple (*Dovyalis caffra*) fruit is a rich source of amino acids and they have excellent antioxidant properties.**

**BETTER BUBBLY**

A recent study focussed on the impact of grape temperature at harvest on the quality of *Méthode Cap Classique* (MCC) sparkling wines.

Research showed that the temperature of the grapes at the time of pressing affects pH, total acidity, organic acids and other wine quality parameters, and that it also has a significant effect on the aroma of MCC sparkling wines, but not on the taste.

This study provided winemakers with a better understanding of how the manipulation of some existing MCC production strategies such as temperature can improve the aroma and final quality of MCC sparkling wines.

**REDUCING BITTERNESS IN HONEYBUSH TEA**

The ARC conducted research aimed at reducing the intrinsic bitterness of processed honeybush produced from *Cyclopia genistoides*, a potential limiting factor in expansion of the honeybush market. Sorting was evaluated for rapid sensory profiling of honeybush as an alternative to descriptive sensory analysis, which requires trained tasters to assess and score each tea sample for a range of individual characteristics. With the sorting method tea samples with similar aroma and taste are simply grouped together, which is easily done by trained or semi-trained assessors and the information is easy to interpret. The potential application of sorting for rapid quality grading of honeybush is currently being investigated.

**STRATEGIC GOAL 3**

**RESEARCH FOCUSSING ON SUSTAINABLE USE, CONSERVATION AND PROTECTION OF NATURAL RESOURCES**

**EVALUATION OF THE LONG-TERM EFFECT OF GLYPHOSATE USE IN MAIZE**

Glyphosate was developed in 1964 and introduced as an herbicide for crop production during the mid-1970's, primarily for burn-down of annual weeds and to control problematic perennial weeds. Recent reports of yield loss in crops that were sprayed with glyphosate have been published and confirmed by some maize producers in South Africa. Glyphosate has also been shown to affect the micro-nutrient status of plants.

The ARC conducted a study to determine 1) the effect of application time of glyphosate and generic variations on yield of Roundup Ready® (RR) cultivars through field studies, and 2) to determine if chelation of micro-nutrients increases where glyphosate is applied in mixture with foliar nutrient products in glasshouse trials.

Five different glyphosate products were applied at various growth stages (V4, V4+V6, V6 and V8) to eight RR maize hybrids in a field trial. No significant yield reduction was observed with any of the applied treatments. Four nutrient products were applied separately, as well as in combination with glyphosate at the V6 growth stage of two RR maize cultivars in a glasshouse trial. The application of glyphosate, either alone or in combination with foliar nutrients, did not...
have a significant effect on yield (kernel mass) obtained per plant.

Leaf analyses indicated that there was no negative effect on the uptake of four micronutrients (calcium, magnesium, manganese and zinc) when nutrient products were applied in combination with glyphosate. A mixture of one product (Functional) and glyphosate actually increased the amount of iron and aluminium in the leaves significantly.

**MOLECULAR IDENTIFICATION OF ROOT-KNOT NEMATODES REVEALS IMPORTANT INFORMATION**

Root-knot nematodes cause enormous crop losses worldwide. Host plant resistance is an effective control strategy to minimize damage, but some species, such as *Meloidogyne enterolobii*, are able to overcome the host plant’s resistance. ARC in collaboration with the University of the North West, used new molecular techniques to develop genetic markers able to distinguish between the three *Meloidogyne* species in South Africa (*M. enterolobii*, *M. incognita* and *M. javanica*). This was not possible previously, because the species are morphologically very similar. The study confirmed that *Meloidogyne enterolobii* is much more prevalent than anticipated and that it is apparently more pathogenic than *M. incognita* and *M. javanica*.

**BIOCONTROL AGENT RELEASED AGAINST INVASIVE MEXICAN SUNFLOWER**

Mexican sunflower, *Tithonia diversifolia*, is an aggressive invasive weed which is naturalized in many countries, including South Africa. It was introduced into South Africa during the 1930s as an ornamental plant and has become invasive in the tropical and subtropical provinces including Limpopo, Mpumalanga and KwaZulu Natal. It invades farms, forest margins, disturbed lands, railroad and roadside reserves by outcompeting native plants. After a decade of research, the first biocontrol agent, a leaf defoliating tortoise beetle (*Physonota maculiventris*) has finally been released against Mexican sunflower at several sites in Limpopo, Mpumalanga and KwaZulu-Natal.

**BIOLOGICAL CONTROL AGENT AGAINST INVASIVE SPIDERWORT RELEASED**

The ARC organized a field day for the first release of the tip-feeding beetle, *Neolema abbreviata*, as a biological control agent against the invasive spiderwort or Wandering Jew (*Tradescantia fluminensis*). The field day was organized in collaboration with the eThekwini Municipality and the releases were hosted by the Kloof and Everton Conservancies at the Iphithi Nature Reserve in the KwaZulu-Natal Province.
Climate change and population expansion are limiting the amount of water available for agricultural use, therefore increasing water use efficiency in agriculture has become of paramount importance.

Wineries traditionally produce large quantities of waste water that cannot be returned to water sources such as rivers because it is contaminated with a range of mineral elements and organic compounds. The ARC has been conducting research for more than a decade on various aspects relating to the quality, disposal and re-use of winery waste and waste water.

Recently completed research showed that the composition and volume of winery wastewater change throughout the year. Quality is usually at its worst when vintage operations are dominated by the production of red wines. Many wineries dispose of waste water by irrigating pastures (land application).

A recent study on a poorly drained duplex soil showed that continuous irrigation of the same patch of land resulted in the accumulation of high levels of potassium in the soil. Application of high volumes of wastewater irrigation plus annual rainfall resulted in over irrigation and large amounts of potassium leached beyond 90 cm soil depth. These leached elements are bound to end up in natural water resources, resulting in the pollution of the environment. Disposal of winery wastewater on these soil types is recommended only where wastewater application does not exceed the water requirement of the crop. Regular soil monitoring should be done to prevent over irrigation and contamination of water sources.

Disposal of solid winery waste (skins, pips, stems, fining agents and filter materials) also poses problems for wineries. Research comparing the effect of composted winery waste and synthetic fertilizer on the growth and yield of cabbage in a sandy soil in the Western Cape, showed that cabbage can be produced successfully by using winery waste compost.

Limited skills in potato production and identification of markets, as well as high input costs associated with potato production restrict entry and sustainability of smallholder farmers within the potato industry. The ARC has put together a comprehensive training manual for a training course in potato production which aims to address the skills shortage of smallholder farmers which directly impacts production. The potato breeding team also formulated an own seed production pipeline suitable for smallholder farmers aimed at reducing input costs associated with potato production. In addition to training farmers, the ARC is interested in training agricultural advisors who are the custodians of these smallholder farmers. This stems from the limited knowledge that these advisors have on commodities, since the majority of them are skilled in general agricultural practices.

Thirteen farmers from the Mothong medicinal nursery attended a combined vegetable, nursery and hydroponics training course at the ARC training centre. Five received training on Unit Standard 116314 (Produce crops in a hydroponics system) and eight received training on Unit Standard 116079 (Monitor the establishment of a crop). The farmers have a nursery for plant propagation and small plots of land for planting. Since medicinal plants are long term crops, they also plant vegetables as cash crops to sustain the project. The training provided them with practical information on the importance of bacterial, fungal and viral diseases, as well as an introduction to the identification of vegetable pests and pest management as part of an integrated pest management programme. The course focussed on site visits rather than lectures, which helped the learners to understand the concepts more easily, as they could relate the information to their own practical experience. The farmers were awarded certificates of attendance and they will receive certificates of competence endorsed by the AgriSE-TA in vegetable production and hydroponics training after moderation by the ETQA.
GREAT THINGS FROM SMALL BEGINNINGS

Sweet potato is a popular cash crop amongst smallholder farmers, and it is promoted by the ARC to address food security and malnutrition (especially the orange-fleshed cultivars). An on-farm sweet potato cultivar demonstration trial was established at the Phezukomkho Project near Weenen. The farmer received an additional eight bags of sweet potato vines from the ARC to plant for production. The farmer now supplies the local informal market on a daily basis and secured a market in Pietermaritzburg for his Bopelo orange-fleshed sweet potatoes (an ARC cultivar). Through this initiative, a women’s association was formed to participate in sweet potato production for food security in the uThukela district, which led to support from DAFF. After the demonstration trial was harvested in May 2018, a tasting session of cooked sweet potatoes was held in participation with local farmers. More than 40 people attended the tasting and presentations on cultivation practices and uses of sweet potatoes were also done.

IRRIGATION GUIDELINES FOR WINE GRAPES

Wine grape irrigation research carried out in South Africa over more than 50 years enabled the ARC to develop irrigation guidelines in the form of the *Handbook for Irrigation of Wine Grapes*, particularly with respect to optimising wine quality and maximizing water use efficiency. The primary focus of the book is on practical irrigation, rather than the physiology concerning grapevine water relations. In addition to irrigation strategies and the scheduling thereof, it also addresses related aspects such as climate, soil properties, water quality, irrigation systems, and frost protection.

This book will be a useful guide for present and future generations of wine grape growers, as well as for viticulture students.

COLLABORATION ON WEED CONTROL

Pakistan has an increasing problem with the invasive alien plant *Parthenium hysterophorus* (also known as Famine weed) and is embarking on a biological control programme. The ARC has one of the most extensive biological control programmes on parthenium weed in the world, therefore *Centre for Agriculture and Bioscience International (CABI)* Pakistan commissioned the ARC to provide training on the biological control of parthenium weed to scientists and officials from the Pakistan National Agricultural Research Centre (PNARC) and CABI Pakistan.

The ARC was also asked to undertake host-specificity testing on the stem-boring weevil *Listronotus setosipennis* for Pakistan at the ARC quarantine facility and to later provide a starter culture of this biocontrol agent to Pakistan.

Four delegates from Pakistan visited the ARC for training. with the purpose to learn more about weed biocontrol through discussion, viewing of facilities and projects, theoretical and practical training on biological control of parthenium and specifically the mass-rearing of the biocontrol agent *L. setosipennis*.

EMPOWERING SMALL SCALE GRAPE FARMERS

The ARC has been providing training and extension to small scale and emerging farmers in the Orange River Valley, Northern Cape, for more than a decade.

A training course in grapevine pest and disease identification, monitoring and control was presented at Eksteenskuil near Keimoes. The event was attended by 26 farmers from the Eksteenskuil and surrounding communities.

The training concentrated on practical identification of pests and disease symptoms, as well as practical pest monitoring. Attendees all received a certificate of attendance and expressed their appreciation for the continued commitment of the ARC to their communities.
The work done in the Animal Sciences Division, also known as the Animal Health, Production and Improvement Programme (AHPI) largely supports the following ARC strategic goals:

- Strategic Goal 2: To generate knowledge and technologies that will enhance the efficiencies in livestock, wildlife and aquaculture based agriculture;
- Strategic Goal 3: To generate knowledge and technologies for the conservation and utilisation of natural resources;
- Strategic Goal 4: To generate knowledge, solutions and technologies for food safety, quality and improved efficiencies in the agriculture value chain; and
- Strategic Goal 5: To generate and disseminate knowledge and technologies for decision making and transformation of the agricultural sector.

The AHPI Programme is directed at the social and economic development of the entire livestock value chain. The specific objective of the AHPI Programme is to advance the productivity, production, competitiveness and sustainability of the livestock industry. This is achieved through scientific research, human capital development and implementing new and improved technologies for animal health, production, improvement, veterinary science and animal products. Strategic objectives are defined for each of the focus areas. The ARC Animal Health, Production and Improvement Programme is in dynamic partnerships with the livestock industry from grassroots production to the levels of industrial activity and to product consumption.

In addition, the Programme discharges certain national services on behalf of the DAFF and serves as the custodian of some national assets for the DST. The national services provided by the programme include the National Animal Improvement Schemes which includes the Kaonafatso ya Dikgomo (KyD) Scheme, a special-purpose vehicle to improve livestock productivity in the smallholder farming sector. The national assets under the care of the programme include the national forage genebank, rabies laboratory, blood vaccine production unit, national tick and helminth collection and the col-
lection of beneficial gastrointestinal and food fermentation micro-organisms, to name but a few.

Statutory obligations form a second channel for scientific services and research, the results of which have wide application according to the objectives of the various animal improvement and health acts (e.g. the Animal Improvement Act No. 62 of 1998). Although the main sites of operation for the Programme are at Irene, south of Pretoria and at Onderstepoort, in the north west of Pretoria, it has satellite stations that are strategically positioned in almost all of the nine provinces of South Africa.

Achievements attained by this Programme under various Agricultural Research Council research and development and service delivery programmes for the financial year 2018/19 are highlighted below:

**STRATEGIC GOAL 2**

**ENHANCING THE EFFIGENCIES IN LIVESTOCK, WILDLIFE AND AQUACULTURE**

**ARC NATIONAL MILK RECORDING AND IMPROVEMENT SCHEME IS INTERNATIONALLY RECOGNISED BY THE INTERNATIONAL COMMITTEE FOR ANIMAL RECORDING (ICAR)**

The National Milk Recording and Improvement Scheme was the main driving force for dairy cattle recording and improvement in South Africa for 100 years and will continue to fulfill this function into the future. The overarching objective of the Milk Recording and Improvement Scheme is to enhance the sustainability and profitability of production, ultimately contributing to food security, job creation and human capital development through providing performance-recording services to all dairy producers. The Scheme also puts more emphasis on information dissemination and uses various platforms such as radio interviews, publication of popular articles and farmer’s days to reach farmers and other relevant stakeholders. The Milk Recording and Improvement Scheme once more received a Certificate of Quality (CoQ) from International Committee for Animal Recording, following an audit conducted during the financial year. The Scheme also hosted the Master Dairyman competition to acknowledge the best of South Africa’s dairy farmers for outstanding achievements in sustainable dairy production. Recognition was given to superior commercial and smallholder dairy farmers at this event. The ARC Annual National Dairy Performers Awards took place at the Agri Expo Experience, Sandringham near Stellenbosch, and was attended by 84 invited guests.

**GENOME-WIDE GENETIC MARKER DISCOVERY IN SOUTH AFRICAN INDIGENOUS CATTLE BREEDS**

Livestock has played an important role in food security, history and development of South Africa.

Indigenous breeds are valuable genetic resources, well adapted to the diverse climatic regions and extensive livestock production systems.

These breeds are important for beef production in combination with exotic breeds. These farm animal genetic resources are needed in a world threatened by climate change to identify breeds that are resistant to drought, extreme heat and tropical diseases.
South African indigenous cattle.

The DNA of every animal contains the genetic code, which is unique to every individual. ARC used whole genome sequencing (WGS) to discover unique single nucleotide polymorphism (SNP) markers in three SA indigenous cattle breeds, namely Afrikaner, Drakensberger, and Nguni, which could be used to identify genes of economic importance. This research identified a panel of breed-specific markers to discriminate between Afrikaner, Drakensberger and Nguni breeds and these markers will be used for individual and breed identification, and for traceability in SA indigenous breeds. Results of this study provide insight into the genetic composition of indigenous breeds and also offer potential for further use in cattle breeding for unique traits like disease resistance.

**DAIRY RANCHING AS AN ALTERNATIVE PRODUCTION SYSTEM COMPARED TO BEEF AND MILK PRODUCTION SYSTEMS FOR SMALL-SCALE FARMERS IN SOUTH AFRICA**

Dairy ranching can be defined as the practice of keeping cows of relatively low milk yield, being parted from their calves in the evening, milked out in the morning, and spend the day with their calves at foot. These cows are usually not milked in the evening.

The aim of the study was to generate results that can be used by existing and new emerging cattle farmers and to benchmark the system of dairy ranching in comparison with small-scale dairy production and an ordinary beef cattle suckler (weaner calf) system. The experimental herd comprised of females from Bonsmara, Brahman, Jersey, Nguni and Red Poll breeds. The animals were compared in the following three systems: Small-scale dairy farming with Jersey cows; dairy ranching with Bonsmara, Brahman, Nguni and Red Poll cows and a weaner production system with Bonsmara, Brahman, Nguni and Red Poll cows. Data from the project was used to simulate results for a small-scale farm with a carrying capacity to sustain 25 Large Stock Units.

When comparing different breeds in different production systems, the Nguni cows followed by the Brahman cows showed the highest potential income. With the Jersey cows milked in a conventional dairy system, the potential income reduced by 32% when cows were milked once per day, instead of twice per day. The conventional dairy system produced a higher potential income than a weaner production system, but less than the dairy ranching system.

Compared to a conventional dairy system, dairy ranching has a higher income, lower input costs, labour requirements and need limited infrastructure. It can also add value to small-scale beef production enterprises. Dairy ranching development in the rural-based, small farmer-oriented cattle industry can therefore increase productivity, raise income, ensure profitability, promote self-reliance, reduce malnutrition and improve standard of living.

**PROTECTIVE EFFECTS OF SA PLANTS AGAINST AFLATOXIN B1-INDUCED TOXICITY**

Aflatoxin B1 (AFB1) is a mycotoxin produced by filamentous fungi and can potentially contaminate food and feeds. It can induce mutagenicity, genotoxicity and liver cancer in both humans and animals upon consumption of contaminated food. The ARC envision that prevention of AFB1 induced mutagenicity and carcinogenesis can be averted by administration of antimutagenic compounds isolated from plants. Sixteen *Plectranthus* species extracts were screened for antioxidant activity and antimutagenic activity against AFB1 induced mutagenicity. The antioxidant properties of *Plectranthus* species were investigated using the 2, 2-di-phenyl-1-picrylhydrazyl, 2, 2-azinobis (DPPH) assay, the 3-ethylbenzothiazoline 6-sulfonate (ABTS) assay and the FRAP assay with 2, 4, 6-trypyridyl-s-triazine. The Ames test using *Salmonella typhimurium* strains TA98 and TA100 and Vitotox tests *Salmonella typhimurium* TA104 were used to assay for antimutagenicity. Plant extracts that were solvent extracted from *P. montanus* had high antioxidant properties in the ABTS assay. Extracts from *P. caninus, P. montanus,* showed the highest potential income. With the Jersey cows milked in a conventional dairy system, the potential income reduced by 32% when cows were milked once per day, instead of twice per day. The conventional dairy system produced a higher potential income than a weaner production system, but less than the dairy ranching system.
**P. vericillutus** and **P. saccatus** had anti-genotoxic effects in Ames test while extracts of **P. saccatus** and **P. neochilus** showed anti-genotoxic effects in Vitotox. A strong correlation between antioxidant activity and anti-genotoxic activity may help reduce the number of assays to be used for screening purposes (a potential Cost-cutting measure).

### EVALUATION OF ANTI-NUTRITIVE FACTORS IN SOUTH AFRICAN PLANT SPECIES THAT POSE A SERIOUS THREAT TO LIVESTOCK

Plants represent the most affordable and accessible form of feeds that livestock can depend on for nutrition. They grow virtually over a wide range of geographic areas, including, but not limited to, tropical, sub-tropical and semi-arid regions around the world. They tolerate extremely high environmental conditions, such as temperatures and drought; hence, they have been widely used as raw material in animal feed. In order to provide safety and protection of the livestock, feed industries subject selected plant species to rigorous processing due to the inherent plant contents that have massive adverse physiological effects.

In contrast, apart from the livestock browsing directly on tree fodders containing high yields of palatable and digestive herbage in the rangelands, traditional farmers cut and feed their livestock with unprocessed tree foliage as supplements due to their distinct advantage over tropical grasses in terms of their superior nutritional value, especially during dry seasons.

The nutritional value of the tree foliage has a significant impact on the quality of milk, eggs and meat production. Although utilisation of tree foliage has a pivotal role for small scale farmers, these plants contain toxic and anti-nutrients such as oxalates, goitrogens, saponins (triterpenes), trypsin inhibitors, cardiac glycosides and toxic amino acids that are known to cause a number of nutritional disturbances and toxic effects on livestock and humans.

Even though most anti-nutrients are generally not lethal, they may act either as anti-proteins, anti-vitamins or anti-minerals to deprive animals of nutrition when ingested in abundance. This results in nutritional disturbances, growth and reproduction impairments and reduction in quality of livestock products. Hence there is a need to find appropriate decontamination strategies to be used in agricultural feeds.

Plant species including **Hyperacanthus amoenus**, **Carissa bispinosa**, **Nerium oleander**, **Lantana camara**, various **Acacia** species, **Peltophorum africanum** and **Gleditsia triacanthos** were selected for investigation. Traditional methods such as organic and aqueous (using boiling and warm water) extractions were investigated to decontaminate the anti-nutritive and toxins from the selected plant species. Qualitative and quantitative analysis were carried out to determine the presence and the levels of toxic material. High Performance Liquid Chromatography (HPLC) was used for quantitative analysis where contents of feed and selected plant species were compared and analysed. The results indicated that animal browsing in the rangelands is considered a serious threat to livestock since the selected plant species contained high levels of anti-nutrients and toxins.
IDENTIFICATION AND CHARACTERISATION OF EHRLICHIA RUMINANTIUM EPITOPES AS VACCINE CANDIDATES

E. ruminantium is an obligate intracellular rickettsial agent, and therefore, cell-mediated immunity (CMI) is expected to play an important role in protection. It is known that pathogen proteins may contain epitopes which inhibit protective immune responses or induce immunopathology. These negative effects can be avoided if T cell epitopes that specifically stimulate CMI are identified for use in a vaccine. This study, therefore, aimed to identify and characterise the individual epitopes that induce interferon (IFN)-γ by cluster of differentiating CD4+ T-helper (Th)1 or CD8+ T cells using E. ruminantium proteins previously shown to stimulate Th1 immunity in peripheral blood mononuclear cells (PBMC) from sheep infected by needle challenge.

To ensure that these proteins were immunogenic, they were first evaluated for their ability to induce CMI in PBMC from tick infected sheep. Thirteen of these proteins were selected and overlapping peptides of 16-mer, spanning these proteins, were synthesised. Each peptide was assayed with immune PBMC from infected sheep, to evaluate their ability to induce recall T cell responses and cytokine production, in vitro. From thirteen vaccine candidate proteins, 352 peptides that induce IFN-γ and other cytokines were identified. Most peptides activated CD4+ T cells but only a few peptides induced CD8+ T cells that were shown to be cytotoxic. Peptides that induce the strongest and different immune responses were selected and tested in vitro to determine the optimum combination.

These epitopes were used to generate four multi-epitope DNA vaccine constructs using a mammalian expression vector designed for dual expression of CD4+ and CD8+ specific peptides. Each multi-epitope construct contained specific tags including LAMP or KFERQ that target MHC processing, or signal peptides for secretion for CD4+, and a ubiquitin tag for CD8+ T cell targeting.

These constructs were first tested with in vitro immune assays followed by in vivo testing. Sheep were immunised with the constructs together with adjuvant using a gene gun and intramuscular (IM) injection and were challenged with E. ruminantium using a laboratory tick challenge. Partial protection was achieved, with 3 out of 5 sheep immunised with the pLamp DNA construct surviving following natural tick challenge of E. ruminantium. The protective efficiency of the construct was significantly (p≤0.05, Student’s t-test) enhanced by co-administration of the vaccine with monophosphoryl lipid A (MPL) adjuvant. The current study paves the way for the next generation vaccines against several pathogens focused on by the ARC.

Preparation of the multi-epitope DNA vaccine for immunising sheep subcutaneously with the gene gun.

Subcutaneous multi-epitope DNA immunisation in the ear of sheep using the gene gun.

ANTIBODIES IN A TUBE

Antibodies are often used for research purposes and for diagnostic tests. They are molecules made by humans or animals in response to matter such as proteins, bacteria and viruses entering their bodies. Antibodies are designed to bind to other molecules. These reactions are usually very specific and can be visualised by scientists in the laboratory. Scientists exploit this specificity, not only to find solutions to problems related to animal and human health, but also to develop diagnostic tests. In the past, experimental animals have been used to make antibodies against specific targets, such as proteins, viruses and bacteria. However, in line with the current international trend to minimize the use of experimental animals, the ARC has been working on sustainable antibody production methods that depend as little as possible on animal use. Using phage display technology, the full immune repertoire of the chicken has been cloned in a bacteriophage system.

Recently the immune repertoire of the indigenous ostrich has also been cloned with funding from Red Meat Research & Development of South Africa. These two universal ‘pots’ are trademarked as the Nkuku® and Inshi® antibody libraries. From these libraries useful antibodies have been found.

ANTIBODIES IN A TUBE

Preparation of the multi-epitope DNA vaccine for immunising sheep subcutaneously with the gene gun.

Subcutaneous multi-epitope DNA immunisation in the ear of sheep using the gene gun.
against important veterinary diseases such as African Horse Sickness Virus (AHSV), Bluetongue Virus (BTV), Wessielbron Virus, Foot and Mouth Disease Virus (FMDV), bovine tuberculosis and the horse parasite Babesia caballi. These antibodies are very well characterised and are of unlimited source, compared to those from experimental animals which are finite.

Surface plasmon resonance showing Inshi® antibody binding to its target in real time.

**STRICT STRATEGIC GOAL 3**

**THE CONSERVATION AND**

**UTILISATION OF NATURAL**

**RESOURCES**

**THE EFFECTS OF TEMPERATURE, WATER AVAILABILITY AND SEED BURIAL DEPTH ON SEED GERMINATION AND SEEDLING ESTABLISHMENT OF THE INDIGENOUS LEGUME CALOBOTA SERICEA (FABACEAE) AS A POTENTIAL FODDER CROP**

To meet the future demand for livestock products in South Africa, livestock production will have to increase in areas that are generally not regarded as highly productive, such as those characterized by water-limitation, poor- and restrictive soils, and marginal bioclimatic conditions.

One of the key limitations to this is the lack of suitable livestock forages for these marginal agro-ecological areas. To try and overcome the limitations of the current commercial forage species, the ARC have started investigating the potential of native/indigenous legume species for their potential as alternative fodder crops for use within these marginal agro-ecological areas.

From these studies, the potential of Calobota sericea was highlighted as a fodder crop for the semi-arid agro-ecosystems of Namaqualand in the Northern Cape province of South Africa. Within the Northern Cape, C. sericea, is primarily found within the winter rainfall regions of Namaqualand, where the species is adapted to the low rainfall conditions of the Namaqualand rangelands.

Within these rangelands, C. sericea has a shrubby growth form, grows up to 1.8 m in length, and is primarily found on sandy soils. Livestock will not actively graze the green foliage of C. sericea when other, presumably more palatable forages available.

This, however, allows the plant to accumulate a substantial amount of biomass throughout the year. A feeding ecology study conducted by the ARC on different livestock breeds in the Kammiesberg Granite Renosterveld vegetation type in the Lelefontein communal rangelands of Namaqualand, indicated that when there is a feed shortage within the rangelands, usually during the late summer months, the dry foliage of C. sericea constituted approximately 15% and 16% of herded sheep and goat diets, respectively. In order to establish this species effectively as a fodder crop, proper information regarding requirements for seedling establishment is required.

The ARC did research to determine the germination and establishment abilities of C. sericea at different temperatures, water potentials and seed burial depths.

Results indicated that seeds germinated best at temperatures ranging between 10 and 20°C, but still had a germination percentage greater than 80% at 5°C. Calobota sericea seeds were also found to require a water potential of at least -0.3 MPa to reach a germination potential of 60%.

Below this level germination was severely reduced. Seedling emergence was highest at burial depths of 2-3 cm. Results from the current study suggest that C. sericea seeds can be planted between 2 and 3 cm deep during the winter season when temperatures are lower and rainfall more prevalent.

If developed and managed properly, C. sericea has the potential to contribute significantly to filling the late summer feed gaps experienced within these semi-arid, water-limited agro-ecosystems, and potentially also other ecosystems experiencing similar bioclimatic conditions.
TRADITIONAL MOBILE PASTORALISM IN A CONTEMPORARY SEMIARID RANGELAND IN NAMAQUALAND, SOUTH AFRICA

Pastoral systems (commonly known as communal farming systems in South Africa), are complex social-ecological systems that are always changing. A study was done in Namaqualand to assess the spatial distribution of 256 herds and their mobility patterns over a decade in the 10 villages that comprise the spatially constrained Leliefontein pastoral area.

Several levels of interconnected socio-economic, climatic and environmental factors play a role in how the grazing areas in this 192 000 ha semi-arid environment are used. Access to the Leliefontein pastoral area is formally regulated and those who are not considered residents of the communal area are not allowed to keep livestock. The place where herd owners live largely define which of the 10 village commons are used by their livestock. Larger herds of wealthier farmers are located further away from the villages. The location of water sources and croplands determine the boundaries of the seasonal grazing areas and the movement of stockpots.

Because of these factors and the overall variability in the availability of grazing, the patterns of herd movement are very changeable and are adapted constantly.

The study concluded that policies should embrace the complexity of the pastoral system and enable the adaptive management of herds. This could reduce the level of vulnerability experienced by pastoralists to climate variability and wider societal change.

REHABILITATION POTENTIAL OF RANGELAND IN THE ARID TANKWA KAROO

Few soil seedbank studies have been conducted in arid rangelands in South Africa. Insight into the soil seedbank could improve assessment of rangeland dynamics and enhance the success rates of rehabilitation efforts.

Research was done to characterise the soil seedbanks in 43 sites located in various vegetation types in the arid region of the Tankwa Karoo in South Africa, during the spring and autumn seasons.

Seed density was 8 034 seeds per m² of which 55% was viable, and the common life-forms were therophytes and chamaephytes. While the seedbank composition suggested poor veld condition, there was enough seed density and viability for future regeneration and rehabilitation initiatives.

However, the absence of many perennial species in the soil seedbank means that seeds of these species will have to be added to rehabilitate the land.
THROUGH THE LENS OF A HERDER: TAPPING INTO LOCAL KNOWLEDGE IN NAMAQUALAND

Communal areas around the world, including South Africa, are resource poor, and external development interventions to improve rangeland conditions and farming practices have largely been unsuccessful.

Future management and policy planning should incorporate the landscape ethno-ecological knowledge (LEEK) of local pastoralists.

ARC researchers interacted with Namaqualand herders in South Africa to uncover their specific local agricultural needs and what natural resources and infrastructure they consider vital and detrimental in their grazing landscape.

Individual LEEK and management strategies of these pastoralists vary, but all are able to read the signs in the rangeland through various plant, animal and soil indicators.

They systematically plan their grazing routes according to the changing palatability of plants to allow their livestock access to a diverse and nutritious diet.

Incorporating local knowledge into modern science would provide development agencies with the necessary insight into pastoral systems and a platform for better planning and policy development.

DEVELOPING A “KEY GRAZING INDICATOR FOR SPECIES” METHOD FOR ASSESSING THE ECOLOGICAL CONDITION OF MESIC GRASSLAND

Grasses provide most of the forage for livestock and wild game, but over 80% of the plant species in a grassland are herbaceous forbs.

These grassland forbs make up most of the species diversity, play various important ecological roles, and provide forage for animals at critical times.

Despite their importance, grassland forbs are not routinely included in veld condition assessments and monitoring.

Research to assess and describe how different levels of grazing affect the abundance of forbs in two moist grasslands in KwaZulu-Natal showed that there are a relatively small number of abundant forbs that show a consistent decrease (Decreaser species) or increase (Increaser species) with overgrazing.

The sensitivity of just these key forbs can be used together with their abundance to calculate an overall condition score for a site, which we called the Forb Condition Score (FCS). The FCS indicates how heavily a grassland site has been grazed, with a high FCS (towards 100%) indicating lenient grazing and a low score (towards 0%) indicating a history of chronic overgrazing.

Another new and important finding was that one does not have to count all the numerous forb species at a site, because the FCS predicts the total forb species richness, and much better than traditional veld condition scores that ignore forbs.

Field-testing is recommended to validate and refine the forb condition assessment method.
There are fewer than 25,000 rhinos left in the wild in Africa due to a surge in poaching, and only 5,000 of them are black rhinos. The species is rated as critically endangered by the International Union for Conservation of Nature (IUCN). Northern white rhinos disappeared from Chad several decades ago and the last western black rhino was recorded there in 1972, after decades of poaching pushed both subspecies to local extinction. South African National Parks (SANPARKS) in collaboration with AfricaParks, relocated six black rhinos that were captured in Addo Elephant Park (South Africa) to Zakouma National Park in Chad in 2018. This was done in a bid to revive a population of these endangered species in Chad. Sadly, since the relocation four out of the six rhinos have died, but not as a result of poaching.

The deaths sparked interest among veterinarians involved in the project, as well as scientists and pathologists at both the University of Pretoria and the ARC. Samples taken from the rhinos were submitted to various laboratories at the ARC (namely PCR, Bacteriology and Parasitology), as well as the Pathology laboratory at the University of Pretoria. The samples sent to the ARC yielded positive results for Flaviviruses as well as a number of bacterial cultures, such as Pseudomonas spp and Clostridium spp.

Upon identification of the various bacteria and viruses, the samples were then sequenced via next generation sequencing where the presence of the bacteria were confirmed and the Flavivirus was characterized as a West Nile Virus. Although the samples contained many bacteria and a few viruses, the cause of death was considered to be a possible secondary complication to more significant underlying mechanisms. This particular case brought together both veterinarians out in field and in the laboratories, national park officials, as well as scientists from various disciplines to highlight the importance of multidisciplinary research and how thinking outside the box can link many findings. In this particular case, the approach helped lead the way to a conclusion on the mysterious death of the relocated rhinos.
Research on the effect of hind quarter mass and different ageing methods on various meat quality parameters of two beef muscles was initiated as a result of international reports indicating beef aged in dry-ageing bags produces beef of superior sensory quality.

This international research is mostly done on beef carcasses much heavier and with more fat cover than beef carcasses normally produced in South Africa. It was therefore important to evaluate the applicability of this procedure for the South African meat industry.

Research was conducted on two beef cuts to compare the influence of the new dry bag ageing method to the more common ageing methods i.e. the traditional and vacuum bag ageing methods.

Dry bag aged samples lost significantly more mass than the vacuum bag aged samples, and the dry bag aged mass loss of the fillet was more than twice that of the striploin.

The difference between the striploin and the fillet is probably due to the fat covering the one side of the striploin which prevents drying on the fat covered side and hence decreased mass loss. The fillet does not have any fat cover which is then conducive to drying out and consequently a higher mass loss.

The results showed that striploin does improve significantly in tenderness during ageing, whilst the fillet does not show any improvement. It is thus clear that the traditional ageing method in which all the muscles in the hind quarter are aged is not optimal, as different muscles react differently to ageing, therefore there is no real advantage in ageing fillet. It was also shown that in circumstances similar to those applied in this research, vacuum packaged ageing was more advantageous than the dry bag ageing method.

Moisture loss (i.e. mass loss) was clearly reduced using the vacuum packaged ageing method, hence a greater yield, with sensory characteristics very similar in both the packaged ageing methods.

**ARC COLLABORATION WITH PERKIN ELMER**

The Residue Laboratory has established a partnership with PerkinElmer South Africa. This collaboration resulted in the installation and commissioning of a PerkinElmer QSight LC-MS/MS. The system consists of a PerkinElmer LX50 UHPLC with a QSight 220 MS/MS system and Simplicity Software. This system will provide the necessary tool in ensuring the safety of food and feed in South Africa, and will be particularly useful and relevant for the ARC where food analysis is expanding into veterinary residues in aquaculture products. As part of the ARC mandate to provide expertise and capacity for antibiotics and veterinary drug residue analysis, the procurement of the PerkinElmer LC-MS/MS supports this
mandate by accelerating and increasing the laboratory’s analytical capability. Regulatory agencies, particularly those in our niche markets such as the European Union, are imposing new and tighter standards in the food industry and on organizations charged with protecting the public.

This, coupled with an increased pressure to analyze complex samples with fewer resources, the use of the Perkin-Elmer QSight LC-MS/MS will result in savings in time and costs and with 15% more uptime than conventional LC-MS/MS systems.

Furthermore, the system provides ease-of-use with software that streamlines everything from method development, results processing and reporting. Another unique feature is that absolutely no instrument-to-instrument method optimization is necessary. The Residue Laboratory is now accredited for testing veterinary residues using this new technology.
The work done by the Research and Innovation Systems (RIS) Division of the ARC primarily supports two of the organisation’s strategic goals:

- Strategic Goal 3: To generate knowledge and technologies for the conservation and utilisation of natural resources; and,
- Strategic Goal 4: To generate knowledge, solutions and technologies for food safety, quality and improved efficiencies in the agriculture value chain.

However, the research of the RIS Division also overlaps with the work done in the Crop Sciences and Animal Sciences divisions and thus supports both Strategic Goal 1: To generate knowledge and technologies that will enhance the efficiencies in crop based agriculture, and Strategic Goal 2: To generate knowledge and technologies that will enhance the efficiencies in livestock, wildlife and aquaculture based agriculture.

Research in the RIS Division focuses on biotechnology, agricultural mechanization and engineering, and natural resource management (soil, climate and water). With a wide range of services, development and research functions for technologies in areas such as genomics, phenomics, remote sensing, agricultural systems modelling and engineering systems.

The main sites of operation for the RIS Division are Onderstepoort, Silverton and Arcadia, all in Pretoria, but the Division is strategically positioned across most campuses of the ARC. Achievements attained by this Division under various ARC programmes for the financial year 2018/19 are highlighted below:
Dohne Merino sheep of South Africa have been bred and selected for high fertility, rapid lamb growth and fine merino wool production. The gastrointestinal tract (GIT) of sheep houses complex microbes that influence its health and development. Molecular approaches for microbial analysis of gut samples have become a widely accepted method to characterize microbial communities.

The introduction of third generation sequencing platforms such as the Oxford Nanopore Technologies (ONT) Minion™ platform, has resulted in obtaining long sequencing reads. Abomasum contents from 7 sheep were collected. DNA was extracted using QIAamp DNA Microbiome Kit. Each DNA sample was barcoded and sequenced using the Minion system. The bacterial composition of the abomasum was investigated at phylum, class, order, family, genus, and species levels. A total of 24 phyla were detected, where 16 were present across all samples. Firmicutes (78.35%) and Bacteriodetes (13.03%) were the most abundant phyla present in the GIT. Firmicutes are responsible for the degradation of fibre and cellulose in ruminants, whereas, Bacteriodetes are known to aid in digestion of complex carbohydrates, as well as ferment organic matter.

Furthermore, Cyanobacteria (0.23%), Patescibacteria (0.19%), Spirochaetes (0.18%), Epsilonbacteraeota (0.14%), Synergistetes (0.13%), Fibrobacteres (0.10%) and Elusimicrobia (0.07%) were the least abundant phyla. A total of 39 genera (n=7) with operational taxonomic units (OTU) abundance greater than 1% were identified across all samples. Christensenellaceace R-7 group (9.93%), Christensenellaceace R-7 group (rumen) (7.08%) and Rikenellaceace RC9 gut group (5.18%) represents the top three core genera. A total of 3,404 species were detected across all samples, however, they were dominated by uncultured bacterium or uncultured rumen bacterium of specific genera.

Results indicate that several genera contribute to the differences in community composition between different individuals. This is the first study to characterize the abomasum contents of South African Dohne merino sheep by use of ONT Minion technology, expanding our knowledge of the gastrointestinal bacterial community of sheep.

Early detection and identification of foodborne pathogens are critical in the food industry to prevent possible disease outbreaks and associated losses in human life, income, liability and brand prestige. Currently, the most effective method of strain discrimination is Whole Genome Sequencing (WGS), i.e. sequencing all the DNA of a pathogen. Indeed, the WHO now recommends this approach as the way forward in foodborne pathogen screening. The genome can be seen as the “blueprint” for “constructing and operation” of the pathogen/strain. Knowing a pathogen genome therefore provides a host of additional relevant information one would usually only obtain by a number of other typing methods, such as serotyping, sequence typing, resistance profiling and antimicrobial resistance detection.
Traditional methods used for the identification of *Listeria monocytogenes* Serogroups and Sequence Types provide a low resolution. These methods typically label a sample as belonging to a group, but does not provide the client with an exact answer and leaves margins for error. The correct identification of *Listeria monocytogenes* Sequence Type is critical in curbing outbreaks such as the recent South African Listeriosis case.

To date, roughly 250 samples have been analysed by means of whole genome sequencing. Samples were collected from various food sources including “ready-to-eat” products. Sequence Type identification is based on a three-pronged approach to ensure reliable reporting.

Whole genome sequencing has proved to be an efficient and reliable method for foodborne pathogen diagnosis. The data produced by this method will be used to track and monitor *Listeria* species in South Africa. This method will further be extended to other foodborne pathogens such as *Campylobacter*, *E. coli*, *Salmonella*, etc.

**Table:**

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<td>III</td>
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</table>

Traditional methods are only able to label samples according to groups (blue boxes) and are not able to ascertain Sequence Type (red box). These groups contain numerous Sequence Types such as ST6 (circled in red). Whole genome sequencing is used to clearly identify Sequence Types.

**Characterization Viral Populations Associated with Smallholder Crops in South Africa and East Africa**

Smallholder producers are particularly vulnerable to the adverse effects of emerging and re-emerging viral diseases on staple food crops, which are threatening food security in many parts of East and Southern Africa.

Viral diagnostics has generally been performed using polymerase chain reaction and enzyme-linked immunosorbent assays, which are usually directed against known viruses and often preclude the detection of novel viral diversity.

Metaviromic data generated through next generation sequencing (NGS), has the power to characterize complete microbial populations associated with plants, including potential pathogens.

The ARC has one of the most comprehensive NGS infrastructure installations in Africa, which is being used to uncover novel viral diversity associated with crops, such as maize, potato and sweet potato.

An initial study showed that, in addition to those responsible for eliciting maize lethal necrosis disease, a number of samples of Tanzanian maize plants were infected by four additional viruses, two of which were reported in the country for the first time and two which were novel.

Currently, the viral populations of almost 700 samples collected from South Africa and Kenya are being characterized.

This will provide an unprecedented level of knowledge regarding the viral diversity associated with smallholder grown crops in these regions, which could be used to influence agricultural practices, such as appropriate vector control and the planting of resistant varieties.
The world’s population is projected to reach almost 10 billion by 2050. The production of many crops is unable to keep up with this growth, driving the need for new plant varieties with better yields and better resistance to disease, salt and heat stress. The efficiency and productivity of many plant breeding programmes can be dramatically improved through an effective information management system and the integration of molecular tools. The Integrated Breeding Platform provides a unique, comprehensive and easy to use suite of informatics tools to boost crop breeding outputs. These integrated software applications come together in one complete environment called the Breeding Management System (BMS); working together to efficiently collect, store, manage and analyse data. The BMS accommodates conventional breeding approaches as well as programmes that employ more advanced tools. Given the current biotech revolution and the associated availability of genomic technologies, one is now able to understand the plant genotype and its relationship with morphology and the environment to create genetic gains in key crop cultivars at a faster rate than ever before.

The ARC is leading the way in this area through a combination of an informatics suite (BMS) and the advanced genetic infrastructure available which is the most well equipped genomics institute in Africa. The combination of informatics and molecular tools have halved the cultivar production time for a number of vegetable and field crops such as tomatoes and wheat respectively. The tools are also able to identify markers linked to specific traits in advance of the crop reaching maturity and displaying the traits of interest. For example, if one considers that the farmer would like to know the colour of his apples, which he would typically wait 7 years for an answer. A molecular marker is able to indicate whether a tree seedling is going to bear red or green apples, providing increased efficiency and lower costs.

The ARC is gearing up to become the SADC Hub for the BMS, with this in mind more than 30 plant breeders have been trained over the past 3 years. Over 60 staff spanning national ARC campuses now employ the system to design their field trials, track and analyse their field and genetic results on more than 20 crops. The key impact of these activities is using the data to make more informed, effective and efficient decisions.
EFFECT OF CLIMATE CHANGE VARIABLES ON SOYBEAN PRODUCTION

The DAFF funded a project to assess the impacts of climate variability and shift on the production of soybean as both a food crop and a potential biofuel feedstock under different agronomic practices and agro-ecological zones. The findings will contribute smart solutions as well as a decision support tool to rural agrarian transformation, job creation, promoting smallholder and resource-poor farmers’ entry into the bio-economy through increased soybean production, and consequently, reduce the over-dependence on fossil fuels.

The study was carried out over three years at four sites in the Limpopo, Mpumalanga, Free State and North West provinces. A farmer training workshop was held at each site in the first year whilst subsequent training was conducted during field operations. Information dissemination on both soybean production and sustainable agriculture was done through field days and farmer feedback workshops which were held at the end of each season.

The results showed that climate-smart agricultural production technologies of conservation agriculture (CA) improved soybean productivity at each of the study sites. It is therefore prudent that smallholder farmers, who intend to go into soybean farming, consider adoption of CA over the use of conventional tillage. Unfortunately, the persistent drought that occurred during the study period significantly affected soybean production at three of the sites. Planting early resulted in better yields over late planting in late December to January, which was affected by the occurrence of dry spells. Additionally, late planted soybean was also affected by cooler conditions, especially in Free State and Mpumalanga. Cultivar performance was found to be site dependent, indicating the importance of careful cultivar selection.

Smallholder farmers in Limpopo and Mpumalanga showed a willingness to embark on soybean production and an interest in joining the oil production industry. However, they cited challenges such as lack of machinery and access to markets as possible hindrances.

CROP ESTIMATION USING EARTH OBSERVATION DATA

Demand for agricultural products is increasing the pressure on the natural resource base, which in many areas of South Africa is already severely degraded. The challenge is to improve the capability of smallholder farmers to unlock agricultural potential. Knowledge generated at the ARC guides the monitoring of food security and the sustainability of the national land resources, ensuring a transition to sustainable food production. The generated data guides government to distribute resources that support agriculture and improve market access by producers.

The ARC maintains a Sentinel-2 for Agriculture (Sen2-Agri) system developed by the European Space Agency which downloads Sentinel 2 and Landsat 8 images and processes them for crop monitoring and mapping. Sen2-Agri produces four products operationally: a monthly composite cloud-free image; a cropland (planted area) image mid-season and at the end of the season; a crop type image both mid- and late season; and a 10 m spatial resolution vegetation index and leaf area index map every 10 days. The latter is useful for crop condition monitoring, early warning and yield estimation. The system is currently operationalised in the provinces of KwaZulu-Natal, Limpopo, Eastern Cape and Mpumalanga, specifically for small-scale farming areas.
Ground reference data for image classification and validation is collected in the field by the ARC and is supplemented by data obtained from the Producer Independent Crop Estimation System (PICES) that focuses on the large-scale commercial farming sector. Outputs from both systems support the national Crop Estimates Committee of DAFF.

WATER HYACINTH: ADDING VALUE TO A NOXIOUS WEED

Water hyacinth (Eichhornia crassipes) is a perennial, free-floating aquatic weed which has one of the highest growth rates of all plants in the world. Its rapid growth causes numerous problems in water bodies related to navigation, recreation, irrigation and hydropower generation. The total elimination of water hyacinth plants from waterways is almost impossible due to their production of hardy seeds which remain viable for up to 20 years. Furthermore, its complete removal is questionable due to the indirect role of the plants in water treatment. Therefore, control of the plants is preferable to their eradication. The continual removal of water hyacinth plants will result in a sustainable organic feedstock supply, making it attractive as a bioenergy crop. In a project funded by the Water Research Commission (WRC), the potential of water hyacinth for biogas and soil ameliorant production was assessed as a solution to water weed challenges in Hartbeespoort Dam. An anaerobic digestion process was tested which results in a reduction in volume, mass and toxicity of the input substrate, producing a methane-rich biogas and a nutrient-rich digestate that can be used as a soil ameliorant.

Although the technology has thus far only been tested at laboratory scale, the findings of the research have been widely disseminated to both the scientific community and to communities surrounding Hartbeespoort Dam, amongst whom a survey was conducted to establish the need for the technology. Funding is being sourced for phase 2 of the project which entails construction of a pilot plant at the dam. This is anticipated to result in the sale of biogas and soil ameliorant to local communities, thereby promoting the adoption of renewable energy and organic fertilizers.
GUIDELINES TO IMPROVE THE DELINEATION OF WETLANDS

Wetlands in South Africa are areas that are under constant pressure, whether from developers or agricultural land users, or due to the possibility of degradation and pollution caused by human mis-management, either in the wetland itself or in adjoining areas. The ARC, in conjunction with the University of Pretoria and the University of the Free State, carried out a project funded by the WRC to explore the potential application of nationally available land type information (soil, climate and terrain data) to improve wetland identification and delineation.

The project characterised the soils, hillslopes and land types which “feed” water to wetlands, focusing on wetland assessment rather than identification, specifically catchment and wetland hydrological characterisation and condition assessment. If the location of important wetland water source and delivery zones within a catchment could be identified, the premise was that detrimental land uses in these areas could be limited. A methodology was developed for characterising the hydrological hillslopes that make up the wetland catchment, using both land type and field-collected data, in order to support wetland assessment as well as minimising the impact of disturbance on their hydrological condition. The guidelines for regional wetland soil contextualisation in support of wetland delineation must now be tested in the field by conducting a range of investigations at various scales and in different parts of the country (since wetland conditions vary greatly under different environmental conditions). The results of that exercise should enable improved identification of wetland areas, leading to their better protection and sustainable functioning.

Harvesting of water hyacinth from Hartbeespoort Dam.

GOAL 5

INFORMATION DISSIMINATION

Monitoring exercise in a wetland catchment near Rustenburg.
The Programme promotes utilisation of modern tools, structures and equipment in the agricultural production system. It conducts research into agricultural mechanisation, irrigation engineering, renewable energy and infrastructure technologies to increase the productivity and efficiency of agriculture. The aim of mechanisation and engineering research and development is to develop and test appropriate farm machinery and equipment to improve the timeliness of farm operations and to reduce the drudgery of farming activities. This improves the quality of work and products, leading to enhanced output and economic competitiveness of the farm. Some highlights of the work undertaken under this programme include:

**WATER RESOURCES MANAGEMENT SERVICES FOR PROVINCES**

In South Africa as a water scarce country and water resources management is of huge importance. Engineers of the ARC assisted a number of small scale farmers with irrigation systems to apply water correctly to grow vegetables and to improve farmer productivity and food security.

As part of the Pro-active Land Acquisition Strategy (PLAS) farm evaluation project, a manual “Guidelines for Infrastructure Relevant in the Production of Different Agricultural Commodities” (ISBN no. 978-1-86849-599-3) was developed for Entsika and the DRDLR. The relevant ARC commodity experts collaborated in the compilation of the manual.

The purpose of these guidelines was to provide a tool to assist implementing agencies of agricultural development initiatives, such as the PLAS. It should be used for the acquisition of suitable infrastructure and equipment of the correct capacity.

The Guidelines consists of a description of different fixed facilities and other infrastructure, systems, machinery, implements, other equipment as well as labour, power and water requirements necessary for typical commercially viable sized farm enterprises. Every commodity is dealt with in terms of the above, as well as in terms of the purpose of the enterprise, suitable size, dimensions or capacity, number required and whether the specific infrastructure and equipment is optional or not. Through these guidelines it enhanced agricultural mechanisation technologies at farm level to assist in decision making and improve the performance of agricultural infrastructure.

**IRRIGATION TRAINING FOR SUSTAINABLE IRRIGATION**

Training has been conducted by the ARC for small-scale irrigators and potential irrigators in water saving Irrigation technologies to equip them with skills for sustainable and water use efficient irrigation practices. It was funded by the Gauteng Department of Agricultural and Rural Development (GDARD) in support of their small-scale farmers in the province.

A total of 83 farmers and 20 officials attended the trainings over three days. The course covered a general introduction to irrigation across the world and in South Africa; different water saving irrigation technologies available in South Africa and the important factors to consider; practical water saving techniques applicable to small-scale irrigation farming systems; and hi-tech irrigation scheduling methods with special focus on practical scheduling methodologies.
GDARD POULTRY HOUSING PROJECT

ARC is the implementing agent of the Poultry housing project of the Comprehensive Agricultural Support Program (CASP) facilitated by GDARD. It is a key programme aimed at giving small and emerging farmers in Gauteng an economic start in their farming enterprises through the provision of a basic on-farm infrastructure. The scope of work involves implementing poultry broilers and layers in 12 sites based in three regions of Gauteng province (East Rand, Rand West and Tshwane).

This project enhanced agricultural infrastructure technologies to improve the performance. Complimentary to that it created jobs for small scale farmers and increased the number of small holder farmers that have access to ARC technologies, information and services.
The Impact and Partnerships Division predominantly supports Strategic Goal 5 of the ARC, which focuses on translation of research outputs. This is done through three dedicated programmes:

- **Smallholder Agricultural Development** which entails extension support; diagnostic and analytical services; targeted development initiatives; and farming systems research, focusing on smallholder farmers.

- **Agricultural Economics and Commercialisation** deals with enhancing sector competitiveness by facilitating access to intellectual property for commercial exploration; development support for agricultural enterprises; and SMMEs as well as agricultural economic analysis, providing decision support and establishing the impact of our R & D.

- **Training and Extension** relates to training and information services to farmers and extension staff. Access to relevant technical information from the ARC contributes extensively to sector productivity, especially of smallholders.

The Division operates from ARC Central Office in Pretoria, but works strategically across the organisation, with all campuses spread across the country.
SMALLHOLDER AGRICULTURAL DEVELOPMENT

The Smallholder Agricultural Development (SHAD) unit through the Centre of Collaboration (CoC) on smallholder support sponsors two PhD research projects. One study investigates smallholder perceptions on privatisation of extension and willingness to pay for these. The other study deals with social entrepreneurship.

CAPACITY DEVELOPMENT

The ARC supports public and private sector extension capacity development. This includes skills acquisition and knowledge transfer. The SHAD unit delivered training courses for extension professionals and a total of 721 Extension Officers were trained by the ARC this year in various subjects, including free range beef production, animal nutrition, water saving, mechanization, extension concepts and biosecurity. In partnership with Wage-ningen University Research, 38 international delegates received Local Economic Development training. This regional course aimed to assist development organisations to design strategies that catalyse rural economies.

The ARC provides accredited and non-accredited short learning and skills programmes to facilitate farmers' skills development, to boost productivity. The ARC trained 1743 farmers this year in 39 training courses and a range of subjects including vegetable and wine production, meat and dairy processing, sustainable water use, poultry and pig production, artificial insemination, animal health care.

EXTENSION

A study conducted under contract with GIZ to conduct a climate smart agriculture (CSA) skills audit for extension practitioners, valued at R827 488 was completed. It included a literature review, a skills matrix and an electronic survey completed by 299 public sector extension practitioners. The survey investigated Extension Practitioners’ understanding of the concepts of climate change, climate variability and CSA. In general, EPs across all positions, education levels and age had fair knowledge on the subject. However, the majority of EPs demonstrated limited capacity to apply theoretical understanding in terms of advising farmers on ways to mitigate the effects of climate change, or adapt farming practices.

AGRICULTURAL ECONOMICS

The Economic Analysis Unit published nine articles in scientific journals this year. These dealt with the benefits of wheat cultivar trials; return on investment in beef cattle; the value of quality restrictions in wheat breeding; productivity growth; public sector agricultural R&D spending; the impact of public wheat breeding; analysis of tomato production; analysis of vaccines and partnership for research and innovation in Sub-Saharan Africa. The Division published six popular news articles this year. Topics varied from avoiding salmonella; a holistic approach to animal health care; communal grass-fed beef; smallholders in the corporate value chain; antibiotics in animal production and avocados. The Economic analysis unit also delivered twelve EconNews editions, making it 82 issues to date.

Division members participated in several conferences this year, and presented twelve papers. These included seven papers at the 56th annual conference of the Agricultural Economics Association of South Africa, of which one received the first prize for best paper. Topics included land reform; the KyD livestock development programme; animal health care, willingness to pay for livestock vaccines; price seasonality of citrus; integration in potato markets and high value crops farming practices. At other local conferences, the Division presented two papers on the influence of advisors on the sustainability of food gardens and the impact of a strike on wine production and export. Two papers featured at international conferences, including a poster on Water Policy presented in the USA and a paper on diagnostic tests in animal trade in Madrid. A poster on ICT partnerships in Extension won the award for best poster at the 2018 SASAE conference.

Five ARC impact studies were published in a special issue of the Agrekon journal, co-edited by the head of the Agricultural Economics unit. Three Impact Assessments were completed this year. These were; an impact study of the national small grain cultivar trials, an ex-ante economic analysis of vaccines for rift valley fever and lumpy skin disease, and an impact study of the ARC’s investment in animal health facilities.

The small grain cultivar trials study estimated that 40kg/ha of wheat accrued to producers due to the trials, with a net present value of R173 million. An Internal Rate of Return of 7% suggests that investments in the programme have been a worthwhile use of public funds. A cost-benefit analysis on new vaccines for Rift valley Fever and Lumpy Skin diseases indicated net present values of up to R13 million and an internal rate of return in excess of 32%. Awareness on the importance of vaccines to improve livestock productivity is critical. This work indicates justification for investment in livestock vaccine R&D.

Economic Analysis (EA) plays a crucial role in supporting ARC’s decision-making processes by facilitating an understanding of the dynamics of the agriculture economy. Two ARC economists are the focal persons in South Africa for the Agricultural Science and Technology Indicators (ASTI) survey of the International Food Policy Research Institute (IFPRI) that involves collecting information on R&D indicators. The surveys targets all institutions involved in agriculture research in the country, in order to compile info sheets and an interactive database on R&R agendas.
across the globe, informing decision-making in agricultural R&D.

The EA unit participates in an EU funded Europe-Africa project on a partnership for Food and Nutrition Security, and Sustainable Agriculture (LEAP4FNSSA). It aims to establish a Europe-Africa Research Consortium (IRC) as platform for research and innovation. The ARC is co-leading a work package under this partnership on Information Generation and Knowledge Management.

The EA Unit led a Department of Science and Technology (DST) funded rice feasibility study implemented by the National Agricultural Marketing Council (NAMC) and the Land Bank. Findings from the final report suggest that there are opportunities to venture into the rice value chain. There is insufficient information about the suitability of existing cultivars to local conditions, and possible impacts of climate change and disease outbreaks should rice be produced on scale in South Africa. The study recommends investing into research at various levels of the value chain as a prerequisite to dryland rice production in the country.

In collaboration with notable international researchers from Arkansas State University, which appointed the EA unit’s head as visiting professor, conducts studies to establish the return on investment and impacts of ARC programmes on the economy, or conducted.

The unit was also involved in a variety of economic consultancies within the ARC, such as contributing to the ARC-Entsika evaluation of the Pro-Active Land Acquisition Strategy (PLAS) programme.

**STRATEGIC INFORMATION MANAGEMENT**

The Strategic Information Management unit manages an ARC-Entsika consortium’s evaluation of the PLAS for the Department of Rural Development and Land Reform (DRDLR), since June 2017. Entsika sub-contracted the ARC to develop the analytical toolset, conduct the analysis of the dataset and compile the reports. Using the ARC-developed farmer survey toolkit, the team completed the 1990 farm evaluations in the portfolio. Farms are categorised in terms of potential, performance is detailed, risks and limitations specified and recommendations provided. The consortium presented its process and initial results to the advisory panel on land reform appointed by the South African President. The presidential panel commended the work. The team is currently finalising provincial and a national report detailing the scientific analysis. The outcome is a detailed analysis of PLAS, with recommendation to DRDLR to improve productivity and inform land reform policy and implementation. Generally, the potential of PLAS land acquired is good, with most farms having the natural resource base to support viable enterprises. Roughly 10% of all PLAS farmers do well, despite many limitations. The PLAS initiative could achieve its objectives if bottlenecks are addressed. Beneficiary selection, post settlement support and capacity building needs attention. An M&E system of the PLAS should be institutionalised. The ARC team plays a key role in the support strategy for priority PLAS farms, initiated with commodity organisations.

The project improved the ARC’s capacity in Survey Science and ability to analyse on-farm interventions. In total, the ARC evaluation panel met at 22 occasions for 90 days between October 2017 and February 2019 and 26 ARC scientists were involved. Apart from the delivery of individual farm reports, provincial and national reports, the team developed a set of Commodity Standards for a variety of agricultural commodities. In addition, the team generated a set of infrastructural guidelines useful in developing and evaluating agricultural enterprises. The team also aims to develop a series of scientific publications and policy briefs aimed to ensure that land reform benefits from the outcome of this project.

**INTELLECTUAL PROPERTY MANAGEMENT AND COMMERCIALISATION**

The Intellectual Property (IP) Management and Commercialization unit protects and commercialises ARC research output, as part of technological improvement in agriculture. This entails implementation of IP Management (registration and recording) and awareness creation. The unit ensures that the ARC complies and participate in policy making within the innovation value chain. In addition, the programme ensures Enterprise development for meaningful participation of smallholder farmers and entrepreneurs in the agricultural value-chain.

Licensees for commercialization of ARC Intellectual Property contracted through license agreements were the Dry Bean Producers’ Organisation for the commercialisation of beans and Victus Pty (Ltd) for the commercialisation of an inoculant against Crown Gall of Grapevine. The ARC also signed a license agreement with Australian Nurserymen’s Fruit Improvement Company, for commercialisation of the Eureka Seedless Lemon for a period of 10 years. The ARC and Murdoch University signed a license agreement for the commercialisation of Lebeckia ambigua.

The ARC’s royalties received during this year amount to R33 697 316 for all IP commercialised locally and internationally, despite the drought that hit the Western Cape.

Two ARC technologies were nominated as semi-finalists in the Gauteng Accelerator Programme for the Biosciences,
and the ARC team won the second prize of R300 000, that will be used for incubation of their jams fortified with unique ingredients to create niche confectionery products by the Innovation Hub. The ARC team was also nominated to attend the Leaders in Innovation fellowship programme.

National Intellectual Property Management Office (NIPMO) awarded the ARC an IP Fund rebate for the 2018/19 period at the value of R254 716.55.

The Enterprise Development programme focuses on stakeholder engagement for marketing of technologies available. During this year, stakeholder engagement was the focus in marketing ARC technologies. Stakeholders collaborated with include Pioneer Foods, Provincial Departments, the Water Efficient Maize for Africa (WEMA) and Rain for Africa consortiums.

INFORMATION DISSEMINATION AND STAKEHOLDER ENGAGEMENT

Across the ARC, 435 information dissemination activities were conducted this year, including 38 Farmers Days and 255 Popular Publications.

The ARC in collaboration with Mobile Laboratory Southern Africa (MLab) developed the ARC HUB mobile application to support and facilitate virtual advisory services by bringing together Extension, Research and Farmers. The ARC Hub, accessible through the android store, IOS and the web, was launched in May 2018 at the GrainSA’s NAMPO Harvest Day agricultural show at Bothaville. The mobile application now boast 2 623 users of which 26% are women. On average, the application has ± 430 active users monthly and 150 active user weekly.

MARKETING AND COMMUNICATIONS

The unit aims to increase the visibility of the ARC through four focus areas; Media Relations (incorporating Internal Communications); Advertising; Exhibitions and Social Media, combining into Brand and Reputation Management. A particular focus has been on visibility through free media coverage in print, radio, television and online. Big stories this year dealt with the banana bunchy top virus; the ARC and Soybean industry, decriminalisation of Cannabis, Climate-Smart Agriculture, the National Beef Performers Awards, Foot and Mouth Disease and new fruit cultivars unveiled, covered through a number of publications and interviews on media platforms.

The advertisement budget was spend in a targeted fashion as part of a new approach of refocusing resources towards strategic repositioning and brand equity. Publications in which advertising/advertorials were placed included Farmers’ Weekly; Green Economy Journal; the Sunday Times and the Science Forum Magazine.

The ARC also invested in advertising to support its exhibition at NAMPO as well as the launch of the ARC Hub App, on radio and in print. A number of exhibitions displaying ARC expertise, products and services, achieving visibility for the organisation while allowing engagement with stakeholders, were organised. Going forward, the focus is to participate in fewer, yet strategic exhibitions, optimising resources and return on investment. The ARC contributed to 13 exhibitions per month this year, among others, the Berlin Fruit Logistica, International Sorghum Conference in Cape Town, the Royal Show in Pietermaritzburg, the BRICS Ministers Meetings at Kruger Park Gate and the Youth Indaba at the Innovation Hub in Pretoria.

In terms of social media, the ARC participates extensively. By year-end, number of followers on its social media platforms had grown to 13 941 Facebook followers, 3 489 Twitter followers, 616 Instagram followers, 16 461 followers on LinkedIn and 125 YouTube views. The unit also launched an internal campaign aimed at encouraging ARC personnel to contribute on ARC.
Supporting the core business divisions, the ARC has several strategic functions, namely human resources; marketing and communications; finance; information technology and communication; facilities management; risk and planning; and internal audit, all organized under the Administration and Corporate Affairs division and led by different executives and managers. These groups operate from the ARC’s Central Office in Pretoria and aim to achieve good governance, financial sustainability and a high performing and visible organization.

The various units in this Division operate mainly from the Central Office but have representatives in all other ARC locations. Achievements attained under the Administration and Corporate Affairs programme for the financial year 2018/19 are highlighted below:

**HUMAN RESOURCE MANAGEMENT**

During this reporting period, the ARC experienced financial difficulties that impacted on recruitment, retention and managing labour relations within the organisation.

For the ARC to remain relevant and competitive in the Agricultural research space, the ARC continues to attract, develop and retain talent for the Agricultural sector. Nurturing of talent, Human Resource Planning, Performance Management and fostering employee engagements remains critical for the success of the ARC.

**HUMAN RESOURCES DEVELOPMENT**

The ARC creates and provides opportunities to develop capacity for the agricultural sector. The scarcity of adequate qualified and skilled natural and animal scientists in the labour market influenced the ARC Postgraduate Development Programme (PDP). The PDP objective is to serve as pipeline development for succession planning within the ARC. All the participants are engaged with studies, which falls within the critical and scarce skills areas identified by the organisation.
EMPLOYEE DEVELOPMENT – FORMAL STUDIES

During this reporting period, 253 fulltime employees registered for Masters and PhD studies, this shows an increase from the previous financial year.

The graph below depicts doctoral and Masters studies.

The graph below reflects a summary of the current ARC PDP students per study programme.
DEMOGRAPHICS

The ARC had a staff compliment of 2287 permanent employees and 432 temporary employees as at 31 March 2019. This reflects 72.67%. Black employees, 57.12% male and 42.88% female employees. (Permanent appointed employees). The challenge, however, is to retain these employees. The numbers of black and female employees, who are leaving the ARC, are of such nature that there is no progress in the ARC employment equity figures.

STAFF TURNOVER AND VACANCY RATE

The staff turnover rate for 2018/19 is 3.81%, which is a drop from the 2017/18 financial year; the turnover rate was 4.06%. The turnover rate for Researchers is 6.12% and 6.34% for Research Technicians. During this reporting period the ARC vacancy rate is 7.6%.

<table>
<thead>
<tr>
<th>Occupational Level</th>
<th>Year to date turnover rate</th>
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<tbody>
<tr>
<td>Top Management</td>
<td>11.11%</td>
</tr>
<tr>
<td>Senior Management</td>
<td>0.00%</td>
</tr>
<tr>
<td>Professionally qualified and experienced Specialists and Middle Management</td>
<td>6.12%</td>
</tr>
<tr>
<td>Skilled Technical and Academically qualified workers, Junior Management, Supervisors, Foremen and Superintendents</td>
<td>5.41%</td>
</tr>
<tr>
<td>Semi-skilled and discretionary decision making</td>
<td>1.87%</td>
</tr>
<tr>
<td>Unskilled and defined decision making</td>
<td>2.17%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>3.81%</td>
</tr>
</tbody>
</table>
The table below indicate a growing gap between Solidarity (23.48%) and NEHAWU (66.94%).

<table>
<thead>
<tr>
<th>Union</th>
<th>Membership</th>
<th>% of permanent workforce (2287)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEHAWU</td>
<td>1531</td>
<td>66.94%</td>
</tr>
<tr>
<td>Solidarity</td>
<td>537</td>
<td>23.48%</td>
</tr>
<tr>
<td>Sub total</td>
<td>2068</td>
<td>90.42%</td>
</tr>
<tr>
<td>Non-Unionised employees</td>
<td>219</td>
<td>9.58%</td>
</tr>
</tbody>
</table>

**AWARDS AND RECOGNITION**

**Dr N. Mkhize** was appointed as an Honorary Lecturer at the University of KwaZulu-Natal in the School of Life Sciences, College of Agriculture, and Engineering Sciences on 22 May 2018.

**Dr R. Thomas** received best oral presentation award for Animal Production at the 11th annual Gauteng Department of Agriculture and Rural Development Research Symposium held at Midrand Conference Centre on 20th June 2018.

**Dr R. Thomas** was awarded certificate of recognition for publication from projects funded by Gauteng Department of Agriculture and Rural Development at the 11th annual GDARD Research Symposium held at Midrand Conference Centre on 20th June 2018.

**Dr C. Ncobela** was awarded certificate of recognition for achieving his PhD, the project was funded by Gauteng Department of Agriculture and Rural Development at the 11th annual GDARD Research Symposium held at Midrand Conference Centre on 20th June 2018.

**Dr L. van der Westhuizen** won the 1st prize (Laptop, Laptop Bag, Gold Medal & Certificate) for PhD oral presentation titiled “The genetic assessment of South African Nguni sheep breeds using the OVINE50K chip” during the 5th Annual PDP Conference held at ARC-VOP from 27-29 August 2018.

**Mr. K.S. Nxumalo** won the 1st prize (Laptop, Laptop Bag, Gold Medal & Certificate) for the MSc oral presentation titled “The genetic assessment of South African Nguni sheep breeds using the OVINE50K chip” during the 5th Annual PDP Conference held at ARC-VOP from 27-29 August 2018.

**Ms. S.J. Mothotsi** won the 2nd prize (iPad, Silver Medal & Certificate) for MSc oral presentation titled “SNP-based inbreeding in the South African Brahman cattle” during the 5th Annual PDP Conference held at ARC-VOP from 27-29 August 2018.

**Ms. D.A. Linde** won the 3rd prize (Tablet, Bronze Medal, Certificate) for the MSc oral presentation titled “A transcriptomic approach to the effect of levels of energy in the diet on Nguni and Bonsmara cattle” during the 5th Annual PDP Conference held at ARC-VOP from 27-29 August 2018.

**Dr O. Koekemoer** participated as a keynote speaker at the EU African Horse Sickness and Bluetongue Reference Laboratories Workshop 2018, November 27th, 2018 at the Ministerio de Transición Ecológica Plaza de San Juan de la Cruz, Madrid, Spain. Title of talk: Molecular diagnostics and epidemiology of AHSV in South Africa over two seasons.

**Dr D.B. Wallace, Dr M. van Kleef** and **Dr J. Fehrsen** are appointed as extraordinary lecturers at the University of Pretoria in the Department of Veterinary and Tropical Diseases, Faculty of Veterinary Sciences, 2019.

**Dr P. Opperman** was appointed as an extraordinary lecturer at the University of Pretoria in the Department of Production Animal Studies, Faculty of Veterinary Science from January 2019 for 3 years (until December 2021).

**Dr K. Scott** was appointed as executive committee member of the Global Foot and Mouth Disease Research Alliance (GFRA) in 2018.

**Dr K. Scott** was appointed as executive committee member of the Global Foot and Mouth Disease Research Alliance (GFRA) in 2018.
Dr. C. Sabeta, a NRF C2 rated researcher, is Associate Editor for the peer reviewed journal: BMC Infectious Diseases.

Dr. J. Fehrsen has been appointed to Editorial Board Member for the peer reviewed journal BMC Biotechnology.

Dr. A. Mather was appointed as Chairperson of the Scientific Advisory Committee (2013-present) and Impartiality Committee (2018-present) for the National Independent Halal Trust (NIHT). He is also a founding Director and Council Member of the African Muslim Farmers Association (AMFA).

Dr. J. van Heerden, a NRF C3 rated researcher, has been appointed as Council Member for the South African Council for Natural Scientific Professions from June 2015-August 2019.

Dr. D.B. Wallace was awarded best oral presentation for category “Animal Health” at the 11th annual Gauteng Department of Agriculture and Rural Development Research Symposium held at Midrand Conference Centre on the 20th June 2018.

Dr. B.J. Mans was invited as keynote speaker at the Symposium: Adaptations to Hematophagy in Blood-feeding Parasites, 111th Annual Meeting of the German Zoological Society, Greifswald, Germany, September 2018. Title of talk: Functional evolution at the tick-host interface: adaptive or neutral evolution?

Dr. K. Junker (NRF C2 researcher), Dr. D.B. Wallace and Dr. A. Mather are appointed as Section Editor’s for the Onderste poort Journal of Veterinary Research.

Dr. G. Venter is appointed as Editorial Committee member for the journal Medical and Veterinary Entomology.

Ms. K. Masenya was awarded funding from UNISA DSF bursary to travel to the USA to present the findings of her research at the International Congress of Plant Pathology 2018 (ICPP2018).

BTP PhD students received awards in the first, second and third best poster awards under the PhD category at the 2018 PDP conference.

i. Ms. K. Ncube won first prize for PhD poster presentation
ii. Ms. N. Hlongwane won second prize for PhD poster presentation
iii. Ms. E. Pillay and Ms. K. Masenya won third prize PhD poster presentation

Mr. F. Reinders was been granted the title of Guest Professorship at Nanchang Institute of Technology (NIT) on the 20 October 2018.

Ms. P. Burger was awarded Top Intellectual Property Creator by the Minister of Science and Technology in terms of actionable disclosures and technology transfer, in March 2019.

Prof. L. Joubert received an award for exceptional achievements by the Council of the South African Academy of Science and Art, on 21 September 2018.

Prof. L. Joubert received a NRF “B” rating; assigned to Researchers who enjoy considerable international recognition by their peers for the high quality and impact of their recent research outputs.

Dr. O. Caleb received a NRF “Y” rating; assigned to Young researchers (40 years or younger), who have held the doctorate or equivalent qualification for less than five years at the time of application.

Dr. C. Visagie at Biosystematics received a NRF “P” rating, assigned to researchers (normally under 35 years of age) who have held a doctorate or equivalent qualification for less than five years at the time of application.

Dr. H. Araya, Mr. F. Kruger, Ms. M. Matshaya and Dr. S. Mokgehle were awarded a trophy and certificate at the Innovation Hub-Gauteng Accelerator Programme competition in the category of GAP Biosciences on 15 November 2018, on Nala Health Bread from Morogo: a tool to combat malnutrition and hidden hunger in South Africa.

Dr. K. Hannweg was elected as ISHS Awards Committee Member (Africa); ISHS Council member (South Africa); ISHS Chairperson for Tropical and Subtropical Fruit and Nuts and ISHS Africa Group: Southern African Region Coordinator at ISHS at ISHS Conference in Istanbul, Turkey, 6-9 August 2018.

Dr. R.R. Mphahlele was awarded an Honorary Membership to the International Horticultural Society.

Dr. S. Venter has achieved the best overall academic performance on the Senior Management Programme at University of Pretoria Executive Education, Gordon Institute of Business Science.

Dr. S.C. Lamprecht received the Bayer-SANSOR Science for a Better Life award in Pretoria on 10 May 2018.

Ms. A. Shubane won best student poster at the 33rd Symposium of the European Society of Nematologists held at Ghent, Belgium.

Dr. L. Matsaunyane received an award for best paper presented under the category of Crop Production and Biotechnology at the 11th Agricultural Research Symposium held at Midrand Conference Centre on the 20 June 2018.
Prof F. Halleen received the South African Journal of Enology and Viticulture (SAJEV) Prize for best scientific article published in 2016-17. Award was presented at the 41st South African Society of Enology and Viticulture (SASEV) Winetech Conference held in Somerset West, 2-4 October 2018.

Mr I. du Plessis received an award for best presentation delivered at the 41st South African Society of Enology and Viticulture (SASEV) at the Winetech Conference held in Somerset West, 2-4 October 2018.

Ms K. Chauke awarded best scientific poster at the BISMiS. The international conference was held at Misty Hills Hotel and Conference Centre, Muldersdrift, 8-11 April 2018.

Ms K.P. Mmereki, an MSc student at the UFS, and DST intern at ARC, was awarded the best research poster at the SANSOR 29th Annual Congress in Pretoria. Her poster was titled “Improved Fusarium head blight resistance in the South African cultivar Krokodil”.

Ms S.P.F. Ximba received 2nd prize for her oral presentation in the PhD category of the Annual ARC Post-graduate Development Programme Conference which was held at ARC-VOP Training Center from 27-29 August 2018.

Ms J. Mothapo received 3rd prize for the best oral presentation in the PhD category of the of the Annual ARC Post-graduate Development Programme Conference which was held at ARC-VOP Training Center from 27-29 August 2018.

Ms L. Linda received an award for the best oral presentation at the South African Association of Agricultural Technologists (SASAT) Conference, held from 19-21 September 2018 at Casa do Sol in Hazyview, Mpumalanga Province.

Mr W.P. Steyn was warded for most applicable presentation across all categories at the South African Association of Agricultural Technologists (SASAT) Conference, held from 19-21 September 2018 at Casa do Sol in Hazyview, Mpumalanga Province.

Ms A. Msweli received awarded for best poster presentation at the South African Association of Agricultural Technologists (SASAT) Conference, held from 19-21 September 2018 at Casa do Sol in Hazyview, Mpumalanga Province.

Ms S. Willemse was awarded 3rd prize for a poster presentation at the South African Association of Agricultural Technologists (SASAT) Conference, held from 19-21 September 2018 at Casa do Sol in Hazyview, Mpumalanga Province.

Dr Cruywagen was awarded 1st prize for the best poster presentation at Potatoes South Africa Research Symposium.

Dr P. Maponya received recognition certificate for the oral presentation at the 9th International Agriculture Conference, 4-7 October 2018, Bosnia, Herzegovina.

Dr K. Hannweg was presented an award as SASHS Extended Abstract Reviewer and Coordinator for Best Published paper Award presented at the Combined Congress Gala Dinner, Bloemfontein, 21-24 January 2019.

Ms H. Nienaber received Crop Life award for best presentation in Weed Science at the Combined Congress in January 2019.

Dr S. Sydenham received two awards from the South African Society of Crop Production at the Combined Congress in January 2019.
The ICT & Infrastructure Report provides an overview of the work performed during the 2018/19 Financial Year. The background against which the performance of the Division is based has remained consistent with prior years in that the Business Plan targets have been multi-year.

The ICT Strategy developed in prior years has been fully implemented however, owing to developments in the ICT industry processes, is underway to develop new strategies going forward, which will have significant variation to the future performance of ICT in the ARC.

Similarly, the Asset Management Plan, which has been the basis of performance planning for Infrastructure, has also remained subject to multi-year implementation. The Asset Management Plan, while also undergoing review, will remain one of the key drivers of the Division’s performance going forward.

A brief summary of the Division’s performance during the 2018/19 financial year is outlined below.

**DIGITAL TRANSFORMATION**

The 4th Industrial Revolution (4IR), currently under way, differs profoundly from its predecessors - its scope is much broader than simply smart and connected machines and systems. The 4IR has disrupted industry after industry, including the agricultural sector. Better information flows, lower transaction costs and faster communication have made doing business easier and more efficient, and have proved to be major drivers of economic growth. Digital transformation requires organisations to continually refresh their business models and much of the change will be technology-enabled. Digital representations of things and organisational processes are increasingly used to monitor, analyse and control real-world environments. The 4IR will bring significant change to agriculture and agro-processing. Emerging technologies that will transform agricultural practices will be related to water management and related technologies, automation, IoT and sensor technology, remote sensing, precision agriculture and smart farming and genetics, AI and machine learning. South Africa has the opportunity to, through converging technologies of the 4IR, become an early adopter, accelerating its agro processing development.
RAIN FOR AFRICA (R4A)

For the Agricultural Research Council (ARC), some of the most recent advancements transforming this sphere are smart farming tools, such as Rain for Africa (R4A). R4A, a project undertaken by the ARC in partnership with the South African Weather Service (SAWS) and other international non-profit organisations (NGOs), aims to provide food producers with the correct information at the right moment to help them improve the quality and quantity of food production in a sustainable manner. These kinds of smart farming tools will help improve crop yields and the quality thereof, and ultimately reduce water consumption and greenhouse gas emissions.

STOCK MANAGER AND GROUNDNUT GERMPLASM

Other digital transformation initiatives include the Stock Manager and Groundnut Germplasm solutions. Stock Manager is a user-friendly computer program that facilitates record-keeping and analysis for both veld and livestock management. It is time-consuming to keep records and manually process records. Stock Manager places record-keeping and analysis within the reach of every stock farmer in South Africa, regardless of whether production is in field or planted pastures, with small or large stock or game.

Groundnut germplasm has been collected and stored in a systematic system at the ARC Grain Crops Campus in Potchefstroom since the early 1940s. The collection houses an important source of disease resistant material for the groundnut breeding programme. The collection has expanded steadily since its conception and currently stands at about 1 093 accessions, which are renewed in the field every 5 years. The groundnut germplasm database includes both local and introduced cultivars of various botanical and commercial types. The cultivars are characterized for various traits, including growth habit, pod and kernel properties, kernel grading and chemical quantities of kernels. More recent accessions are also noted for any specific characteristics that they may have.

KNOWLEDGE MANAGEMENT

As part of the broader knowledge management strategy, the ICT department started with a process of implementing a document management system in the ARC. Forty users have been trained on SharePoint document management and there are ongoing engagements with teams to establish their document collaboration needs. A collaboration space has been established on SharePoint to allow teams to co-author and share documents with ease. The process to introduce an electronic signature is underway. With electronic signatures, the ARC will see a significant reduction in printing cost and improved efficiency in the submission process.

ICT OPERATIONS

CORPORATE SERVER INFRASTRUCTURE

This year some upgrades were conducted on the corporate server infrastructure to accommodate growth, operational needs and new projects. These upgrade included:

- Memory and CPU upgrades of the Blade servers in the corporate datacentre to cater for the ERP AXR3 upgrade project.
- Intergis storage was migrated from the old EVA technology onto the newer 3PAR storage, which is still in HPE support.
- The storage capacity and the software platform on the HPC (High Performance Cluster) at Biotech Platform was increased and upgraded to the latest version.
- UPS solution supporting the HPC was also upgraded.
- A new cooling solution was installed in the ARC’s DR (Disaster Recovery) site.
SERVICES UNDER VODACOM RT15-2016
The ARC decided to participate in the National Treasury’s RT15 Vodacom contract to benefit from all the added services on offer, as the ARC already had a formal Vodacom business engagement in relation to voice and mobile data services. The main focus was to migrate the ARC’s in-house perimeter security services to a hosted model and also to migrate the ARC’s remote site links to Vodacom.

Project status:
- Migration of firewall services from local checkpoint to hosted Fortigate solution-successfully completed;
- Migration of Corporate APN (mobile data services) to Vodacom datacentre - successfully completed;
- Rustenburg (IC) remote site link successfully upgraded, cut over and stable;
- Remote site links built and ready for cut-over: Bien Donné, Glen, Ncera, Vredenburg and Port Elizabeth (PE);
- Remote site links building in progress: Addo, Middleburg, Vryburg and Elsenburg; and
- SMS services platform activated.

LOCAL AREA NETWORK (LAN) UPGRADE PROJECT (2ND PHASE)
In 2016 the ARC started replacing its aging LAN infrastructure in accordance with capital funding made available. Phase 1, which included Central Office (CO), Vegetable and Ornamental Plants (VOP), Plant Health and Protection (PHP), Infruitec, Small Grain (SG), Onderstepoort Veterinary Research (OVR), Agricultural Engineering (AE) and Soil Climate and Water (SCW), was completed in late 2016. Phase 2, to upgrade the remaining sites of the ARC that included Animal Production (AP), Tropical and Subtropical Crops (TSC), Grain Crops (GC), Industrial Crops (IC) and all remote sites, kicked off late in 2018. The project was successfully completed before the end of the financial year.

COST CONTAINMENT REVIEW IN ICT
As part of the cost containment process the following actions were implemented:
- All contracts and service level agreements were reviewed to ensure optimal levels of service in relation to cost;
- Telecommunications and data communications services across all ARC campuses were optimised;
- Rationalising of all MFUs (multi-functional printing solution) and desktop printing solutions to ensure optimal use and printing cost containment;
- Reviewing all corporate software licencing to ensure optimal licencing structure for all corporate software.

LOCAL INFRASTRUCTURE
Two major renovation were concluded at the ARC during the 2018/19 financial year, namely: (1) renovation of the central office ground floor, and (2) upgrading the cellar at Nietvoorbij.

CENTRAL OFFICE
The renovation of the ground floor at Central Office was undertaken to achieve the following key objectives:
- Improve compliance with provisions of the Occupational Health and Safety Act 85 of 1993 as amended;
- Improve compliance with provisions of the National Environmental Management Air Quality Act 39 of 2004 pertaining to the phasing-out and management of ozone depleting substances;
- Implement energy saving initiatives;
- Reduce water use in men’s bathrooms; and,
- Improve ergonomics.

UPGRADE OF THE CELLAR
Part of the cellar upgrade project was the renovation of part of the old commercial cellar into a functional tasting room/function venue. It is envisioned that this space will be used for Nietvoorbij wines as well as a distribution/selling point for wines by emerging wine makers. The main aim is to ensure that the tasting room provides for a broad customer base that will dramatically improve ARC sales and promote our wines and other ARC agro processed goods, such as jams. The renovated tasting room will also reinstate the ARC on the Stellenbosch Wine Route map.

SECURITY SERVICES
ERECTION OF THE SECURITY FENCE - NIETVOORBIJ
A rigid mesh security fence of approximately 2km was erected on the premises to safeguard the farm from illegal entrance. The fence is running alongside major roads with limited access areas. Since the erection of the security fence we have encountered a major reduction in criminal activities on the farm compared to the previous years, thus worth the expenditure on the project.

TECHNOLOGY - CCTVS
The following technological infrastructure installations were made during the course of the financial year: CCTV surveillance systems at VOP, PHP, SG, AP, and CO. Existing electronic access control systems at CO, AP were modified, and new installations were installed at SG and IC. Intruder alarm system maintenance and monitoring for AE, CO, SCW, SG and AP. A focus on existing and new areas security technologies, especially at campuses where security/guarding services are not provided, remains a priority in the new financial year.
Reception at Central Office.

Upgraded Cellar.
Knowledge generation is the bigger part of the work the ARC is involved in. In order to showcase its work and the impact thereof, it is important for the ARC to share the knowledge it creates from its research. The organisation bridges the gap between its research and practice by disseminating the findings of its research to a range of target stakeholders through among other channels publishing of journal articles by researchers, documenting of these by students, publishing of chapters in books and presenting papers for inclusion in conference proceedings by research. Some of the knowledge dissemination interventions for 2018/19 include the following:

JOURNAL ARTICLES


Sambo, D.C., Senzanje, A. & Dhuvi, K. 2018. Using network analysis to analyse the complex interaction of factors causing the failure of small-scale water infrastructure (SWI) in...
the rural areas of South Africa. *Water SA*, http://dx.doi.org/10.4314/wsa.v44i3.02, pp 348-357.


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THESES AND DISSERTATIONS


Christians, L.J. 2018. Proteomic characterisation of wine yeast strains for the expression of arginases involved in urea formation during fermentation. Master of Science (Biotechnology), University of the Western Cape.


Du Plessis, H.W. 2018. Effect of non-Saccharomyces yeasts and lactic acid bacteria interactions on wine flavour. Doctor of Philosophy (Wine biotechnology), Stellenbosch University.

Du Preez, G.C. 2018. Nematodes as bio indicators of irrigated soil health in the Crocodile (West) and Marico catchments. Doctor of Philosophy in Environmental Sciences, North West University.

Dyafta, V. 2018. Rose-Scented geranium oil yield composition as affected by leaf age, herbage drying and paclobutrazol concentrations. Master of Science in Agriculture (Horticultural Science), University of Fort Hare.


Hart, R.S. 2018. Proteomic and Metabolomic Characterisation of Novel Wine Yeasts: Towards the Evaluation and Improvements of their Ability to Produce Aromatic Sauvignon Blanc Wines. Doctor of Philosophy (Biotechnology), University of the Western Cape.


Husselman, J.H. 2018. Induced mutation and distant hybridization as breeding techniques to improve papaya. Master of Science (Agriculture), University of the Free State.


Lekala, S. 2018. Evaluating the effectiveness of shadennet structure and temperature controlled plastic tunnel on growth, yield, quality and postharvest storage quality in eleven red sweet pepper cultivars. Master of Technology (Agriculture), Tshwane University of Technology.


Makkele, I. 2019. Biodiesel production with waste product cycling. Master of Science (Microbiology & Biotechnology), University of the Witwatersrand.


Makoya, P.R. 2018. Effects of Carica papaya seed (Linn) meal on health and performance of Jersey calves. Master of Science (Agriculture), University of South Africa.

Malaka, S.F. 2017. Estimation of greenhouse gas emissions from agriculture in the eastern Free State, South Africa. Master of Science (Geography), University of the Free State.


Mampholo, B. 2018. Effect of nitrogen fertilization on postharvest quality of lettuce cultivars grown in a closed hydroponic system. Doctor of Technology (Agriculture), Tshwane University of Technology.

Mangwane, M. 2018. Evaluation of grass species identified around an open-cast mine area for germination and seeding growth performance under saline conditions in Mpumalanga, South Africa. Master of Science (Pasture Science), University of Pretoria.

Mangwane, M. 2019. Evaluation of grass species identified around an open-cast mine area for germination and seeding growth performance under saline conditions in Mpumalanga, South Africa. Master of Agricultural Science (Pasture Science), University of Pretoria.


Matabane, M. 2018. Effect of advanced reproductive technologies on smallholders’ pig productivity in Gauteng Prov-
ince. Doctor of Philosophy (Animal Production), University of Limpopo.

Matafeni, N. 2018. Stem cutting propagation protocol for rose-scented geranium (*Pelargonium graveolens*). Master of Science in Agriculture (Horticultural Science), University of Fort Hare.


Mbatyoti, O.A. 2018. Soybean host status to *Meloidogyne incognita* and nematode biodiversity in local soybean cropping systems. Doctor of Philosophiae (Environmental Sciences), North-West University.

Mditshwa, S. 2017. Estimating maize grain yield from crop growth stages using remote sensing and GIS in the Free State Province, South Africa. Master of Science (Geography), University of Fort Hare.

Mfeka, N. 2018. Morphology and mineral content of cowpea lines in response to plating date and zinc application rate. Master of Technology (Agriculture), Cape Peninsula University of Technology.


Mmboyi, M.M. 2018. Serological and molecular characterization of SPV2 and SPCSV infecting sweet potato in the Limpopo, Gauteng and Mpumalanga provinces of South Africa. Master of Technology (Biotechnology), Tshwane University of Technology.


Moelich, E.I. 2018. Development and validation of prediction models and rapid sensory methodologies to understand intrinsic bitterness of *Cyclopia genistoides*. Doctor of Philosophy (Food Science), Stellenbosch University.

Mogano, K. 2017. The utility of new generation multispectral sensors in assessing aboveground biomass of *Phragmites australis* in wetlands areas in the City of Tshwane Metropolitan Municipality; South Africa. Master of Science (Environmental Science), University of KwaZulu-Natal.


Mukhuba, M. 2017. Ecological guild of microbes that drive production of biogas from multiple feedstock. Master of Science (Life Sciences), University of South Africa.


Mulaudzi, T. 2018. *In vitro* effects of *Megasphaera elsdenii* NCIMB 41125 and *Saccharomyces cerevisiae* 1026 on rumen fermentation. Master of Science (Agriculture), University of South Africa.

Muller, L.C. 2018. Preparation of polyurethane foam from lignin and crude glycerol. Doctor of Philosophy (Chemical), University of the North-West.


Nyamandi, N.T. 2018. Effects of Nemarioc-AL and Nemafic-BL phytonematicides, Biomuti and soil microorganisms on growth of tomato plants and population of *Meloidogyne javanica*. Master of Science (Agriculture), University of Limpopo.

Pyoos, G.M. 2019. Crossbreeding effects on cow efficiency and component traits. Master of Science (Animal Production), University of the Free State.


Sishi, M. 2018. Evaluation of rooibos waste plant material for the development of a high-value herbal tea product. Master of Science (Food Science), Stellenbosch University.


Thavhana, M.P. 2018. Runoff simulation using the SWAT model for flood frequency analysis and design flood estimations in the Luvuvhu River catchment, South Africa. Master of Science in Agriculture (Agrometeorology), University of KwaZulu-Natal.

Thema, N. 2018. Identification and characterisation of *Ehrlichia ruminantium* epitopes as vaccine candidates. Doctor of Philosophy (Veterinary Tropical Diseases), University of Pretoria.

Tobin, J. 2018. Rooibos fermentation—Characterising phenolic changes using chemometric analysis and kinetic modelling. Master of Science (Food Science), Stellenbosch University.


Tshabalala, M.M. 2019. The effect of egg yolk extracted low-density lipoprotein on the cryopreservation of Nguni bull semen. Magister Technology (Agriculture), Tshwane University of Technology.

Van Der Loo, A.M.J. 2018. An analytical pre-breeding method for flavonoid screening in grapefruit. Master of Science (Biochemistry and Plant Breeding), University of the Free State.


Williams, M.T. 2018. Characterisation of wine yeasts for varietal red wine production by using chemical, sensory, metabolomic and Proteomic tools. Master of Science (Microbiology), Stellenbosch University.

**CHAPERS IN BOOKS**


CONFERENCE PROCEEDINGS


**Allsopp, E.** 2018. Intergated production of Wine grapes 2018: Stellenbosch Afrikaans. Course presented to 61 commercial farmers and members of industry at the IPW training course on 1 August in Stellenbosch.


**Chiloane, S.** 2018. Vegetable seedling production and nursery management. *ARC-Vegetable and Ornamental Plants Newsletter* No 2 pp 3-5, April-June.


De Villiers, C. 2018. The infection process of Fusarium ear blight. PULA/IMVULA. June.


Fourie, J.C. 2018. Grondbewering, dekgewasse en onkruidebeheer as deel van ’n geïntegreerde benadering tot wierderbouwing: Deel 1, Deel 2 & Deel 3. Course presented to 8 commercial farmers in Kakamas, Benede Oranjrivier, 8 August.

Fourie, J.C. 2018. Grondbewering, dekgewasse en onkruidebeheer as deel van ’n geïntegreerde benadering tot wierderbouwing: Deel 1, Deel 2 & Deel 3. Course presented to 8 commercial farmers in the Olifants River Valley, 8 August.


Reinders, F.B. 2018. Water is life: Respect it, Conserve it and enjoy it! Nguni Journal, p 139.


Smit, H. & Barnard, A. 2018. A chain with a weak link is a broken chain - main factors affecting the yield of wheat. PULA/IMVULA, June.


CORPORATE GOVERNANCE

REPORT ON GOVERNANCE

ARC Board
The ARC Council appointed by the Executive Authority (the Minister responsible for the ARC) in terms of the Agricultural Research Council Act, 1990 (Act no. 86 of 1990) governs the ARC.

Members of the ARC Board
The members of the Board serving in the year under review were:

Prof. S. Vil-Nkomo (Chairperson- appointed, effective from 1 September 2014)
Dr. J. Chitja (Vice-Chairperson- appointed, effective from 1 September 2017)
Ms. J Mashiteng
Mr. A Bishop
Dr. M Ngoepe-Ntsoane
Adv. E Mphahlele
Mr. M Mahanjana
Dr. M Ngidi
Dr. S Van Oosterhout
Mr. S Mthombeni
Mr. A Makenete
Mr. M Brinkhuis
Prof. P Mashela
Dr. M Makhura
Dr. A Stroebel
Ms. B Kali
Dr. SR Moephuli (President and CEO)

Responsibilities of the Board
The statutory functions of the ARC Council are determined in terms of the provisions of the Agricultural Research Council Act, 1990 (Act No 86 of 1990) and the Public Finance Management Act, 1999 (Act No 1 of 1999) (the PFMA). These include the following: To be the Accounting Authority; approval of the corporate business plan, strategic plan and the policies of the ARC; and setting of performance targets for the organization.

In the year under review, applicable accounting standards were adhered to and adequate accounting records and an effective system of internal control were maintained. Appropriate accounting policies, supported by reasonable and prudent judgements and estimates were applied on a consistent basis. Detailed delegations as required by the PFMA were in place.

Board members’ Remuneration
Council members, who are not Government officials, receive fees for the services they render to the ARC in accordance with the relevant tariffs as determined by National Treasury and approved by the Minister of Agriculture, Forestry & Fisheries.

Members of the Audit & Risk Committee are remunerated in accordance with an agreed tariff set by the ARC.

Detailed information on fees, emoluments, bonuses and subsistence and travel claims paid to Council members, Audit & Risk Committee members and executive members as required per Treasury Regulation 28.1.1 is provided in note 29 of the notes to the Annual Financial Statements.

Board Members’ Interests in Contracts
None of the Board members are involved in/ have any interest on contracts entered into by the ARC in the year under review.

Public Finance Management Act
The ARC is fully committed to comply with the provisions of the Public Finance Management Act (PFMA). The internal and External auditors continue to provide the Council with assurance on the degree of compliance with the PFMA.

Materiality Framework
In accordance with the PFMA and Treasury Regulations 28.1.5 the ARC has developed a Framework of acceptable levels of materiality and significance.

During the year under review, the following Council members attended at least five (5) Council meetings scheduled:
### Council member No. of meetings attended

<table>
<thead>
<tr>
<th>Name</th>
<th>Designation in terms of Board</th>
<th>Date appointed</th>
<th>Date resigned/tenured</th>
<th>Qualifications</th>
<th>Area of expertise</th>
<th>Board of directors</th>
<th>Other committees (e.g. task teams)</th>
<th>Number of meetings attended</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prof. S Ve-Nkomo</td>
<td>Chairperson</td>
<td>01/09/2010</td>
<td></td>
<td>BA MA, PhD</td>
<td>Research</td>
<td>Yes</td>
<td></td>
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</tr>
<tr>
<td>Dr. J Chitja</td>
<td>Deputy Chairperson</td>
<td>01/09/2010</td>
<td></td>
<td>PhD food science, M. Soc. Sci, Bachelor of Science in agriculture</td>
<td>Research</td>
<td>Yes</td>
<td>Research</td>
<td>4</td>
</tr>
<tr>
<td>Mr. A Bishop</td>
<td>Member</td>
<td>01/09/2013</td>
<td></td>
<td>B. Comm Honours, B. Compt Honours</td>
<td>Audit</td>
<td>Yes</td>
<td>Audit &amp; Risk, Research, Finance</td>
<td>4</td>
</tr>
<tr>
<td>Ms. J Mashiteng</td>
<td>Member</td>
<td>01/09/2013</td>
<td></td>
<td>Masters, Post Cert, management, Masters cert in nuclear</td>
<td>Human Resource</td>
<td>Yes</td>
<td>Human Resource</td>
<td>5</td>
</tr>
<tr>
<td>Dr. M Ngoepe-Nisoane</td>
<td>Member</td>
<td>01/04/2017</td>
<td></td>
<td>PhD (Management of Technology and Innovation)</td>
<td>Human Resource</td>
<td>Yes</td>
<td>Human Resource</td>
<td>4</td>
</tr>
<tr>
<td>Dr. M Makura</td>
<td>Member</td>
<td>01/04/2017</td>
<td></td>
<td>PhD (Agricultural Economics)</td>
<td>Research</td>
<td>Yes</td>
<td>Finance</td>
<td>4</td>
</tr>
<tr>
<td>Adv. E Mphahlele</td>
<td>Member</td>
<td>01/04/2017</td>
<td></td>
<td>B Proc, LLB (Commercial Law)</td>
<td>Commercial law</td>
<td>Yes</td>
<td>Audit &amp; Risk, Human Resource</td>
<td>4</td>
</tr>
<tr>
<td>Mr. M Maharijana</td>
<td>Member</td>
<td>01/04/2017</td>
<td></td>
<td>BPhil (Sustainable Development Planning and Management)</td>
<td>Research</td>
<td>Yes</td>
<td>Research</td>
<td>4</td>
</tr>
<tr>
<td>Dr. M Ngidi</td>
<td>Member</td>
<td>01/04/2017</td>
<td></td>
<td>PhD (Poultry Science)</td>
<td>Research</td>
<td>Yes</td>
<td>Research</td>
<td>4</td>
</tr>
<tr>
<td>Dr. S Van Oosterhout</td>
<td>Member</td>
<td>01/04/2017</td>
<td></td>
<td>PhD (Agricultural Ecology)</td>
<td>Research</td>
<td>Yes</td>
<td>Finance Research</td>
<td>5</td>
</tr>
<tr>
<td>Mr. S Mhombeni</td>
<td>Member</td>
<td>01/04/2017</td>
<td></td>
<td>MBA (Finance and Strategy)</td>
<td>Finance</td>
<td>Yes</td>
<td>Finance</td>
<td>4</td>
</tr>
<tr>
<td>Mr. A Makenene</td>
<td>Member</td>
<td>01/04/2017</td>
<td></td>
<td>BSc (Agric)</td>
<td>Finance</td>
<td>Yes</td>
<td>Finance</td>
<td>4</td>
</tr>
<tr>
<td>Mr. M Bankhuis</td>
<td>Member</td>
<td>01/04/2017</td>
<td></td>
<td>MPhil (Agricultural Systems Management (Economics))</td>
<td>Research</td>
<td>Yes</td>
<td>Research</td>
<td>4</td>
</tr>
<tr>
<td>Prof. P Mashela</td>
<td>Member</td>
<td>01/04/2017</td>
<td></td>
<td>PhD (Entomology and Nematology)</td>
<td>Research</td>
<td>Yes</td>
<td>Research</td>
<td>5</td>
</tr>
<tr>
<td>Dr. A Stroebel</td>
<td>Member</td>
<td>01/04/2017</td>
<td></td>
<td>PhD (Socio-Economic complexities of smallholder resource-)</td>
<td>Research</td>
<td>Yes</td>
<td>Human Resource Research</td>
<td>3</td>
</tr>
<tr>
<td>Ms. B Kali</td>
<td>Member</td>
<td>01/04/2017</td>
<td></td>
<td>Business Management (Strategic Leadership, HR Management, Commercial Law.)</td>
<td>Human Resource</td>
<td>Yes</td>
<td>Human Resource</td>
<td>5</td>
</tr>
</tbody>
</table>
Statement of Adherence

The ARC, as Public Entity, confirms its commitment to the principles of transparency, integrity and accountability as advocated in the King III report on Corporate Governance. The ARC Council takes note of the principles contained in the King III Report and will ensure that the ARC complies with these principles to the extent that they apply.

Corporate Structure and Responsibility

In the governance of the ARC, the Council is responsible for policy making and control while the ARC President and CEO has been delegated the responsibility for the day-to-day execution of the policies and objectives as directed by the Council. The members of the Council are appointed by the Minister of Agriculture, Forestry & Fisheries on the basis of their expertise in the fields of agriculture, business, financial management, law, research, technology development and technology transfer in the field of agriculture, as prescribed by the Agricultural Research Act, 1990 (Act No. 86 of 1990). Council members are appointed for a maximum period of three years and eligible for re-appointment. With the exception of the President and CEO of the ARC none of the members of the Council hold an executive position in the ARC. The Council exercises full and effective control over the ARC and monitors its Executive Management Committee. The Council may obtain independent professional advice if deemed necessary.

Governance Structures

In order to comply with these principles, the ARC has and continues to design and implement appropriate governance structures across the organization. ARC acknowledges that, for it to set up an effective governance framework, robust governance structures need to be in place. The following Council Committees operates as at 01 April 2017 together with their respective terms of reference in the form of Committee Charters:

Executive Committee

During the year under review, three (3) Executive Committee meeting was held.

<table>
<thead>
<tr>
<th>Council member</th>
<th>No. of meetings attended</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. SR Moephuli (CEO)</td>
<td>3</td>
</tr>
<tr>
<td>Prof. S Vil-Nkomo - Chairperson</td>
<td>3</td>
</tr>
<tr>
<td>Dr. J Chitja - Deputy Chair</td>
<td>3</td>
</tr>
<tr>
<td>Ms. J Mashiteng</td>
<td>3</td>
</tr>
<tr>
<td>Mr. A Makenete</td>
<td>3</td>
</tr>
</tbody>
</table>
AUDIT AND RISK COMMITTEE REPORT

Report of the Audit & Risk Committee
We are pleased to present our report for the financial year ended 31 March 2019.

Audit & Risk Committee and attendance
The function of the Audit and Risk Committee (the Committee) of the ARC is to assist the Council of the ARC in discharging its duties relating to the safeguarding of assets, the operation of adequate systems, control processes and the preparation of financial reports and statements.

These tasks are conducted in line with all applicable legal requirements and accounting standards as prescribed in the Public Finance Management Act of 1999 (Act no. 1 of 1999) (the PFMA). The Committee operates in terms of a written Terms of Reference (The Audit and Risk Committee Charter) which provides clear guidelines with regards to the membership, authority and responsibilities. The Audit & Risk Committee Charter was reviewed and updated recently to accommodate new and extended responsibilities.

The membership of the Committee as at 31 March 2018 comprised of 5 (five) independent external members and two members of Council and their attendance is reflected in the table below.

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Mr. V Naicker</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Ms. P Mokoena</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mr. H McBain</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ms. J Bruinders</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mr. L Mangquku</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mr. A Bishop (ARC Council)</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adv. E Mphahlele (ARC Council)</td>
<td></td>
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<td></td>
<td></td>
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</tr>
</tbody>
</table>

*SP refers to Special Meeting

The Committee hereby also, confirms that Members of the Audit and Risk Committee met with Senior Management of the ARC, Internal Audit and the Auditor-General, individually and collectively, to address risks and challenges facing the ARC. Several in-committee meetings were held to address control weaknesses within the ARC which matters were handed to management for follow up.

Audit and Risk Committee responsibility
The Audit and Risk Committee confirms that it has complied with its responsibilities arising from section 38(1) of the PFMA and Treasury Regulations 3.1.13. including the adoption of formal terms of reference as its Audit & Risk Committee Charter and has regulated its activities in compliance with this Charter and has discharged all its responsibilities as contained therein.

In the conduct of its duties, the Committee has, inter alia, reviewed the following:

- The effectiveness of the internal control systems;
- The operational risk areas covered in the scope of internal and external audits;
- The adequacy, reliability and accuracy of financial information provided to management and other users of such information;
- Any accounting and auditing concerns identified as a result of internal and external audits;
- Compliance with legal, accounting and regulatory frameworks;
- The activities of the Internal Audit Function, including its annual work program, co-ordination with external auditors, the reports of significant investigations and the response of management to specific recommendations; and,
- Where relevant, the independence and objectivity of external auditors.

The Committee is extremely disappointed with the audit outcome despite numerous assurances of turn-around provided by the management team. Evidence contained in the detailed management report indicates that the control environment requires substantial improvement in the areas of financial reporting, asset and inventory management. The Committee was unable to obtain adequate assurance from the internal audit function because the function was not fully operational for a significant portion of the financial year due discontinuation of services provided by the outsourced service provider.

The effectiveness of internal control and Information and Communication Technology (ICT) Governance
In line with the PFMA and the recommendation from King IV Report on Corporate Governance requirements, Internal Audit provides the Audit Committee and Management with assurance
that the internal controls are appropriate and effective. This is achieved by means of the risk management process, as well as the identification of corrective actions and suggested enhancements to the controls and processes. The ARC has made improvements in the control environment and management of performance information for the current year. Improvements were also made in a number of areas including the implementation of enhanced Human Resource policies and procedures. The ARC paid increased attention to implementing Auditor General and Internal Audit findings raised in previous years.

The current ERP system continues to pose implementation challenges despite management assurances that adequate remedial action has been taken. The Committee will intensify its monitoring of the required corrective action in the coming year.

The Audit Committee also reviewed the progress with respect to the ICT Governance in line with the ICT Framework approved by the ARC. Whilst the Committee acknowledges the Auditor General’s findings on the delayed approval of the ICT Governance documentation, it is comfortable with the progress made to date. The Audit Committee together with management have identified security protocols, disaster recovery and certain ICT internal controls and these will be the subject of increased oversight in the coming financial year.

In conclusion, the Audit and Risk Committee notes some improvement in the ICT control environment compared to last year however the Auditor General has raised a number of controls findings needing management attention.

Internal Audit
The Committee directs, monitors and evaluates the activities of the Internal Audit Function. The Internal Audit Function is managed by a Chief Audit Executive, who is assisted by an independent service provider under a co-sourced arrangement.

The Internal Audit Unit was not fully operational for the entire financial year thus limited the level of assurance that the Audit and Risk Committee received and had to rely on the management team for assurance that his role was being adequately fulfilled. The lack of capacity was the result of a need to change service providers midway through the financial year. The change was necessitated by internal changes within the service provider which were deemed a breach of the supply chain management and procurement regulations and standards.

The Internal Audit Plan was thus, despite assurances from management, not fulfilled to the satisfaction of the Committee. The Audit and Risk Committee is satisfied that the new service provider has the necessary capacity to ensure that there is no limitation in delivering on the current year internal audit plan and providing the Council with the required assurances.

Risk Management
The Audit and Risk Committee is satisfied that the risk management function is at an appropriate level within the organisation and continues to receive attention and refinements in line with its business model. Embedding of risk and mitigation around risk is now a continuous process. The Audit and Risk Committee together with management has noted the observation of the Auditor General that operational risk reporting is limited to the Committee. The Committee has in the past tracked incidents separately under each functional area but will now ensure that this is consolidated into the Chief Risk Officers Report. The Committee has acknowledged that independent risk assurance by Internal Audit was limited due to the capacity constraints during the financial year.

Forensic Investigations
Investigation into alleged financial irregularities, financial irregularities, financial misconduct and fraud were completed during the year under review. Various measures were recommended, including taking actions against the identified officials. The recommendations are at various stages of implementation. There are no outstanding matters of significant nature which highlighting.

Evaluation of Annual Financial Statements
The Audit and Risk Committee has:

- Reviewed and discussed the audited Annual Financial Statements to be included in the Annual Report, with the AGSA and the Accounting Officer;
- Reviewed the Audit Report of the AGSA;
- Reviewed the AGSA’s Management Report and Management’s response thereto;
- Reviewed the Entity’s compliance with legal and regulatory provisions; and
- Reviewed significant adjustments resulting from the audit.

The Committee has once again taken note of the concerns of the Auditor General, more notably the emphasis on material misstatements and financial record keeping and accept that there is room for improvement in the accounting function and elements of the internal control environment. As in the previous years the Committee will ensure that the internal audit plan addresses these issues and will monitor the implementation of the recommendations of the Auditor General’s Report.

The Committee notes the potential future difficulties associated with the going concern status of the ARC as this is highly dependent on the extent of cost containment, support from Government, the magnitude of the Parliamentary Grant and the ability of the ARC to attract external funding for research. The Committee considers that the statement relating to the going concern status of the organization contained in the Annual Financial Statements remains appropriate.
The Audit and Risk Committee has once again noted the constraints to achieve certain targets as identified by management. These constraints continue to adversely impact upon the ARC achieving certain objectives. The Committee is of the view that in an environment of limited fiscal constraints faced by the shareholder the Council will need to increase its efforts to rationalize and consider a more appropriate funding of institutions model. The failure to secure additional funding and rationalise the institution will place considerable strain on the financial resources of the ARC, which in turn places at risk the ARC’s ability to fulfil its mandates.

The monitoring of the organisation’s performance is a key function of Management, Executive Management and the Council. The Committee has no direct line responsibility for the Council’s performance measurement. However, the Committee has ensured, principally through the internal audit function, that the systems of performance measurement and reporting, as well as the systems of internal control that underpin the performance management framework of the Council are addressed routinely in the audit plans. The Committee also obtained assurance from management and internal audit that the Council’s performance management system adequately and effectively reports appropriate and relevant information.

One-on-One Meeting with the Accounting Authority
The Audit and Risk Committee met on three occasions with the Accounting Authority (the Council) to address unresolved issues.

Auditor-General of South Africa
The Audit and Risk Committee met on three occasions with the AGSA to ensure that there are no unresolved issues.

In Conclusion
The Committee appreciates the effort made by Management to ensure that the entity does not regress further even though it has received a qualified opinion. We also wish to highlight the increasing pressure on the Council, CEO and staff of the ARC, to ensure that going forward, the audit opinion improves, for the overall improvement of governance, accountability and service delivery.

I would further like to thank all members of the Committee for their personal and professional contributions made during the reporting year.

Vishnu Naicker
Chairperson of the ARC Audit & Risk Committee
31 July 2019
REPORT ON THE AUDIT OF THE FINANCIAL STATEMENTS

Qualified opinion

1. I have audited the financial statements of the Agricultural Research Council (ARC) set out on pages 138 to 185, which comprise the statement of financial position as at 31 March 2019, the statement of financial performance, statement of changes in net assets, cash flow statement and statement of comparison of budget and actual amounts for the year then ended, as well as the notes to the financial statements, including a summary of significant accounting policies.

2. In my opinion, except for the possible effects of the matters described in the basis for qualified opinion section of this auditor’s report, the financial statements present fairly, in all material respects, the financial position of the Agricultural Research Council (ARC) as at 31 March 2019, and its financial performance and cash flows for the year then ended in accordance with the Standards of Generally Recognised Accounting Practice (Standards of GRAP) and the requirements of the Public Finance Management Act of South Africa, 1999 (Act No. 1 of 1999) (PFMA).

Basis for qualified opinion

Property Plant and Equipment

3. I was unable to obtain sufficient appropriate audit evidence to confirm that the public entity reviewed the residual values and useful lives of property, plant and equipment in accordance with GRAP 17, Property, plant and equipment as disclosed in note 12 to the financial statements as at 31 March 2019, and its financial performance and cash flows for the year then ended in accordance with the Standards of Generally Recognised Accounting Practice (Standards of GRAP) and the requirements of the Public Finance Management Act of South Africa, 1999 (Act No. 1 of 1999) (PFMA).

4. The public entity did not correctly apply the requirements of GRAP 17, Property, plant and equipment as they did not measure assets acquired through non-exchange transactions at fair value at the date of acquisition. As a result, the acquisition price of multiple items of property, plant and equipment was incorrectly recorded resulting in an understatement of the gross carrying amount. I was unable to determine the full impact of the misstatement on the gross carrying amount and the net carrying amount of property, plant and equipment as it was impracticable to do so.

5. Furthermore, I was unable to obtain sufficient appropriate audit evidence to confirm assets under construction stated at R62 786 068 (2018: R58 433 552), as per note 12 to the financial statements as the public entity did not maintain proper accounting records. I could not confirm the assets under construction by alternative means. Consequently, I was unable to determine whether any adjustments were necessary to the assets under construction.

6. In addition, property, plant and equipment were overstated by R20 645 431 due to a combination of differences between accounting records and financial statements and transactions not recorded in the correct period.

Inventories

7. I was unable to obtain sufficient appropriate audit evidence for inventories (livestock and bearer plants) as the entity recognises all living resources as inventories, and not only the items used for research purposes, as required by GRAP 27 biological assets. The entity incorrectly applied the prescriptions of GRAP 27, GRAP 17 property, plant and equipment and GRAP 12 Inventories, to account for the living resources that are used for research purposes or non-research purposes. As a result, the inventory value contains all the livestock of the entity. The bearer plants remain unaccounted for as property plant and equipment as they were expensed. The public entity did not maintain proper accounting records of the bearer plants, and non-research livestock. I was unable to determine the full extent of the under/overstatement of inventory as it was impracticable to do so.

8. Consequently, I was unable to determine whether any adjustments were necessary to the inventories of R18 875 493, as disclosed in the statement of financial position as well as note 8, to the financial statements, the property plant.
and equipment of R1 057 701 303 as disclosed in the statement of financial position and note 12 to the annual financial statements.

9. In addition, inventories were understated by R4 399 600 due to a combination of incorrect inventory valuation and differences between inventory records and financial statements. Additionally, there was an impact on the surplus for the period and accumulated surplus.

Payables from exchange transactions

10. I was unable to obtain sufficient appropriate audit evidence for other payables as the public entity did not maintain proper accounting records. I could not confirm the other payables by alternative means. Consequently, I was unable to determine whether any adjustments were necessary to the other payables stated at R227 051 432 (2018: R211 116 730) in note 16 to the financial statements and the operating and administrative expenditure stated at R379 236 005.

11. I was unable to obtain sufficient appropriate audit evidence for payments received in advance as the public entity did not maintain proper accounting records. I could not confirm the payments received in advance by alternative means. Consequently, I was unable to determine whether any adjustments were necessary to the payments received in advance stated at R47 488 194 (2018: R41 400 705) in note 16. Consequently, I was unable to determine whether any adjustments were necessary to payables from exchange transactions, stated at R394 895 183 (2018: R371 529 103) in the statement of financial position.

12. In addition, payables from exchange transactions were understated by R6 170 425 due to a combination of differences between accounting records and financial statements and incorrect application of accounting principles.

Receivables from exchange transactions

13. I was unable to obtain sufficient appropriate audit evidence for trade debtors as the public entity did not maintain proper accounting records. I could not confirm the trade debtors by alternative means. Consequently, I was unable to determine whether any adjustments were necessary to the trade debtors, stated at R144 200 672 as disclosed in note 09 to the financial statements, and the revenue from services rendered stated at R278 156 712 (2018: R320 691 618) in the statement of financial performance.

14. I was unable to obtain sufficient appropriate audit evidence for staff debtors as the entity did not perform adequate reconciliation of outstanding debtors, resulting in errors in the amounts outstanding of the debtors recorded. I could not confirm staff debtors by alternative means. Consequently, I was unable to determine whether any adjustments were necessary to staff debtors, stated at R13 552 072 (2018: R15 964 806) of note 9 to the annual financial statements.

15. The public entity did not recognise receivables from exchange transactions, in accordance with GRAP 1, presentation of financial statements as assets and liabilities were offset inappropriately and adequate internal controls were not established for the reconciliation of control accounts used for project revenue recognition. I was unable to determine the full extent of the under/overstatement of receivables from exchange transactions and other payables as it was impracticable to do so.

16. In addition, receivables from exchange transactions were overstated by R3 995 875 due to staff debtors that are not recoverable being included in the financial statements.

Revenue from rendering of services

17. The entity incorrectly recognised revenue for rendering of services for the year. The revenue from rendering of services, did not meet the definition of revenue according to GRAP 9, Revenue from exchange transactions. In addition, revenue from rendering of services was not recorded in the correct period. This resulted in revenue from services rendered being overstated by R28 143 107. Additionally, there was an impact on surplus for the period and on the accumulated surplus.

18. I was unable to obtain sufficient appropriate audit evidence for rendering of services as the entity did not maintain adequate source documents. I could not confirm rendering of services by alternative means. Consequently, I was unable to determine whether any adjustments were necessary to rendering of services, stated at R278 156 712 in the annual financial statements. Additionally, there was a resultant impact on surplus for the period and on the accumulated surplus.

Context for the opinion

19. I conducted my audit in accordance with the International Standards on Auditing (ISAs). My responsibilities under those standards are further described in the auditor-general’s responsibilities for the audit of the financial statements section of this auditor’s report.

20. I am independent of the public entity in accordance with sections 290 and 291 of the International Ethics Standards Board for Accountants’ Code of ethics for professional accountants (IESBA code), parts 1 and 3 of the International Ethics Standards Board for Accountants’ International Code of Ethics for Professional Accountants (including International Independence Standards) and the ethical requirements
that are relevant to my audit in South Africa. I have fulfilled my other ethical responsibilities in accordance with these requirements and the IESBA codes.

21. I believe that the audit evidence I have obtained is sufficient and appropriate to provide a basis for my qualified opinion.

Material uncertainty relating to going concern/financial sustainability

22. I draw attention to the matter below. My opinion is not modified in respect of these matters.

23. I draw attention to note 6 to the financial statements, which indicates that the public entity incurred a deficit of R22 063 265 (2018: R38 065 955) during the year ended 31 March 2019 and, as of that date the public entity’s current liabilities exceeded its current assets by R138 750 408 (2018: R93 077 188), as stated in note 32. These events or conditions, along with other matters as set forth in note 32, indicate that a material uncertainty exists that may cast significant doubt on the public entity’s financial sustainability.

Emphasis of matter

24. I draw attention to the matter below. My opinion is not modified in respect of these matters.

Material impairments – trade debtors

25. As disclosed in note 9 to the financial statements, material impairments of R75 045 024 (2018: R39 459 340) were incurred as a result of long-outstanding debtor’s balances.

Restatement of corresponding figures

26. As disclosed in note 30 to the financial statements, the corresponding figures for 31 March 2018 were restated as a result of an error in the financial statements of the entity at, and for the year ended, 31 March 2018.

Responsibilities of the accounting authority for the financial statements

27. The accounting authority is responsible for the preparation and fair presentation of the financial statements in accordance with the South African Standards of Standards of GRAP and the requirements of the PFMA, and for such internal control as the accounting authority determines is necessary to enable the preparation of financial statements that are free from material misstatement, whether due to fraud or error.

28. In preparing the financial statements, the accounting authority is responsible for assessing the ARC’s ability to continue as a going concern, disclosing, as applicable, matters relating to going concern and using the going concern basis of accounting unless the appropriate governance structure either intends to liquidate the public entity or to cease operations, or has no realistic alternative but to do so.

Auditor-general’s responsibilities for the audit of the financial statements

29. My objectives are to obtain reasonable assurance about whether the financial statements as a whole are free from material misstatement, whether due to fraud or error, and to issue an auditor’s report that includes my opinion. Reasonable assurance is a high level of assurance, but is not a guarantee that an audit conducted in accordance with the ISAs will always detect a material misstatement when it exists. Misstatements can arise from fraud or error and are considered material if, individually or in aggregate, they could reasonably be expected to influence the economic decisions of users taken on the basis of these financial statements.

30. A further description of my responsibilities for the audit of the financial statements is included in the annexure to this auditor’s report.

REPORT ON THE AUDIT OF THE ANNUAL PERFORMANCE REPORT

Introduction and scope

31. In accordance with the Public Audit Act of South Africa, 2004 (Act No. 25 of 2004) (PAA) and the general notice issued in terms thereof, I have a responsibility to report material findings on the reported performance information against predetermined objectives for selected programmes presented in the annual performance report. I performed procedures to identify findings but not to gather evidence to express assurance.

32. My procedures address the reported performance information, which must be based on the approved performance planning documents of the public entity. I have not evaluated the completeness and appropriateness of the performance indicators/measures included in the planning documents. My procedures also did not extend to any disclosures or assertions relating to planned performance strategies and information in respect of future periods that may be included as part of the reported performance information. Accordingly, my findings do not extend to these matters.

33. I evaluated the usefulness and reliability of the reported performance information in accordance with the criteria developed from the performance management and reporting framework, as defined in the general notice, for the following
selected programmes presented in the annual performance report of the public entity for the year ended 31 March 2019:

<table>
<thead>
<tr>
<th>Programmes</th>
<th>Pages in the annual performance report</th>
</tr>
</thead>
<tbody>
<tr>
<td>Programme 1 - crop production, improvement and protection</td>
<td>186</td>
</tr>
<tr>
<td>Programme 2 - animal health, production and improvement</td>
<td>186</td>
</tr>
<tr>
<td>Programme 3 - natural resources management</td>
<td>187</td>
</tr>
<tr>
<td>Programme 5 – agro-processing, food technology and safety</td>
<td>187</td>
</tr>
<tr>
<td>Programme 6 – smallholder agricultural development</td>
<td>188</td>
</tr>
</tbody>
</table>

34. I performed procedures to determine whether the reported performance information was properly presented and whether performance was consistent with the approved performance planning documents. I performed further procedures to determine whether the indicators and related targets were measurable and relevant, and assessed the reliability of the reported performance information to determine whether it was valid, accurate and complete.

35. I did not raise any material findings on the usefulness and reliability of the reported performance information for the following programmes:

- Programme 1 - crop production, improvement and protection
- Programme 2 - animal health, production and improvement
- Programme 3 - natural resources management
- Programme 5 – agro-processing, food technology and safety
- Programme 6 – smallholder agricultural development

Other matters

36. I draw attention to the matters below.

Achievement of planned targets

37. Refer to the annual performance report on pages 186 to 189 for information on the achievement of planned targets for the year and explanations provided for the under/over achievement of a number of targets.

REPORT ON THE AUDIT OF COMPLIANCE WITH LEGISLATION

Introduction and scope

38. In accordance with the PAA and the general notice issued in terms thereof, I have a responsibility to report material findings on the compliance of the public entity with specific matters in key legislation. I performed procedures to identify findings but not to gather evidence to express assurance.

39. The material findings on compliance with specific matters in key legislations are as follows:

Annual financial statements

40. The financial statements submitted for auditing were not prepared in accordance with the prescribed financial reporting framework and supported by full and proper records, as required by sections 55(1)(a) and (b) of the PFMA. Material misstatements identified by the auditors in the submitted financial statements were not adequately corrected and the supporting records could not be provided subsequently, which resulted in the financial statements receiving a qualified opinion.

Expenditure management

41. Effective and appropriate steps were not taken to prevent irregular expenditure, as required by section 51(1)(b)(ii) of the PFMA. Irregular expenditure of R2 500 023 was incurred during the year.

42. Contributions received by the public entity, as disclosed in note 19 to the financial statements, was not spent in accordance with the conditions imposed by the contributor concerned, as required by section 20(2)(c) of the Agricultural Research Act.

Revenue management

43. Effective and appropriate steps were not taken to collect all revenue due, as required by section 51(1)(b)(i) of the PFMA. Management had embarked on a project to collect all monies due to the entity and have circulated notices of debt to some of the entity debtors, however that has not been effective.
OTHER INFORMATION

44. The accounting authority is responsible for the other information. The other information comprises the information included in the annual report which includes the following sections as per the table of contents: The Agricultural Research Council leadership, ARC board members, orga-ogram, chairperson’s overview, ARC executive management, message from the president and chief executive officer of ARC, executive report, chief financial officer’s review, strategic goals and organisational achievements, overview and highlights of crop sciences, overview and highlights of the animal sciences, overview and highlights of human resources and legal services, information communication technology and infrastructure, knowledge dissemination, corporate governance and report on governance. The other information does not include the financial statements, the auditor’s report and those selected programmes presented in the annual performance report that have been specifically reported on in this auditor’s report.

45. My opinion on the financial statements and findings on the reported performance information and compliance with legislation do not cover the other information and I do not express an audit opinion or any form of assurance conclusion thereon.

46. In connection with my audit, my responsibility is to read the other information and, in doing so, consider whether the other information is materially inconsistent with the financial statements and the selected objectives presented in the annual performance report, or my knowledge obtained in the audit, or otherwise appears to be materially misstated.

47. I did not receive the other information prior to the date of this auditor’s report. When I do receive and read this information, and if I conclude that there is a material misstatement therein, I am required to communicate the matter to those charged with governance and request that the other information be corrected. If the other information is not corrected, I may have to retract this auditor’s report and re-issue an amended report as appropriate. However, if it is corrected this will not be necessary.

INTERNAL CONTROL DEFICIENCIES

48. I considered internal control relevant to my audit of the financial statements, reported performance information and compliance with applicable legislation; however, my objective was not to express any form of assurance on it. The matters reported below are limited to the significant internal control deficiencies that resulted in the basis for the qualified opinion and the findings on compliance with legislation included in this report.

49. The public entity did not have sufficient monitoring controls to ensure adherence to the internal policies and procedures at an organisation-wide level for taking corrective action. A large number of policies and procedures were approved in the final quarter of the year; however, they were not fully implemented. This resulted in inconsistent reporting and inadequate record keeping.

50. The entity did not formulate and implement adequate record management policies and procedures to ensure that all supporting documentation is properly co-ordinated, readily available, and easily accessible to facilitate timely retrieval on request.

51. Although the entity has documented policies and procedures to guide its operations to support the understanding and execution of internal control objectives, processes and areas of responsibility, instances of non-compliance with the policies and procedures were identified. These deficiencies resulted in multiple repeat findings on assets, revenue, payables, receivables and non-compliance with legislation, as well as a limitation on documents received for audit purposes. This was mainly as a result of insufficient monitoring controls.

52. Adequate daily and monthly financial processing and reconciliations did not always take place, for staff advances, assets, the general ledger and subsidiary ledger on inventory and trade payables, as well as the opening and closing balances on the leave accrual and multiple uncleared control accounts. Where reconciliations were prepared, reconciling items were not resolved timely and review measures were not adequate to detect this.

53. Compliance monitoring controls implemented by the public entity were not adequate to prevent material non-compliance with key legislation.
1. As part of an audit in accordance with the ISAs, I exercise professional judgement and maintain professional scepticism throughout my audit of the financial statements, and the procedures performed on reported performance information for selected programmes and on the public entity’s compliance with respect to the selected subject matters.

2. In addition to my responsibility for the audit of the financial statements as described in this auditor’s report, I also:

- identify and assess the risks of material misstatement of the financial statements whether due to fraud or error, design and perform audit procedures responsive to those risks, and obtain audit evidence that is sufficient and appropriate to provide a basis for my opinion. The risk of not detecting a material misstatement resulting from fraud is higher than for one resulting from error, as fraud may involve collusion, forgery, intentional omissions, misrepresentations, or the override of internal control;

- obtain an understanding of internal control relevant to the audit in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the public entity’s internal control;

- evaluate the appropriateness of accounting policies used and the reasonableness of accounting estimates and related disclosures made by the accounting authority;

- conclude on the appropriateness of the accounting authority’s use of the going concern basis of accounting in the preparation of the financial statements. I also conclude, based on the audit evidence obtained, whether a material uncertainty exists related to events or conditions that may cast significant doubt on the ARC’s ability to continue as a going concern. If I conclude that a material uncertainty exists, I am required to draw attention in my auditor’s report to the related disclosures in the financial statements about the material uncertainty or, if such disclosures are inadequate, to modify the opinion on the financial statements. My conclusions are based on the information available to me at the date of this auditor’s report. However, future events or conditions may cause a public entity to cease continuing as a going concern;

- evaluate the overall presentation, structure and content of the financial statements, including the disclosures, and whether the financial statements represent the underlying transactions and events in a manner that achieves fair presentation.

3. I communicate with the accounting authority regarding, among other matters, the planned scope and timing of the audit and significant audit findings, including any significant deficiencies in internal control that I identify during my audit.

4. I also confirm to the accounting authority that I have complied with relevant ethical requirements regarding independence, and communicate all relationships and other matters that may reasonably be thought to have a bearing on my independence and, where applicable, related safeguards.
GENERAL INFORMATION

Country of incorporation and domicile  South Africa
Nature of business and principal activities  Conduct research, develop technology, and to transfer technology that promotes agriculture and industry.
Registered office  1134 Park Street
                    Hatfield
                    0083
Business address  1134 Park Street
                    Hatfield
                    0083
Postal address  P O Box 8783
                    Pretoria
                    0001
Controlling entity  Department of Agriculture, Forestry and Fisheries
Economic entity  Department of Agriculture, Forestry and Fisheries
Bankers  Standard Bank of South Africa
Auditors  Auditor General of South Africa
Company secretary  Ayanda Ndamase
Published  31 July 2019

INDEX

The reports and statements set out below comprise the annual financial statements presented to the parliament:

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<td>160-185</td>
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</tbody>
</table>
The Accounting Authority (Council) is required by the Public Finance Management Act (Act 1 of 1999) and the Agricultural Research Act No. 86 of 1990 as amended, to maintain adequate accounting records and are responsible for the content and integrity of the annual financial statements and related financial information included in this report. It is the responsibility of the Council to ensure that the Annual Financial Statements fairly present the state of affairs of the entity as at the end of the financial year and the results of its operations and cash flows for the period then ended. The external auditors were engaged to express an independent opinion on the annual financial statements and were given unrestricted access to all financial records and related data.

The annual financial statements have been prepared in accordance with Standards of Generally Recognised Accounting Practice (GRAP) including any interpretations, guidelines and directives issued by the Accounting Standards Board.

The annual financial statements are based upon appropriate accounting policies consistently applied and supported by reasonable and prudent judgements and estimates.

The Council acknowledge that they are ultimately responsible for the system of internal financial control established by the entity and place considerable importance on maintaining a strong control environment. To enable the Council to meet these responsibilities, the accounting authority sets standards for internal control aimed at reducing the risk of error or deficit in a cost effective manner. The standards include the proper delegation of responsibilities within a clearly defined framework, effective accounting procedures and adequate segregation of duties to ensure an acceptable level of risk. These controls are monitored throughout the ARC and all employees are required to maintain the highest ethical standards in ensuring the entity’s business is conducted in a manner that in all reasonable circumstances is above reproach. The focus of risk management in the entity is on identifying, assessing, managing and monitoring all known forms of risk across the entity. While operating risk cannot be fully eliminated, the entity endeavours to minimise it by ensuring that appropriate infrastructure, controls, systems and ethical behaviour are applied and managed within predetermined procedures and constraints.

The council are of the opinion, based on the information and explanations given by management, that the system of internal control provides reasonable assurance that the financial records may be relied on for the preparation of the annual financial statements. However, any system of internal financial control can provide only reasonable, and not absolute, assurance against material misstatement or deficit.

The Council have reviewed the entity’s cash flow forecast for the year to 31 March 2020 and, in the light of this review and the current financial position, they are satisfied that the entity has or has access to adequate resources to continue in operational existence for the foreseeable future.

We draw your attention to the fact that the net deficit of the entity was R22 million (2018: deficit R38 million).

The ARC’s financial statements are prepared based on the going concern assumption. This assumption presumes that funds will be available to finance future operations and that the realisation of assets and settlement of liabilities, contingent obligations and commitments will occur in the ordinary course of business.

The following position at year end has raised substantial doubt around continued use of the going concern assumption in reporting the entity’s results:

- The ARC’s current liabilities of R403 million exceed current assets by R139 million. This is in spite of the organisation having cash reserves of R76 million;
- The ARC has cash commitments (represented by both current and noncurrent liabilities) of R543 million versus cash and cash/near cash equivalents (represented by cash balances and trade accounts receivables) of R245 million. This represents a cash shortfall of R298 million as at 31 March 2019;
- The recovery of long outstanding debtors with significant amounts, mainly government departments, presented difficulty for the ARC and this strained the organisation’s working capital. To this end, the Department of Agriculture, Forestry and Fisheries (DAFF)’s long outstanding debtors balance remained at R81 million however the organisation is pleased with the R25 million received subsequent to year-end;
- During the MTEF period ending 31 March 2018, the ARC Parliamentary Grant was reduced by R246 million; which was inclusive of the grant allocation from the Department of Science and Technology (DST) for the maintenance and operation of national genebanks (National Public Good Assets), being reduced by R60 million. These Parliamentary grant (“PG”) funding cuts from the Department of Agriculture, Forestry and Fisheries (“DAFF”) have contributed to the deficit that the ARC has experienced over the last three financial periods. This situation has led to the ARC utilising funds that were meant to be
ring-fenced in an effort to maintain operations. This act, which was a desperate measure aimed at survival of the ARC, was against the PFMA and has led to the Irregular Expenditure arising from over expenditure.

- Although the ARC reduced expenditure through various cost containment measures, difficult economic conditions resulted in some fixed costs increasing above budget inflation rates. These costs include electricity, municipal services and security that could not be contained sufficiently. Although overall the ARC’s cash expenditure was within the approved budget, the financial performance still resulted in a deficit (which is not sustainable over time) and the organisation did not manage to secure a favourable response from National Treasury for incurring such deficit.

In the event that the going concern assumption was not used, the annual financial statements would have to be prepared on a liquidation basis. This assumes cessation of operations, which could lead to a firesale of assets, or material scale down in operations.

In spite of the dire situation presented by the challenges above, the following are considered mitigating factors:

- Financial performance: 2018/19

The financial performance of the ARC in the 2018/19 financial year was a deficit of R22 million against prior year deficit of R38 million. This is evident of management’s effort to contain costs and generate as much external income as possible.

Under the circumstances, the ARC’s efforts to manage working capital resulted in improvement of the cash balance of R76 million at year end. This unfortunately could only be achieved through stretching our supplier payment terms beyond those contracted towards the end of a financial year, which has all been subsequently settled.

Operationally as well, the ARC continued to show excellence in research, technology development and transfer through achievement in the year of planned targets within its programmes. This bodes well for the ARC’s ability to secure external funding.

- Approved 3-year plan (2019/20 to 2021/22)

As communicated through the MTEF allocation, the ARC’s 3 year plan has been approved by the government. This budget indicates PGs of R1.09 billion, R1.15 billion and R1.20 billion in the 2019/20; 2020/21 and 2021/22 financial years respectively. These amounts include both grant allocations to be transferred from DAFF’s and the Department of Science and Technology. These PGs, together with planned external income, are sufficient to sustain the operations of the ARC over the planned period.

A letter of allocation from the DAFF pledging the above support provides evidence to the effect that there is no intention by the ARC’s shareholder (as represented by Minister for Agriculture, Forestry and Fisheries on behalf of the Government of South Africa) neither to cease its operations nor curtail the scale of its operation materially.

Further discussions with stakeholders and financial partners are planned for later this year. These are meant not only to deal with government/external funding but to explore partnerships that may lead to possible revenue generating initiatives as well.

- Strategic importance of the ARC

The ARC is a juristic person that was established by the Agricultural Research Act (“Act”). The objects of the organization are spelt out in the Act and these include conducting “research, development and technology transfer, to promote agriculture and industry and thereby to contribute to the improvement of the quality of life of the people of the Republic, and having regard to the protection of the environment to perform such other functions as me be assigned to the ARC by or under this Act”.

The ARC is a strategic state entity, the importance of which includes the development and delivery of scientific solutions and technologies for national biosecurity aimed at prevention and management of plant and animal diseases that could damage not only the agricultural sector but the South African economy, including effective management of public health (preventing zoonotic diseases). In addition, the ARC’s scientific solutions and technologies contribute towards the attainment of agricultural yields.

The ARC remains committed to exploring opportunities for increasing external income that has grown to average R413 million over the last four years. Similar focus continues to be placed on the management of expenses to ensure that the organisation is sustainable. Management has developed and submitted A Sustainability and Financial Turnaround plan has since been considered by the Accounting Authority. Such plan was subsequently submitted to the Executive Authority, for approval, which is aimed at addressing the following funding challenges of the ARC:

- Reliance on declining Parliamentary Grant
- The lack of growth in external income over the same period has resulted in heavy reliance on PG.
- Co-funding arrangements - Most of the co-funding arrangements within the ARC require the ARC’s commitment of a matching amount of PG. The cuts in PG allocations deprive the ARC of the opportunity to leverage this kind of funding going forward. Nevertheless, co-funding arrangements could be explored by the ARC where the scientific solution is near commercialization for income generation.
• Non profit “brand” The fact that the ARC is a not for profit organisation has resulted in a culture of heavy reliance on PG funding at the expense of exploring alternative funding opportunities. Through historical practice, the cohort of researchers within the ARC are not accustomed to innovative and aggressive pursuit of fundraising in competitive milieu. Accordingly, the ARC needs to build capabilities for competitive and innovative pursuit of competitive external funding, including through delivering excellent scientific solutions and technologies.

• ARC’s existing partnerships (farmers, primarily agriculture commodity organizations, trusts and private sector) and stakeholder perceptions have not contributed much to the financial wellbeing of the public entity as some of these partnerships end up being subsidised by the ARC. The quality of these partnerships has not been a focal area of the ARC over the years. Therefore, the ARC has through its turnaround plan, reviewed the form of relationships towards sustainable management of resources while also delivering scientific excellence.

• Reliance on traditional external funders - The ARC has experienced a decline in funding from its traditional funders. This is partly due to the prevailing economic conditions that are affecting the traditional funders but also from the lack of initiatives to explore the new funding sources over an extended period of time. Insufficient high-profile scientists with the ability to do the kind of leading research work that attracts funding and external support. This in turn affects the ability to attract significant new and or to roll over external funds.

• Lack of commercial acumen in our service areas. The ARC has potential for generating increased revenue through its intellectual assets (IP), is well structured and positioned with the infrastructure that it has build up over the generations to support its wide range of service offerings. Currently the individual and multi purpose institutes that host the service laboratories are not self funding and are primarily subsidised by PG. The ARC as a primary delivery of Research and Development is geared towards these type of skill sets and knowledge development, with most scientists not stimulated or focused on the generation of capital or the commercial aspects of research delivery. The organisation as a result lacks the capacity and tools necessary to immediately be commercialised unless it undergoes significant re engineering to adopt a commercial approach in providing such services. A challenge to illustrate this fact is that the revenue received from royalties is fairly low compared to the amount of registered IP within the ARC.

The ARC has continued to engage with its key stakeholders which include DAFF, DST, National Treasury and Commodity organizations with a view to explore further options to pursue towards achieving the desired sustainability and financial turnaround.

The ARC is of the view that the above factors alleviate substantial doubt relating to the going concern assumption. On this basis, management accordingly considers that preparing the ARC’s financial statements based on the going concern assertion is still appropriate.

The Council and Executive Management emoluments for the period under review are disclosed in note 29.

The external auditors are responsible for independently reviewing and reporting on the entity annual financial statements. The annual financial statements have been examined by the entity’s external auditors and their report is presented on page 127.

The Annual Financial Statements set out on pages 138 to 185, which have been prepared on the going concern basis, were approved by the accounting authority on 31 July 2019 and were signed on its behalf by:

Prof S Vil-Nkomo
Chairperson of the ARC Council

Dr SR Moephuli
President and CEO
# Statement of Financial Performance

<table>
<thead>
<tr>
<th>Figures in Rand</th>
<th>Note(s)</th>
<th>2019</th>
<th>2018 Restated*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Revenue</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Revenue from exchange transactions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sale of goods in agricultural activities</td>
<td></td>
<td>20 173 801</td>
<td>28 023 199</td>
</tr>
<tr>
<td>Rendering of services</td>
<td></td>
<td>278 156 712</td>
<td>320 691 618</td>
</tr>
<tr>
<td>Royalty income</td>
<td></td>
<td>33 697 316</td>
<td>16 606 185</td>
</tr>
<tr>
<td>Rental of facilities and equipment</td>
<td></td>
<td>22 589 348</td>
<td>19 733 321</td>
</tr>
<tr>
<td>Other income</td>
<td></td>
<td>22 717 399</td>
<td>23 212 290</td>
</tr>
<tr>
<td>Interest received</td>
<td>4</td>
<td>7 218 048</td>
<td>3 968 110</td>
</tr>
<tr>
<td>Dividends received</td>
<td>4</td>
<td>703 193</td>
<td>268 692</td>
</tr>
<tr>
<td><strong>Total revenue from exchange transactions</strong></td>
<td>3</td>
<td><strong>385 255 817</strong></td>
<td><strong>412 723 615</strong></td>
</tr>
<tr>
<td>Revenue from non-exchange transactions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Transfer revenue</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Government grants</td>
<td>5</td>
<td>929 050 029</td>
<td>695 466 669</td>
</tr>
<tr>
<td><strong>Total revenue</strong></td>
<td>3</td>
<td><strong>1 314 305 846</strong></td>
<td><strong>1 308 220 284</strong></td>
</tr>
<tr>
<td><strong>Expenditure</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employee related costs</td>
<td>21</td>
<td>(820 446 617)</td>
<td>(805 577 985)</td>
</tr>
<tr>
<td>Depreciation and amortisation</td>
<td>12 &amp; 13</td>
<td>(43 627 580)</td>
<td>(44 978 909)</td>
</tr>
<tr>
<td>Impairment loss/ Reversal of impairments</td>
<td></td>
<td>(43 095 349)</td>
<td>(21 374 457)</td>
</tr>
<tr>
<td>Finance costs</td>
<td></td>
<td>(93 982)</td>
<td>(82 596)</td>
</tr>
<tr>
<td>Lease rentals on operating lease</td>
<td>6</td>
<td>(23 526 976)</td>
<td>(21 143 340)</td>
</tr>
<tr>
<td>Operating and administrative expenses</td>
<td>7</td>
<td>(379 236 005)</td>
<td>(422 087 687)</td>
</tr>
<tr>
<td>* See Note 30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Repairs and maintenance</td>
<td></td>
<td>(26 901 667)</td>
<td>(29 041 743)</td>
</tr>
<tr>
<td><strong>Total expenditure</strong></td>
<td></td>
<td>(1 330 928 278)</td>
<td>(1 344 220 717)</td>
</tr>
<tr>
<td><strong>Operating deficit</strong></td>
<td></td>
<td>(22 622 432)</td>
<td>(36 066 433)</td>
</tr>
<tr>
<td><em>(Loss) / gain on disposal of assets</em></td>
<td></td>
<td>401 120</td>
<td>(149 913)</td>
</tr>
<tr>
<td><em>(Loss) / gain on foreign exchange</em></td>
<td></td>
<td>439 904</td>
<td>(181 718)</td>
</tr>
<tr>
<td>Fair value adjustment on other financial assets at fair value</td>
<td></td>
<td>(746 577)</td>
<td>7 656</td>
</tr>
<tr>
<td>Actuarial gains/(losses)</td>
<td>18</td>
<td>464 820</td>
<td>(1 675 547)</td>
</tr>
<tr>
<td><strong>Deficit for the year</strong></td>
<td></td>
<td>559 167</td>
<td>(1 999 522)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(22 063 265)</td>
<td>(38 065 955)</td>
</tr>
</tbody>
</table>
# Statement of Financial Position as at 31 March 2019

<table>
<thead>
<tr>
<th>Figures in Rand</th>
<th>Note(s)</th>
<th>2019</th>
<th>2018 (Restated)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Assets</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Current Assets</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inventories</td>
<td>8</td>
<td>18 875 493</td>
<td>19 722 574</td>
</tr>
<tr>
<td>Receivables from exchange transactions</td>
<td>9</td>
<td>159 161 737</td>
<td>199 947 739</td>
</tr>
<tr>
<td>Cash and cash equivalents</td>
<td>10</td>
<td>76 348 179</td>
<td>58 303 483</td>
</tr>
<tr>
<td><strong>Total Current Assets</strong></td>
<td></td>
<td><strong>264 405 409</strong></td>
<td><strong>287 973 796</strong></td>
</tr>
<tr>
<td><strong>Non-Current Assets</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Investment property</td>
<td>11</td>
<td>98 648</td>
<td>98 648</td>
</tr>
<tr>
<td>Property, plant and equipment</td>
<td>12</td>
<td>1 057 701 303</td>
<td>1 029 659 972</td>
</tr>
<tr>
<td>Intangible assets</td>
<td>13</td>
<td>22 706 138</td>
<td>28 957 614</td>
</tr>
<tr>
<td>Heritage assets</td>
<td>14</td>
<td>223 167</td>
<td>223 157</td>
</tr>
<tr>
<td>Other financial assets</td>
<td>15</td>
<td>4 982 778</td>
<td>5 224 107</td>
</tr>
<tr>
<td><strong>Total Non-Current Assets</strong></td>
<td></td>
<td><strong>1 085 801 034</strong></td>
<td><strong>1 064 163 506</strong></td>
</tr>
<tr>
<td><strong>Total Assets</strong></td>
<td></td>
<td><strong>1 350 206 443</strong></td>
<td><strong>1 352 137 304</strong></td>
</tr>
<tr>
<td><strong>Liabilities</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Current Liabilities</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating lease liability</td>
<td></td>
<td>-</td>
<td>51 079</td>
</tr>
<tr>
<td>Payables from exchange transactions</td>
<td>16</td>
<td>394 895 133</td>
<td>371 529 103</td>
</tr>
<tr>
<td>* See Note 30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VAT payable</td>
<td></td>
<td>8 170 165</td>
<td>9 470 802</td>
</tr>
<tr>
<td>Provisions</td>
<td>17</td>
<td>90 469</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total Current Liabilities</strong></td>
<td></td>
<td><strong>403 155 817</strong></td>
<td><strong>381 050 984</strong></td>
</tr>
<tr>
<td><strong>Non-Current Liabilities</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employee benefit obligation</td>
<td>18</td>
<td>13 491 000</td>
<td>15 387 000</td>
</tr>
<tr>
<td>Unspent conditional grants and receipts</td>
<td>19</td>
<td>126 154 331</td>
<td>126 754 807</td>
</tr>
<tr>
<td><strong>Total Non-Current Liabilities</strong></td>
<td></td>
<td><strong>139 645 331</strong></td>
<td><strong>142 141 807</strong></td>
</tr>
<tr>
<td><strong>Total Liabilities</strong></td>
<td></td>
<td><strong>542 801 148</strong></td>
<td><strong>523 192 791</strong></td>
</tr>
<tr>
<td><strong>Net Assets</strong></td>
<td></td>
<td><strong>807 405 295</strong></td>
<td><strong>828 944 513</strong></td>
</tr>
<tr>
<td>Capital funds</td>
<td>20</td>
<td>111 966 013</td>
<td>111 966 013</td>
</tr>
<tr>
<td>Insurance reserve</td>
<td></td>
<td>3 043 478</td>
<td>3 043 478</td>
</tr>
<tr>
<td>Accumulated surplus</td>
<td></td>
<td>692 375 804</td>
<td>713 915 022</td>
</tr>
<tr>
<td><strong>Total Net Assets</strong></td>
<td></td>
<td><strong>807 405 295</strong></td>
<td><strong>826 944 513</strong></td>
</tr>
</tbody>
</table>

* See Note 30
### Statement of Changes in Net Assets

<table>
<thead>
<tr>
<th>Figures in Rand</th>
<th>Capital fund</th>
<th>Insurance reserve</th>
<th>Accumulated surplus</th>
<th>Total net assets</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Balance at 01 April 2017</strong></td>
<td>111 986 013</td>
<td>2 393 323</td>
<td>751 980 977</td>
<td>866 360 313</td>
</tr>
<tr>
<td>Deficit for the year</td>
<td>-</td>
<td>-</td>
<td>(38 065 055)</td>
<td>(38 065 055)</td>
</tr>
<tr>
<td>Decrease in reserves</td>
<td>-</td>
<td>650 155</td>
<td>-</td>
<td>650 155</td>
</tr>
<tr>
<td><strong>Total changes</strong></td>
<td>-</td>
<td>650 155</td>
<td>(38 065 055)</td>
<td>(37 415 800)</td>
</tr>
<tr>
<td>Opening balance as previously reported</td>
<td>111 986 013</td>
<td>3 043 475</td>
<td>688 968 527</td>
<td>803 998 018</td>
</tr>
<tr>
<td>Prior period error (Note 29)</td>
<td>-</td>
<td>-</td>
<td>24 946 494</td>
<td>24 946 494</td>
</tr>
<tr>
<td><strong>Restated</strong> Balance at 01 April 2018 as restated</td>
<td>111 986 013</td>
<td>3 043 475</td>
<td>713 915 021</td>
<td>828 944 512</td>
</tr>
<tr>
<td>Changes in net assets</td>
<td>-</td>
<td>-</td>
<td>(22 063 265)</td>
<td>(22 063 265)</td>
</tr>
<tr>
<td>Deficit for the year</td>
<td>-</td>
<td>-</td>
<td>(2 644 015)</td>
<td>(2 644 015)</td>
</tr>
<tr>
<td>Decrease in reserves</td>
<td>-</td>
<td>2 644 015</td>
<td>(2 644 015)</td>
<td>-</td>
</tr>
<tr>
<td>Transfer from retained earnings</td>
<td>-</td>
<td>-</td>
<td>3 168 063</td>
<td>3 168 063</td>
</tr>
<tr>
<td>Gains (losses) from mergers or transfer of functions between entities under common control (Note 25)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total changes</strong></td>
<td>-</td>
<td>-</td>
<td>(21 539 217)</td>
<td>(21 539 217)</td>
</tr>
<tr>
<td><strong>Balance at 31 March 2019</strong></td>
<td>111 986 013</td>
<td>3 043 475</td>
<td>692 375 804</td>
<td>807 405 295</td>
</tr>
</tbody>
</table>

* See Note 30
# Cash Flow Statement

<table>
<thead>
<tr>
<th>Figures in Rand</th>
<th>Note(s)</th>
<th>2019</th>
<th>2018 Restated*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cash flows from operating activities</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Receipts</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sale of goods and services</td>
<td></td>
<td>367 004 905</td>
<td>367 350 555</td>
</tr>
<tr>
<td>Grants</td>
<td></td>
<td>928 449 553</td>
<td>881 213 163</td>
</tr>
<tr>
<td>Interest income</td>
<td></td>
<td>7 218 048</td>
<td>3 968 110</td>
</tr>
<tr>
<td>Dividends received</td>
<td></td>
<td>197 845</td>
<td>309 014</td>
</tr>
<tr>
<td><strong>Total Receipts</strong></td>
<td></td>
<td>1 302 870 351</td>
<td>1 272 840 842</td>
</tr>
<tr>
<td><strong>Payments</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employee costs</td>
<td></td>
<td>(806 343 568)</td>
<td>(799 880 947)</td>
</tr>
<tr>
<td>Suppliers</td>
<td></td>
<td>(424 154 439)</td>
<td>(428 462 831)</td>
</tr>
<tr>
<td>Finance costs</td>
<td></td>
<td>(93 682)</td>
<td>(82 595)</td>
</tr>
<tr>
<td><strong>Total Payments</strong></td>
<td></td>
<td>(1 230 591 996)</td>
<td>(1 228 428 374)</td>
</tr>
<tr>
<td><strong>Net cash flows from operating activities</strong></td>
<td>23</td>
<td>72 278 362</td>
<td>44 414 466</td>
</tr>
<tr>
<td><strong>Cash flows from investing activities</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Purchase of property, plant and equipment</td>
<td>12</td>
<td>(65 114 275)</td>
<td>(73 467 805)</td>
</tr>
<tr>
<td>Proceeds from sale of property, plant and equipment</td>
<td>12</td>
<td>732 826</td>
<td>449 303</td>
</tr>
<tr>
<td>Purchase of other Intangible assets</td>
<td>13</td>
<td>(883 055)</td>
<td>(400 741)</td>
</tr>
<tr>
<td>Transfer of functions between entities under common control</td>
<td>26</td>
<td>1 041 940</td>
<td>-</td>
</tr>
<tr>
<td>Proceeds from sale of financial assets</td>
<td></td>
<td></td>
<td>1 040</td>
</tr>
<tr>
<td><strong>Net cash flows used in investing activities</strong></td>
<td></td>
<td>(64 233 666)</td>
<td>(73 483 597)</td>
</tr>
<tr>
<td><strong>Net increase/(decrease) in cash and cash equivalents</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cash and equivalents at the beginning of the year</td>
<td></td>
<td>68 303 483</td>
<td>67 372 612</td>
</tr>
<tr>
<td><strong>Cash and cash equivalents at the end of the year</strong></td>
<td>10</td>
<td>76 348 179</td>
<td>68 303 483</td>
</tr>
</tbody>
</table>

* See Note 30
### Statement of Comparison of Budget and Actual Amounts

#### Budget on Accrual Basis

<table>
<thead>
<tr>
<th>Figures in Rand</th>
<th>Approved budget</th>
<th>Adjustments</th>
<th>Final Budget</th>
<th>Actual amounts on comparable basis</th>
<th>Difference between final budget and actual</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Revenue</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sale of goods in agricultural activities</td>
<td>30 799 878</td>
<td>-</td>
<td>30 799 878</td>
<td>20 173 801</td>
<td>(10 626 077)</td>
<td>#1</td>
</tr>
<tr>
<td>Rendering of services</td>
<td>410 330 367</td>
<td>-</td>
<td>410 330 367</td>
<td>278 156 712</td>
<td>(132 173 655)</td>
<td>#2</td>
</tr>
<tr>
<td>Royalty income</td>
<td>17 819 747</td>
<td>-</td>
<td>17 819 747</td>
<td>33 697 316</td>
<td>15 877 569</td>
<td>#3</td>
</tr>
<tr>
<td>Rental of facilities and equipment</td>
<td>19 754 218</td>
<td>-</td>
<td>19 754 218</td>
<td>22 569 348</td>
<td>2 815 130</td>
<td>#4</td>
</tr>
<tr>
<td>Other income</td>
<td>4 957 790</td>
<td>-</td>
<td>4 957 790</td>
<td>22 717 399</td>
<td>17 759 609</td>
<td>#5</td>
</tr>
<tr>
<td>Interest received</td>
<td>5 100 000</td>
<td>-</td>
<td>5 100 000</td>
<td>7 218 048</td>
<td>2 118 048</td>
<td>#6</td>
</tr>
<tr>
<td>Dividends received</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>703 193</td>
<td>703 193</td>
<td>#7</td>
</tr>
<tr>
<td><strong>Total revenue from exchange transactions</strong></td>
<td>488 762 000</td>
<td>-</td>
<td>488 762 000</td>
<td>385 255 817</td>
<td>(103 506 163)</td>
<td></td>
</tr>
</tbody>
</table>

| **Revenue from non-exchange transactions** |                 |             |              |                                   |                                          |           |
| Transfer revenue |                 |             |              |                                   |                                          |           |
| Government grants | 932 113 000 | - | 932 113 000 | 929 050 029 | (3 062 971) | #8 |
| **Total revenue** | 1 420 875 000 | - | 1 420 875 000 | 1 314 305 846 | (106 569 154) |           |

| **Expenditure** |                 |             |              |                                   |                                          |           |
| Personnel | (867 300 800) | - | (867 300 800) | (820 446 617) | 46 854 183 | #9 |
| Depreciation and amortisation | (45 566 200) | - | (45 566 200) | (43 627 680) | 1 938 520 | #10 |
| Impairment loss/Reversal of impairments | (342 341) | - | (342 341) | (43 095 349) | (42 753 008) | #11 |
| Finance costs | (12 000) | - | (12 000) | (9 382) | (9 162) | #12 |
| Lease rentals on operating lease | (23 638 835) | - | (23 638 835) | (23 526 878) | 111 957 |           |
| Repairs and maintenance | (33 093 451) | - | (33 093 451) | (26 901 667) | 6 191 784 | #13 |
| Operating and administrative expenses | (450 921 373) | - | (450 921 373) | (379 236 053) | 71 685 368 |           |
| **Total expenditure** | 1 420 875 000 | - | 1 420 875 000 | (1 336 928 278) | 83 946 722 |           |

| Operating deficit | - | - | - | (22 622 432) | (22 622 432) |           |
| Gain on disposal of assets and liabilities | - | - | - | 401 120 | 401 120 |           |
| Gain on foreign exchange | - | - | - | 439 904 | 439 904 |           |
| Fair value adjustments | - | - | - | (746 677) | (746 677) |           |
| Actuarial gains/losses | - | - | - | 464 820 | 464 820 |           |
| **Deficit before taxation** | - | - | - | (22 063 265) | (22 063 265) |           |

| Net Surplus/(Deficit) | - | - | - | (22 063 265) | (22 063 265) |           |
| Capital expenditure | (95 396 476) | - | (95 396 476) | (66 008 232) | 29 388 244 |           |

| Net Operational Surplus/(Deficit) | (95 396 476) | - | (95 396 476) | (88 071 497) | 7 324 979 |           |

| Deficit before taxation | - | - | - | (22 063 265) | (22 063 265) |           |

| Net Surplus/(Deficit) | - | - | - | (22 063 265) | (22 063 265) |           |
| Capital expenditure | (95 396 476) | - | (95 396 476) | (66 008 232) | 29 388 244 |           |

| Net Operational Surplus/(Deficit) | (95 396 476) | - | (95 396 476) | (88 071 497) | 7 324 979 |           |
#1 Sale of goods in agriculture activities  
Due to demand being less than anticipated.

#2 Rendering of Services  
Due to delay in starting projects, as well lower demand of our services.

#3 Royalty income  
Variance is due royalties of R13 million received from NADOR COTT Protection for sales that occurred in the prior 2 financial years.

#4 Rental of facilities and equipment  
Variance is due to the high occupational rate of our properties, as well increasing the rate to market value.

#5 Other income  
The variance is due to blood vaccine sales which were not anticipated.

#6 Interest Received  
Variance is due to transferring the PG received in advanced to an investment account with a favourable rate.

#7 Dividends Received  
Dividends were not expected in the current financial year.

#8 Government grants  
Variance is due to the revised Vat rate from 14% to 15%. R600k was recognised on the Foot and Mouth Disease project.

#9 Personnel  
Saving is due to non filling of vacancies and reduction of temporary employees.

#10 Depreciation and amortisation  
Capital expenditure was lower in the current than budgeted for thus resulting in lower amortisation and depreciation of assets.

#11 Impairment loss/ Reversal of impairments  
The increase is due to current year’s provision on doubtful debts which is mainly emanating from long outstanding customer balances.

#12 Repairs and maintenance  
The saving on repairs and maintenance is due the decision to stop procurement towards the end of the financial year.

#13 Operating and administrative expenses  
Saving in operating and administrative expense, is linked to the under performing external income.
1. Presentation of Annual Financial Statements

The Annual Financial Statements have been prepared in accordance with the Standards of Generally Recognised Accounting Practice (GRAP), issued by the Accounting Standards Board in accordance with Section 91(1) of the Public Finance Management Act (Act 1 of 1999) as amended and the Agricultural Research Act No. 86 of 1990.

These Annual Financial Statements have been prepared on an accrual basis of accounting and are in accordance with historical cost convention as the basis of measurement, unless specified otherwise. They are presented in South African Rand, rounded to the nearest rand.

Assets, liabilities, revenues and expenses were not offset, except where offsetting is either required or permitted by a Standard of GRAP.

A summary of the significant accounting policies, which have been applied in the preparation of these Annual Financial Statements, is disclosed below.

1.1 Offsetting

Transactions are offset when such offsetting reflects the substance of the transaction or event. Where a legally enforceable right of offset exists for recognised financial assets and financial liabilities, and there is an intention to settle the liability and realise the asset simultaneously, or to settle on a net basis all related financial effects are offset and the accounting standard permits.

1.2 Going concern assumption

These Annual Financial Statements have been prepared based on the expectation that the entity will continue to operate as a going concern for at least the next 12 months.

1.3 Critical accounting policies with key management judgement

Certain critical accounting policies require the use of judgement in their application or require estimates of inherently uncertain matters. Although the accounting policies are in compliance with Standards of Generally Recognised Accounting Practice (GRAP), a change in the facts and circumstances of the underlying transactions could significantly change the implication of the accounting policy and the resulting financial statement impact.

Listed below are those policies that the Council believe are critical and require the use of complex judgement in their application:

**Property, plant and equipment**

The entity’s management determines useful lives, residual values and related depreciation charges for its property, plant and equipment with reference to the estimated periods that the entity intends to derive future economic benefits from the use of these assets. Residual values and estimated useful lives are assessed on an annual basis. The residual values of vehicles are estimated on published second hand vehicle values as well as trading history.

Land and buildings residual values are estimated using market conditions that will exist at end of the useful life. This includes management using its estimates between the periods where a sworn valuer is not used for valuation.

The estimates relating to equipment, land and buildings are included in the property, plant and equipment accounting policy.

**Intangible assets**

The useful life for software is determined by Management at the time that it is acquired and brought into use and is regularly reviewed for appropriateness.

**Post retirement benefits**

The entity’s post retirement benefits relate to post retirement medical aid benefits. The present value of the post retirement obligation depends on a number of factors that are determined on an actuarial basis using a number of assumptions. The assumptions used in determining the net cost (income) include the discount rate. Any changes in these assumptions will impact on the carrying amount of post retirement obligations.

The entity determines the appropriate discount rate at the end of each year. This is the interest rate that should be used to determine the present value of estimated future cash outflows expected to be required to settle the post retirement medical aid obligations. In determining the appropriate discount rate, the entity considers the interest rates of high quality corporate bonds that are denominated in the currency in which the benefits will be paid, and that have terms to maturity approximating the terms of the related benefit liability.

Other key assumptions for post retirement medical aid obligations are based on current market conditions. Additional information is disclosed in Note 18.

**Post retirement medical benefits**

The accounting for post retirement medical and end of service benefits requires the Council to make certain assumptions that
have a significant impact on the expenses and liabilities that are recorded for these employment benefits. These assumptions are included in the notes to the annual financial statements.

Because of the typically long-term nature of the entity’s obligations in its post-employment benefit schemes, and the short term volatility of financial markets, the Council recognises any impact of a modification of such assumptions over the expected remaining active life of beneficiaries. The accounting for post retirement medical benefits requires the Council to make certain assumptions that have a significant impact on the expenses and liabilities that are recorded for these employment benefits.

Provisions
Provisions were raised and management determined an estimate based on the information available. Additional disclosure of these estimates of provisions are included in note 17 Provisions.

Allowance for doubtful debts
On debtors an impairment loss is recognised in surplus and deficit when there is objective evidence that it is impaired. The impairment is measured as the difference between the debtors carrying amount and the present value of estimated future cash flows discounted at the effective interest rate, computed at initial recognition.

Capitalisation of intellectual property
ARC generates royalty revenue from Intellectual Property (IP) including Plant Breeders Rights, Patents and a Design arising from research conducted (either by ARC employees or funded by ARC or research collaboration or industry funding). These are internally generated intangible assets, however, they arise as a result of research activities and not development activities as envisioned by paragraph 52 of GRAP 31.

ARC protects the IP in terms of the Act by registering the results of the research (either an improved variant or cultivars or other products) with the relevant authorities. ARC protects the IP in terms of the Intellectual Property Rights from Publicly Financed Research and Development Act of 2008. It is a requirement to protect IP as a publicly funded institution.

ARC does not intend to sell the IP nor to use the IP for its own use but rather holds the IP for use by third parties and earns royalties from the IP. The object from the results of the research conducted by ARC (either through employees or funded research by ARC) is generally to improve farming quality, either through more cost effective techniques, better yield and/or better quality of product for all levels of farming including Small and Medium Enterprises.

Consequently, ARC does not recognise any internally generated intangible assets in the statement of financial position but expenses all research costs when incurred.

1.4 Transfer of functions between entities under common control

Definitions
An acquirer is the entity that obtains control of the acquiree or transferor.

Carrying amount of an asset or liability is the amount at which an asset or liability is recognised in the statement of financial position.

Control is the power to govern the financial and operating policies of another entity so as to benefit from its activities.

A function is an integrated set of activities that is capable of being conducted and managed for purposes of achieving an entity’s objectives, either by providing economic benefits or service potential.

A merger is the establishment of a new combined entity in which none of the former entities obtains control over any other and no acquirer can be identified.

Transfer date is the date on which the acquirer obtains control of the function and the transferor loses control of that function. A transfer of functions is the reorganisation and/or the reallocation of functions between entities by transferring functions between entities or into another entity.

A transferor is the entity that relinquishes control of a function.

Common control
For a transaction or event to occur between entities under common control, the transaction or event needs to be undertaken between entities within the same sphere of government or between entities that are part of the same economic entity. Entities that are ultimately controlled by the same entity before and after the transfer of functions are within the same economic entity.

A function is an integrated set of activities that is capable of being conducted and managed for purposes of achieving an entity’s objectives, either by providing economic benefits or service potential. A function consists of inputs and processes applied to those inputs that have the ability to create outputs. A function can either be a part or a portion of an entity or can consist of the whole entity. Although functions may have outputs, outputs are not required to qualify as a function. The three elements of a function are defined as follows:

• Input: Any resource that creates, or has the ability to create, outputs when one or more processes are applied to it.
• Process: Any system, standard, protocol, convention or rule that when applied to an input or inputs, creates or has the ability to create outputs.
Identifying the acquirer and transferor

For each transfer of functions between entities under common control an acquirer and transferor are identified. All relevant facts and circumstances are considered in identifying the acquirer and transferor.

The terms and conditions of a transfer of functions undertaken between entities under common control are set out in a binding arrangement. The binding arrangement governing the terms and conditions of a transfer of functions may identify which entity to the transaction or event is the transferor(s) and which entity is the acquirer. Where the binding arrangement does not clearly identify the acquirer or the transferor, the behaviour or actions of the entities may indicate which entity is the acquirer and which entity is the transferor.

Determining the acquirer includes a consideration of, amongst other things, which of the entities involved in the transfer of functions initiated the transaction or event, the relative size of the entities, as well as whether the assets or revenue of one of the entities involved in the transaction or event significantly exceed those of the other entities. If no acquirer can be identified, the transaction or event is accounted for in terms of the Standard of GRAP on Mergers.

Determining the transfer date

The acquirer and the transferor identify the transfer date, which is the date on which the acquirer obtains control and the transferor loses control of that function. All relevant facts and circumstances are considered in identifying the transfer date.

Assets acquired [transferred] and liabilities assumed [relinquished]

The recognition of assets and liabilities, is subject to the following conditions:

The assets acquired and the liabilities assumed are part of what had been agreed in terms of the binding arrangement (if applicable), rather than the result of separate transactions.

Determining what is part of the transfer of functions transaction

Where the entity and the transferor have a pre-existing relationship before or when negotiations for a transfer of functions began, or where a binding arrangement is entered into during the negotiations that are separate from a transfer of functions, any amounts that are not part of what were transferred in a transfer of functions are identified. This policy only applies to the consideration transferred and the assets acquired and liabilities assumed in a transfer of functions as governed by the terms and conditions of the binding arrangement.

The following factors are considered, which are neither mutually exclusive nor individually conclusive, to determine whether a transaction is part of a transfer or function or whether the transaction is separate:

- the reasons for the transaction; and,
- the timing of the transaction

Accounting by the entity as acquirer

Initial recognition and measurement

As of the transfer date, the entity recognises the purchase consideration paid to the transferor and all the assets acquired and liabilities assumed in a transfer of functions. The assets acquired and liabilities assumed are measured at their carrying amounts. If, prior to the transfer of functions, the transferor was not applying the accrual basis of accounting, the transferor changes its basis of accounting to the accrual basis of accounting prior to the transfer.

The consideration paid by the entity can be in the form of cash, cash equivalents or other assets. If the consideration paid is in the form of other assets, the entity derecognises such assets on the transfer date at their carrying amounts.

The difference between the carrying amounts of the assets acquired, the liabilities assumed and the consideration paid to the transferor, is recognised in accumulated surplus or deficit.

Measurement period

If the initial accounting for a transfer of functions is incomplete by the end of the reporting period in which the transfer occurs, the entity reports in its annual financial statements provisional amounts for the items for which the accounting is incomplete. During the measurement period, the entity retrospectively adjusts the provisional amounts recognised at the transfer date to reflect new information obtained about facts and circumstances that existed as of the transfer date and, if known, would have affected the measurement of the amounts recognised as of that date. The measurement period ends as soon as the entity receives the information it was seeking about facts and circumstances that existed as of the transfer date or learns that more information is not obtainable. However, the measurement period does not exceed two years from the transfer date.

The entity considers all relevant factors in determining whether information obtained after the transfer date should result in an adjustment to the provisional amounts recognised or whether that information results from events that occurred after the transfer date.

The entity recognises an increase (decrease) in the provisional amount recognised for an asset (liability) by means of decreasing (increasing) the excess of the purchase consideration paid over the carrying amount of the assets acquired and liabilities
assumed previously recognised in accumulated surplus or deficit. However, new information obtained during the measurement period may sometimes result in an adjustment to the provisional amount of more than one asset or liability.

During the measurement period, the entity recognises adjustments to the provisional amounts as if the accounting for the transfer of functions had been completed at the transfer date. Thus, the entity revises comparative information for prior periods presented in annual financial statements as needed, including making any change in depreciation, amortisation or other income effects recognised in completing the initial accounting. After the measurement period ends, the entity revises the accounting for a transfer of functions only to correct an error in accordance with the Standard of GRAP on Accounting Policies, Changes in Accounting Estimates and Errors.

**Subsequent measurement**

The entity subsequently measure any assets acquired and any liabilities assumed in a transfer of functions in accordance with the applicable Standards of GRAP.

At the transfer date, the entity classifies or designates the assets acquired and liabilities assumed as necessary to apply other Standards of GRAP subsequently. The entity makes those classifications or designations on the basis of the terms of the binding arrangement, economic conditions, its operating or accounting policies and other relevant conditions that exist at the transfer date. An exception is that the entity classifies the following contracts on the basis of the contractual terms and other factors at the inception of the contract (or, if the terms of the contract have been modified in a manner that would change its classification, at the date of that modification, which might be the transfer date):

- classification of a lease contract as either an operating lease or a finance lease in accordance with the Standard of GRAP on Leases; and
- classification of a contract as an insurance contract in accordance with the International Financial Reporting Standard on Insurance Contracts.

**1.5 Investment property**

Investment property is property (land or a building or part of a building or both) held to earn rentals or for capital appreciation or both, rather than for:

- use in the production or supply of goods or services; or
- administrative purposes, or
- sale in the ordinary course of operations.

Investment property is recognised as an asset when, it is probable that the future economic benefits or service potential that are associated with the investment property will flow to the entity, and the cost or fair value of the investment property can be measured reliably.

Investment property is initially recognised at cost. Transaction costs are included in the initial measurement. Subsequent to initial recognition, investment property is measured at cost less accumulated depreciation and any accumulated impairment losses.

Where investment property is acquired through a non exchange transaction, its cost is its fair value as at the date of acquisition. Costs include costs incurred initially and costs incurred subsequently to add to, or to replace a part of, or service a property. If a replacement part is recognised in the carrying amount of the investment property, the carrying amount of the replaced part is derecognised.

**Cost model**

Investment property is carried at cost less accumulated depreciation and any accumulated impairment losses.

Depreciation is provided to write down the cost, less estimated residual value by equal installments over the useful life of the property, which is as follows:

<table>
<thead>
<tr>
<th>Item</th>
<th>Useful life</th>
</tr>
</thead>
<tbody>
<tr>
<td>Property</td>
<td>40 to 70 years</td>
</tr>
<tr>
<td>buildings</td>
<td>40 to 70 years</td>
</tr>
</tbody>
</table>

Investment property is derecognised on disposal or when the investment property is permanently withdrawn from use and no future economic benefits or service potential are expected from its disposal.

**1.6 Property, plant and equipment**

Property, plant and equipment are tangible non current assets (including infrastructure assets) that are held for use in the production or supply of goods or services, rental to others, or for administrative purposes, and are expected to be used during more than one period.

The cost of an item of property, plant and equipment is recognised as an asset when:

- it is probable that future economic benefits or service potential associated with the item will flow to the entity; and
- the cost of the item can be measured reliably.

Property, plant and equipment is carried at cost less accumulated depreciation and any impairment losses.

Buildings and infrastructure in the course of construction for production, rental or administrative purposes, or for purposes not yet determined, are carried at cost, less any recognised impairment loss. Cost includes professional fees, acquisition costs, construction and, for qualifying assets, borrowing costs are capitalised in accordance with the ARC accounting policy.
These assets are depreciated on the same basis as other buildings and depreciation commences when the assets are ready for their intended use. Buildings under construction are not depreciated. Buildings and or infrastructure available for use are accounted for at cost less accumulated depreciation and accumulated impairments.

Property, plant and equipment are depreciated on the straight line basis over their expected useful lives to their estimated residual value.

The estimated useful lives of items of property, plant and equipment have been assessed as follows:

<table>
<thead>
<tr>
<th>Item</th>
<th>Depreciation method</th>
<th>Average useful life</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land</td>
<td>Straight line</td>
<td>Not depreciated</td>
</tr>
<tr>
<td>Buildings</td>
<td>Straight line</td>
<td>3 to 70 years</td>
</tr>
<tr>
<td>Machinery &amp; Farming Equipment</td>
<td>Straight line</td>
<td>3 to 60 years</td>
</tr>
<tr>
<td>Office Furniture &amp; Equipment</td>
<td>Straight line</td>
<td>5 to 30 years</td>
</tr>
<tr>
<td>Motor vehicles and aircraft</td>
<td>Straight line</td>
<td>4 to 20 years</td>
</tr>
<tr>
<td>Computer equipment</td>
<td>Straight line</td>
<td>3 to 15 years</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>Straight line</td>
<td>10 to 60 years</td>
</tr>
<tr>
<td>Laboratory equipment</td>
<td>Straight line</td>
<td>5 to 60 years</td>
</tr>
</tbody>
</table>

The depreciable amount of an asset is allocated on a systematic basis over its useful life.

The entity assesses at each reporting date whether there is any indication that the entity expectations about the residual value and the useful life of an asset have changed since the preceding reporting date. If any such indication exists, the entity revises the expected useful life and/or residual value accordingly. The change is accounted for as a change in an accounting estimate. The depreciation charge for each period is recognised in surplus or deficit unless it is included in the carrying amount of another asset.

Items of property, plant and equipment are derecognised when the asset is disposed of or when no future economic benefits or service potential are expected from its use or disposal.

The gain or loss arising from the derecognition of an item of property, plant and equipment is included in surplus or deficit when the item is derecognised. The gain or loss arising from the derecognition of an item of property, plant and equipment is determined as the difference between the net disposal proceeds, if any, and the carrying amount of the item.

The entity separately discloses expenditure to repair and maintain property, plant and equipment in the notes to the financial statements (see note 12).

The entity discloses relevant information relating to assets under construction or development per asset class, in the notes to the financial statements (see note 12).

1.7 Intangible assets

An intangible asset is an identifiable non monetary asset without physical substance.

An intangible asset is recognised when:

- it is probable that the expected future economic benefits or service potential that are attributable to the asset will flow to the entity; and
- the cost or fair value of the asset can be measured reliably.

The entity assesses the probability of expected future economic benefits or service potential using reasonable and supportable assumptions that represent management’s best estimate of the set of economic conditions that will exist over the useful life of the asset. Intangible assets are measured initially at cost. Where an intangible asset is acquired through a non exchange transaction, its initial cost at the date of acquisition is measured at its fair value as at that date.

The entity has registered a number of patents, plant breeders rights and designs emanating from the research conducted or funded by ARC in terms of Agricultural Research Act in order to protect the Intellectual Property derived from the research. ARC does not capitalize the research costs incurred, but expenses these costs in terms of GRAP 31: Intangible Assets, as the criteria to capitalize these assets as development costs has not been met.

An intangible asset arising from development (or from the development phase of an internal project) is recognised when:

- it is technically feasible to complete the asset so that it will be available for use or sale.
- there is an intention to complete and use or sell it.
- there is an ability to use or sell it.
- it will generate probable future economic benefits or service potential.
- there are available technical, financial and other resources to complete the development and to use or sell the asset.
- the expenditure attributable to the asset during its development can be measured reliably.

Intangible assets are carried at cost less any accumulated amortisation and any impairment losses.
The amortisation period and the amortisation method for intangible assets are reviewed at each reporting date.

Amortisation of intangible assets is included in the depreciation and amortisation line item in the statement of financial performance.

Reassessing the useful life of an intangible asset with a finite useful life after it was classified as indefinite is an indicator that the asset may be impaired. As a result, the asset is tested for impairment and the remaining carrying amount is amortised over its useful life.

Amortisation is provided to write down the intangible assets, on a straight line basis, to their residual values as follows:

<table>
<thead>
<tr>
<th>Item</th>
<th>Depreciation method</th>
<th>Average useful life</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer software</td>
<td>Straight line</td>
<td>3 to 10 years</td>
</tr>
</tbody>
</table>

Intangible assets are derecognised:
- on disposal; or
- when no future economic benefits or service potential are expected from their use or disposal.

The gain or loss arising from the derecognition of an intangible assets is included in surplus or deficit when the asset is derecognised (unless the Standard of GRAP on leases requires otherwise on a sale and leaseback).

1.8 Heritage assets

Heritage assets are assets that have a cultural, environmental, historical, natural, scientific, technological or artistic significance and are held indefinitely for the benefit of present and future generations.

Recognition
The entity recognises a heritage asset as an asset if it is probable that future economic benefits or service potential associated with the asset will flow to the entity, and the cost or fair value of the asset can be measured reliably.

Initial measurement
Heritage assets are measured at cost.
Where a heritage asset is acquired through a non exchange transaction, its cost is measured at its fair value as at the date of acquisition.

Subsequent measurement
After recognition as an asset, a class of heritage assets is carried at its cost less any accumulated impairment losses. These assets are not depreciated.

Impairment
The entity assesses at each reporting date whether there is an indication that the asset may be impaired. If any such indication exists, the entity estimates the recoverable amount or the recoverable service amount of the heritage asset.

Derecognition
The entity derecognises heritage asset on disposal, or when no future economic benefits or service potential are expected from its use or disposal.

The gain or loss arising from the derecognition of a heritage asset is included in surplus or deficit when the item is derecognised.

1.9 Financial instruments

A financial instrument is any contract that gives rise to a financial asset of one entity and a financial liability or a residual interest of another entity.

The amortised cost of a financial asset or financial liability is the amount at which the financial asset or financial liability is measured at initial recognition minus principal repayments, plus or minus the cumulative amortisation using the effective interest method of any difference between that initial amount and the maturity amount, and minus any reduction (directly or through the use of an allowance account) for impairment or uncollectibility.

A financial asset is:
- cash;
- a residual interest of another entity; or
- a contractual right to:
  - receive cash or another financial asset from another entity; or
  - exchange financial assets or financial liabilities with another entity under conditions that are potentially favourable to the entity.

A financial liability is any liability that is a contractual obligation to:
- deliver cash or another financial asset to another entity; or
- exchange financial assets or financial liabilities under conditions that are potentially unfavourable to the entity.

Liquidity risk is the risk encountered by an entity in the event of difficulty in meeting obligations associated with financial liabilities that are settled by delivering cash or another financial asset.

Market risk is the risk that the fair value or future cash flows of a financial instrument will fluctuate because of changes in market prices. Market risk comprises three types of risk: currency risk, interest rate risk and other price risk.
Interest rate risk is the risk that the fair value or future cash flows of a financial instrument will fluctuate because of changes in market interest rates.

Other price risk is the risk that the fair value or future cash flows of a financial instrument will fluctuate because of changes in market prices (other than those arising from interest rate risk or currency risk), whether those changes are caused by factors specific to the individual financial instrument or its issuer, or factors affecting all similar financial instruments traded in the market.

The entity has the following types of financial assets (classes and category) as reflected on the face of the statement of financial position or in the notes thereto:

<table>
<thead>
<tr>
<th>Class</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trade and other receivables</td>
<td>Financial asset measured at amortised cost</td>
</tr>
<tr>
<td>Cash and cash equivalents</td>
<td>Financial asset measured at amortised cost</td>
</tr>
<tr>
<td>Other financial asset</td>
<td>Financial asset measured at fair value</td>
</tr>
<tr>
<td>Other financial asset</td>
<td>Financial asset measured at cost</td>
</tr>
</tbody>
</table>

The entity has the following types of financial liabilities (classes and category) as reflected on the face of the statement of financial position or in the notes thereto:

<table>
<thead>
<tr>
<th>Class</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trade and other payables</td>
<td>Financial liability measured at amortised cost</td>
</tr>
</tbody>
</table>

Initial recognition
The entity recognises a financial asset or a financial liability in its statement of financial position when the entity becomes a party to the contractual provisions of the instrument.

Initial measurement of financial assets and financial liabilities
The entity measures a financial asset and financial liability initially at its fair value plus transaction costs that are directly attributable to the acquisition or issue of the financial asset or financial liability.

Receivables from exchange transactions
Trade receivables are measured at initial recognition at fair value, and are subsequently measured at amortised cost using the effective interest rate method. Appropriate allowances for estimated irrecoverable amounts are recognised in surplus or deficit when there is objective evidence that not all amounts due will be collected according to original terms of the receivables. Significant financial difficulties of the debtor, probability that the debtor will enter bankruptcy or financial reorganisation, and default or delinquency in payments are considered indicators that the trade receivable is impaired. The allowance recognised is measured as the difference between the asset’s carrying amount and the present value of estimated future cash flows, discounted at the effective interest rate computed at initial recognition.

The carrying amount of the asset is reduced through the use of an allowance account, and the amount of the credit loss is recognised in surplus or deficit within operating expenses. When a trade receivable is uncollectible, it is written off against the allowance account for trade receivables. Subsequent recoveries of amounts previously written off are credited against operating expenses in surplus or deficit.

Government debtors are considered generally slow payers and therefore amounts receivable from them, regardless of ageing, are not provided for.

Payables from exchange transactions
Trade payables are initially measured at fair value, and are subsequently measured at amortised cost, using the effective interest rate method.

Cash and cash equivalents
Cash and cash equivalents are measured initially at amortised cost, which is their fair value and subsequently recorded at amortised cost. Cash and cash equivalents comprise cash on hand and short term deposits held on call with banks, all of which are available for use by the ARC. Cash equivalents comprise of highly liquid investment that are convertible to cash with insignificant risk of changes in value.

Other financial assets
Other financial assets measured initially at cost, which is their fair value and subsequently recorded at amortised cost. The fair value of other financial assets traded in active markets is based on quoted market prices (level 1) at the statement of financial position date. The quoted market price used for financial assets held by the ARC is the closing price.

Subsequent measurement of financial assets and financial liabilities
The entity measures all financial assets and financial liabilities after initial recognition using the following categories:
- Financial instruments at fair value.
- Financial instruments at amortised cost.
- Financial instruments at cost.

Impairment and uncollectibility of financial assets
The entity assesses at the end of each reporting period whether there is any objective evidence that a financial asset or group of financial assets is impaired.
• **Financial assets measured at amortised cost:**
  If there is objective evidence that an impairment loss on financial assets measured at amortised cost has been incurred, the amount of the loss is measured as the difference between the asset’s carrying amount and the present value of estimated future cash flows (excluding future credit losses that have not been incurred) discounted at the financial asset’s original effective interest rate. The carrying amount of the asset is reduced directly or through the use of an allowance account. The amount of the loss is recognised in surplus or deficit.

• **Financial assets measured at cost:**
  If there is objective evidence that an impairment loss has been incurred on an investment in a residual interest that is not measured at fair value because its fair value cannot be measured reliably, the amount of the impairment loss is measured as the difference between the carrying amount of the financial asset and the present value of estimated future cash flows discounted at the current market rate of return for a similar financial asset. Such impairment losses are not reversed.

**Derecognition**

**Financial assets**
The entity derecognises a financial asset only when:

- the contractual rights to the cash flows from the financial asset expire, are settled or waived;
- the entity transfers to another party substantially all of the risks and rewards of ownership of the financial asset; or
- the entity, despite having retained some significant risks and rewards of ownership of the financial asset, has transferred control of the asset to another party and the other party has the practical ability to sell the asset in its entirety to an unrelated third party, and is able to exercise that ability unilaterally and without needing to impose additional restrictions on the transfer. In this case, the entity:
  - derecognise the asset; and
  - recognise separately any rights and obligations created or retained in the transfer.

If, as a result of a transfer, a financial asset is derecognised in its entirety but the transfer results in the entity obtaining a new financial asset or assuming a new financial liability, or a servicing liability, the entity recognise the new financial asset, financial liability or servicing liability at fair value.

On derecognition of a financial asset in its entirety, the difference between the carrying amount and the sum of the consideration received is recognised in surplus or deficit.

If the transferred asset is part of a larger financial asset and the part transferred qualifies for derecognition in its entirety, the previous carrying amount of the larger financial asset is allocated between the part that continues to be recognised and the part that is derecognised, based on the relative fair values of those parts, on the date of the transfer. For this purpose, a retained servicing asset is treated as a part that continues to be recognised. The difference between the carrying amount allocated to the part derecognised and the sum of the consideration received for the part derecognised is recognised in surplus or deficit.

If a transfer does not result in derecognition because the entity has retained substantially all the risks and rewards of ownership of the transferred asset, the entity continue to recognise the transferred asset in its entirety and recognise a financial liability for the consideration received. In subsequent periods, the entity recognises any revenue on the transferred asset and any expense incurred on the financial liability. Neither the asset, and the associated liability nor the revenue, and the associated expenses are offset.

**Financial liabilities**
The entity removes a financial liability (or a part of a financial liability) from its statement of financial position when it is extinguished — i.e. when the obligation specified in the contract is discharged, cancelled, expires or waived.

The difference between the carrying amount of a financial liability (or part of a financial liability) extinguished or transferred to another party and the consideration paid, including any non-cash assets transferred or liabilities assumed, is recognised in surplus or deficit. Any liabilities that are waived, forgiven or assumed by another entity by way of a non-exchange transaction are accounted for in accordance with the Standard of GRAP on Revenue from Non-exchange Transactions (Taxes and Transfers).

**Presentation**
Interest relating to a financial instrument or a component that is a financial liability is recognised as revenue or expense in surplus or deficit.

Dividends or similar distributions relating to a financial instrument or a component that is a financial liability is recognised as revenue or expense in surplus or deficit.

Losses and gains relating to a financial instrument or a component that is a financial liability is recognised as revenue or expense in surplus or deficit.

The effective interest method is a method of calculating the amortised cost of a financial asset or a financial liability (or group of financial assets or financial liabilities) and of allocating the interest income or interest expense over the relevant period. The effective interest rate is the rate that exactly discounts estimated future cash payments or receipts through the expected life of the financial instrument or, when appropriate, a short-
er period to the net carrying amount of the financial asset or financial liability. When calculating the effective interest rate, an entity shall estimate cash flows considering all contractual terms of the financial instrument (for example, prepayment, call and similar options) but shall not consider future credit losses. The calculation includes all fees and points paid or received between parties to the contract that are an integral part of the effective interest rate (see the Standard of GRAP on Revenue from Exchange Transactions), transaction costs, and all other premiums or discounts. There is a presumption that the cash flows and the expected life of a group of similar financial instruments can be estimated reliably. However, in those rare cases when it is not possible to reliably estimate the cash flows or the expected life of a financial instrument (or group of financial instruments), the entity shall use the contractual cash flows over the full contractual term of the financial instrument (or group of financial instruments).

**1.10 Tax**

**Value added tax**
The entity is subject to a value added tax (“VAT”) of 15% for the sale of goods and services. The amount of VAT liability is determined by applying the applicable tax rate to the invoiced amount of the sale of goods and services (output VAT) less VAT paid on purchases made with the relevant supporting invoices (input VAT). The entity reports revenue net value added tax for all the periods presented in the statement of financial performance.

**1.11 Leases**

**Operating leases lessor (Rental of facilities and equipment)**
Operating lease revenue is recognised as revenue on a straight line basis over the lease term.

Income for leases is disclosed under revenue in statement of financial performance.

**Operating leases lessee**
Operating lease payments are recognised as an expense on a straight line basis over the lease term. The difference between the amounts recognised as an expense and the contractual payments are recognised as an operating lease asset or liability.

**1.12 Inventories**

Inventories that qualify for recognition as assets shall initially be measured at cost except where inventories are acquired through a non exchange transaction, their cost shall be measured at their fair value as at the date of acquisition.

Subsequently inventories are measured at the lower of cost and net realisable value. Inventories are measured at the lower of cost and current replacement cost where they are held for:
- distribution at no charge or for a nominal charge;
- consumption in the production process of goods to be distributed at no charge or for a nominal charge.

Net realisable value is the estimated selling price in the ordinary course of operations less the estimated costs of completion and the estimated costs necessary to make the sale, exchange or distribution.

Current replacement cost is the cost the entity incurs to acquire the asset on the reporting date.

The cost of inventories comprises of all costs of purchase, costs of conversion and other costs incurred in bringing the inventories to their present location and condition.

The cost of inventories is assigned using the weighted average cost formula. The same cost formula is used for all inventories having a similar nature and use to the entity.

Consumable stores are valued at the lower of weighted average cost or net realisable value. Livestock is valued at standard values. Cost of work in progress and finished goods includes direct costs and an appropriate allocation of overheads based on normal production levels.

Farm produce resulting from research, is not accounted for as inventories and the income resulting from the sale of these products is brought to account in the year in which it is sold. Excess farm produce harvested for resale is treated as inventory and valued at fair value less estimated point of sale costs.

Vaccines for foot and mouth disease are at lower of cost and net realisable value.

When inventories are sold, the carrying amounts of those inventories are recognised as an expense in the period in which the related revenue is recognised. If there is no related revenue, the expenses are recognised when the goods are distributed, or related services are rendered. The amount of any write down of inventories to net realisable value or current replacement cost and all losses of inventories are recognised as an expense in the period the write down or loss occurs. The amount of any reversal of any write down of inventories, arising from an increase in net realisable value or current replacement cost, are recognised as a reduction in the amount of inventories recognised as an expense in the period in which the reversal occurs.

**1.13 Impairment of cash generating assets**

Cash generating assets are assets used with the objective of generating a commercial return. Commercial return means that positive cash flows are expected to be significantly higher than
the cost of the asset.

Impairment is a loss in the future economic benefits or service potential of an asset, over and above the systematic recognition of the loss of the asset’s future economic benefits or service potential through depreciation (amortisation).

Carrying amount is the amount at which an asset is recognised in the statement of financial position after deducting any accumulated depreciation and accumulated impairment losses thereon.

A cash generating unit is the smallest identifiable group of assets used with the objective of generating a commercial return that generates cash inflows from continuing use that are largely independent of the cash inflows from other assets or groups of assets.

Costs of disposal are incremental costs directly attributable to the disposal of an asset, excluding finance costs and income tax expense.

Fair value less costs to sell is the amount obtainable from the sale of an asset in an arm’s length transaction between knowledgeable, willing parties, less the costs of disposal.

Recoverable amount of an asset or a cash generating unit is the higher its fair value less costs to sell and its value in use.

Identification
When the carrying amount of a cash generating asset exceeds its recoverable amount, it is impaired.

The entity assesses at each reporting date whether there is any indication that a cash generating asset may be impaired. If any such indication exists, the entity estimates the recoverable amount of the asset.

Irrespective of whether there is any indication of impairment, the entity also test a cash generating intangible asset with an indefinite useful life or a cash generating intangible asset not yet available for use for impairment annually by comparing its carrying amount with its recoverable amount. This impairment test is performed at the same time every year. If an intangible asset was initially recognised during the current reporting period, that intangible asset was tested for impairment before the end of the current reporting period.

Value in use
Value in use of a cash generating asset is the present value of the estimated future cash flows expected to be derived from the continuing use of an asset and from its disposal at the end of its useful life.

When estimating the value in use of an asset, the entity estimates the future cash inflows and outflows to be derived from continuing use of the asset and from its ultimate disposal and the entity applies the appropriate discount rate to those future cash flows.

Recognition and measurement (individual asset)
If the recoverable amount of a cash generating asset is less than its carrying amount, the carrying amount of the asset is reduced to its recoverable amount. This reduction is an impairment loss. An impairment loss is recognised immediately in surplus or deficit.

Any impairment loss of a revalued cash generating asset is treated as a revaluation decrease.

When the amount estimated for an impairment loss is greater than the carrying amount of the cash generating asset to which it relates, the entity recognises a liability only to the extent that is a requirement in the Standard of GRAP.

After the recognition of an impairment loss, the depreciation (amortisation) charge for the cash generating asset is adjusted in future periods to allocate the cash generating asset’s revised carrying amount, less its residual value (if any), on a systematic basis over its remaining useful life.

Reversal of impairment loss
The entity assess at each reporting date whether there is any indication that an impairment loss recognised in prior periods for a cash generating asset may no longer exist or may have decreased. If any such indication exists, the entity estimates the recoverable amount of that asset.

An impairment loss recognised in prior periods for a cash generating asset is reversed if there has been a change in the estimates used to determine the asset’s recoverable amount since the last impairment loss was recognised. The carrying amount of the asset is increased to its recoverable amount. The increase is a reversal of an impairment loss. The increased carrying amount of an asset attributable to a reversal of an impairment loss does not exceed the carrying amount that would have been determined (net of depreciation or amortisation) had no impairment loss been recognised for the asset in prior periods.

A reversal of an impairment loss for a cash generating asset is recognised immediately in surplus or deficit.

Any reversal of an impairment loss of a revalued cash generating asset is treated as a revaluation increase.

After a reversal of an impairment loss is recognised, the depreciation (amortisation) charge for the cash generating asset is adjusted in future periods to allocate the cash generating asset’s revised carrying amount, less its residual value (if any), on a systematic basis over its remaining useful life.
A reversal of an impairment loss for a cash generating unit is allocated to the cash generating assets of the unit pro rata with the carrying amounts of those assets. These increases in carrying amounts are treated as reversals of impairment losses for individual assets. No part of the amount of such a reversal is allocated to a non cash generating asset contributing service potential to a cash generating unit.

In allocating a reversal of an impairment loss for a cash generating unit, the carrying amount of an asset is not increased above the lower of:

- its recoverable amount (if determinable); and
- the carrying amount that would have been determined (net of amortisation or depreciation) had no impairment loss been recognised for the asset in prior periods.

The amount of the reversal of the impairment loss that would otherwise have been allocated to the asset is allocated pro rata to the other assets of the unit.

1.14 Impairment of non cash generating assets

Non cash generating assets are assets other than cash generating assets.

Impairment is a loss in the future economic benefits or service potential of an asset, over and above the systematic recognition of the loss of the asset’s future economic benefits or service potential through depreciation (amortisation).

Carrying amount is the amount at which an asset is recognised in the statement of financial position after deducting any accumulated depreciation and accumulated impairment losses thereon.

Costs of disposal are incremental costs directly attributable to the disposal of an asset, excluding finance costs and income tax expense.

Fair value less costs to sell is the amount obtainable from the sale of an asset in an arm’s length transaction between knowledgeable, willing parties, less the costs of disposal.

Recoverable service amount is the higher of a non cash generating asset’s fair value less costs to sell and its value in use.

Useful life is either:

- the period of time over which an asset is expected to be used by the entity; or
- the number of production or similar units expected to be obtained from the asset by the entity.

Identification

When the carrying amount of a non cash generating asset exceeds its recoverable service amount, it is impaired.

The entity assesses at each reporting date whether there is any indication that a non cash generating asset may be impaired. If any such indication exists, the entity estimates the recoverable service amount of the asset.

Recognition and measurement

If the recoverable service amount of a non cash generating asset is less than its carrying amount, the carrying amount of the asset is reduced to its recoverable service amount. This reduction is an impairment loss.

An impairment loss is recognised immediately in surplus or deficit.

Any impairment loss of a revalued non cash generating asset is treated as a revaluation decrease.

After the recognition of an impairment loss, the depreciation (amortisation) charge for the non cash generating asset is adjusted in future periods to allocate the non cash generating asset’s revised carrying amount, less its residual value (if any), on a systematic basis over its remaining useful life.

Reversal of an impairment loss

The entity assess at each reporting date whether there is any indication that an impairment loss recognised in prior periods for a non cash generating asset may no longer exist or may have decreased. If any such indication exists, the entity estimates the recoverable service amount of that asset.

An impairment loss recognised in prior periods for a non cash generating asset is reversed if there has been a change in the estimates used to determine the asset’s recoverable service amount since the last impairment loss was recognised. The carrying amount of the asset is increased to its recoverable service amount. The increase is a reversal of an impairment loss. The increased carrying amount of an asset attributable to a reversal of an impairment loss does not exceed the carrying amount that would have been determined (net of depreciation or amortisation) had no impairment loss been recognised for the asset in prior periods.

A reversal of an impairment loss for a non cash generating asset is recognised immediately in surplus or deficit.

Any reversal of an impairment loss of a revalued non cash generating asset is treated as a revaluation increase.

After a reversal of an impairment loss is recognised, the depreciation (amortisation) charge for the non cash generating asset is adjusted in future periods to allocate the non cash generating asset’s revised carrying amount, less its residual value (if any), on a systematic basis over its remaining useful life.
1.15 Capital funds

The capital fund represents the amount of net assets at the date of transfer from the government to the ARC.

1.16 Employee benefits

**Short term employee benefits**

The cost of short term employee benefits, (those payable within 12 months after the service is rendered, such as paid vacation leave and sick leave, bonuses, and non monetary benefits such as medical care), are recognised in the period in which the service is rendered and are not discounted.

The expected cost of compensated absences is recognised as an expense as the employees render services that increase their entitlement or, in the case of non accumulating absences, when the absence occurs.

The expected cost of surplus sharing and bonus payments is recognised as an expense when there is a legal or constructive obligation to make such payments as a result of past performance.

**Defined contribution plans**

Payments to defined contribution retirement benefit plans are charged as an expense as they fall due.

Payments made to industry managed (or state plans) retirement benefit schemes are dealt with as defined contribution plans where the entity’s obligation under the schemes is equivalent to those arising in a defined contribution retirement benefit plan.

**Defined benefit plans**

For defined benefit plans the cost of providing the benefits is determined using the projected credit method.

Actuarial valuations are conducted on an annual basis by independent actuaries separately for each plan.

Consideration is given to any event that could impact the funds up to end of the reporting period where the interim valuation is performed at an earlier date.

Past service costs are recognised immediately to the extent that the benefits are already vested, and are otherwise amortised on a straight line basis over the average period until the amended benefits become vested.

Gains or losses on the curtailment or settlement of a defined benefit plan is recognised when the entity is demonstrably committed to curtailment or settlement.

The amount recognised in the statement of financial position represents the present value of the defined benefit obligation as adjusted for unrecognised actuarial gains and losses and unrecognised past service costs, and reduces by the fair value of plan assets.

Any asset is limited to unrecognised actuarial losses and past service costs, plus the present value of available refunds and reduction in future contributions to the plan.

**Other post retirement obligations**

The ARC provides post retirement medical benefits to qualifying employees. The expected costs of these benefits are determined using an accounting methodology similar to that of defined benefit pension plans, with actuarial valuations carried out every year. Contributions are made to the relevant funds over the expected service lives of the employees entitled to those funds. The estimated cost of providing such benefits is charged to the statement of financial performance on a systematic basis over the employees’ working lives within the ARC.

The entitlement to post retirement health care benefits is based on the employee remaining in service up to retirement age and the completion of a minimum service period. The expected costs of these benefits are accrued over the period of employment. Independent qualified actuaries carry out valuations of these obligations.

The amount recognised in the statement of financial position represents the present value of the post retirement medical aid obligation as adjusted for unrecognised actuarial gains and losses.

**Long term employee benefits**

The liability for employees’ entitlements to long service leave represents the present value of the estimated future cash outflows resulting from employees’ services provided to the reporting date.

In determining the liability for employee benefits, consideration has been given to future increases in wage and salary rates, and ARC’s experience with staff turnover.

1.17 Provisions and contingencies

A provision is a liability of uncertain timing or amount. Provisions are recognised when:

- the entity has a present obligation as a result of a past event;
- it is probable that an outflow of resources embodying economic benefits or service potential will be required to settle the obligation; and,
- a reliable estimate can be made of the obligation.
The amount of a provision is the best estimate of the expenditure expected to be required to settle the present obligation at the reporting date.

Provisions are reviewed at each reporting date and adjusted to reflect the current best estimate. Provisions are reversed if it is no longer probable that an outflow of resources embodying economic benefits or service potential will be required, to settle the obligation.

Provisions are not recognised for future operating losses.

Contingent liabilities are disclosed, unless the possibility of an outflow of resources embodying economic benefits or service potential is remote.

Contingent assets are not recognised in financial statements since this may result in the recognition of revenue that may never be realised. However, when the realisation of revenue is virtually certain, then the related asset is not a contingent asset and its recognition is appropriate.

Contingent assets and contingent liabilities are not recognised. Contingencies are disclosed in note 27.

### 1.18 Commitments

Items are classified as commitments when an entity has committed itself to future transactions that will normally result in the outflow of cash.

Disclosures are required in respect of unrecognised contractual commitments.

Commitments for which disclosure is necessary to achieve a fair presentation should be disclosed in a note to the financial statements, if both the following criteria are met:

- Contracts should be non-cancellable or only cancellable at significant cost (for example, contracts for computer or building maintenance services); and,
- Contracts should relate to something other than the routine, steady, state business of the entity - therefore salary commitments relating to employment contracts or social security benefit commitments are excluded.

### 1.19 Revenue from exchange transactions

Revenue is the gross inflow of economic benefits or service potential during the reporting period when those inflows result in an increase in net assets, other than increases relating to contributions from owners.

An exchange transaction is one in which the entity receives assets or services, or has liabilities extinguished, and directly gives approximately equal value (primarily in the form of goods, services or use of assets) to the other party in exchange.

Fair value is the amount for which an asset could be exchanged, or a liability settled, between knowledgeable, willing parties in an arm’s length transaction.

#### Measurement

Revenue is measured at the fair value of the consideration received or receivable.

#### Diagnostic services

Due to the short lead time and the nature of the diagnostic tests, the diagnostic revenue is recognised at the completion of the diagnostic tests.

#### Royalty income

Royalty income is recognised in terms of royalty agreements.

#### Research revenue

When the outcome of a research can be estimated reliably, research revenue and research costs associated with the research are recognised with reference to the stage of completion of the research at the reporting date. The stage of completion is determined using costs or scientific estimate and or milestone achieved as set in the project.

An expected loss on research is recognised in the statement of financial performance immediately.

When the outcome of research cannot be estimated reliably, revenue is recognised only to the extent of research costs incurred for which it is probable that the costs will be recovered. Research costs are recognised as expenses in the period they are incurred.

#### Excess farm produce revenue

Revenue is recognised when significant risks and rewards of ownership are transferred to the buyer, when costs can be measured reliably and when receipt of the future economic benefits is probable.

#### Other income

Other income is income that does not come from the entity’s main business. Other income comprises tender sales, blood vaccine sales, recoveries and other ad hoc income.

Revenue is recognised when significant risks and rewards of ownership are transferred to the buyer, when costs can be measured reliably and when receipt of the future economic benefits is probable.

#### Sale of goods

Revenue from the sale of goods is recognised when all the following conditions have been satisfied:

- the entity has transferred to the purchaser the significant risks and rewards of ownership of the goods;
- the entity retains neither continuing managerial involve-
ment to the degree usually associated with ownership nor effective control over the goods sold;
• the amount of revenue can be measured reliably;
• it is probable that the economic benefits or service potential associated with the transaction will flow to the entity; and,
• the costs incurred or to be incurred in respect of the transaction can be measured reliably.

Rendering of services
When the outcome of a transaction involving the rendering of services can be estimated reliably, revenue associated with the transaction is recognised by reference to the stage of completion of the transaction at the reporting date. The outcome of a transaction can be estimated reliably when all the following conditions are satisfied:
• the amount of revenue can be measured reliably;
• it is probable that the economic benefits or service potential associated with the transaction will flow to the entity;
• the stage of completion of the transaction at the reporting date can be measured reliably; and,
• the costs incurred for the transaction and the costs to complete the transaction can be measured reliably.

When the outcome of a research can be estimated reliably, research revenue and research costs associated with the research are recognised with reference to the stage of completion of the research at the reporting date. The stage of completion is determined using costs or scientific estimate and or milestone achieved as set in the project.

An expected loss on research is recognised in the statement of financial performance immediately.

When the outcome of research cannot be estimated reliably, revenue is recognised only to the extent of research costs incurred for which it is probable that the costs will be recovered. Research costs are recognised as expenses in the period they are incurred.

Interest, royalties and dividends
Revenue arising from the use by others of entity assets yielding interest, royalties and dividends or similar distributions is recognised when:

• It is probable that the economic benefits or service potential associated with the transaction will flow to the entity, and,
• The amount of the revenue can be measured reliably.

Interest is recognised, in surplus or deficit, using the effective interest rate method as it accrues.

Royalties are recognised as they are earned in accordance with the substance of the relevant agreements.

Dividends or similar distributions are recognised, in surplus or deficit, when the entity’s right to receive payment has been established.

1.20 Revenue from non exchange transactions
Revenue received from conditional grants, donations and funding are recognised as revenue at fair value of the consideration received to the extent that the entity has complied with any of the criteria, conditions or obligations embodied in the agreement. To the extent that the criteria, conditions or obligations have not been met a liability is recognised.

Non exchange transactions are transactions that are not exchange transactions. In a non exchange transaction, an entity either receives value from another entity without directly giving approximately equal value in exchange, or gives value to another entity without directly receiving approximately equal value in exchange.

Government grants are recognised when it is probable that future economic benefits will flow to the public entity and these benefits can be measured reliably. The grants are recognised as income to the extent that there are no further obligations arising from the receipt of the grants.

Recognition
Government grants received for the purpose of giving immediate financial support with no future related costs are recognised as revenue in the period in which they become receivable. Government grants relating to specific expenditure are recognised in the year during which the expenses are incurred.

Measurement
Revenue from a non exchange transaction is measured at the amount of the increase in net assets recognised by the entity.

1.21 Translation of foreign currencies

Foreign currency transactions
A foreign currency transaction is recorded, on initial recognition in Rands, by applying to the foreign currency amount the spot exchange rate between the functional currency and the foreign currency at the date of the transaction.

At each reporting date:
• foreign currency monetary items are translated using the closing rate;
• non monetary items that are measured in terms of historical cost in a foreign currency are translated using the exchange rate at the date of the transaction; and
• non monetary items that are measured at fair value in a foreign currency are translated using the exchange rates at the date when the fair value was determined.
Exchange differences arising on the settlement of monetary items or on translating monetary items at rates different from those at which they were translated on initial recognition during the period or in previous annual financial statements are recognised in surplus or deficit in the period in which they arise. When a gain or loss on a non monetary item is recognised directly in net assets, any exchange component of that gain or loss is recognised directly in net assets. When a gain or loss on a non monetary item is recognised in surplus or deficit, any exchange component of that gain or loss is recognised in surplus or deficit. Cash flows arising from transactions in a foreign currency are recorded in Rands by applying to the foreign currency amount the exchange rate between the Rand and the foreign currency at the date of the cash flow.

1.22 Insurance reserve

In terms of the ARC policy to cover a portion of vehicle, non vehicle, stated benefits and fire and allied perils insurance claims, a risk assessment is made annually in conjunction with the insurance brokers in order to determine the extent of the self insured amount to be credited to the reserve. In determining the amount to be credited, the principle of maximum insurance cover at the lowest possible cost is applied. The portion of claims borne by the ARC is accounted for against the reserve. Any shortfalls on the reserve are written off against income in the year in which it originated and any surplus is carried over to the following year.

1.23 Comparative figures

Where necessary, comparative figures have been reclassified to conform to changes in presentation in the current year.

1.24 Fruitless and wasteful expenditure

Fruitless and wasteful expenditure means expenditure which was made in vain and would have been avoided had reasonable care been exercised. All expenditure relating to fruitless and wasteful expenditure is recognised as an expense in the statement of financial performance in the year that the expenditure was incurred. The expenditure is classified in accordance with the nature of the expense, and where recovered, it is subsequently accounted for as revenue in the statement of financial performance.

1.25 Irregular expenditure

Irregular expenditure as defined in section 1 of the PFMA is expenditure other than unauthorised expenditure, incurred in contravention of or that is not in accordance with a requirement of any applicable legislation, including

(a) this Act; or
(b) the State Tender Board Act, 1968 (Act No. 86 of 1968), or any regulations made in terms of the Act; or
(c) any provincial legislation providing for procurement procedures in that provincial government.

Irregular expenditure that was incurred and identified during the current financial and which was condoned before year end and/or before finalisation of the financial statements must also be recorded appropriately in the irregular expenditure register. In such an instance, no further action is also required with the exception of updating the note to the financial statements.

Irregular expenditure that was incurred and identified during the current financial year and for which condonement is being awaited at year end must be recorded in the irregular expenditure register. No further action is required with the exception of updating the note to the financial statements. Where irregular expenditure was incurred in the previous financial year and is only condoned in the following financial year, the register and the disclosure note to the financial statements must be updated with the amount condoned.

Irregular expenditure that was incurred and identified during the current financial year and which was not condoned by the National Treasury or the relevant authority must be recorded appropriately in the irregular expenditure register. If liability for the irregular expenditure can be attributed to a person, a debt account must be created if such a person is liable in law. Immediate steps must thereafter be taken to recover the amount from the person concerned. If recovery is not possible, the accounting officer or accounting authority may write off the amount as debt impairment and disclose such in the relevant note to the financial statements. The irregular expenditure register must also be updated accordingly. If the irregular expenditure has not been condoned and no person is liable in law, the expenditure related thereto must remain against the relevant programme/expenditure item, be disclosed as such in the note to the financial statements and updated accordingly in the irregular expenditure register.

1.26 Segment information

A segment is an activity of an entity:

• that generates economic benefits or service potential (including economic benefits or service potential relating to transactions between activities of the same entity);
• whose results are regularly reviewed by management to make decisions about resources to be allocated to that activity and in assessing its performance; and,
• for which separate financial information is available.

Reportable segments are the actual segments which are reported on in the segment report. They are the segments identified above or alternatively an aggregation of two or more of those segments where the aggregation criteria are met.

Measurement
The amount of each segment item reported is the measure reported to management for the purposes of making decisions about allocating resources to the segment and assessing its performance. Adjustments and eliminations made in preparing the entity’s financial statements and allocations of revenues and expenses are included in determining reported segment surplus or deficit only if they are included in the measure of the segment’s surplus or deficit that is used by management. Similarly, only those assets and liabilities that are included in the measures of the segment’s assets and segment’s liabilities that are used by management are reported for that segment. If amounts are allocated to reported segment surplus or deficit, assets or liabilities, those amounts are allocated on a reasonable basis.

If management uses only one measure of a segment’s surplus or deficit, the segment’s assets or the segment’s liabilities in assessing segment performance and deciding how to allocate resources, segment surplus or deficit, assets and liabilities are reported in terms of that measure. If management uses more than one measure of a segment’s surplus or deficit, the segment’s assets or the segment’s liabilities, the reported measures are those that management believes are determined in accordance with the measurement principles most consistent with those used in measuring the corresponding amounts in the entity’s financial statements.

1.27 Budget information

Entity are typically subject to budgetary limits in the form of appropriations or budget authorisations (or equivalent), which is given effect through authorising legislation, appropriation or similar. General purpose financial reporting by entity shall provide information on whether resources were obtained and used in accordance with the legally adopted budget. The approved budget is prepared on an accrual basis and presented by economic classification linked to performance outcome objectives. The budget for the economic entity includes all the entities approved budgets under its control. The annual financial statements and the budget are on the same basis of accounting therefore a comparison with the budgeted amounts for the reporting period have been included in the Statement of comparison of budget and actual amounts.

1.28 Related parties

A related party is a person or an entity with the ability to control or jointly control the other party, or exercise significant influence over the other party, or vice versa, or an entity that is subject to common control, or joint control. Control is the power to govern the financial and operating policies of an entity so as to obtain benefits from its activities. Joint control is the agreed sharing of control over an activity by a binding arrangement, and exists only when the strategic financial and operating decisions relating to the activity require the unanimous consent of the parties sharing control (the venturers). Related party transaction is a transfer of resources, services or obligations between the reporting entity and a related party, regardless of whether a price is charged. Significant influence is the power to participate in the financial and operating policy decisions of an entity, but is not control over those policies.

Management are those persons responsible for planning, directing and controlling the activities of the entity, including those charged with the governance of the entity in accordance with legislation, in instances where they are required to perform such functions. Close members of the family of a person are considered to be those family members who may be expected to influence, or be influenced by, that management in their dealings with the entity.

The entity is exempt from disclosure requirements in relation to related party transactions if that transaction occurs within normal supplier and/or client/recipient relationships on terms and conditions no more or less favourable than those which it is reasonable to expect the entity to have adopted if dealing with that individual entity or person in the same circumstances and terms and conditions are within the normal operating parameters established by that reporting entity’s legal mandate.

Where the entity is exempt from the disclosures in accordance with the above, the entity discloses narrative information about the nature of the transactions and the related outstanding balances, to enable users of the entity’s financial statements to understand the effect of related party transactions on its annual financial statements.

1.29 Events after reporting date

Events after reporting date are those events, both favourable and unfavourable, that occur between the reporting date and the date when the financial statements are authorised for issue.

Two types of events can be identified:

- those that provide evidence of conditions that existed at the reporting date (adjusting events after the reporting date); and,
- those that are indicative of conditions that arose after the reporting date (non adjusting events after the reporting date).

The entity will adjust the amount recognised in the financial statements to reflect adjusting events after the reporting date once the event occurred.

The entity will disclose the nature of the event and an estimate of its financial effect or a statement that such estimate cannot be made in respect of all material non adjusting events, where non disclosure could influence the economic decisions of users taken on the basis of the financial statements.
### NEW STANDARDS AND INTERPRETATIONS

#### Standards and interpretations issued, but not yet effective

The entity has not applied the following standards and interpretations, which have been published and are mandatory for the entity’s accounting periods beginning on or after 01 April 2019 or later periods:

<table>
<thead>
<tr>
<th>Standard/ Interpretation:</th>
<th>Effective date: Years beginning on or after</th>
<th>Expected impact:</th>
</tr>
</thead>
<tbody>
<tr>
<td>GRAP 34: Separate Financial Statements</td>
<td>01 April 2020</td>
<td>Unlikely there will be a material impact</td>
</tr>
<tr>
<td>GRAP 104 (revised): Financial Instruments</td>
<td>01 April 2019</td>
<td>Unlikely there will be a material impact</td>
</tr>
<tr>
<td>GRAP 35: Consolidated Financial Statements</td>
<td>01 April 2020</td>
<td>Unlikely there will be a material impact</td>
</tr>
<tr>
<td>GRAP 36: Investments in Associates and Joint Ventures</td>
<td>01 April 2020</td>
<td>Unlikely there will be a material impact</td>
</tr>
<tr>
<td>GRAP 37: Joint Arrangements</td>
<td>01 April 2020</td>
<td>Unlikely there will be a material impact</td>
</tr>
<tr>
<td>GRAP 38: Disclosure of Interests in Other Entities</td>
<td>01 April 2020</td>
<td>Unlikely there will be a material impact</td>
</tr>
<tr>
<td>GRAP 110 (as amended 2016): Living and Non living Resources</td>
<td>01 April 2020</td>
<td>Unlikely there will be a material impact</td>
</tr>
<tr>
<td>GRAP 20: Related parties</td>
<td>01 April 2019</td>
<td>Unlikely there will be a material impact</td>
</tr>
<tr>
<td>GRAP 32: Service Concession Arrangements: Grantor</td>
<td>01 April 2019</td>
<td>Unlikely there will be a material impact</td>
</tr>
<tr>
<td>GRAP 108: Statutory Receivables</td>
<td>01 April 2019</td>
<td>Unlikely there will be a material impact</td>
</tr>
<tr>
<td>GRAP 109: Accounting by Principals and Agents</td>
<td>01 April 2019</td>
<td>Unlikely there will be a material impact</td>
</tr>
</tbody>
</table>

### REVENUE

<table>
<thead>
<tr>
<th>Income</th>
<th>2019</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sale of goods</td>
<td>20 173 801</td>
<td>28 023 199</td>
</tr>
<tr>
<td>Rendering of services</td>
<td>278 156 712</td>
<td>320 691 618</td>
</tr>
<tr>
<td>Royalty income</td>
<td>33 697 316</td>
<td>16 806 185</td>
</tr>
<tr>
<td>Rental of facilities and equipment</td>
<td>22 589 348</td>
<td>19 733 321</td>
</tr>
<tr>
<td>Other income</td>
<td>22 717 399</td>
<td>23 212 290</td>
</tr>
<tr>
<td>Interest received</td>
<td>7 218 048</td>
<td>3 968 110</td>
</tr>
<tr>
<td>Dividends received</td>
<td>703 193</td>
<td>288 892</td>
</tr>
<tr>
<td>Government grants</td>
<td>929 050 029</td>
<td>895 496 669</td>
</tr>
</tbody>
</table>

**Total Revenues:**

- **2019:** 1 314 305 846
- **2018:** 1 308 220 284
The amount included in revenue arising from exchanges of goods or services are as follows:

<table>
<thead>
<tr>
<th>Description</th>
<th>2019</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sale of goods</td>
<td>20 173 801</td>
<td>28 023 199</td>
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<tr>
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<td>278 156 712</td>
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</tr>
<tr>
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<td>7 218 048</td>
<td>3 968 110</td>
</tr>
<tr>
<td>Dividends received</td>
<td>703 193</td>
<td>288 892</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>385 255 817</strong></td>
<td><strong>412 723 615</strong></td>
</tr>
</tbody>
</table>

The amount included in revenue arising from non exchange transactions is as follows:

<table>
<thead>
<tr>
<th>Description</th>
<th>2019</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transfer revenue</td>
<td>929 050 029</td>
<td>895 496 669</td>
</tr>
<tr>
<td>Government grants</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. **INVESTMENT REVENUE**

<table>
<thead>
<tr>
<th>Description</th>
<th>2019</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dividend revenue</td>
<td>703 193</td>
<td>288 892</td>
</tr>
<tr>
<td>Interest revenue</td>
<td>7 218 048</td>
<td>3 968 110</td>
</tr>
<tr>
<td>Bank</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>7 921 241</strong></td>
<td><strong>4 257 002</strong></td>
</tr>
</tbody>
</table>

Compared to the prior year, the dividends received increased mainly as a result of La Concorde Holdings declaring a dividend in specie.

5. **GOVERNMENT GRANTS**

<table>
<thead>
<tr>
<th>Description</th>
<th>2019</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating grants</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Government grant</td>
<td>832 653 553</td>
<td>798 020 509</td>
</tr>
<tr>
<td>Capital grants</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Government grant</td>
<td>96 396 476</td>
<td>97 476 160</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>929 050 029</strong></td>
<td><strong>895 496 669</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Description</th>
<th>2019</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conditional and Unconditional</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Included in above are the following grants received:

Included in the capital grant is R600 476 (2018: R6 138 169) that relate the conditional grant specifically and exclusively allocated for the construction of the FMD facility.
6. OPERATING DEFICIT

Operating deficit for the year is stated after accounting for the following:

**Remuneration, other than to employees, for:**

<table>
<thead>
<tr>
<th>Description</th>
<th>2019</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Council remuneration</td>
<td>1 708 596</td>
<td>1 708 054</td>
</tr>
<tr>
<td>Audit committee remuneration</td>
<td>352 803</td>
<td>290 763</td>
</tr>
<tr>
<td>External auditors remuneration</td>
<td>6 229 376</td>
<td>5 480 911</td>
</tr>
<tr>
<td>Internal auditors remuneration</td>
<td>1 134 816</td>
<td>1 504 677</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>9 425 591</strong></td>
<td><strong>8 984 405</strong></td>
</tr>
</tbody>
</table>

**Operating lease charges**

**Premises**
- Contractual amounts: 1 045 034, 882 205

**Motor vehicles**
- Contingent amounts: 7 007, 27 750

**Equipment**
- Contractual amounts: 22 474 937, 20 233 385

**(Loss)/gain on sale of property, plant and equipment**
- 401 120, (149 913)

**Amortisation on intangible assets**
- 7 073 639, 6 974 382

**Impairment on other financial assets**
- 41 095 673, 24 342 664

**Impairment on trade and other receivables**
- 36 554 041, 38 004 527

**Depreciation on property, plant and equipment**
- 820 446 617, 805 577 985

**Employee costs**
- 59 630 132, 100 702 958

7. OPERATING AND ADMINISTRATIVE EXPENSES

<table>
<thead>
<tr>
<th>Description</th>
<th>2019</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advertising</td>
<td>2 806 229</td>
<td>851 436</td>
</tr>
<tr>
<td>Animal feed</td>
<td>8 528 757</td>
<td>11 213 361</td>
</tr>
<tr>
<td>Auditors remuneration</td>
<td>7 046 206</td>
<td>5 783 980</td>
</tr>
<tr>
<td>Bank charges</td>
<td>765 990</td>
<td>882 545</td>
</tr>
<tr>
<td>Cleaning</td>
<td>9 072 408</td>
<td>9 377 812</td>
</tr>
<tr>
<td>Computer expenses</td>
<td>21 866 138</td>
<td>23 597 015</td>
</tr>
<tr>
<td>Entertainment</td>
<td>1 769</td>
<td>8 949</td>
</tr>
<tr>
<td>Conferences and seminars</td>
<td>595 180</td>
<td>1 521 485</td>
</tr>
<tr>
<td>Consulting and professional fees</td>
<td>35 590 076</td>
<td>31 177 150</td>
</tr>
<tr>
<td>Fleet</td>
<td>11 329 683</td>
<td>10 131 149</td>
</tr>
<tr>
<td>Fuel and oil</td>
<td>5 556 407</td>
<td>4 846 922</td>
</tr>
<tr>
<td>General expense</td>
<td>25 089 571</td>
<td>26 710 183</td>
</tr>
<tr>
<td>Insurance</td>
<td>2 875 221</td>
<td>4 495 656</td>
</tr>
<tr>
<td>Magazines, books and periodicals</td>
<td>9 913 449</td>
<td>11 214 187</td>
</tr>
<tr>
<td>Marketing</td>
<td>1 174 711</td>
<td>1 111 576</td>
</tr>
</tbody>
</table>
Figures in Rand

<table>
<thead>
<tr>
<th></th>
<th>2019</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pest control</td>
<td>4 271 848</td>
<td>3 236 789</td>
</tr>
<tr>
<td>Plants</td>
<td>2 709 639</td>
<td>4 487 301</td>
</tr>
<tr>
<td>Postage and courier</td>
<td>822 588</td>
<td>844 696</td>
</tr>
<tr>
<td>Printing and stationery</td>
<td>3 388 213</td>
<td>4 787 709</td>
</tr>
<tr>
<td>Protective clothing</td>
<td>1 773 968</td>
<td>1 795 315</td>
</tr>
<tr>
<td>Research and development costs</td>
<td>59 630 132</td>
<td>100 702 958</td>
</tr>
<tr>
<td>Scrapping of fixed assets</td>
<td>1 363 881</td>
<td>2 544 975</td>
</tr>
<tr>
<td>Security</td>
<td>20 434 908</td>
<td>17 529 893</td>
</tr>
<tr>
<td>Staff welfare</td>
<td>6 702 110</td>
<td>14 364 994</td>
</tr>
<tr>
<td>Telephone and fax</td>
<td>4 866 545</td>
<td>6 111 563</td>
</tr>
<tr>
<td>Transport and freight</td>
<td>8 673 707</td>
<td>8 024 243</td>
</tr>
<tr>
<td>Travel local</td>
<td>24 822 314</td>
<td>22 081 636</td>
</tr>
<tr>
<td>Travel overseas</td>
<td>11 705 099</td>
<td>16 498 871</td>
</tr>
<tr>
<td>Utilities</td>
<td>85 859 258</td>
<td>76 153 338</td>
</tr>
<tr>
<td></td>
<td><strong>379 236 005</strong></td>
<td><strong>422 087 687</strong></td>
</tr>
</tbody>
</table>

8. INVENTORIES

<table>
<thead>
<tr>
<th></th>
<th>2019</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finished goods</td>
<td>2 270 527</td>
<td>4 348 884</td>
</tr>
<tr>
<td>Forage</td>
<td>1 158 233</td>
<td>985 207</td>
</tr>
<tr>
<td>Livestock</td>
<td>10 970 294</td>
<td>9 354 80</td>
</tr>
<tr>
<td>Consumable stores</td>
<td>4 476 439</td>
<td>5 033 675 8</td>
</tr>
<tr>
<td></td>
<td><strong>18 875 493</strong></td>
<td><strong>19 722 574</strong></td>
</tr>
</tbody>
</table>

9. RECEIVABLES FROM EXCHANGE TRANSACTIONS

<table>
<thead>
<tr>
<th></th>
<th>2019</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trade debtors</td>
<td>144 200 672</td>
<td>175 732 833</td>
</tr>
<tr>
<td>Staff debtors</td>
<td>13 552 077</td>
<td>15 964 806</td>
</tr>
<tr>
<td>Deposits</td>
<td>1 077 558</td>
<td>1 063 273</td>
</tr>
<tr>
<td>Prepaid expenses</td>
<td>3 263 990</td>
<td>2 003 521</td>
</tr>
<tr>
<td>Other debtors*</td>
<td>7 087 440</td>
<td>5 183 306</td>
</tr>
<tr>
<td></td>
<td><strong>169 181 737</strong></td>
<td><strong>199 947 739</strong></td>
</tr>
</tbody>
</table>

Trade receivables are shown net of impairment losses.

Trade receivables are stated at amortised cost.

Of the receivables balance as at 31 March 2019, R83 million is due from the largest customer Department of Fisheries and Forestry and R27 million is due from the second largest customer Department of Rural Development and Land Reforms and R26 million is due from the third largest customer Department of Environmental Affairs, the fourth largest customer National Research Foundation and fifth largest customer Entsika Consulting Services (Pty) Ltd owe 3% and 4% of the total balance of the trade receivables. There are no other debtors who represent more than 4% of the total balance of the trade receivables.

Staff debtors are made up of travel advances. These are recovered on a monthly basis by employees paying back the amount owed or ARC deducting the amount owed from the employees’ salary.
Of the R157 million in 150 days R119 million is due from the three major customers who are government department. In line with our credit policy, amounts due from government for more than a year will be assessed annually for impairment.

Credit quality of trade and other receivables
The credit quality of trade and other receivables that are neither past nor due nor impaired can be assessed by reference to external credit ratings (if available) or to historical information about counterparty default rates:

Trade and other receivables past due but not impaired
The ageing of amounts past due but not impaired is as follows:

<table>
<thead>
<tr>
<th></th>
<th>2019</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>60 days</td>
<td>1 816 389</td>
<td>1 248 179</td>
</tr>
<tr>
<td>90 days</td>
<td>6 015 184</td>
<td>110 583</td>
</tr>
<tr>
<td>120 days</td>
<td>1 472 007</td>
<td>143 261</td>
</tr>
<tr>
<td>150+ days</td>
<td>87 856 062</td>
<td>65 688 634</td>
</tr>
<tr>
<td>Total</td>
<td>97 159 642</td>
<td>67 190 657</td>
</tr>
</tbody>
</table>

Reconciliation of provision for impairment of trade and other receivables
As at 31 March 2019, receivables at nominal value of R75 045 024 (2018: R39 459 340) were impaired and provided for. Receivables that are past due and not impaired represent slow paying clients. Although a significant balance is due from three largest customers these customers are not provided for as the risk of non payment is regarded to be low. Movements in the provision for impairment of receivables were as follows:

<table>
<thead>
<tr>
<th></th>
<th>2019</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opening balance</td>
<td>39 459 340</td>
<td>15 248 980</td>
</tr>
<tr>
<td>Provision for impairment</td>
<td>40 888 017</td>
<td>24 210 360</td>
</tr>
<tr>
<td>Amounts written off as uncollectible</td>
<td>(5 302 333)</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>75 045 024</td>
<td>39 459 340</td>
</tr>
</tbody>
</table>

The receivables impairment was estimated based on irrecoverable amounts and reference to the past default. Other than the concentration mentioned above, credit risk is limited due to customer base being large and unrelated. Accordingly Council members believe that there is no further impairment provision required in excess of the current allowance for doubtful debts.

10. CASH AND CASH EQUIVALENTS

Cash and cash equivalents consist of:

<table>
<thead>
<tr>
<th></th>
<th>2019</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bank balances</td>
<td>46 939 171</td>
<td>58 980 455</td>
</tr>
<tr>
<td>Short term deposits</td>
<td>29 409 008</td>
<td>9 323 028</td>
</tr>
<tr>
<td>Total</td>
<td>76 348 179</td>
<td>68 303 483</td>
</tr>
</tbody>
</table>

The total unsecured credit facilities granted to ARC relate to fleet management cards. The facility as at 31 March 2019 was R1,2 million (2018: R1,2 million).
11. INVESTMENT PROPERTY

<table>
<thead>
<tr>
<th></th>
<th>2019</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cost/Valuation</td>
<td>Accumulated depreciation and accumulated impairment</td>
</tr>
<tr>
<td>Investment property</td>
<td>125 435</td>
<td>(26 787)</td>
</tr>
</tbody>
</table>

Reconciliation of investment property

<table>
<thead>
<tr>
<th></th>
<th>2019</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Opening balance</td>
<td>Total</td>
</tr>
<tr>
<td>Investment property</td>
<td>98 648</td>
<td>98 648</td>
</tr>
</tbody>
</table>

This investment property is located in the Eastern Cape province, Queenstown and is being let out to the South African Police Service for rental income.

Details of valuation

The effective date of the revaluations was Tuesday, 30 April 2013. Revaluations were performed by an independent valuer, Ms Penny Lindstrom [Professional Valuer and Appraiser], of Penny Lindstrom Valuations. Ms Penny Lindstrom is not connected to the entity and have recent experience in location and category of the property being valued.

The valuation was based on open market value for existing use.

These assumptions are based on current market conditions.

Amounts recognised in surplus and deficit for the year.

Investment property located in (a foreign country: specify) is governed by that country’s exchange controls and therefore the rental income and proceeds from any sale of that investment property are not available to the entity:

Amounts recognised in surplus or deficit

Rental revenue from Investment property 256 185 252 714

There were no repairs and maintenance effected on investment property.
## 12. PROPERTY, PLANT AND EQUIPMENT

<table>
<thead>
<tr>
<th></th>
<th>2019</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cost/Valuation</td>
<td>Accumulated depreciation and accumulated impairment</td>
</tr>
<tr>
<td>Land</td>
<td>120 620 673</td>
<td>(5 012 085)</td>
</tr>
<tr>
<td>Buildings</td>
<td>556 193 325</td>
<td>(153 376 350)</td>
</tr>
<tr>
<td>Machinary and farming equipment</td>
<td>124 272 540</td>
<td>(46 567 991)</td>
</tr>
<tr>
<td>Office furniture and equipment</td>
<td>41 065 079</td>
<td>(31 984 508)</td>
</tr>
<tr>
<td>Motor vehicles and aircraft</td>
<td>89 908 790</td>
<td>(62 991 473)</td>
</tr>
<tr>
<td>Computer equipment</td>
<td>81 497 504</td>
<td>(48 591 118)</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>71 838 248</td>
<td>(7 412 726)</td>
</tr>
<tr>
<td>Laboratory equipment</td>
<td>418 352 302</td>
<td>(152 896 975)</td>
</tr>
<tr>
<td>Assets under construction</td>
<td>62 786 068</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1 566 534 529</strong></td>
<td><strong>(508 833 226)</strong></td>
</tr>
</tbody>
</table>

### Reconciliation of property, plant and equipment - 2019

<table>
<thead>
<tr>
<th></th>
<th>Opening balance</th>
<th>Additions</th>
<th>Additions through transfer of functions / mergers</th>
<th>Disposals</th>
<th>Other movements</th>
<th>Transfers</th>
<th>Scrapping loss</th>
<th>Depreciation</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land</td>
<td>115 608 588</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>115 608 588</td>
</tr>
<tr>
<td>Buildings</td>
<td>396 096 567</td>
<td>3 980 739</td>
<td>1 403 869</td>
<td>(10 862)</td>
<td>1 884 858</td>
<td>2 452 198</td>
<td>(313 385)</td>
<td>(2 677 009)</td>
<td>402 816 975</td>
</tr>
<tr>
<td>Machinary and farming equipment</td>
<td>76 800 877</td>
<td>5 931 223</td>
<td>79 448</td>
<td>(73 781)</td>
<td>114 716</td>
<td>94 421</td>
<td>(659 035)</td>
<td>(4 583 320)</td>
<td>77 704 549</td>
</tr>
<tr>
<td>Office furniture and equipment</td>
<td>10 017 546</td>
<td>720 154</td>
<td>8 202</td>
<td>(7 069)</td>
<td>(37 799)</td>
<td>-</td>
<td>(91 493)</td>
<td>(1 528 970)</td>
<td>9 080 571</td>
</tr>
<tr>
<td>Motor vehicles and aircraft</td>
<td>32 094 182</td>
<td>2 971 381</td>
<td>10 370</td>
<td>(200 127)</td>
<td>(508 926)</td>
<td>-</td>
<td>(375 428)</td>
<td>(7 074 135)</td>
<td>26 917 317</td>
</tr>
<tr>
<td>Computer equipment</td>
<td>32 312 294</td>
<td>3 663 014</td>
<td>88 778</td>
<td>-</td>
<td>(157 259)</td>
<td>-</td>
<td>(30 815)</td>
<td>(2 969 526)</td>
<td>32 906 386</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>47 014 905</td>
<td>18 120 747</td>
<td>103 710</td>
<td>-</td>
<td>(1 213 912)</td>
<td>1 833 525</td>
<td>(132 443)</td>
<td>(1 301 010)</td>
<td>64 425 522</td>
</tr>
<tr>
<td>Laboratory equipment</td>
<td>261 281 461</td>
<td>20 994 358</td>
<td>-</td>
<td>(39 667)</td>
<td>279 251</td>
<td>-</td>
<td>(640 011)</td>
<td>(16 420 065)</td>
<td>265 455 327</td>
</tr>
<tr>
<td>Assets under construction</td>
<td>58 433 552</td>
<td>8 732 660</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>(4 380 144)</td>
<td>-</td>
<td>-</td>
<td>62 786 068</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1 029 659 972</strong></td>
<td><strong>65 114 276</strong></td>
<td><strong>1 694 377</strong></td>
<td><strong>(331 506)</strong></td>
<td><strong>360 929</strong></td>
<td>-</td>
<td><strong>(2 242 710)</strong></td>
<td><strong>(36 554 035)</strong></td>
<td><strong>1 057 701 303</strong></td>
</tr>
</tbody>
</table>
**Reconciliation of property, plant and equipment - 2018**

<table>
<thead>
<tr>
<th></th>
<th>Cost/Valuation</th>
<th>Additions</th>
<th>Disposals</th>
<th>Transfers</th>
<th>Scrapping loss</th>
<th>Depreciation</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Land</strong></td>
<td>115 608 588</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>115 608 588</td>
</tr>
<tr>
<td><strong>Buildings</strong></td>
<td>379 822 163</td>
<td>6 615 080</td>
<td>-</td>
<td>13 832 582</td>
<td>(1 945 994)</td>
<td>(2 227 264)</td>
<td>396 096 567</td>
</tr>
<tr>
<td><strong>Machinery and farming equipment</strong></td>
<td>67 361 653</td>
<td>12 846 219</td>
<td>-</td>
<td>1 315 057</td>
<td>(72 241)</td>
<td>(4 649 811)</td>
<td>76 800 877</td>
</tr>
<tr>
<td><strong>Office furniture and equipment</strong></td>
<td>10 182 807</td>
<td>1 651 205</td>
<td>-</td>
<td>-</td>
<td>(29 805)</td>
<td>(1 786 661)</td>
<td>10 017 546</td>
</tr>
<tr>
<td><strong>Motor vehicles and aircraft</strong></td>
<td>36 024 975</td>
<td>3 741 947</td>
<td>(143 603)</td>
<td>-</td>
<td>(92 672)</td>
<td>(7 436 465)</td>
<td>32 094 182</td>
</tr>
<tr>
<td><strong>Computer equipment</strong></td>
<td>33 194 606</td>
<td>3 915 808</td>
<td>(115 400)</td>
<td>622 800</td>
<td>(108 064)</td>
<td>(5 197 456)</td>
<td>32 312 294</td>
</tr>
<tr>
<td><strong>Infrastructure</strong></td>
<td>40 048 496</td>
<td>7 968 897</td>
<td>-</td>
<td>128 000</td>
<td>(29 402)</td>
<td>(1 101 086)</td>
<td>47 014 905</td>
</tr>
<tr>
<td><strong>Laboratory equipment</strong></td>
<td>248 789 800</td>
<td>28 753 959</td>
<td>(340 213)</td>
<td>-</td>
<td>(316 301)</td>
<td>(15 605 784)</td>
<td>261 281 461</td>
</tr>
<tr>
<td><strong>Assets under construction</strong></td>
<td>66 357 301</td>
<td>7 974 690</td>
<td>-</td>
<td>(15 898 439)</td>
<td>-</td>
<td>-</td>
<td>58 433 552</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>997 390 389</td>
<td>73 467 805</td>
<td>(599 216)</td>
<td>-</td>
<td>(2 594 479)</td>
<td>(38 004 527)</td>
<td>1 029 659 972</td>
</tr>
</tbody>
</table>

**Pledged as security**

Land and buildings are unencumbered and full details of the titles are available at the registered office of the ARC.

**Other information:**

**Property, plant and equipment fully depreciated and still in use (Gross carrying amount)**

- **Buildings**: 25 782 156 / 30 784 480
- **Computer equipment**: 42 156 478 / 38 630 996
- **Infrastructure**: 1 273 008 / 1 270 438
- **Laboratory equipment**: 27 369 722 / 21 518 637
- **Machinery and farming equipment**: 11 811 834 / 11 063 107
- **Motor vehicles and aircraft**: 33 380 637 / 24 323 838
- **Office furniture and equipment**: 23 382 128 / 21 518 637

Some fully depreciated assets are still in use and due to budget constraints they have not been replaced.

**Reconciliation of Work in Progress - 2019**

<table>
<thead>
<tr>
<th></th>
<th>Buildings</th>
<th>Computer equipment</th>
<th>Infrastructure</th>
<th>*Other PPE</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Opening balance</strong></td>
<td>56 566 457</td>
<td>-</td>
<td>1 615 827</td>
<td>251 269</td>
<td>58 433 553</td>
</tr>
<tr>
<td><strong>Additions/capital expenditure</strong></td>
<td>6 605 203</td>
<td>579 341</td>
<td>1 503 292</td>
<td>94 421</td>
<td>8 782 257</td>
</tr>
<tr>
<td><strong>Other movements</strong></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>(2 965)</td>
<td>(2 965)</td>
</tr>
<tr>
<td><strong>Transferred to completed items</strong></td>
<td>(2 452 198)</td>
<td>-</td>
<td>(1 883 525)</td>
<td>(94 421)</td>
<td>(4 430 144)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>60 719 462</td>
<td>579 341</td>
<td>1 235 594</td>
<td>251 269</td>
<td>62 785 666</td>
</tr>
</tbody>
</table>
### Reconciliation of Work in Progress - 2018

<table>
<thead>
<tr>
<th></th>
<th>Buildings</th>
<th>Computer equipment</th>
<th>Infrastructure</th>
<th>*Other PPE</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opening balance</td>
<td>64 520 014</td>
<td>538 358</td>
<td>(270 363)</td>
<td>1 569 291</td>
<td>66 357 300</td>
</tr>
<tr>
<td>Additions/capital expenditure</td>
<td>13 954 923</td>
<td>84 442</td>
<td>2 014 190</td>
<td>-</td>
<td>16 053 555</td>
</tr>
<tr>
<td>Other movements</td>
<td>(8 380 781)</td>
<td>-</td>
<td>-</td>
<td>(2 965)</td>
<td>(8 383 746)</td>
</tr>
<tr>
<td>Transferred to completed items</td>
<td>(13 527 699)</td>
<td>(622 800)</td>
<td>(128 000)</td>
<td>(1 315 057)</td>
<td>(15 593 556)</td>
</tr>
<tr>
<td></td>
<td>56 566 457</td>
<td>-</td>
<td>1 615 827</td>
<td>251 269</td>
<td>58 433 553</td>
</tr>
</tbody>
</table>

*Included in other PPE is machinery and farming equipment.

### Expenditure incurred to repair and maintain property, plant and equipment

#### Expenditure incurred to repair and maintain property, plant and equipment included in Statement of Financial Performance

- **Contracted services**
  - **2019**: 27 202 411
  - **2018**: 28 809 960

Contractual commitments for the acquisition of property, plant and equipment are included in note 27.

### 13. INTANGIBLE ASSETS

<table>
<thead>
<tr>
<th></th>
<th>2019</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cost/Valuation</td>
<td>Accumulated amortisation and accumulated impairment</td>
</tr>
<tr>
<td>Computer software</td>
<td>50 579 420</td>
<td>(27 784 282)</td>
</tr>
</tbody>
</table>

### Reconciliation of intangible assets - 2019

<table>
<thead>
<tr>
<th></th>
<th>Opening balance</th>
<th>Additions</th>
<th>Additions through transfer of functions / mergers</th>
<th>Amortisation</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer software</td>
<td>28 957 614</td>
<td>893 956</td>
<td>17 207</td>
<td>(7 073 639)</td>
<td>22 795 138</td>
</tr>
</tbody>
</table>

### Reconciliation of intangible assets - 2018

<table>
<thead>
<tr>
<th></th>
<th>Opening balance</th>
<th>Additions</th>
<th>Amortisation</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer software</td>
<td>35 465 255</td>
<td>466 741</td>
<td>(6 974 382)</td>
<td>28 957 614</td>
</tr>
</tbody>
</table>
14. HERITAGE ASSETS

<table>
<thead>
<tr>
<th></th>
<th>2019</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cost/Valuation</td>
<td>Accumulated</td>
</tr>
<tr>
<td></td>
<td></td>
<td>impairment losses</td>
</tr>
<tr>
<td>Heritage buildings</td>
<td>223 167</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>223 167</td>
<td>-</td>
</tr>
</tbody>
</table>

Reconciliation of heritage assets - 2019

<table>
<thead>
<tr>
<th></th>
<th>Opening balance</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heritage buildings</td>
<td>223 167</td>
<td>223 167</td>
</tr>
</tbody>
</table>

Reconciliation of heritage assets - 2018

<table>
<thead>
<tr>
<th></th>
<th>Opening balance</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heritage buildings</td>
<td>223 167</td>
<td>223 167</td>
</tr>
</tbody>
</table>

The Standard of GRAP on Heritage Assets (GRAP 103) became effective on 1 April 2012.

15. OTHER FINANCIAL ASSETS

Designated at fair value

<table>
<thead>
<tr>
<th></th>
<th>2019</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distell Group Holdings (Capevin unbundling) 34 027 shares at R128.83 (2018: 510 409 shares at R8.62)</td>
<td>4 383 695</td>
<td>4 399 726</td>
</tr>
<tr>
<td>La Concorde Holdings Limited (formerly KWV Holdings LTD) 51 041 shares at R3.25 (2018: 51 041 shares at R12.50)</td>
<td>165 883</td>
<td>638 013</td>
</tr>
<tr>
<td>Hosken Passenger Logistics and Rail Limited 64 955 shares at R3,80 (2018:)</td>
<td>246 829</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>4 796 407</td>
<td>5 037 739</td>
</tr>
</tbody>
</table>

Other financial assets designated at fair value are shares in JSE listed companies in which the ARC is a shareholder. The fair value of other financial assets traded in active markets is based on quoted market prices (level 1) at the statement of financial position date. The quoted market price used for financial assets held by the ARC is the closing price.
### Residual interest at cost *

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>De Doorns Winery</td>
<td>9 880</td>
<td>9 880</td>
<td>5 434</td>
<td>5 434</td>
</tr>
<tr>
<td>Lutzville 2009 Co-operative</td>
<td>107 000</td>
<td>107 000</td>
<td>1 070</td>
<td>1 070</td>
</tr>
<tr>
<td>Burpak Limited</td>
<td>1 948</td>
<td>1 948</td>
<td>1 948</td>
<td>1 948</td>
</tr>
<tr>
<td>Lutzville Vineyard Co-operative</td>
<td>44 867</td>
<td>44 867</td>
<td>44 867</td>
<td>44 867</td>
</tr>
<tr>
<td>Lutzville Vineyard Co-operative</td>
<td>1 070 000</td>
<td>1 070 000</td>
<td>10 700</td>
<td>10 700</td>
</tr>
<tr>
<td>Hex Valley Coolrooms</td>
<td>16 092</td>
<td>16 092</td>
<td>8 049</td>
<td>8 046</td>
</tr>
<tr>
<td>Mcgregor Co-operative Limited</td>
<td>93 240</td>
<td>110 320</td>
<td>93 240</td>
<td>93 240</td>
</tr>
<tr>
<td>Lanko Co-operative Limited</td>
<td>21 063</td>
<td>21 063</td>
<td>21 063</td>
<td>21 063</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>187 371</td>
<td>186 368</td>
</tr>
<tr>
<td><strong>Total other financial assets</strong></td>
<td><strong>4 982 778</strong></td>
<td><strong>5 224 107</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*These interests represent the ARC’s shareholding in wine cooperatives that the ARC was a founding member of. There is no active market for the shares which are unlisted. Management considers the carrying value of the shares to be an approximation of their fair values.

In 2018, distribution shares were unbundled to La Concorde shareholders resulting in the ARC acquiring 64 955 shares in Hosken Passenger Logistics and Rail Limited.

### 16. PAYABLES FROM EXCHANGE TRANSACTIONS

<table>
<thead>
<tr>
<th>Description</th>
<th>2019</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trade payables</td>
<td>53 844 251</td>
<td>60 970 788</td>
</tr>
<tr>
<td>Payments received in advanced contract in process</td>
<td>47 488 194</td>
<td>41 400 705</td>
</tr>
<tr>
<td>*Other payables</td>
<td>227 051 432</td>
<td>211 116 730</td>
</tr>
<tr>
<td>Accrued leave pay</td>
<td>60 281 930</td>
<td>52 559 969</td>
</tr>
<tr>
<td>Accrued audit fees</td>
<td>6 229 376</td>
<td>5 480 911</td>
</tr>
<tr>
<td></td>
<td>394 895 183</td>
<td>371 529 103</td>
</tr>
</tbody>
</table>

* Included in other payables is accruals, salary control accounts and WIP revenue. The movement is mainly due to the increase in goods received not invoiced and income received in advance.
### Figures in Rand

<table>
<thead>
<tr>
<th></th>
<th>2019</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fair value of trade and other payables</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current</td>
<td>31 836 582</td>
<td>47 169 515</td>
</tr>
<tr>
<td>Up to 60 days</td>
<td>16 240 212</td>
<td>10 712 562</td>
</tr>
<tr>
<td>90 days</td>
<td>3 375 050</td>
<td>2 452 625</td>
</tr>
<tr>
<td>91-120 days</td>
<td>1 585 412</td>
<td>111 474</td>
</tr>
<tr>
<td>121-150 days</td>
<td>515 032</td>
<td>241 185</td>
</tr>
<tr>
<td>+150 days</td>
<td>291 963</td>
<td>283 427</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>53 844 251</td>
<td>60 970 788</td>
</tr>
</tbody>
</table>

17. **PROVISIONS**

**Reconciliation of provisions - 2019**

<table>
<thead>
<tr>
<th></th>
<th>Opening balance</th>
<th>Additions</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bonus provision</td>
<td>-</td>
<td>90 469</td>
<td>90 469</td>
</tr>
</tbody>
</table>

The bonus relates to performance bonuses due to Ncera Farms employees.

18. **EMPLOYEE BENEFIT OBLIGATIONS**

**Retirement funds**

The ARC has made provision for pension and provident fund schemes covering substantially all employees. At the end of the financial year the following funds were in existence:

- ARC Pension fund (Category D), operating as a defined contribution fund
- ARC Provident fund, operating as a defined contribution fund

The ARC Pension Fund is administered by Alexander Forbes while the ARC Provident Fund is administered by Sanlam.

Members pay a contribution of 7.5%. The employer’s contribution of 16% is expensed when incurred. All funds are governed by the South African Pension Fund Act No. 24 of 1956.

**Post retirement medical aid benefits**

This includes current and past employees of ARC who are currently members of the medical aid fund. Membership to the fund is voluntary.

The Council attempted to restructure the defined medical aid scheme, in terms of which the ARC had obligations to provide certain post retirement medical aid benefits to ARC pensioners in terms of ARC service conditions, by renegotiating the benefit structuring from a medical subsidy to a guaranteed income (pension). ARC currently has no continuation members with effect from 1 April 2004.

The scheme is actuarially valued on an annual basis. The effective date of the most recent actuarial valuation was 31 March 2019. At that date, in the opinion of the actuary, the defined benefit plan was found to be in a sound financial position. The projected unit credit method has been used for purposes of determining the actuarial valuation. Change in currency or interest rate result is an insignificant change in the plan obligation.
Figures in Rand

<table>
<thead>
<tr>
<th></th>
<th>2019</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The following table summarises the components of the net benefit expense recognised in the statement of financial performance and amounts recognised in the statement of financial position at 31 March 2019. The obligation is fulfilled as the employees exit this fund.

The amount included in the statement of financial position arising from the ARC’s obligation in respect of post retirement medical benefits is as follows:

The amounts recognised in the statement of financial position are as follows:

<table>
<thead>
<tr>
<th>Carrying value</th>
<th>2019</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Present value of the defined benefit obligation wholly unfunded</td>
<td>(13 491 000)</td>
<td>(15 387 000)</td>
</tr>
</tbody>
</table>

Changes in the present value of the defined benefit obligation are as follows:

<table>
<thead>
<tr>
<th></th>
<th>2019</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opening balance</td>
<td>15 387 000</td>
<td>15 059 000</td>
</tr>
<tr>
<td>Current service cost</td>
<td>481 000</td>
<td>477 000</td>
</tr>
<tr>
<td>Interest cost</td>
<td>1 046 000</td>
<td>1 030 000</td>
</tr>
<tr>
<td>Benefits paid</td>
<td>(2 958 180)</td>
<td>(2 854 547)</td>
</tr>
<tr>
<td>Actuarial (gains) / losses</td>
<td>(464 820)</td>
<td>1 675 547</td>
</tr>
<tr>
<td></td>
<td>(13 491 000)</td>
<td>(15 387 000)</td>
</tr>
</tbody>
</table>

Key assumptions used

Assumptions used at the reporting date:

<table>
<thead>
<tr>
<th></th>
<th>2019</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discount rates used</td>
<td>6,80%</td>
<td>6,84%</td>
</tr>
<tr>
<td>Membership of the fund at 31 March</td>
<td>366</td>
<td>392</td>
</tr>
</tbody>
</table>

The nominal and real zero curves as at 31 March 2019 supplied by the JSE were used to determine the discount rates at each relevant time period.

Defined contribution funds

Employer contributions and membership for the period were as follows:

<table>
<thead>
<tr>
<th></th>
<th>2019</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>The total economic entity contribution to ARC Pension (Fund (Option D))</td>
<td>44 460 307</td>
<td>42 613 747</td>
</tr>
<tr>
<td>The total contribution to ARC Provident Fund</td>
<td>15 184 461</td>
<td>14 427 293</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>2019</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Membership</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ARC Pension Fund (Option D)</td>
<td>1 350</td>
<td>1 386</td>
</tr>
<tr>
<td>ARC Provident Fund</td>
<td>921</td>
<td>957</td>
</tr>
</tbody>
</table>

19. UNSPENT CONDITIONAL GRANTS AND RECEIPTS

These are government grants received that will be recognised in future accounting periods. Recognition in future periods will be in line with reporting standards and determined by construction work on the facilities concerned. The funds relate to the construction of the following facilities, work on which is in progress:

- The Foot and Mouth Disease (“FMD”) vaccines facility; and
- The Exotic Disease and the Wild Suide facilities.
### Movement during the year

<table>
<thead>
<tr>
<th>Description</th>
<th>2019</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balance at the beginning of the year</td>
<td>126 754 807</td>
<td>132 892 976</td>
</tr>
<tr>
<td>Income recognition during the year</td>
<td>(600 476)</td>
<td>(6 138 169)</td>
</tr>
<tr>
<td>Total</td>
<td>126 154 331</td>
<td>126 754 807</td>
</tr>
</tbody>
</table>

Of the R187 million allocated by National Treasury for the FMD project, R126m has yet to be spent. These funds for the project have not been ring fenced by the ARC and funding of future work will be financed by available cash reserves of the organisation at that point. At year end, the ARC had cash and cash equivalents of R76m to fund work on this project as well as to fund its operational requirements. The rest of the balance relates to the outstanding spending on the Exotic Decease and the Wild Suicide facilities. Similarly, these funds have not been ring fenced.

The fact that funds from the conditional grants were not ring fenced for the projects intended constitutes irregular expenditure which note 34 provides further details of.

### 20. CAPITAL FUNDS

**Issued**

- Capital fund: 111 986 013

The capital fund represents the cost of land when the ARC was transferred out of the Department of Agriculture, Forestry and Fisheries.

### 21. EMPLOYEE RELATED COSTS

<table>
<thead>
<tr>
<th>Description</th>
<th>2019</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic</td>
<td>685 265 454</td>
<td>689 619 969</td>
</tr>
<tr>
<td>Bonus</td>
<td>9 307 157</td>
<td>8 846 328</td>
</tr>
<tr>
<td>Medical aid company contributions</td>
<td>17 923 806</td>
<td>17 867 174</td>
</tr>
<tr>
<td>UIF</td>
<td>3 902 867</td>
<td>4 109 578</td>
</tr>
<tr>
<td>WCA</td>
<td>1 333 384</td>
<td>1 725 130</td>
</tr>
<tr>
<td>SDL</td>
<td>6 918 733</td>
<td>7 205 763</td>
</tr>
<tr>
<td>Leave pay provision charge</td>
<td>12 576 049</td>
<td>(6 365 609)</td>
</tr>
<tr>
<td>Employee training</td>
<td>7 014 914</td>
<td>7 475 797</td>
</tr>
<tr>
<td>Other short term costs</td>
<td>1 879 046</td>
<td>3 762 397</td>
</tr>
<tr>
<td>Defined contribution plans</td>
<td>59 645 022</td>
<td>57 039 046</td>
</tr>
<tr>
<td>Overtime payments</td>
<td>2 770 191</td>
<td>2 141 616</td>
</tr>
<tr>
<td>Long service awards</td>
<td>3 152 616</td>
<td>3 647 539</td>
</tr>
<tr>
<td>Allowances</td>
<td>8 757 378</td>
<td>8 503 257</td>
</tr>
<tr>
<td>Total</td>
<td>820 446 617</td>
<td>805 577 985</td>
</tr>
</tbody>
</table>

### 22. TAXATION

The ARC is exempt from Income Tax in terms of section 10(1) (a) of the Income Tax Act No. 58 of 1962.
23. CASH GENERATED FROM OPERATIONS

Deficit
(22 063 265)        (38 065 955)

Adjustments for:
Depreciation and amortisation 43 627 680        44 978 909
(Loss) gain on sale of assets and liabilities (401 120)        149 913
Loss on foreign exchange -        49 505
Fair value adjustments 746 677        (7 656)
Dividends in specie (505 350)        -
Impairment deficit 43 095 349        21 374 457
Movements in operating lease assets and accruals (51 079)        1 594
Movements in retirement benefit assets and liabilities (1 431 180)        (1 347 547)
Movements in provisions 90 469        650 155
Movement in reserves -        1 675 547
Actuarial gains or losses (464 820)        2 544 975
Scraping loss 1 363 882        -
Transfers from entities under common control (1 711 584)

Changes in working capital:
Inventories (1 152 595)        143 141
Receivables from exchange transactions (10 329 671)        (21 116 058)
Payables from exchange transactions 23 366 082        38 973 564
VAT (1 300 637)        548 093
Unspent conditional grants and receipts (600 476)        (6 138 169)

72 278 362        44 414 468

24. FINANCIAL INSTRUMENTS DISCLOSURE

Categories of financial instruments

2019

Financial assets

<table>
<thead>
<tr>
<th></th>
<th>At fair value</th>
<th>At amortised cost</th>
<th>At cost</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other financial assets</td>
<td>4 796 407</td>
<td>-</td>
<td>186 371</td>
<td>4 982 778</td>
</tr>
<tr>
<td>Receivables from exchange transactions</td>
<td>-</td>
<td>165 917 747</td>
<td>-</td>
<td>165 917 747</td>
</tr>
<tr>
<td>Cash and cash equivalents</td>
<td>-</td>
<td>76 348 179</td>
<td>-</td>
<td>76 348 179</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>4 796 407</strong></td>
<td><strong>242 265 926</strong></td>
<td><strong>186 371</strong></td>
<td><strong>247 248 704</strong></td>
</tr>
</tbody>
</table>

Financial liabilities

<table>
<thead>
<tr>
<th></th>
<th>At fair value</th>
<th>At amortised cost</th>
<th>At cost</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Payables from exchange transactions</td>
<td>-</td>
<td>287 125 059</td>
<td>-</td>
<td>287 125 059</td>
</tr>
</tbody>
</table>
### 2018 Financial assets

<table>
<thead>
<tr>
<th></th>
<th>At fair value</th>
<th>At amortised cost</th>
<th>At cost</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other financial assets</td>
<td>5 037 739</td>
<td>-</td>
<td>186 371</td>
<td>5 224 107</td>
</tr>
<tr>
<td>Receivables from exchange transactions</td>
<td>-</td>
<td>197 944 218</td>
<td>-</td>
<td>197 944 218</td>
</tr>
<tr>
<td>Cash and cash equivalents</td>
<td>68 303 483</td>
<td>-</td>
<td>-</td>
<td>68 303 483</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>5 037 739</strong></td>
<td><strong>266 247 701</strong></td>
<td><strong>186 368</strong></td>
<td><strong>271 471 808</strong></td>
</tr>
</tbody>
</table>

### Financial liabilities

<table>
<thead>
<tr>
<th></th>
<th>At fair value</th>
<th>At amortised cost</th>
<th>At cost</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Payables from exchange transactions</td>
<td>-</td>
<td>277 568 429</td>
<td>-</td>
<td>277 568 429</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>-</strong></td>
<td><strong>277 568 429</strong></td>
<td><strong>-</strong></td>
<td><strong>277 568 429</strong></td>
</tr>
</tbody>
</table>

#### 25. TRANSFER OF FUNCTIONS BETWEEN ENTITIES UNDER COMMON CONTROL

**Transfer of functions between entities under common control occurring during the current reporting period**

Entities involved in the transfer of functions were:
- Agricultural Research Council;
- Department of Agriculture, Forestry and Fisheries; and
- Ncera Farms (Pty) Ltd

The following functions were transferred:
- Ncera Farms (Pty) Ltd was transferred as a going concern.
- The transfer of function took place during the 2018/19 financial year.
- The transfer was finalised on Sunday, 01 April 2018.

#### Value of the assets acquired and liabilities assumed

**Assets acquired**

<table>
<thead>
<tr>
<th></th>
<th>At fair value</th>
<th>At amortised cost</th>
<th>At cost</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Property, plant and equipment</td>
<td>1 694 359</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Intangible assets</td>
<td>17 207</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Inventory</td>
<td>764 211</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Receivables from exchange transactions</td>
<td>14 305</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Cash and cash equivalents</td>
<td>1 041 940</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>3 532 022</strong></td>
<td><strong>-</strong></td>
<td><strong>-</strong></td>
<td><strong>-</strong></td>
</tr>
</tbody>
</table>

**Liabilities assumed**

<table>
<thead>
<tr>
<th></th>
<th>At fair value</th>
<th>At amortised cost</th>
<th>At cost</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trade creditors</td>
<td>363 959</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>363 959</strong></td>
<td><strong>-</strong></td>
<td><strong>-</strong></td>
<td><strong>-</strong></td>
</tr>
</tbody>
</table>

**Difference between the carrying amounts of the assets acquired, the liabilities assumed and adjustments required to the basis of accounting**

**3 168 063** -

**Difference between net assets and the consideration paid**

**3 168 063** -
26. COMMITMENTS

Authorised capital expenditure

Already contracted for but not incurred
- Buildings 470 370 419 175
- Computer equipment - 314 205
- Infrastructure 6 675 898 2 269 169
- Laboratory equipment 171 695 3 145 357
- Machinery and farming equipment - 1 198 634
- Office furniture and equipment 159 366 53 050

__________              __________
7 477 329               7 399 590

Total capital commitments
Already contracted for but not incurred 7 477 329 7 399 590

Operating leases as lessee (expense)

Minimum lease payments due
- within one year 3 577 089 19 092 669
- in second to fifth year inclusive 1 793 923 2 131 953

_________                   __________
5 371 012            21 224 622

ARC leases certain of its equipment in terms of operating leases. The ARC does not have the option to acquire the assets at the termination on the lease. There are no escalation or renewal terms clauses or restrictions imposed by the leases. The ARC is not charged any contingent rentals.

27. CONTINGENCIES

There are contingent liabilities in respect of:
Guarantees on municipal and electricity accounts 1 075 360 1 075 360
Legal costs and litigations 4 939 800 5 540 536
Pending labour dispute 70 000 2 001 460

________                          _________
6 085 160               8 617 356

The guarantees on municipal and electrical accounts relate to the City of Tshwane municipality to ensure a continued service to the ARC-Onderstepoort Veterinary Research Campus.

Legal costs and litigations relate to in the nature of the ARC's business, agreements with complex deliverables may be entered into. All necessary steps are taken to manage the risks inherent to these transactions. If and when it is evident that there is a reasonable probability that a dispute on a transaction could lead to costs against the ARC, such costs will be disclosed.
28. RELATED PARTIES

Relationships

Members Refer to members’ report note 29
Ultimate controlling entity Department of Agriculture, Forestry and Fisheries

Controlling entity Department of Agriculture, Forestry and Fisheries

Public entity (With significant influence over the ARC) Department of Science and Technology
Public entity (Under common control with the ARC) National Agricultural Market Council
Public entity (Under common control with the ARC) Onderstepoort Biological Products
Public entity (Under common control with the ARC) Perishable Products Export Control Board
Public entity (Under common control with the ARC) South African Veterinary Council

All the transactions with related parties are at arms length.

Related party balances

Receivable from exchange transactions (Payables from exchange transactions) regarding related parties

<table>
<thead>
<tr>
<th>Entity</th>
<th>2019</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Department of Agriculture, Forestry and Fisheries Other Grants</td>
<td>81 589 834</td>
<td>83 375 435</td>
</tr>
<tr>
<td>Onderstepoort Biological Products</td>
<td>(1 819 992)</td>
<td>15 321 725</td>
</tr>
<tr>
<td>Department of Agriculture Forestry and Fisheries</td>
<td>(4 877 451)</td>
<td>(4 877 451)</td>
</tr>
<tr>
<td>Department of Agriculture Forestry and Fisheries FMD</td>
<td>(121 276 880)</td>
<td>(121 877 356)</td>
</tr>
<tr>
<td>Department of Science and Technology</td>
<td>-</td>
<td>(962 998)</td>
</tr>
<tr>
<td>Onderstepoort Biological Products</td>
<td>(47 899)</td>
<td>(15 032)</td>
</tr>
<tr>
<td>Department of Agriculture, Forestry and Fisheries PBR registration</td>
<td>(15 796)</td>
<td>-</td>
</tr>
</tbody>
</table>

Related party transactions

Services from (to) related parties

<table>
<thead>
<tr>
<th>Entity</th>
<th>2019</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Department of Agriculture Forestry and Fisheries PIA registrations</td>
<td>8 675</td>
<td>3 004</td>
</tr>
<tr>
<td>Department of Agriculture Forestry and Fisheries PBR registration</td>
<td>18 422</td>
<td>6 413</td>
</tr>
<tr>
<td>Department of Agriculture Forestry and Fisheries</td>
<td>820</td>
<td>161 937</td>
</tr>
<tr>
<td>Department of Agriculture Forestry and Fisheries Services</td>
<td>(19 344 465)</td>
<td>(66 575 547)</td>
</tr>
<tr>
<td>Department of Science and Technology Other Revenue Grants</td>
<td>(10 581 375)</td>
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Parliamentary Grant

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<td>Department of Science and Technology</td>
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### 29. COUNCIL AND PRESCRIBED OFFICERS’ EMOLUMENTS

#### Executive

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<th>Subsistence and travel</th>
<th>Pension paid or receivable</th>
<th>Medical aid</th>
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**Note 1:** Ms MM Manyama was appointed as CFO effective from 10 September 2018.

**Note 2:** Mr DS Chocho was appointed as CFO from 01 May 2018 to 31 July 2018.

**Note 3:** Mr F Monkwe resigned as GE: ICT and Infrastructure effective from 28 February 2018.

**Note 4:** Dr LL Magingxa resigned as GE: Agri Economics and Capacity Development effective from 28 February 2018.

**Note 5:** Mr K Maake was appointed acting CFO from 01 January 2018 to 30 April 2018 and 01 August 2018 to 07 September 2018.

**Note 6:** Dr Y Pakela Jezile was appointed acting GE: GE: Agri Economics and Capacity Development effective from 05 March 2018 to 15 June 2018.

**Note 7:** Dr TS Mkhabela was appointed as GE: Agri Economics and Capacity Development effective from 18 June 2018.

**Note 8:** Dr T Sethibe was appointed as GE: ICT and Infrastructure effective from 05 November 2018.

**Note 9:** Ms M Phaswana was appointed acting GE: ICT and Infrastructure effective from 05 March 2018 to 02 November 2018.
### Figures in Rand

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* Other benefits comprise travel allowance and medical benefits.

Note 10: The Labour Court has rescinded the ARC’s non–renewal of an employment contract with Dr Jeenah. Accordingly, these emoluments are a result of the said court’s decision for reinstatement of the employee for the period of 1 July 2015 to 31 March 2018.

### Council members

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| 1 571 550 | 136 504 | 1 708 054 |

#### Audit committee members

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| 338 591 | 14 212 | 352 803 |

### 2018

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| 282 548 | 8 215 | 290 763 |

*Other benefits comprise travel allowance and subsistence allowance
30. PRIOR PERIOD ERRORS AND RECLASSIFICATIONS

Presented below are those items contained in the statement of financial position, statement of financial performance and cash flow statement that have been affected by prior year adjustments:

Certain comparative figures have been reclassified and prior period errors had to be corrected.

During the current financial year, management embarked on an exercise to clean up old POs and GRNs that could not be cancelled due to system limitation. This resulted in the prior period adjustments that were affecting property, plant and equipment, employee costs, lease expenses and operating expenses.

During the 2017/18 audit it was noted that an amount of R8,368,547 relating to vaccines was included in the cost of asset under construction (AUC) instead of being expensed thus resulting in an overstatement of assets. The error was subsequently corrected in the current financial year.

During the current financial year, management noted a misstatement of R377,320 in the accrual of an employee settlement amount which was subsequently corrected in the current financial year. This error resulted in the overstatement of payroll accruals.

During the current financial year, management embarked on an exercise to eliminate old projects (WIP) that could not be eliminated due to system limitation. This resulted in the prior period adjustments that were affecting revenue, receivables and payables.

During the 2017/18 audit a finding was raised around the movement in provision for bad debts not being adjusted in the cash receipts from sale of goods and services. Management decided to reallocate the movement in provision for bad debts of R24,342,962 from cash paid to suppliers to cash receipt from sale of goods and services.

The effect of the restatement on the financial statements is summarised below.

Statement of financial position

2017

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<td>Property, plant and equipment</td>
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2018

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Cash flow statement - 2018

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<th>As previously reported</th>
<th>Correction of error</th>
<th>Reclassification</th>
<th>Restated</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>405 122 663</td>
<td>(17 772 106)</td>
<td>-</td>
<td>387 350 557</td>
</tr>
<tr>
<td></td>
<td>(811 104 160)</td>
<td>11 223 213</td>
<td>-</td>
<td>(799 880)</td>
</tr>
<tr>
<td></td>
<td>(418 997 310)</td>
<td>(9 465 521)</td>
<td>-</td>
<td>(947)</td>
</tr>
<tr>
<td></td>
<td>(195 222)</td>
<td>112 626</td>
<td>-</td>
<td>(428 462)</td>
</tr>
<tr>
<td></td>
<td>(825 174 029)</td>
<td>(15 901 788)</td>
<td>-</td>
<td>(841 075)</td>
</tr>
<tr>
<td></td>
<td>(89 369 595)</td>
<td>15 901 790</td>
<td>-</td>
<td>(73 467 805)</td>
</tr>
</tbody>
</table>

31. RISK MANAGEMENT

Financial Risk Management
The Council members monitor and manage the financial risks relating to the operations of the entity through internal risk reports which analyse exposures by degree and magnitude of risks. These risks include market risk (including currency risk, fair value interest rate risk, cash flow interest rate risk and price risk), credit risk and liquidity risk.

Compliance with policies and exposure limits is reviewed by the internal auditors on a continuous basis. The entity does not enter into or trade financial instruments, including derivative financial instruments, for speculative purposes.

Liquidity Risk
The entity’s risk to liquidity is a result of the funds available to cover future commitments. The entity manages liquidity risk through an ongoing review of future commitments and credit facilities.

Liquidity risk refers to the risk that an entity will encounter difficulty in meeting obligations associated with financial liabilities. The Council members are satisfied that the entity will be able to settle its financial liabilities (payables and leave pay accrual) in
the normal course of business. Liquidity risk is managed by cash forecasting.

The cash commitments of the entity have cast doubt around the entity’s ability to continue operating as a going concern. These concerns are allayed by mitigating circumstances that are articulated in the Accounting Authority’s Responsibilities and Approval statement. The Liquidity risk is reduced by the entity’s continued focus on financial discipline as well as the commitment by DAFF to fund the entity.

**Credit Risk**

Credit risk consists mainly of cash deposits, cash equivalents, derivative financial instruments and trade debtors. The entity only deposits cash with major banks with high quality credit standing and limits exposure to any one counter party.

Financial assets which potentially subject the ARC to concentrations of credit risk consist principally of cash short term deposits placed with high credit quality financial institutions. Trade receivables are presented net of an allowance for doubtful receivables. Currently only five of the entity’s largest debtors exceed 2% of the total trade receivables balance as disclosed in note 9. The ARC does not have any significant exposure to any other individual customer or counter party.

The carrying amounts of financial assets included in the statement of financial position represent the ARC’s maximum exposure to credit risk in relation to these assets. ARC does not hold collateral or any credit enhancements to cover its credit risk.

**Market Risk**

**Interest Rate Risk**

Interest rate exposure and investment strategies are evaluated by management on a regular basis. Interest bearing investments are held with several reputable banks in order to minimise exposure.

The following demonstrates the sensitivity to a reasonable change in interest rates, with all being constant and the impact on net surplus:

**Sensitivity Analysis**

<table>
<thead>
<tr>
<th>Financial instrument</th>
<th>Current interest rate</th>
<th>Due in less than a year</th>
<th>Due in one to two years</th>
<th>Due in two to three years</th>
<th>Due in three to four years</th>
<th>Due after five years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash in current banking institutions</td>
<td>7.35%</td>
<td>76 348 179</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>South African Rand (ZAR)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increase by 50 base points</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>381 741 (381 741)</td>
<td>341 517 (341 517)</td>
</tr>
<tr>
<td>Decrease by 50 base points</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The following table identifies the period within which the financial instruments that are sensitive to interest rate risk reprice.

ARC surplus funds are invested in terms of its investments policy as approved by its Council:

<table>
<thead>
<tr>
<th>Financial instrument</th>
<th>2019</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current cash balances</td>
<td>46 939 171</td>
<td>58 980 455</td>
</tr>
<tr>
<td>Short term cash deposits</td>
<td>29 409 008</td>
<td>9 323 028</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>76 348 179</strong></td>
<td><strong>68 303 483</strong></td>
</tr>
</tbody>
</table>
**Foreign Exchange Risk**

The entity does not hedge foreign exchange fluctuations. The entity is exposed to currency risk on sales and purchases that are denominated in a currency other than the functional currency of the entity. The currencies in which the Council primarily deals are US Dollars and Euros. No forward exchange contracts are taken out for these transactions. The Council members consider the foreign currency risk to be insignificant.

**Exchange rates used for conversion of foreign items were:**

USD 14,3172  
GBP 18,6032  
EURO 16,0405

**Price Risk**

The ARC is exposed to price risk on its purchases. Prices for future purchases, sales of goods and services are generally established on normal commercial terms. The risk is managed by the application of procurement policy that encourages obtaining goods and services at best prices.

The Council members consider the price risk to be insignificant.

**Fair Value Hierarchy**

As at 31 March 2019, the entity held the following financial instruments carried at fair value on the statement of financial position:

The entity uses the following hierarchical technique for determining and disclosing the fair value of financial instruments:

- **Level 1:** quoted prices in active markets for identical assets or liabilities
- **Level 2:** other techniques for which all inputs which have a significant effect on the recorded fair value are observable, either directly or indirectly
- **Level 3:** techniques which use inputs that have a significant effect on the recorded fair value that are not based on observable market data.

The fair value of financial assets and financial liabilities is determined as follows:

<table>
<thead>
<tr>
<th>Assets measured at fair value</th>
<th>31 March 2019</th>
<th>Level 1</th>
<th>31 March 2018</th>
<th>Level 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial assets at fair value</td>
<td>4 796 407</td>
<td>4 796 407</td>
<td>5 037 739</td>
<td>5 037 739</td>
</tr>
</tbody>
</table>

**Category of financial instruments and maturity profile**

<table>
<thead>
<tr>
<th>31 March 2019</th>
<th>0 1 years</th>
<th>&gt;1 year</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>R</td>
<td></td>
<td>R</td>
</tr>
<tr>
<td>Investments</td>
<td></td>
<td>4 982 778</td>
<td>4 982 778</td>
</tr>
<tr>
<td>Cash and cash equivalents</td>
<td>76 348 179</td>
<td>-</td>
<td>76 348 179</td>
</tr>
<tr>
<td>Trade and other receivables</td>
<td>165 917 747</td>
<td>-</td>
<td>165 917 747</td>
</tr>
<tr>
<td>Trade and other payables</td>
<td>(287 125 059)</td>
<td>-</td>
<td>(287 125 059)</td>
</tr>
<tr>
<td></td>
<td>(44 859 133)</td>
<td>4 982 778</td>
<td>(39 876 355)</td>
</tr>
</tbody>
</table>
32. GOING CONCERN

The annual financial statements have been prepared on the basis of accounting policies applicable to a going concern. This basis presumes that funds will be available to finance future operations and that the realisation of assets and settlement of liabilities, contingent obligations and commitments will occur in the ordinary course of business.

The following position at year end has raised substantial doubt around continued use of the going concern assumption in reporting the entity’s results:

- The ARC’s current liabilities of R403 million exceed current assets by R139 million. This is in spite of the organization having cash reserves of R76 million;
- The ARC has cash commitments (represented by both current and non current liabilities) of R542 million versus cash and cash/near cash equivalents (represented by cash balances and trade accounts receivables) of R297 million. This represents a cash shortfall of R245 million as at 31 March 2019; additionally
- Parliamentary grant (“PG”) funding cuts from the Department of Agriculture, Forestry and Fisheries (“DAFF”) that have contributed to the deficit that the ARC has experienced over the last three financial periods.

Management is of the view that in spite of substantial doubt around the validity of the going concern assumption in the preparation of these financial statement, that there are sufficient mitigating circumstances to support this basis of reporting. Refer to the Accounting Authority’s Responsibilities and Approval on page 135-137 for further details on these.

33. FRUITLESS AND WASTEFUL EXPENDITURE

<table>
<thead>
<tr>
<th>Opening balance</th>
<th>480 347</th>
<th>393 999</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interest on late payment of suppliers</td>
<td>93 982</td>
<td>82 596</td>
</tr>
<tr>
<td>Flights missed</td>
<td>6 834</td>
<td>-</td>
</tr>
<tr>
<td>Lost parcels</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Fruitless and wasteful expenditure means expenditure which was made in vain and would have been avoided had reasonable care been exercised.

The 31 March 2019 fruitless and wasteful expenses were incurred by paying interest charged on late payment and costs incurred on missed flights. Disciplinary steps to be determined.
34. IRREGULAR EXPENDITURE

Irregular expenditure as defined in section 1 of the PFMA is expenditure other than unauthorised expenditure, incurred in contraven- tion of or that is not in accordance with a requirement of any applicable legislation, including -

(a) this Act; or

(b) the State Tender Board Act, 1968 (Act No. 86 of 1968), or any regulations made in terms of the Act; or

(c) any provincial legislation providing for procurement procedures in that provincial government.

Opening balance                                                                                      510 734 370         404 440 838  
Add: Irregular Expenditure   current year                                           2 500 022         104 685 803  
Add: Irregular Expenditure   prior year                                                           -              1 607 729

513 234 392         510 734 370

Analysis of expenditure awaiting condonation per age classification

Prior years                                                                                      510 734 370           404 440 838

Details of irregular expenditure

Disciplinary steps taken/criminal proceedings

Archimedes Laboratory Solutions order exceeded amount quoted       To be determined    20 226
Costs incurred on incorrect delivery                               To be determined    10 247
Costs incurred on incorrect delivery                               To be determined    5 665
Costs incurred on expired Steiner contract                         To be determined    32 408
Costs incurred on expired Tracker contract                         To be determined    4 322
Costs incurred on expired Eureka security contract                 To be determined    26 496
Order issued after invoice was received                            To be determined    1 236
Procurement of refreshments not authorised                        To be determined    1 055
WIETA audits were conducted on farms without an order number      To be determined    40 690
Deviations                                                         To be determined    2 357 677

2 500 022

35. EVENTS AFTER THE REPORTING DATE

The Council is not aware of any other significant matters or circumstances arising since the end of the annual financial statements which needs to be reported as part of these annual financial statements.

36. SEGMENT INFORMATION

General information

Identification of segments

The entity is organised and reports to management on the basis of five major functional areas: animal sciences, crop sciences and research and innovation systems. The segments were organised around the type of service delivered and the target market.

Management uses these same segments for determining strategic objectives. Segments were aggregated for reporting purposes. Information reported about these segments is used by management as a basis for evaluating the segments’ performances and for
making decisions about the allocation of resources. The disclosure of information about these segments is also considered appropriate for external reporting purposes.

**Aggregated segments**
The entity operates throughout the South Africa in 8 provinces. Segments were aggregated on the basis of services delivered as management considered that the economic characteristics of the segments throughout South Africa were sufficiently similar to warrant aggregation.

**Types of goods and/or services by segment**
These reportable segments as well as the goods and/or services for each segment are set out below:

<table>
<thead>
<tr>
<th>Reportable segment</th>
<th>Goods and/or services</th>
</tr>
</thead>
<tbody>
<tr>
<td>Animal Sciences</td>
<td>Animal health and production</td>
</tr>
<tr>
<td>Crop Sciences</td>
<td>Improvement and cultivation of various crops</td>
</tr>
<tr>
<td>Impact and Partnerships</td>
<td>Translating the ARC’s research results into useable outputs in support of agrarian transformation and the efficiency and competitiveness of the sector</td>
</tr>
<tr>
<td>Soil, Climate and Water</td>
<td>Carry out research and development on the natural agricultural resources, viz, soil, climate and water</td>
</tr>
<tr>
<td>Research and Innovation Systems</td>
<td>Provides collaborative and support functions to a wide range of technologies in areas such as genomics, phenomics, emote sensing, agricultural systems modelling and engineering systems.</td>
</tr>
</tbody>
</table>

**Segment surplus or deficit, assets and liabilities 2019**

<table>
<thead>
<tr>
<th></th>
<th>Animal Sciences</th>
<th>Crop Sciences</th>
<th>Impact and Partnerships</th>
<th>Soil, Climate and Water</th>
<th>Research and Innovation Systems</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Revenue</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Revenue from non exchange</td>
<td>180 853 384</td>
<td>302 884 527</td>
<td>21 483 120</td>
<td>35 084 617</td>
<td>30 052 212</td>
<td>570 357 860</td>
</tr>
<tr>
<td>transactions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Revenue from exchange transactions</td>
<td>129 503 334</td>
<td>181 193 472</td>
<td>6 540 134</td>
<td>24 816 822</td>
<td>18 123 446</td>
<td>360 177 208</td>
</tr>
<tr>
<td>Interest revenue</td>
<td>37 197</td>
<td>279 468</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Profit on sale of assets</td>
<td>-</td>
<td>212 114</td>
<td></td>
<td>130 762</td>
<td>62 588</td>
<td></td>
</tr>
<tr>
<td>Total segment revenue</td>
<td>310 393 915</td>
<td>484 569 581</td>
<td>28 023 254</td>
<td>60 032 201</td>
<td>48 238 246</td>
<td>931 257 197</td>
</tr>
<tr>
<td>Entity’s revenue</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>931 257 197</td>
</tr>
<tr>
<td><strong>Expenditure</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salaries and wages</td>
<td>232 096 025</td>
<td>364 574 856</td>
<td></td>
<td>50 792 609</td>
<td>25 920 843</td>
<td>690 534 306</td>
</tr>
<tr>
<td>Other expenses</td>
<td>134 568 854</td>
<td>156 534 249</td>
<td>9 154 288</td>
<td>3 588 602</td>
<td>3 568 972</td>
<td>350 782 656</td>
</tr>
<tr>
<td>Depreciation and amortisation</td>
<td>11 103 188</td>
<td>17 288 941</td>
<td></td>
<td></td>
<td></td>
<td>35 554 703</td>
</tr>
<tr>
<td>Total segment expenditure</td>
<td>377 768 067</td>
<td>538 398 046</td>
<td>26 309 261</td>
<td>88 083 450</td>
<td>46 312 841</td>
<td>1 076 871 665</td>
</tr>
<tr>
<td>Total segmental surplus/deficit</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(145 614 468)</td>
</tr>
<tr>
<td>Interest expense</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>87 612</td>
</tr>
</tbody>
</table>
2018

<table>
<thead>
<tr>
<th>Revenue</th>
<th>Animal Sciences</th>
<th>Crop Sciences</th>
<th>Impact and Partnerships</th>
<th>Soil, Climate and Water</th>
<th>Research and Innovation Systems</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revenue from non exchange transactions</td>
<td>170 773 123</td>
<td>296 119 258</td>
<td>21 883 018</td>
<td>33 511 250</td>
<td>29 235 139</td>
<td>551 521 788</td>
</tr>
<tr>
<td>Revenue from exchange transactions</td>
<td>143 811 588</td>
<td>204 783 342</td>
<td>5 379 040</td>
<td>20 895 213</td>
<td>21 277 697</td>
<td>396 146 880</td>
</tr>
<tr>
<td>Interest revenue</td>
<td>113 917</td>
<td>9 516</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>123 433</td>
</tr>
<tr>
<td>Profit on sale of assets</td>
<td>36 079</td>
<td>112 476</td>
<td>-</td>
<td>3</td>
<td>156</td>
<td>148 714</td>
</tr>
<tr>
<td>Total segment revenue</td>
<td>314 734 707</td>
<td>501 024 592</td>
<td>27 262 058</td>
<td>54 406 466</td>
<td>50 512 992</td>
<td>947 940 815</td>
</tr>
</tbody>
</table>

| Entity’s revenue | 947 940 815 |

<table>
<thead>
<tr>
<th>Expenditure</th>
<th>Animal Sciences</th>
<th>Crop Sciences</th>
<th>Impact and Partnerships</th>
<th>Soil, Climate and Water</th>
<th>Research and Innovation Systems</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salaries and wages</td>
<td>224 425 507</td>
<td>361 333 985</td>
<td>17 806 792</td>
<td>49 505 508</td>
<td>27 105 804</td>
<td>680 177 596</td>
</tr>
<tr>
<td>Other expenses</td>
<td>146 265 230</td>
<td>173 399 907</td>
<td>10 793 333</td>
<td>29 427 086</td>
<td>20 786 321</td>
<td>380 671 877</td>
</tr>
<tr>
<td>Depreciation and amortisation</td>
<td>11 539 994</td>
<td>16 907 418</td>
<td>5 000</td>
<td>3 630 371</td>
<td>5 092 286</td>
<td>37 175 069</td>
</tr>
<tr>
<td>Total segment expenditure</td>
<td>382 230 731</td>
<td>551 641 310</td>
<td>28 605 125</td>
<td>82 562 965</td>
<td>52 984 411</td>
<td>1 098 024 542</td>
</tr>
<tr>
<td>Total segmental surplus/(deficit)</td>
<td>(150 083 727)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interest expense</td>
<td>69 643</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# PERFORMANCE REPORT
## 2018/19

<table>
<thead>
<tr>
<th>Programme</th>
<th>Key Outputs</th>
<th>Indicator</th>
<th>Targets</th>
<th>Actuals</th>
<th>Variance</th>
<th>Reason for Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Goal 1: To Generate knowledge and technologies that will enhance the efficiencies in crop based agriculture</strong></td>
<td></td>
<td>Number of scientific publications</td>
<td>111</td>
<td>119</td>
<td>8</td>
<td>Publications accepted faster than anticipated.</td>
</tr>
<tr>
<td>Crop production, improvement and protection</td>
<td></td>
<td>- articles in refereed journals, chapters in books, full length papers in conference proceedings, post graduate degree conferred</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Knowledge Generated</td>
<td></td>
<td>Number of cultivars registered</td>
<td>9</td>
<td>9</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Technologies Development</td>
<td></td>
<td>Number of diagnostic and analytical services rendered</td>
<td>861</td>
<td>644</td>
<td>(217)</td>
<td>Lower demand for ARC services.</td>
</tr>
<tr>
<td>Scientific Services rendered</td>
<td></td>
<td>Number of technical reports and manuals</td>
<td>322</td>
<td>516</td>
<td>194</td>
<td>Higher number of reports generated for the PLAS farms.</td>
</tr>
<tr>
<td>Information Disseminated</td>
<td></td>
<td>Number of field trial sites</td>
<td>322</td>
<td>356</td>
<td>34</td>
<td>Extra field trials for barley from the AB-InBev project.</td>
</tr>
<tr>
<td><strong>Goal 2: To Generate knowledge and technologies that will enhance the efficiencies in livestock, wildlife and aquaculture based agriculture</strong></td>
<td></td>
<td>Number of scientific publications</td>
<td>105</td>
<td>111</td>
<td>6</td>
<td>Publications accepted faster than anticipated.</td>
</tr>
<tr>
<td>Animal health, production and improvement</td>
<td></td>
<td>- articles in refereed journals, chapters in books, full length papers in conference proceedings, post graduate degree conferred</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Knowledge Generated</td>
<td></td>
<td>Number of patents registered</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Technologies Developed</td>
<td></td>
<td>Number of diagnostic and analytical services rendered</td>
<td>17755</td>
<td>20887</td>
<td>3132</td>
<td>Target exceeded due to automation. OVR acquired a new machine, which processes samples very rapidly. In addition, requests for testing of boehole water samples has increased in the Western Cape.</td>
</tr>
<tr>
<td>Scientific Services rendered</td>
<td></td>
<td>Number of technical reports and manuals</td>
<td>19</td>
<td>20</td>
<td>1</td>
<td>Higher demand for technical report from clients.</td>
</tr>
<tr>
<td>Information Disseminated</td>
<td></td>
<td>Number of farmers participating in animal improvement schemes</td>
<td>390</td>
<td>465</td>
<td>75</td>
<td>Higher than anticipated demand for services together with a conscious effort to aggressively recruit farmers, to register for participation in the Animal Improvement Schemes was made.</td>
</tr>
<tr>
<td>PROGRAMME</td>
<td>KEY OUTPUTS</td>
<td>INDICATOR</td>
<td>TARGETS</td>
<td>ACTUALS</td>
<td>VARIANCE</td>
<td>REASON FOR VARIANCE</td>
</tr>
<tr>
<td>---------------------------</td>
<td>----------------------------------------</td>
<td>----------------------------------------------------------------------------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
<td>------------------------------------------</td>
</tr>
<tr>
<td>Natural resources</td>
<td>Knowledge generated</td>
<td>Number of scientific publications:</td>
<td>79</td>
<td>79</td>
<td>20</td>
<td>Publications accepted faster than anticipated.</td>
</tr>
<tr>
<td></td>
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<td>articles in refereed journals</td>
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<td>chapters in books</td>
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<td>full length papers in conference proceedings</td>
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<td></td>
<td></td>
<td>post graduate degree conferred</td>
<td></td>
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</tr>
<tr>
<td>Technologies Developed</td>
<td>Number of prototypes Developed</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>(1)</td>
<td>Delays due to technical challenges.</td>
</tr>
<tr>
<td>Scientific Services</td>
<td>Number of Analytical and Advisory</td>
<td>1,138</td>
<td>1,094</td>
<td>(94)</td>
<td>Fewer analytical services requested by clients.</td>
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</tr>
<tr>
<td>rendered</td>
<td>services rendered</td>
<td></td>
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</tr>
<tr>
<td>Information Disseminated</td>
<td>Number of technical reports and</td>
<td>119</td>
<td>115</td>
<td>(4)</td>
<td>Lower request for reports from clients.</td>
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</tr>
<tr>
<td></td>
<td>Number of field trial sites</td>
<td>52</td>
<td>02</td>
<td>10</td>
<td>More field trials due to good rains.</td>
<td></td>
</tr>
<tr>
<td>Mechanisation and</td>
<td>Knowledge generated</td>
<td>Number of scientific publications:</td>
<td>8</td>
<td>10</td>
<td>2</td>
<td>Publications accepted faster than anticipated.</td>
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<td>Engineering</td>
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<td></td>
<td>post graduate degree conferred</td>
<td></td>
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</tr>
<tr>
<td>Technologies Developed</td>
<td>Number of prototypes developed</td>
<td>5</td>
<td>3</td>
<td>(2)</td>
<td>Failure to pursue the construction of tipping buckets in 2018/19 resulted in the variation.</td>
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<tr>
<td>Scientific Services</td>
<td>Number of Analytical and Advisory</td>
<td>11</td>
<td>8</td>
<td>(3)</td>
<td>Lower demand for ARC services.</td>
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<tr>
<td>rendered</td>
<td>services rendered</td>
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<td></td>
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<tr>
<td>Information Disseminated</td>
<td>Number of technical reports and</td>
<td>26</td>
<td>102</td>
<td>76</td>
<td>Higher request for client reports</td>
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<td>manuals</td>
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</table>

**GOAL 4 TO GENERATE KNOWLEDGE, SOLUTIONS AND TECHNOLOGIES FOR FOOD SAFETY, QUALITY AND IMPROVED EFFICIENCIES IN THE AGRICULTURE VALUE CHAIN**

<table>
<thead>
<tr>
<th>PROGRAMME</th>
<th>KEY OUTPUTS</th>
<th>INDICATOR</th>
<th>TARGETS</th>
<th>ACTUALS</th>
<th>VARIANCE</th>
<th>REASON FOR VARIANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agro-processing, food</td>
<td>Knowledge generated</td>
<td>Number of scientific publications:</td>
<td>52</td>
<td>90</td>
<td>38</td>
<td>Publications accepted faster than anticipated.</td>
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<td>post graduate degree conferred</td>
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<td>Technologies Developed</td>
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<td>Number of Analytical and Advisory</td>
<td>205</td>
<td>192</td>
<td>(13)</td>
<td>Lower demand for ARC services.</td>
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<tr>
<td>Information Disseminated</td>
<td>Number of technical reports and</td>
<td>97</td>
<td>104</td>
<td>7</td>
<td>High request for reports from clients.</td>
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<td></td>
<td>manuals</td>
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<td>TARGETS</td>
<td>ACTUALS</td>
<td>VARIANCE</td>
<td>REASON FOR VARIANCE</td>
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<td>-----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Agriculture Economics &amp; Commercialisation</td>
<td>Knowledge Generated</td>
<td>Number of scientific publications</td>
<td>10</td>
<td>13</td>
<td>3</td>
<td>Publications accepted faster than anticipated.</td>
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<tr>
<td></td>
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<td>articles in refereed journals</td>
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<td>post graduate degree conferred</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Number of Economic Impact Study Reports</td>
<td>Number of Economic Impact Study Reports</td>
<td>3</td>
<td>3</td>
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<tr>
<td></td>
<td>Technologies released to the agriculture sector</td>
<td>Number of technologies transferred under license</td>
<td>15</td>
<td>12</td>
<td>(3)</td>
<td>Negotiations took longer than expected resulting in delays with signing of agreements.</td>
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<tr>
<td>Smallholder Agriculture Development</td>
<td>Scientific Services Rendered</td>
<td>Number of smallholder farmers supported</td>
<td>813</td>
<td>2 434</td>
<td>1 621</td>
<td>The project on PLAS farms had to be fast-tracked on request by DRDLR.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Number of smallholder farmers participating in KyD</td>
<td>9 000</td>
<td>1 726</td>
<td>(7 274)</td>
<td>Due to non-payment from DAFF, no technicians could be appointed to assist with KyD services.</td>
</tr>
<tr>
<td>Training and Extension</td>
<td>Information Disseminated</td>
<td>Number of farmer field days</td>
<td>57</td>
<td>38</td>
<td>(19)</td>
<td>Lower demand from farmers for field days.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Number of popular publications</td>
<td>198</td>
<td>255</td>
<td>57</td>
<td>Higher than anticipated demand from industry and media houses.</td>
</tr>
<tr>
<td></td>
<td>Training</td>
<td>Number of farmers trained</td>
<td>1 511</td>
<td>1 743</td>
<td>232</td>
<td>Increased demand, including requests from Provincial Departments of Agriculture.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Number of extension officers trained</td>
<td>692</td>
<td>721</td>
<td>29</td>
<td>Higher demand for ARC training services.</td>
</tr>
<tr>
<td>PROGRAMME</td>
<td>KEY OUTPUTS</td>
<td>INDICATOR</td>
<td>TARGETS</td>
<td>ACTUALS</td>
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<tr>
<td></td>
<td><strong>GOAL 6 APPLY BEST RESOURCE MANAGEMENT PRACTICES, TOWARDS A HIGH PERFORMING AND VISIBLE ORGANISATION</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Improved Postgraduate SET Base</td>
<td>Number of students obtaining postgraduate degrees, with: Masters</td>
<td>35</td>
<td>54</td>
<td>19</td>
<td>Increased in availability of external funding for pursuing postgraduate studies.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Doctoral</td>
<td>7</td>
<td>24</td>
<td>17</td>
<td>Increased in availability of external funding for pursuing postgraduate studies.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Number of employees appointed with: Masters Degrees</td>
<td>15</td>
<td>9</td>
<td>(6)</td>
<td>Was affected by the slow progress from Masters graduates as a pipeline for succession.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Doctoral Degrees</td>
<td>5</td>
<td>12</td>
<td>7</td>
<td>Intake from last year's pipeline of students.</td>
<td></td>
</tr>
<tr>
<td>Improved staff profile</td>
<td>Number of employees with: Masters</td>
<td>268</td>
<td>219</td>
<td>(49)</td>
<td>Low intake of new employees with Masters degrees, as well as employees acquiring Master degrees.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Doctoral Degrees</td>
<td>238</td>
<td>250</td>
<td>14</td>
<td>Increase in employees obtaining doctoral degrees.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Percentage staff turnover</td>
<td>3.50%</td>
<td>2.65%</td>
<td>(0.85%)</td>
<td>Stability in staff turn-over.</td>
<td></td>
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<tr>
<td></td>
<td>Percentage increase in employment equity ratio's in the designated groupings in core business, in respect of Black</td>
<td>2.10%</td>
<td>0.67%</td>
<td>(1.43%)</td>
<td>Fewer appointments made within designated grouping.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>1.5%</td>
<td>0.39%</td>
<td>(1.11%)</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Disability</td>
<td>1%</td>
<td>0.56%</td>
<td>(0.44%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Improved staff profile</td>
<td>Total spend on PDP stipend and registration</td>
<td>R 21.1 m</td>
<td>R 15.7 m</td>
<td>(R 5.4m)</td>
<td>This was a saving due to lower intake of PDP students due to affordability.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Training spend a % of salary bill</td>
<td>2%</td>
<td>1.57%</td>
<td>(0.43%)</td>
<td>The variance was caused by suspension of invoicing due to current financial situation.</td>
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<tr>
<td>Funding and Revenue Generation</td>
<td>Rand Value of external income</td>
<td>R 436 m</td>
<td></td>
<td></td>
<td>CONTAINED IN AUDITED FINANCE REPORT</td>
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<td>Rand Value of royalty income</td>
<td>R 9.5 m</td>
<td></td>
<td></td>
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<td>Current Ratio</td>
<td>0.91</td>
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<td>BEE spend</td>
<td>R 183 m</td>
<td>R 149.8 m</td>
<td>(R 33.2m)</td>
<td>Financial constraint resulted in suspension of procurement initiatives.</td>
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<tr>
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<td>ARC BBBEE rating</td>
<td>Level 3</td>
<td>Level 8</td>
<td>(5)</td>
<td>Supplier and staff development scoring decrease.</td>
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<td>Optimal use of Information resources</td>
<td>Number of initiatives implemented towards the development of a KM platform</td>
<td>3</td>
<td>3</td>
<td>0</td>
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</tr>
<tr>
<td></td>
<td>Number of national assets collections digitised</td>
<td>3</td>
<td>3</td>
<td>0</td>
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<tr>
<td></td>
<td>Number of stakeholder-interactive platforms developed</td>
<td>2</td>
<td>22</td>
<td>21</td>
<td>More platforms developed than was anticipated.</td>
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<td>Percentage increase in rental income</td>
<td>5%</td>
<td>14.5%</td>
<td>9.5%</td>
<td>Rental income was higher than anticipated.</td>
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<td>Number of business cases developed for implementation of Asset Management Plan</td>
<td>3</td>
<td>5</td>
<td>2</td>
<td>More business cases developed, as was anticipated.</td>
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