ARC • LNR
Excellence in Agricultural Research and Development

ANNUAL REPORT 2015/16

About the ARC

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 shareholder;

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 equity, 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 shareholder;

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 shareholder.

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Agricultural Research Council

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AGRICULTURAL RESEARCH COUNCIL RESEARCH FACILITIES

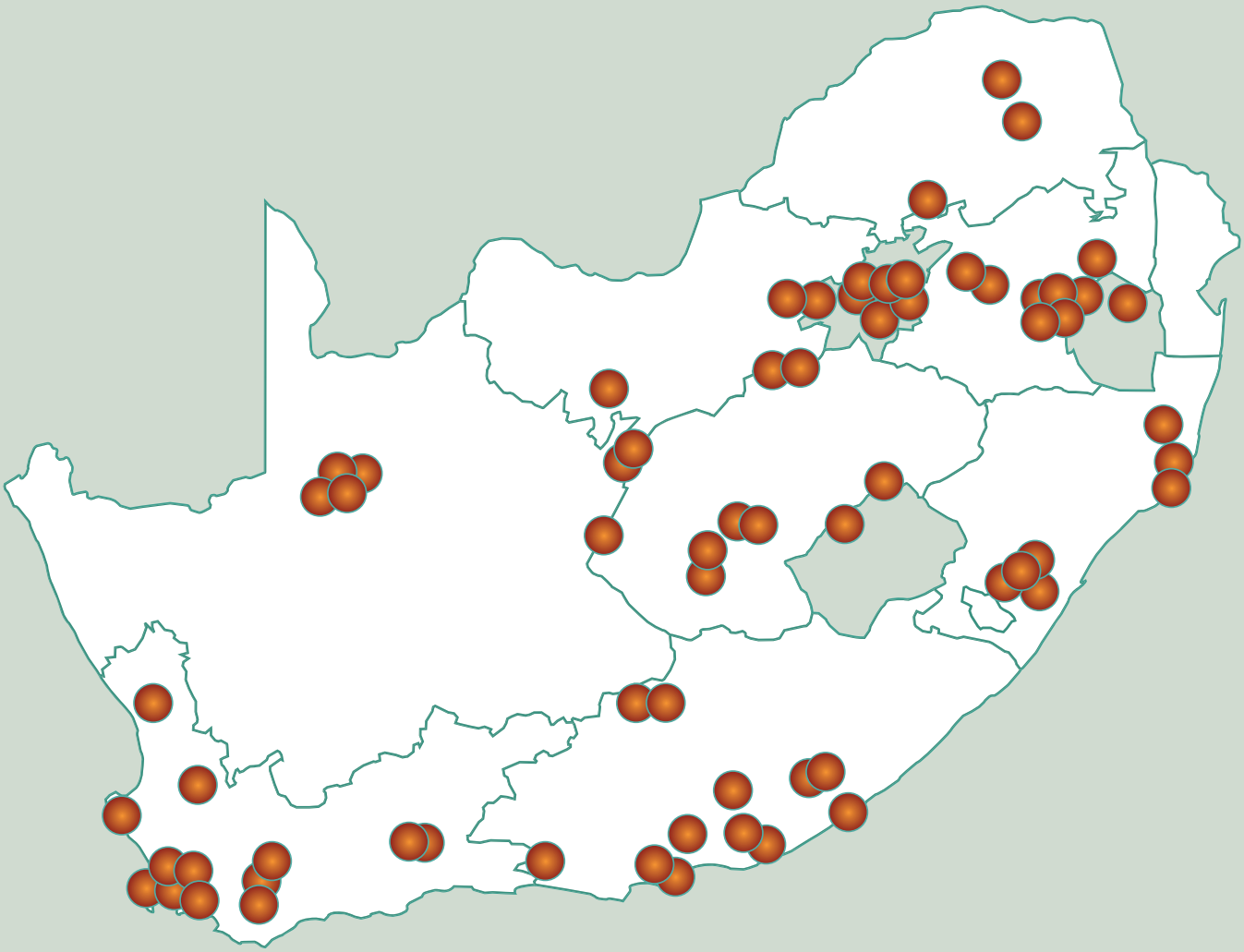


TABLE OF CONTENTS

The Agricultural Research Council Leadership

The Agricultural Research Council is led at the top by a Board of 15 capable and competent members who oversee governance and performance of the organisation. Under the Board is the Executive Management led by the Chief Executive Officer. The Executive Management is responsible for the overall running 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 2015/16 BOARD MEMBERS

Prof Sibusiso Nkomo
(Gauteng) PhD (Economics and Policy Analysis/Public Sector/Political Economy); Research Prof – Centre for the Advancement of Scholarships at University of Pretoria; Serves on various Public Sector Boards and Chairperson of Mapungubwe Institute for Strategic Reflection

Prof Frans Swanepoel
(Free State) PhD (Animal Science); Professor: Centre for Sustainable Agriculture; Director: Research Development

Prof Michael Kahn
(Western Cape) PhD (Mathematical Physics); MA (Policy); Management Consultant; and Professor Extraordinaire, University Stellenbosch

Dr Joyce Chitja
(KwaZulu-Natal) PhD (Food Security); Lecturer: Food Security, University of KwaZulu-Natal

Mr Clive Kneale
(Gauteng) Fellow of the Chartered Institute of Secretaries and Administrators (International); Fellow of the Southern African Institute of Chartered Secretaries and Administrators; Company Secretary

Dr Wilna Jansen Van Rijssen
(Gauteng) PhD, Pr. Nat Sci M.Sc (Applied Toxicology, Plant Biochemistry, Masters in Public Administration); Honours in Pharmacology; Consultant to Government

Distinguished Prof Louw Hoffman
(Western Cape) PhD (Meat Science); Professor Meat Science DST/NRF South African Research; Chair in Meat Science: Genomics to nutriomics, Department of Animal Sciences, Faculty of AgriSciences University Stellenbosch

Mr Mzolisi Dyasi
(Eastern Cape) Diploma in Business Administration; Red Meat Farmer

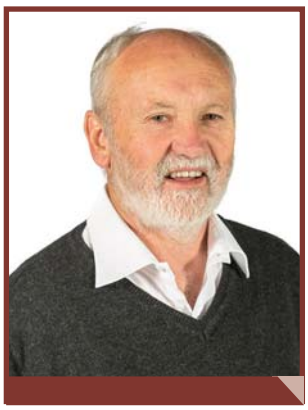
Ms Dora Ndaba
(Gauteng) BTech Transport Logistics; Business Person

Mr Allan Bishop
(Western Cape) B.Com (Hons), B.Compt (Hons) (CTA); Independent Business Consultant

Mr Gerard Martin
(Western Cape) B.Sc; Business Management (Master); Executive Manager, Winetech

Ms Joyce Mashiteng
(Gauteng) B.Sc (Master); Environmental Management Programme Manager: Nuclear Sites, ESKOM

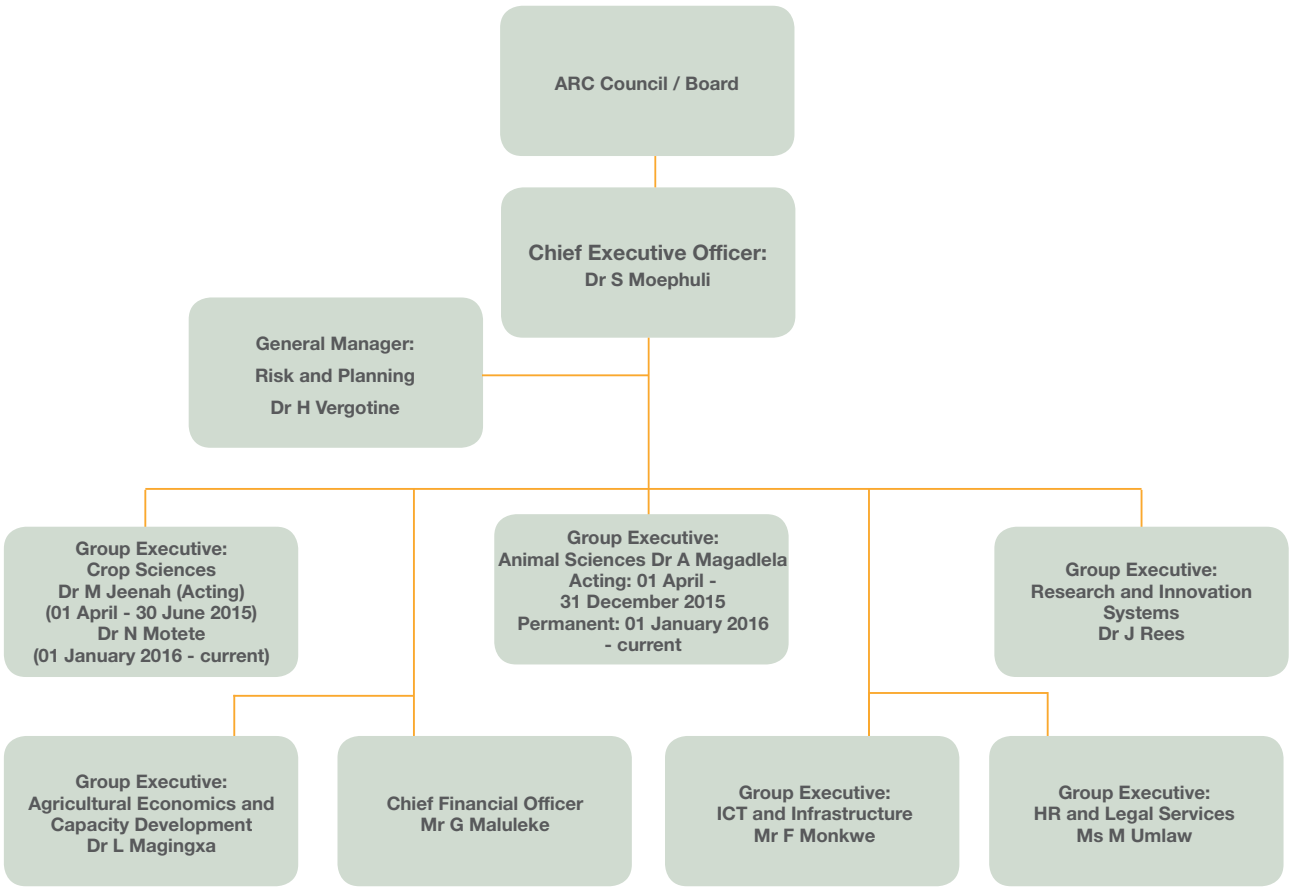
Mr Ismail Motala
(Western Cape) Farmer



Mr Rowan Nicholls
(Western Cape) B.Com CA (SA); Business Person; Registered Accountant and Auditor

Dr Shadrack Moephuli
(Gauteng) PhD
ARC President and CEO

ORGANOGRAM


ARC Council / Board
Chief Executive Officer:
Dr S Moephuli
General Manager:
Risk and Planning
Dr H Vergotine
Group Executive:
Crop Sciences
Dr M Jeenah (Acting)
(01 April - 30 June 2015)
Dr N Motete
(01 January 2016 - current)
Group Executive:
Animal Sciences Dr A Magadlela
Acting: 01 April -
31 December 2015
Permanent: 01 January 2016
- current
Group Executive:
Research and Innovation
Systems
Dr J Rees
Group Executive:
Agricultural Economics and
Capacity Development
Dr L Magingxa
Chief Financial Officer
Mr G Maluleke
Group Executive:
ICT and Infrastructure
Mr F Monkwe
Group Executive:
HR and Legal Services
Ms M Umlaw

CHAIRPERSON'S OVERVIEW

Prof Sibusiso Vil-Nkomo
Chairperson of the ARC Council

The Governing Council of the Agricultural Research Council is happy to present to the South African public and our global partners the 2015/2016 Annual Report. When preparing this statement, we acknowledged the support given by the Honorable Minister Zenzeni Zokwana and Deputy Minister General Bheki Cele.

As Chairperson of the council, on behalf of all the members. I wish to express our appreciation to the Chief Executive Officer, his Executive Management team, senior managers and equally important all researchers and staff for the work they have all produced to make the ARC an outstanding Science Institution in our country. We recognize the global collaborations that have been established that make the ARC an internationally recognized body of knowledge.

2015/2016 has been a trying year as far as the economies of South Africa and the world. The global economic crisis has affected us and many other countries. The ARC continued with its mandate to make sure that we do not get destructed by these challenges. We acknowledged the budget cuts from DAFF but remained determined to success in our endeavors.

The Year under reflection also created an opportunity for the ARC to successfully host the GCARD3 International Conference in South Africa. This occasion was attended by individuals from different parts of the world. The focus was largely on Agriculture as a major contributor to sustainable development, excellent nutrition and Agriculture as an important component of our economies. This latter was particularly relevant to South Africa as the commodity market of our country continues to lose its significant.

This report indicates that the ARC went through an institutional review. This review is intended to position and consolidate the competitive advantage of the ARC in the next 30 years. The Governing Council took it upon itself to establish a Strategic Review Committee to make sure that the recommendations and commendations made by the Institutional Review are effectively implemented. The council looks forward to a bright future for the ARC.

Let me also take the opportunity to thank all the Governing Council members for their commitments to the success of the ARC. You have successfully carried out your corporate governance responsibilities so far, the ARC is regarded as one of the best governed entities in the science bodies. I am sure the tax payers will be happy to learn that their hard earned monies are handled with due care and diligence.

Prof Sibusiso Vil-Nkomo
Chairperson of the ARC Council

ARC 2015/16 EXECUTIVE MANAGEMENT

Standing: from left to right:

Dr J Rees, Phd (GE: Research and Innovation Systems); Dr L Magingxa, Phd (GE: Agricultural Economics and Capacity Development); Mr F Monkwe, MBA (GE: ICT & Infrastructure); Dr A Magadlela, Phd (GE: Animal Sciences) and Mr G Maluleke, CA (SA) (Chief Financial Officer)

Seated: from left to right:

Ms M Umlaw, MBA (GE: Human Resources and Legal Services); Dr S Moephuli, Phd (ARC President and CEO) and Dr N Motete, Phd (GE: Crop Science)

CHIEF EXECUTIVE OFFICER'S INTRODUCTION

Dr Shadrack Moephuli
President and CEO of ARC

MESSAGE FROM THE PRESIDENT AND CEO OF ARC

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 Agricultural Research Council (ARC) containing audited financial statements and performance information for the year ending 31 March 2016. Accordingly, it is with great honour on behalf of all of us, the employees of the ARC together with Council (our board) that we submit this annual report to South Africa's Parliament, through the Executive Authority, the Minister of Agriculture, Forestry and Fisheries: Honourable Mr. Senzeni Zokwana.

The outputs in this annual report were in accordance with the pre-determined objectives that are contained in the Business Plan for financial year 2015/16 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 a fair representation of organisational performance for the first year of the five (5) year strategic plan for the period 2015/16 to 2019/20.

On behalf of all employees of the ARC we hereby express our gratitude for good governance and the support given to the ARC by the Honourable Minister and Council during this period. Further, management and staff hereby express their appreciation for the oversight and stewardship of the Audit Committee.

As reflected in the performance information report the ARC has successfully delivered on its pre – determined outputs. Analysis of performance indicates that in many instances the ARC has exceeded the set targets for some of the strategic objectives. However, it should be noted that good organizational performance was achieved with limited resources (people, finances, equipment, infrastructure) and through a variety of partnerships.

During financial year 2014/15, the ARC Council established an External Institutional Review for the period 2007 to 2014. Following international good practice, a panel of experts drawn from South Africa, Australia, Netherlands, Uganda, United States of America and Zimbabwe as well as a team of strategic advisors were appointed by Council to conduct the review. The resulting Institutional Review report was presented to Council and management in this reporting period of financial year 2015/16.

Primarily, the Institutional Review ascertained that the ARC continues to meet its mandate, mission and objectives as outlined in the Agriculture Research Act, 1990 (Act no. 86 of 1990 as amended by act no. 27 of 2001). It was noted that for the review period, the ARC has stabilized and strengthened governance and executive management functions when compared to 2005/06. The ARC has also made commendable progress on fiduciary matters with unqualified audits and human resource development, particularly transformation. The ARC has established a track record of impact with smallholder agriculture. Partnerships with commodity organizations, provincial government departments and international organizations have improved, resulting in several key success stories with impact in areas such as honeybush, indigenous chickens, irrigation pedal power, sweet potatoes and others.

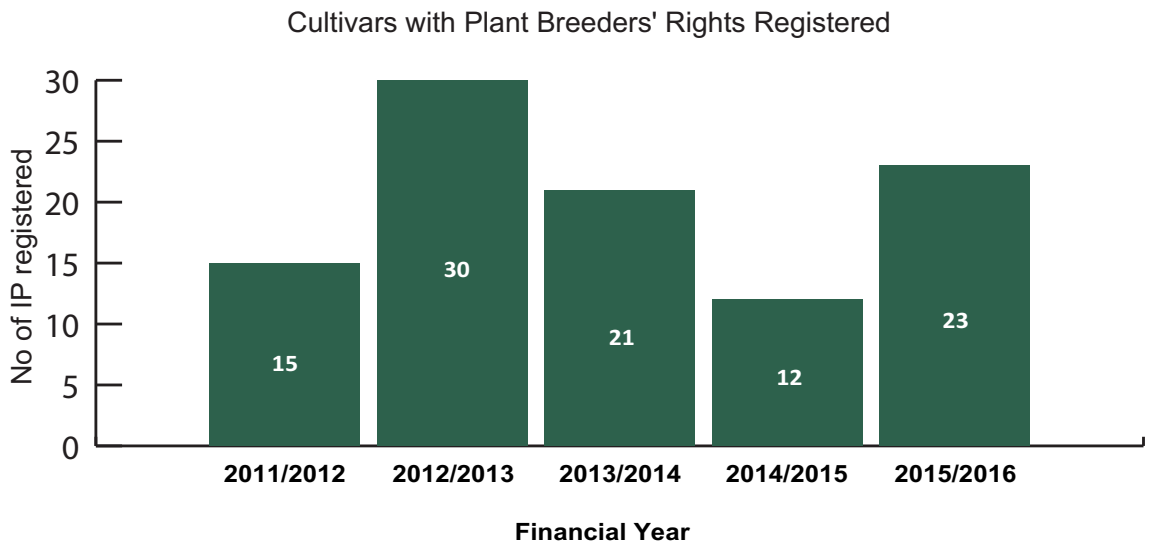
In spite of successes, the review noted the ARC was exposed to several threats, including imminent retirement of several key senior scientists in the absence of successors; a depreciated and poorly maintained research infrastructure and a declining financial base primarily government grants. Management and Council were advised to implement innovative and radical changes towards eliminating or reducing such threats.

Management and staff of the ARC have studied the Institutional Review report as part of organizational learning. Accordingly, management has accepted both the accolades for the successful achievements of the ARC as well as areas that require improvements. In that spirit, management has collaborated with Council to develop strategic interventions that would enable the organization to further succeed.

DISSEMINATING SCIENTIFIC SOLUTIONS FOR AGRICULTURAL DEVELOPMENT

A significant part of South Africa is unsuitable for crop production due to low rainfall and poor soil conditions. It's estimated that no more than 15% of the country is arable. Further, smallholder farmers often attain very low maize and other crop yields because they seldom apply inputs for soil health; and, their crops are often subjected to moisture stress during periodic droughts. Climate change is predicted to worsen the situation with more variable rainfall and above average temperatures. It's against this backdrop that the ARC has placed significant focus on research and development that provides solutions/technologies for South Africa's agriculture.

Accordingly, dissemination of scientific solutions and information to the relevant users in agriculture is essential for the sustainable success of the sector. In the last five (5) years the ARC has successfully developed and released no less than 100 cultivars (fruit, grains, vegetables, medicinal plants etc) to the agricultural sector. The figure overleaf shows the cultivars with plant breeders' rights registered. These cultivars have been developed to enable farmers to successfully increase production and productivity under conditions of adverse climatic stress (drought, floods, pests and diseases) as well as enhance competitiveness of enterprises. South Africa's agriculture success lies in the effective application of innovations.



In this reporting period the ARC transferred under license no less than 23 cultivars to users in the agriculture sector. When compared to prior year, this represents a 50 % increase in dissemination of needed technologies, mainly through a wide variety of partners.

The ARC has been successful at targeted dissemination of cultivars for adoption and use by farmers under certain conditions. For example, in the year under review the ARC released four new wheat cultivars and one new oat cultivars for farmers to produce. Two wheat cultivars, Koedoes and Renoster, are both short growth season cultivars that were targeted for production under irrigation. Whereas the other two cultivars, Kougas and Wedzi were targeted for release to farmers producing under dryland summer rainfall conditions. These wheat cultivars are generally high yielding and should enable farmers to generate higher income.

To ensure food and nutrition security it's important to ensure access to animal protein in people's diet. Accordingly, livestock are an important source of animal protein. In the year under review, the ARC embarked on information and technology dissemination programmes that integrate scientific research into production systems of smallholder livestock producers, popularly known as Kaonafatso ya dikgomo (KyD). Following training by ARC, to date KyD has registered more than 8400 smallholder livestock farmers on Integrated Registration Genetic Information System (INTERGIS), a national animal improvement database. Evidence suggests that participants have experienced market off – take increased by 16%. Further, in the reporting period particular emphasis was on providing scientific information, including through demonstrations on drought feeding strategies, mainly through alternative and supplementary feeding methods.

This annual report contains highlights of a wide range of initiatives implemented by the ARC, often with a diversity of partners such as the public sector, private sector, rural and urban communities, farmers organisations, donor agencies and international organizations. These highlights also provide an illustration of the kinds of innovations that could be applied for sustainable agriculture towards food and nutrition security.

The ARC's performance was focused on contributing to the National Development Plan's Medium Term Strategic Framework Outcomes. Through a range of projects that have been implemented in the ARC in this reporting period, the organization has contributed towards the following outcomes:

a) Outcome 4: Decent employment through inclusive economic growth;

b) Outcome 7: Vibrant, equitable, sustainable rural communities contributing towards food security for all; and,

c) Outcome 10: Protect and enhance our environmental assets and natural resources.

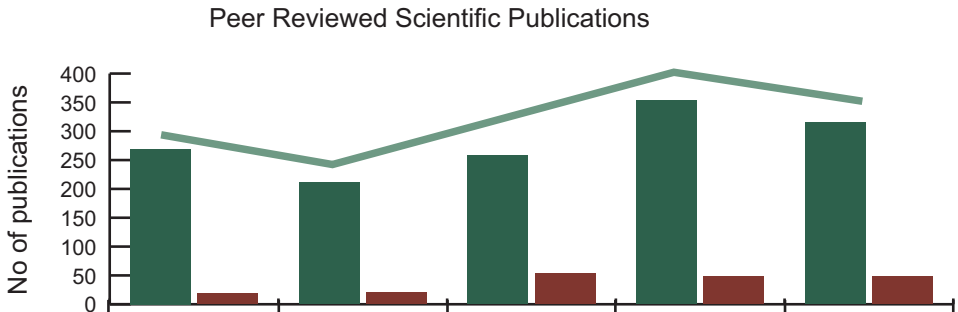
TOWARDS SOLUTIONS FOR A DEVELOPING ECONOMY: RESEARCH AND DEVELOPMENT

Research and development efforts within the ARC continue to contribute towards the scientific excellence within the country's National System of Innovation. Further, the ARC's research and development initiatives continue to contribute towards national priorities as outlined in the Medium Term Strategic Framework.

In the year under review the ARC has continued to increase its contribution to scientific knowledge base of our economy through peer reviewed publications emanating from research and development.

In the last 5 years the ARC has maintained a steady increase in the number of peer reviewed scientific publications (journal articles, conference proceedings, chapters in books etc). During the reporting period the ARC achieved 363 peer reviewed scientific publications, compared to 401 in prior year. This is mainly attributable to impacts arising from reductions in grant allocations and prevailing drought that reduced the number of research trial sites.

The figure below provides a graphical presentation of the scientific achievements of the ARC in the last five years.



	2011/2012	2012/2013	2013/2014	2014/2015	2015/2016
Journal Articles	269	211	258	353	315
Conference Proceedings	19	20	53	48	48
Total Articles	288	231	311	401	363

ARC's scientific achievements as reflected above include the increased number of publications with ISI rating (impact factor) higher than 2.0 suggesting improved quality of science and publications. These outcomes are particularly significant as they form the basis of technology development, information dissemination and possible development of new innovations; which in turn, indicates the ARC's excellence in research and development.

Climate change is a serious threat to South Africa's primary objective of food security, sustainable agricultural production, rural development and economic growth. The adverse impacts of climate change have often been experienced through decreased agricultural production and productivity, with severe consequences on food security and people's livelihoods. To enable the agriculture sector to respond with practical solutions towards climate change, the ARC has been engaged in a range of scientific research and development initiatives, including learning about experiences and solutions from other countries. In order to mitigate climate change, the ARC has a number of breeding programmes, such as low chill apples, which can grow in new areas at different temperatures, and development of maize cultivars capable of growing in low nitrogen soils.

Pests and diseases if left unattended could devastate agricultural production and threaten national and household food security. In the year under review, the ARC continued to conduct research and development towards solutions that could mitigate the impacts of pests and diseases in crops and animal production systems.

In the year under review the ARC together with partners (e.g. International Development and Research Centre (IDRC) Canada) continued its research for the development of vaccines against important animal diseases endemic in Southern and Eastern Africa. To date the ARC has successfully developed a multivalent Lumpy Skin Disease (LSD) – Rift Valley Fever (RVF) vaccine that will protect cattle against LSD and RVF. It's expected that following further evaluation in phase II of the project this vaccine will be registered in South Africa. The second is a LSD – RVF – *peste des pestits* (PPR) vaccine that will be registered for use on sheep and goats in Kenya subsequent to further evaluation.

Efforts of the ARC are at various stages of solutions against the diseases mentioned above. One example, towards development of a vaccine for Heartwater (also called cowdriosis) demonstrates success for the ARC. The disease is endemic in South Africa and can easily kill large numbers of animals. As vaccination is the main method of managing the disease, an effective and efficacious vaccine is critical for animal production. To date, the ARC has conducted clinical trials to investigate the efficacy of a live attenuated vaccine against heartwater disease in livestock, specifically in small stock (goats and sheep). Results from clinical trials demonstrate that this attenuated heartwater vaccine is safe and protective, which in turn enable the ARC to develop appropriate standard operation procedures for production and use of the vaccine.

The ARC continues to provide technical advice, data and information for the National Cultivar Evaluation Programme on the most suitable crops for specific agro – ecological zone production. The Cultivar Evaluation Programme continues to provide valuable information and advice to producers through the publication and dissemination of production guidelines such as the "Maize Information Guide", "Guidelines for Production of Small Grains," printed in English, Sesotho and in isi-Xhosa.

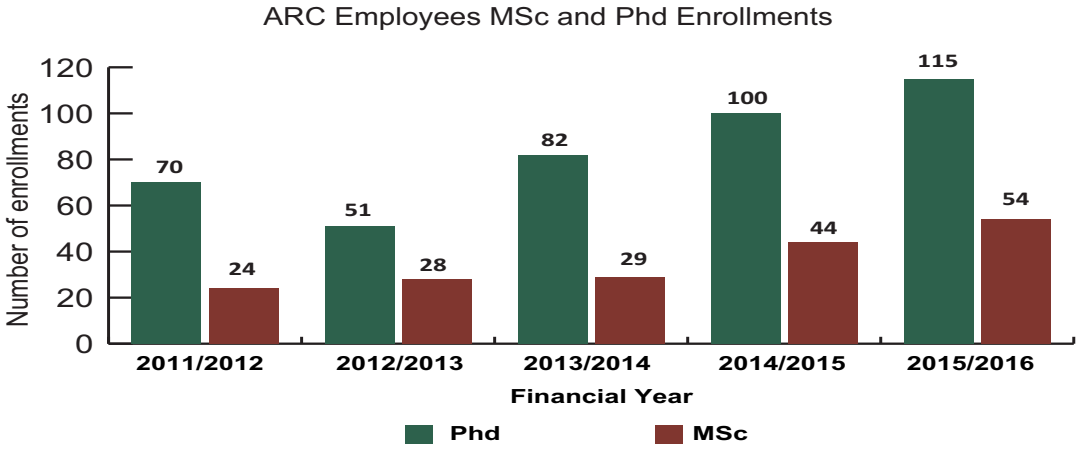
OUR PEOPLE, THE MOST IMPORTANT ASSET FOR EFFECTIVE DELIVERY

The ARC values its human resources for effective delivery and sustainable impact on agriculture development. In the year under review, the ARC embarked on a number of initiatives to provide the best environment that would encourage excellent performance.

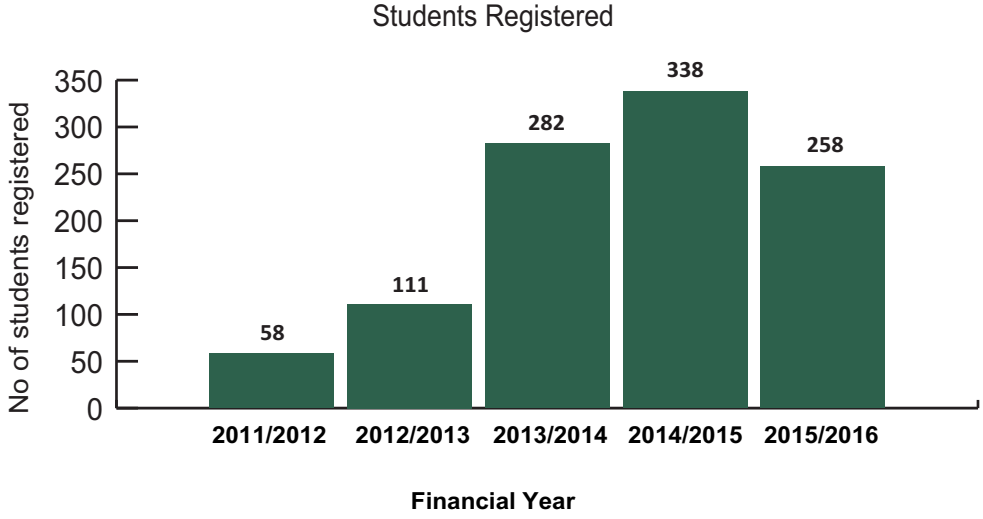
Management continued to place a premium on good employee relations. The relationship between organized labour and management at ARC has been collaborative; thereby resulting in agreement on a number of policies and collective agreements. This situation allowed for organized labour to support the organization in the implementation of a Ministerial Determination for extending overtime in certain areas.

Human resource development is a critical enabler for sustainable growth of the ARC, the agriculture sector and science and technology for South Africa. In this regard, the ARC has implemented a Professional Development Programme and Employee Development system.

To ensure a continuously skilled workforce for succession planning in the ARC employees are encouraged to enrol in further education and training. When compared to prior year (155), the number of employees undergoing formal higher education training increased by 44%. Further analysis indicates that in the year under review 281 employees comprising 12 % of all personnel (2369) were enrolled for higher education. Of the 281 employees 42% were studying towards obtaining doctoral and 25% for master's degrees. See figure below for enrolments of masters and doctoral degree employees.



In the last five years the ARC has successfully increased the number of students enrolled under the PDP, except for financial year 2015/16; where there was a decline of 24% from 338 to 258. Reasons for the decline vary according to circumstances that enable the students to timeously register at institutions of higher learning, but also this was influenced by reductions in the allocations of the Parliamentary Grant (PG). Further analysis indicates that of the 258 approximately 33% enrolled for doctoral studies and 58% towards master's degrees. Key in the success of the programme is the direct relevance of the training to workplace skills requirements and participation of employers (agriculture industry).



Effective talent management enables organisational transformation, recruitment and retention of the best skilled and high performing employees. Talent management within the ARC has been successful as the turnover rate decreased from 3.83% in prior year to 3.48% in the reporting period. The turnover rate for researchers in the reporting period is 4.95% and 5.97% for research technicians. This data reflects a stable organization capable of sustainably contributing to the success of the agriculture sector.

Employees in the ARC continue to perform very well and in some instances with distinction. In the year under review no less than 25 ARC employees were recognized or received awards for excellence in their scientific contributions.

MANAGING OUR FINANCES FOR EFFECTIVE AND SUSTAINABLE SUCCESS

Effective, efficient and transparent management of finances is an important indicator for organizational sustainability and success. The ARC continues to strive for ensuring that its customers and the shareholder derive optimal value from the utilization of financial and other resources.

In order to provide reasonable assurance against material losses and misstatements of financial results, the ARC reviewed its materiality framework for improvement of internal controls. The ARC's internal financial controls comply with the Public Finance Management Act, 1999 (Act no. 1 of 1999, as amended) (hereafter referred to as PFMA) and the organisation's Enterprise Risk Management Framework. Further, management recognized the importance of a good control environment for effective management of risks, improving performance, enhancing governance and enlisting stakeholder confidence in order to strengthen the organization's reputation. Therefore, in the year under review particular emphasis was placed on managing business risk and its possible impact on continuity.

During the reporting period the ARC continuously improved upon its performance information system that is aligned to the Business plan for financial year 2015/16. A dashboard system was used throughout the year to enable management to monitor and report on performance information. This has enhanced the ability of management to ensure accurate and timely reporting of performance on all pre – determined objectives and targets as well as monitoring any non – compliance or failures. The results of this performance information system are contained in this annual report.

Conducting business in financial years 2013/14 to 2015/16 was difficult for the ARC due to poor economic conditions and in some instances poor agriculture sector performance. The ARC's Parliamentary Grant allocation was reduced by R233 million over the MTEF period of 2014/15 – 2016/17. The first cut of R40 million was implemented during financial year 2014/15, while the second was effected in 2015/16. These reductions in Parliamentary Grant allocations adversely impacted on the ability of the ARC to fulfil its mandate. Further, this placed the ARC in difficult position to generate external income, particularly co – funding arrangements.

As confirmed by the Institutional Review Panel, the ARC continued to experience a huge backlog that requires additional funding towards the research infrastructure. Estimates are that the ARC requires capital injection towards research infrastructure of at least R480 million over the MTEF period. Infrastructure and capital equipment investments would enable the ARC to effectively deliver on its mandate, thus positively contribute to sustainable growth of the agriculture sector and economic growth.

Further, the ARC was saddled with unfunded and insufficiently funded mandates from the Department of Agriculture, Forestry and Fisheries (DAFF); which are mainly the national public good assets that continue to adversely impact on the financial performance of the organization. Resource limitations constrained the ARC's potential to grow external income without adversely impacting upon research, technology development and technology transfer. Lack of financial resources adversely impacted upon the ARC's ability to successfully complete some of the research, technology development and technology transfer projects, again compromising the organization's ability to fulfil its mandate.

Internal audit service providers have been instrumental in assisting ARC improve upon its internal controls. This has provided assurance to management, the Audit Committee and Council on the effective and efficient use of resources at the disposal of ARC. Therefore, on behalf of the ARC we thank them for providing this high quality assurance system.

The ARC hereby thanks the Auditor General for providing an external audit service of good quality in a professional manner.

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 DAFF. 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.

Further, on behalf of all at the ARC, Executive management hereby thanks the Executive Authority, the Minister of Agriculture, Forestry and Fisheries: Honourable Minister Mr. Senzeni Zokwana for consideration of this report and the Portfolio Committee for Agriculture, Forestry and Fisheries for the contribution and support towards the success of ARC.

Re a leboha, le ka moso
Re a leboga, le kamoso
Re a leboga, le gosasa
Siyabulela, nangamso
Siyabonga, nakusasa
Siyathokoza, nangamoso
Ha khensa, aswive tano na mudzuku
Ria livhuwa, khazwiralo na matshelo
Baie dankie
Thank you

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 Agricultural Research Council 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 and ensure natural conservation;
- promote national food security; and
- contribute to better quality of life.

Main Functions

The Agricultural Research Council'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 Department of Agriculture, Forestry and Fisheries (DAFF) and the Department of Science and Technology (DST), has mandated the Agricultural Research Council to manage and maintain National Public Goods Assets. The National Public Goods Assets comprise national collections (gene banks) 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 Agricultural Research Council research, technology development and technology transfer, which contributes to a better life for all and the conservation of natural resources. The Agricultural Research Council maintains and manages a combination of the classes 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.

DNA Databank for Stock Identification

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.

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 Gene Bank 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.

Transboundary Animal Disease Programme (TADP)

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 P3 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.

Rabies Laboratory

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 Tick Collection

- National Helminth (parasitic worms) collection
- Serum bank (virology)
- Insect collection (entomology)
- Diagnostic services (reference laboratories for Rift Valley Fever, blue tongue, African horse sickness, lumpy skin disease and African swine fever).

Natural Resources Management, Mechanisation and Engineering

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

Agricultural Engineering

- Agricultural equipment and implementation of test facility.
- Renewable energy demonstration centre.

Soil, Climate and Water

- Agro-meteorological weather station network, databanks and information systems.
- Land type and other soil surveys with associated databases, maps and sample collections.
- Coarse resolution satellite image database for natural resource and disaster management.

Plant Protection

- National collection of insects.
- National collection of arachnids.
- National collection of nematodes.
- National collection of fungi.
- South African plant pathogenic and plant-promoting bacterial collections.
- South African plant virus and antisera collection.
- Rhizobium culture collection.
- Integrated pest and disease management.
- Biological control of invasive alien plants.

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 Acocks' 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.

Germplasm Collection

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.

Deciduous Fruits, Vines and Wine

Grapevine, deciduous fruit, yeast and alternative crops gene banks.

Tropical and Subtropical Crops

Tropical crops gene banks, indigenous plants and vegetable gene banks.

Vegetable and Ornamental Plants

Indigenous plants and vegetable gene banks.

Grain Crops

Protein seeds and summer grain gene banks.

Small Grains

Small grain gene banks, wheat, barley, oats, rye, triticale, durum and tropical crops gene banks.

Industrial Crops

Tobacco, cotton and fibre crops gene banks.

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 phyto-sanitary 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 databanks, as well as weather stations for climate inventories and collection of data;
  - A significant amount of the germplasm contained in the gene banks 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 - Gene banks serve as the basis for resuscitating agricultural production following natural disasters and are important for biodiversity and food security.

- Organisation and Facilities: the Agricultural Research Council conducts its business at various campuses, including its administrative office, situated at different locations within the country – at Bethlehem, Nelspruit, Potchefstroom, Pretoria, Rustenburg and Stellenbosch – and at a number of laboratories, office buildings and research farms throughout the country. Much of the research facilities of the Agricultural Research Council are distributed in accordance with agro-ecological zones, which enables specific focus on particular commodities. The Agricultural Research Council's research and development capability is organised as follows:

  - Crop Production, consisting of the following research areas: Citrus and Subtropical Crops, Deciduous Fruits and Grapes; Vegetable, Medicinal and Ornamental Plants, Summer Grains and Oil and Protein Crops, Small Grains and Industrial Crops;
  - Animal Production, consisting of Animal Production and Improvement, 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 Agricultural Research Council 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 Agricultural Research Council 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.

CHIEF FINANCIAL OFFICER'S REVIEW

Mr Gabriel Maluleke
Chief Financial Officer

Overview

The financial year ending 31 March 2016 was characterised by an 8% decline in revenue. This was driven by the two consecutive years of reduced allocations of Parliamentary Grant from the government and lack of growth in private sector investments in agricultural research and development over the last decade. The ARC's cost structure, in which almost 60% of the costs are personnel costs, make it very difficult to respond to such drastic reductions in Parliamentary Grant allocations in the short period of time. This is mainly because of the continued challenging South African cost environment in respect of labour, maintenance and electricity.

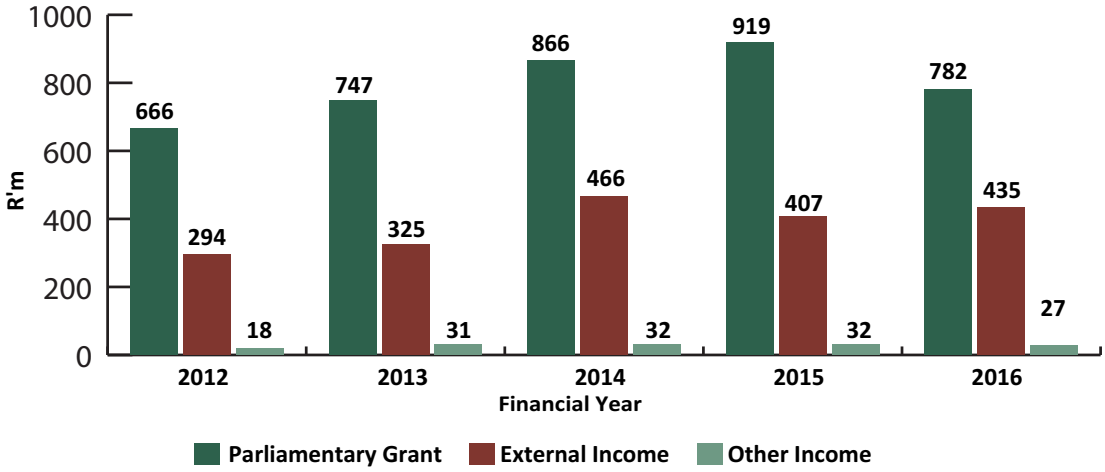
Management however implemented cost control measures to manage the negative effects of cuts in Parliamentary Grant allocation that resulted in operating expenditure being 2% lower than 2014/15, despite the inflationary increases in personnel costs and other operating costs.

The cuts in operational Parliamentary Grant resulted in a deficit of R73m for the year under review despite the 7% growth in external income.

Financial Performance	2015 R'm	2016 R'm	Var. %
Parliamentary Grant	**919**	**782**	**(15%)**
PG - Operational	705	662	**(6%)**
PG - ECSP	135	38	**(72%)**
PG - Capex	79	83	**5%**
External Income	407	435	**7%**
Other Income	32	27	**(16%)**
Total Revenue	**1 358**	**1 244**	**(8%)**
Operating Expenditure	**1 344**	**1 317**	**2%**
Personnel Costs	779	768	**1%**
Other Operating Costs	517	509	**2%**
Depreciation & Impairment	48	40	**15%**
Surplus/(Deficit) for the year	**14**	**(73)**	**(609%)**

Revenue

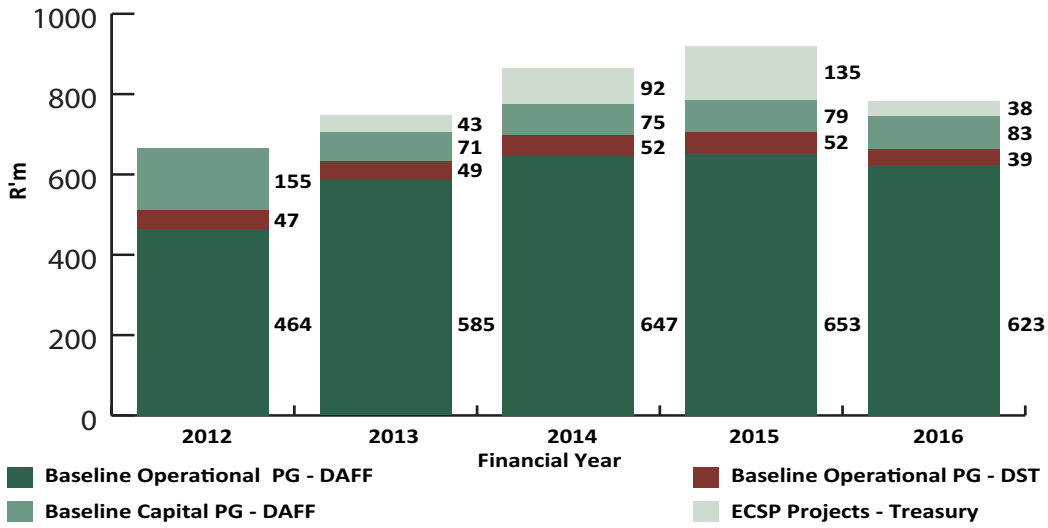
The ARC's revenue is down for the second consecutive year by R115m (2015: R5m) to R1 244m. The ARC derives Parliamentary Grant from the Department of Agriculture, Forestry and Fisheries (DAFF) and the Department of Science and Technology (DST). External Income is derived from contract research and development income from both public and private sector, locally and internationally. Short term investment yielded 2.2% (2015: 2.4%) of total Revenue.



ARC's revenue funds research and development programmes, technology transfer, infrastructure as well as support services. The ARC has processes, policies and guidelines to ensure effective utilisation of the funding in line with the PFMA, National Treasury guidelines and applicable accounting standards.

Parliamentary Grant (PG)

PG went down by 15% to R782m (2015: R919m). The PG is made up of Operational PG, Capital PG and Economic Competitiveness and Support Packages (ECSP).



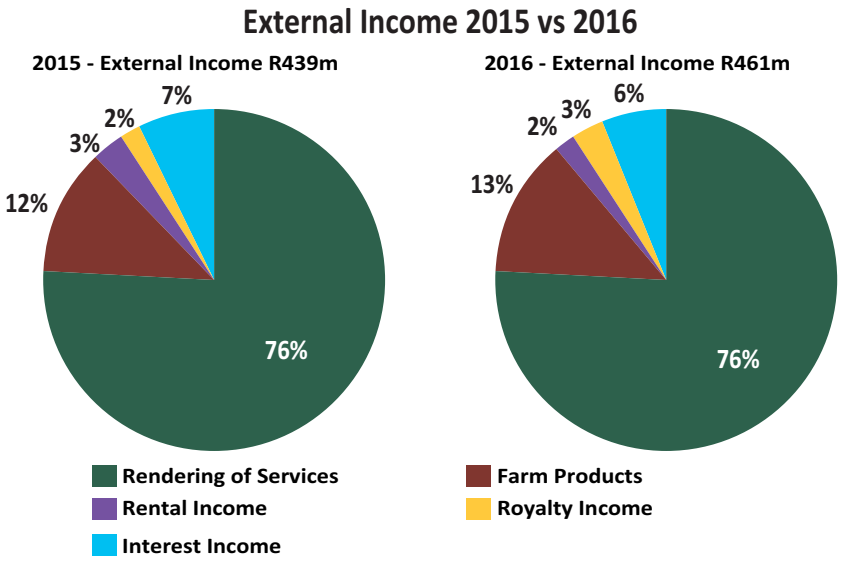
Operational PG from DAFF, which constitutes 80% of the total PG, declined by 5% to R623m (2015: R653m). This grant is generally used to cover operational costs such as salaries, research consumables, travelling costs, maintenance, etc. There was also a cut in Operational PG from DST of 25% to R39m (2015: R52m). This grant is used to maintain the National Assets such as; Indigenous plants and vegetable gene banks.

Economic Competitiveness Support Packages (ECSP) funding declined by 72% to R38m (2015: R135m). Funding for the ECSP projects came to an end in 2015. The ARC received R400m (Vat inclusive) over a 3 year period commencing from 2012/13 to 2014/15. There was however an amount rolled over to 2015/16 for the completion of projects started in prior years. No further funding has been allocated over the MTEF for the continuation of these projects.

Baseline Capital PG from DAFF increased by 4.6% to R83m (2014: R79m). The ageing infrastructure within the ARC requires investments at the rate much higher than the current allocations for the maintenance of the infrastructure and replacement of assets.

External Income

External Income is derived through projects contracts, research and development contracts, royalty from Intellectual property, and sales of farm products.

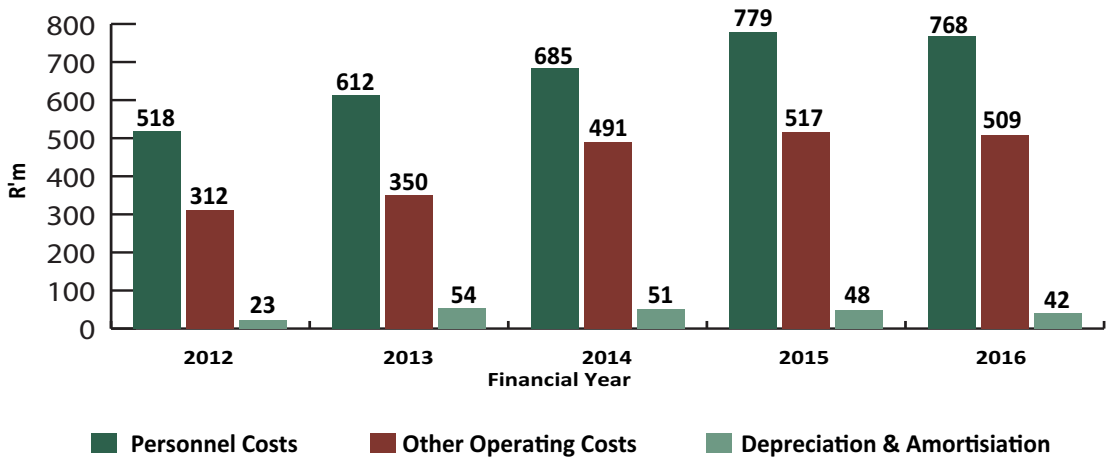


External Income is up 7% to R435m (2015: R407m). The growth is mainly due to the 65% increase in Advisory services as well as 45% increase in diagnostic services. In a bid to grow our external income, special attention was on growing revenue from our farm products, which increased by 18%.

Other Income

Other income comprises mostly of interest received from short-term investments as a result of having invested income received in advance from both government grants and funding for projects from private sector clients. Other income is down 17% to R27m (2015: R32m) as a result of the decrease in cash investments. Over the past couple of years, the ARC have been prudent in the management of its cash resources in order to achieve cash neutrality. This has been achieved through investing in the highest interest-bearing investments to achieve higher short-term returns.

Operating Expenditure



The ARC continuously reviews the operating costs, especially focusing on its costing model to ensure that projects costs do not spiral out of control over the life-cycle of the projects. Total Operational Expenditure is down by 2% to R1 317m (2015: R1 344m). The ARC implemented cost control measures to deal with the cuts in Parliamentary Grants during the year.

- **Personnel Costs**

  Personnel costs are down 1% to R768m (2015: R779m). During the financial year, employees received a 6.5% increase on salaries. The increase in employee's cost was set-off by the employee contracts linked to ECSP coming to an end, as well as the delay in filling of vacancies to mitigate the effects of budget cuts.

- **Operating Cost**

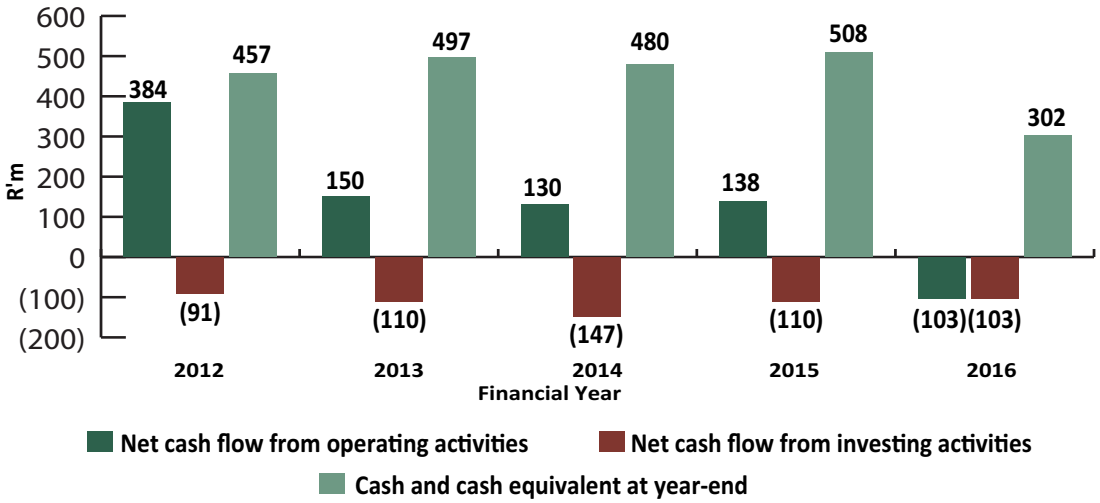
  Operating costs are mainly research-related costs such as consumables and stock feeds, administration and maintenance of infrastructure. Operating costs are down 2% to R509m (2015: R517m), driven mainly by ECSP contracts coming to an end, as well as restricted expenditure to mitigate the effect of cuts in Parliamentary Grant allocations.

- **Depreciation**

  Depreciation and impairment cost down by 15% to R40m (2015: R48m). The ageing of the ARC infrastructure has resulted in a lower depreciation cost, some of our assets in use have fully depreciated.

Cash flow

The ARC cash position went down to R302m as at 31 March 2016, from an opening balance of R508m at the beginning of the financial year. The main driver of this is the cuts in baseline allocation for Parliamentary Grants.



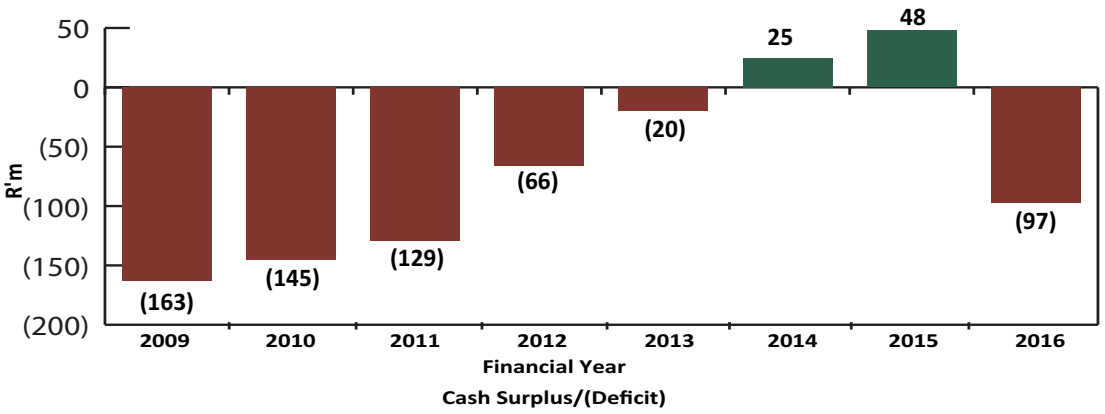
Although the cash balance of ARC still appears high as at 31 March 2016, it should be viewed against the level of cash commitments as at the same date, such as follows:

- The ARC received R188m for the construction of the Food-and-Mouth Disease (FMD) factory over the past few years. As at the 31st of March 2016, R127m (2015: R130m) was still unspent as a result of the delay in the process of development and the design of the facility. This amount is ring-fenced and does not form part of the operational funds of the ARC. The ARC is awaiting further allocation in order to begin the construction of the FMD facility as the existing amout is not sufficient to complete the outstanding work.
- Included in the closing cash balance, is R42m relating to Economic Competitive Support Packages for work to be completed during 2016/17 financial year.
- Acquisition of Assets to the value of R55m were yet to be finalised as at 31 March 2016. The cash forms part of PG – Capex and can only be utilised in acquisition of Assets.
- Income received in advance from clients totalling R80m was on hand as 31 March 2016. This is for contract work to be completed during 2016/17 financial year. The ARC asks for prepayments on contracted work to fund the working capital required to execute the work. This is due to lack of cash reserves within the ARC to fund such contracts which run over an extended period of time.
- Trade creditors, representing amounts owed to providers of goods and services to the ARC, amounted to R61m as at 31 March 2016.

All these commitments need to be provided for from the cash as at the 31 March 2016. The table below indicates the cash and cash equivalents vs the cash commitments as at the end of March 2016 compared to March 2015. The net effect indicates the ARC's ability to meet its short term cash commitments.

Cash and Cash Equivalents				
	2015 R'm	2016 R'm	Variance R'm	Variance %
Cash and Cash Equivalents	508	302	**(207)**	**(41%)**
Add: Net Trade Accounts receivables	121	214	**92**	**76%**
	630	**515**	**(115)**	**(18%)**
Less: Cash Commitments	**582**	**612**	**(30)**	**(5%)**
Non-Current Liabilities	20	17	**4**	**18%**
Deferred Income grant	130	127	**3**	**2%**
Deferred Capex	38	55	**(17)**	**(45%)**
Current Liabilities	394	414	**(20)**	**(5%)**
Cash surplus/(deficit)	**48**	**(97)**	**(145)**	**(301%)**

The ARC over the past seven years implemented cost control measures that saw the reversal from a cash shortage situation back in 2009 to a cash positive situation in 2014 and 2015. The impact of the budget cuts are visible through the return to a negative cash situation as at the end of March 2016 as depicted below.

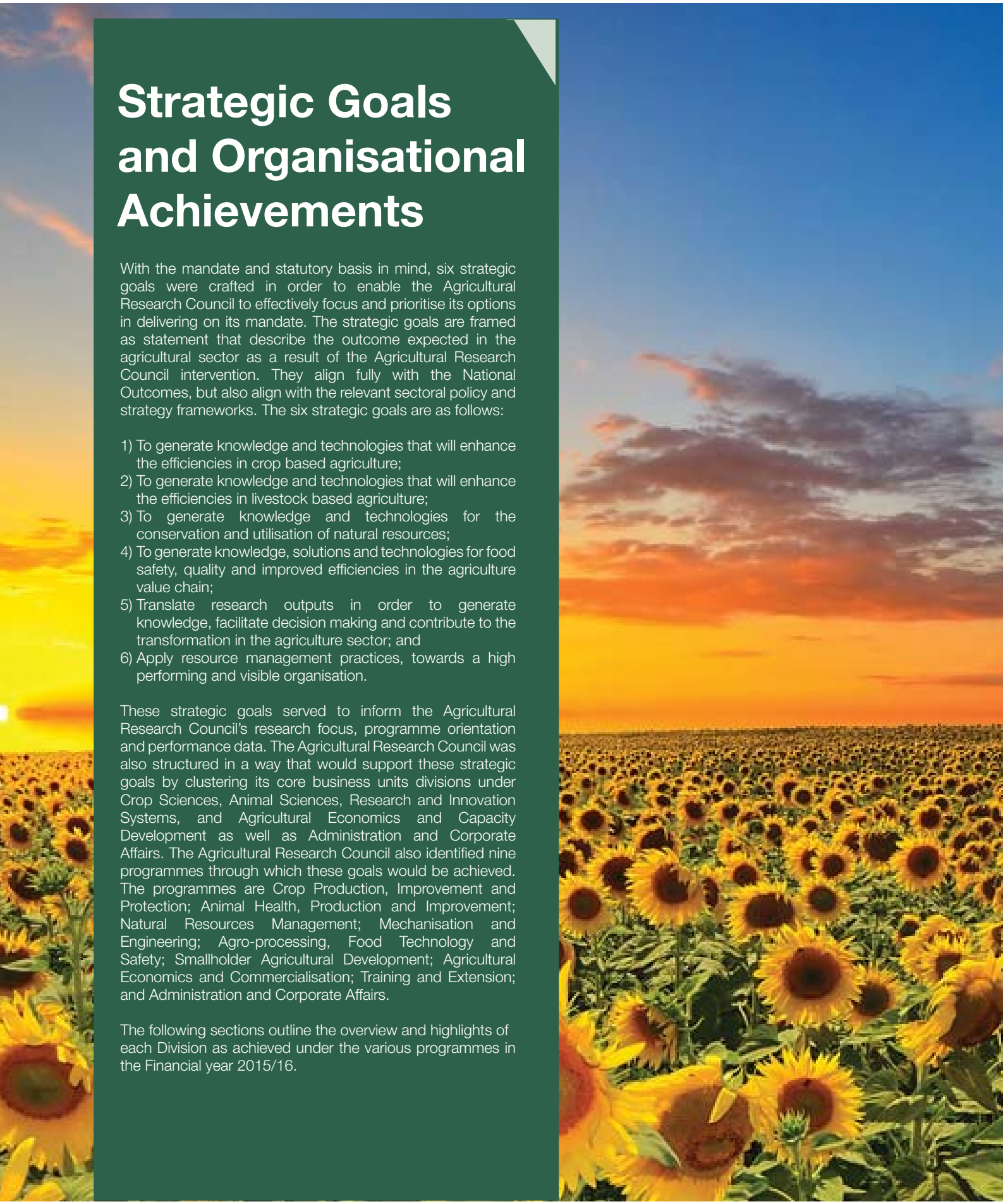


The Control Environment

The ARC received an unqualified audit opinion once again. The Auditor General has however highlighted areas of improvement which management is currently addressing in order to move towards a clean audit next year. The ARC embarked on the restructuring of the Finance function during 2015/16 in order to strengthen controls and beef up capacity. Key positions which were vacant during the past financial year have been filled with competent and skilled people.

10 Year review

AGRICULTURAL RESEARCH COUNCIL-TEN YEAR REVIEW										
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
	R'm	R'm	R'm	R'm	R'm	R'm	R'm	R'm	R'm	R'm
STATEMENT OF FINANCIAL PERFORMANCE										
Total Income	**704**	**730**	**762**	**831**	**871**	**978**	**1 104**	**1 364**	**1 358**	**1 244**
Parliamentary Grant	434	452	470	533	590	666	747	866	866	782
Baseline Operational-DAFF	356	371	373	434	439	464	585	647	647	623
Baseline Operational- DST	37	37	37	42	44	47	49	52	52	39
ECSP Projects-Treasury	-	-	-	-	-	-	43	92	92	38
Baseline Capital- DAFF	41	43	60	57	106	155	71	75	75	83
External Income	235	266	256	293	266	294	325	466	466	435
Other Income	34	12	36	6	14	18	31	31	31	27
Total Expenditure	**696**	**718**	**778**	**773**	**811**	**854**	**1 015**	**1 227**	**1 227**	**1 317**
Personnel Costs	416	416	467	490	511	518	612	685	685	768
Operating Costs	269	289	296	265	282	312	350	491	491	509
Depreciation & Amortisation	11	13	14	18	19	23	54	51	51	40
Net Surplus\(Deficit)	**8**	**12**	**(16)**	**58**	**59**	**124**	**89**	**137**	**137**	**(73)**
STATEMENT OF FINANCIAL POSITION										
Property, plant and equipment	523	608	649	649	666	729	784	880	944	1 006
Investments	2	2	2	2	2	2	4	4	5	5
Current assets (excluding cash)	77	95	82	93	76	84	87	141	134	221
Cash resources (net of bank overdraft)	**97**	**59**	**35**	**73**	**163**	**457**	**497**	**480**	**508**	**302**
Total Assets	**699**	**764**	**768**	**818**	**908**	**1 273**	**1 372**	**1 506**	**1 592**	**1 534**
Capital and Reserves	206	273	502	559	618	742	832	968	985	911
Non Current Liabilities	309	326	87	71	72	115	213	209	213	209
Current Liabilities	184	164	180	188	217	416	327	329	394	414
Total Equity and Liabilities	**699**	**764**	**768**	**818**	**908**	**1 273**	**1 372**	**1 506**	**1 592**	**1 534**
CASH FLOWS										
Net cash flow from operating activities	7	5	36	56	129	384	150	130	138	(103)
Net cash flow from investing activities	(63)	(42)	(60)	(17)	(39)	(91)	(110)	(147)	(110)	(103)
Cash and cash equivalents at beginning of year	153	97	59	35	73	163	457	497	480	508
Cash and cash equivalents at end of year	**97**	**59**	**35**	**73**	**163**	**457**	**497**	**480**	**508**	**302**
RATIO ANALYSIS										
Profitability and asset management										
Asset Turnover	1,3	1,2	1,2	1,3	1,2	1,1	1,0	1,1	1,1	1,1
Return on net assets (%)	1,5%	2,0%	(2,7%)	9,3%	8,6%	31,2%	16,2%	19,6%	2,1%	(9,0%)
Current Ratio	0,9	0,9	0,7	0,9	1,1	1,3	1,8	1,9	1,6	1,3
Operating margin (%)	1,2%	1,7%	(2,2%)	7,1%	6,9%	13,0%	8,3%	10,3%	1,1%	(6,0%)
Performance										
Personnel Costs as a % of Total PG	96%	92%	99%	92%	87%	78%	82%	79%	85%	98%
Personnel Costs as a % of PG (Exc Capex)	106%	102%	114%	103%	106%	101%	90%	87%	93%	110%
Personnel Costs as a percentage of total expenditure %	60%	58%	60%	63%	63%	61%	60%	56%	58%	58%
External revenue as a % of total income	35%	36%	34%	35%	31%	30%	29%	34%	30%	37%
Ratio definitions										
Net Assets	Total assets excluding cash and current liabilities									
Asset turnover	Revenue devided 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 to current liabilities									
Operating margin %	Net surplus\(deficit) as a percentage of turnover									



Strategic Goals and Organisational Achievements

With the mandate and statutory basis in mind, six strategic goals were crafted in order to enable the Agricultural Research Council to effectively focus and prioritise its options in delivering on its mandate. The strategic goals are framed as statement that describe the outcome expected in the agricultural sector as a result of the Agricultural Research Council intervention. They align fully with the National Outcomes, but also align with the relevant sectoral policy and strategy frameworks. The six strategic goals are 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 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) Translate research outputs in order to generate knowledge, facilitate decision making and contribute to the transformation in the agriculture sector; and
6) Apply resource management practices, towards a high performing and visible organisation.

These strategic goals served to inform the Agricultural Research Council's research focus, programme orientation and performance data. The Agricultural Research Council was also structured in a way that would support these strategic goals by clustering its core business units divisions under Crop Sciences, Animal Sciences, Research and Innovation Systems, and Agricultural Economics and Capacity Development as well as Administration and Corporate Affairs. The Agricultural Research Council 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 2015/16.

OVERVIEW AND HIGHLIGHTS OF CROP SCIENCES

The Crop Sciences division of the Agricultural Research Council 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 translate research outputs in order to generate knowledge, facilitate decision making and contribute to the transformation in the agriculture 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 grains and industrial crops.

The Crop Sciences division has research facilities in Stellenbosch, Rustenburg, Potchefstroom, Bethlehem, Pretoria (Roodeplaat) and Nelspruit. 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 financial year 2015/16 are highlighted below.

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

Research focusing on Breeding (Cultivar Development)

The ARC has extensive breeding programmes that encompass almost all the different crops. The work is conducted to create new cultivars that would improve yield, taste or appearance of the commodity, are tolerant or resistant to either pests, diseases or variation in climate, or have improved nutrient value. The development and release of new cultivars increase the competitiveness of the sector and thus creates jobs and increases income. The ARC produced 23 new cultivars in the financial year 2015/16. The examples below give an indication of the potential impact of these new cultivars.

Akwa Plus and Sellie Plus – a boost to the groundnut industry

Groundnut is an important food and feed crop for many farmers in South Africa. The ARC has conducted a groundnut breeding programme for many years to address challenges for higher yielding groundnut cultivars with resistance to foliar and other diseases affecting quality of genotypes as well as a higher oleic acid content of the kernels to improve shelf life. The ARC received Plant Breeder's Rights and Variety Listing for two new cultivars, Akwa Plus and Sellie Plus. Both varieties outperformed the current market leaders on yield and quality, thus contributing to a much needed yield increase. The cultivation of these new cultivars will enhance the food and fodder security in South Africa and also generate royalties.

New wheat and oat cultivars released to boost profitability

The ARC released four new wheat cultivars and one new oat cultivar for commercialisation. Two cultivars for the irrigation areas were approved by the Winter Cereal Trust, a key stakeholder within the cereal industry. The two cultivars, Koedoes and Renoster, are both short growth season cultivars that will assist farmers to mitigate the effects of climate change which shifts and shortens the growing seasons. The cultivar Renoster also possesses a short-straw gene that makes the plants shorter, thereby minimising lodging problems under high yielding irrigated conditions.

The other two cultivars, Kougas and Wedzi, approved by the Winter Cereal Trust were for the dryland summer rainfall area in the Free State region. These cultivars have the genetic potential to realise increased yields in this production area, thereby boosting profits and securing farmer income.

One oat cultivar, Piketberg, was released for the animal feed industry. This cultivar has a superior green biomass as well as good grain yield. In optimal seasons, this cultivar should meet the stringent grain quality requirements of the breakfast cereal industry.

Wheat field.

Drought and low nitrogen tolerant maize hybrids developed – a stride closer to food security

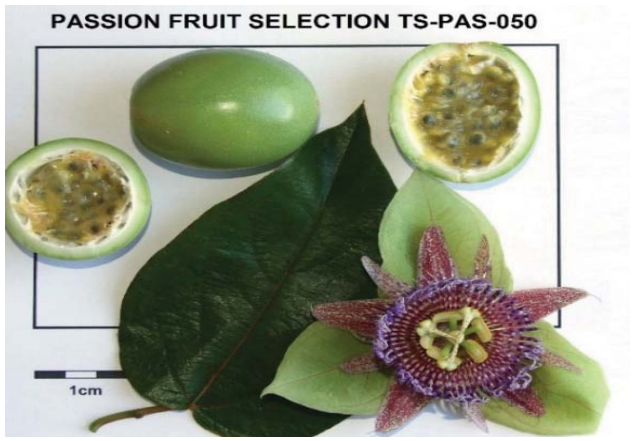
Much of South Africa is unsuitable for crop production due to low rainfall and poor soils. Only about 13% of the country is arable. Smallholder farmers get very low maize yields (about 1.0 t/ha) because they apply very little or no fertiliser and their crops are often subjected to moisture stress during periodic droughts. Climate change is predicted to worsen the situation with more variable rainfall and above-average temperatures. To address these challenges, the ARC is

participating in two international public-private partnerships called Water Efficient Maize for Africa (WEMA) and Improved Maize for African Soils (IMAS). The WEMA and IMAS projects aim to develop and deploy drought tolerant and low nitrogen tolerant hybrids, respectively. The first WEMA Drought*TEGO*™ hybrids, WE3127 and WE3128, were launched in December 2014. They received positive feedback from the various representatives of farmers and extension officers who received 10 000 promotional seed packs during the launch. Eight new drought tolerant conventional hybrids (WE4144, WE4145, WE4147, WE4307, WE4308, WE4338, WE4351 and WE4359) developed by the ARC were added to the National Variety List by the Registrar of Plant Improvement in October 2015. Seven low nitrogen tolerant hybrids (SA4101, SA4108, SA4111, SA4112, SA4115Q, SA4348 and SA4364) were also added to the National Variety List. Seeds of these drought and low nitrogen tolerant maize hybrids will be marketed by licensed local seed companies. The drought and low nitrogen tolerant maize hybrids will enable smallholder farmers to increase and stabilise maize productivity, household food security and family incomes, resulting in improved livelihoods.

New disease-resistant passionfruit cultivar developed

Passionfruit is an economic crop in many countries of the world in terms of income as well as for food security. Passionfruit is a highly sought-after, high value fruit which is marketed on both national and international markets. Unfortunately, passionfruit cultivation in South Africa is reliant on only one commercial cultivar which is highly susceptible to pests and diseases including nematodes, viruses, *Phytophthora* root rot as well as an array of fungal diseases of the foliage and fruit. Furthermore, very few chemical products are registered for the control of these pests and diseases and these do not provide effective control. One of the most important diseases limiting the production of this crop is woodiness disease caused by the Passionfruit woodiness virus which is spread by aphids during pruning of the vines. Passionfruit breeding research concentrates on finding resistant selections against this disease so that vines, which have a relatively short lifespan, do not require producers to replant regularly.

The variety was developed using conventional controlled pollination between one parent having an extremely hard rind, making it difficult for aphids to transmit the virus, and the other parent having excellent juicing characteristics. Evaluation of the resulting seedlings led to the identification of the new variety which is resistant to both viruses and leaf diseases. Although the fruit is not suitable for marketing as a fresh fruit due to its extremely hard and green skin, it was registered for Plant Breeder's Rights as a breeding parent with the ultimate aim of incorporating the resistance/tolerance genes into the purple passionfruit gene pool. Breeding pest- and disease-resistant/tolerant cultivars will ensure that the longevity of producers' plantings is improved, making the industry highly profitable for growers. The resistant/tolerant cultivars will reduce the need for the use of chemical sprays, saving both input costs and reducing the negative impact on the environment.



Newly bred leaf disease and virus resistant passionfruit variety.

New high quality seedless mandarin commercialised in the European Union

In terms of gross value, the citrus industry is the third largest horticultural industry after deciduous fruits and vegetables in South Africa and represents about 20% of the gross horticultural product value. Mandarins make up just over 40% of the soft citrus plantings and are an important foreign exchange earner. Mandanova SL is the first ARC citrus cultivar to be registered in the European Union (EU). The tree and fruit have the same characteristics as the Nova cultivar but contain less than 1 seed/fruit. The fruit size is medium to large, round and fairly smooth, whilst the external and internal colour is orange-red and the flesh has a good flavour.

The Mandanova SL mandarin is a product from the citrus mutation breeding programme of ARC-Tropical and Subtropical Crops where a branch bearing better-quality fruit was selected from irradiated buds of Nova. This branch was evaluated over several seasons to ensure that the improved fruit quality characteristics were stable. Plant Breeder's Rights were granted and the cultivar was released commercially in Spain. This is the first ARC citrus cultivar to be released in the EU. Seedless fruit obtain premium prices on the market and, with the importance of mandarins in the South African citrus industry and its value on global markets, is key to earning increased foreign exchange.

Mandanova SL mandarin.

Enhancing nematode resistance of *Plectranthus esculentus*, an indigenous tuber crop

The introduction of crops developed and/or improved using biotechnology combined with traditional breeding and selection methods can improve yield and crop nutritional value. Root and tuber crops are amongst the most important staple foods contributing to food security throughout the world, particularly in resource-poor regions, although very little research has been carried out on their nutritional value. Induced polyploidy (doubling plant chromosomes) has been used to improve various horticultural characteristics, such as yield, nutritional value and pest and disease resistance, of a wide range of crops. *Plectranthus esculentus*, or Livingstone potato, is one such tuberous crop, but is highly susceptible to rootknot nematodes which cause damage to the tubers and reduce yields for farmers.

Chromosomes of *P. esculentus* were doubled and verified in-house using a technique called flow cytometry and plants with doubled chromosomes and control plants from the mother material were challenged with nematodes to determine if there was any induced resistance/tolerance. Tuber and leaf mineral and starch contents were also investigated.

The induced polyploids had a higher starch content than the original mother material and were also tolerant to rootknot nematodes. These selections therefore had much higher nutritional value and, because they are tolerant to nematodes, yields are higher and the tubers are of better quality, leading to a potentially higher income for farmers. The tolerance to nematodes means that fewer chemical applications are required for nematode control, therefore reducing both input costs and negative effects on the environment. This is one of the very few reported instances of induced tolerance to nematodes.

Rootknot nematode egg masses on roots.

African Delight – an ARC-bred cultivar with highly desirable eating quality

The breeding and evaluation programmes aim to develop plums that satisfy market needs in terms of appearance, taste and eating quality preferences as well as to extend the harvest season so that products are available earlier and later than the traditional season. By breeding improved cultivars for the South African industry, it can stay at the forefront of product delivery by adapting to needs of the producer and the consumer. South African cultivars remain in great demand and contribute to the South African economy on several levels. Although the breeding process can take up to 20 years, new selections are tested for fruit quality, production characteristics, disease tolerance, storability of the harvested fruit and the market strength of the product during this time to ensure that the best selections end up on the market.

African Delight was recently released and is already commanding good prices on the markets owing to its exceptional quality and is the third most exported plum cultivar from South Africa, after two other ARC-bred cultivars. With several tens of hectares still to come into production this variety is set to determine the new standard for plums in South Africa. It also reaffirms the ARC's position in the South African plum industry with in excess of 7.5 million boxes of the total 11.5 million boxes of plums exported resulting from ARC bred cultivars.

African Delight plum cultivar developed by the ARC.

New apricot selections for the dried fruit market

The breeding and evaluation programmes aim to develop apricots that fulfil the diverse market needs of the South African apricot industries, namely processing markets (drying and canning) looking for bright yellow cultivars and dessert markets for blushed or full red apricot cultivars. There is a big drive from the South African apricot industry to replace the current market leader, a more than 60 year old imported cultivar, with new and improved cultivars. New cultivars should also extend the very limited harvesting season to ease pressure on processing and logistical facilities during the peak of the season. Although it takes almost two decades to produce a reputable, marketable cultivar, selections are evaluated for fruit quality, production characteristics, storability and quality of the canned and dried products during this time. Two selections outperformed all the others, having excellent quality and colour, and have already received positive reaction from the markets.

New apricot selections, with excellent colour and quality, for the dried fruit market.

Research focusing on Protection against Pests and Diseases

Pests and diseases, if left unchecked, can cause serious crop losses and even total crop loss before harvest and during post-harvest storage. Research conducted by the ARC includes surveys to identify and monitor new and invasive crop pests and diseases, studies to understand their life cycle, seasonal occurrence and economic damage, as well as the development of monitoring methods and integrated pest and disease management systems. The identification and treatment of pests and diseases decrease the losses farmers face and in turn produce more crops.

Confronting karnal bunt – a threatening fungal disease of wheat in South Africa

In South Africa, the first karnal bunt outbreak occurred in 2000 in the Douglas area, Northern Cape. With strict quarantine regulations imposed, the disease was subdued, but made an unwelcome reappearance in 2015 in the Groblersdal area, Limpopo.

Karnal bunt is a quarantine disease in South Africa and its presence raises trade barriers to wheat and maize. The causal pathogen, ***Tellitia indica***, is difficult to eradicate. Control options include cultural practices, seed and foliar treatments as well as soil fumigation. The fungus infects common wheat, durum wheat and triticale. The ARC, through its dedicated karnal bunt laboratory and expertise, continues to play a vital role in the dissemination of information on karnal bunt through farmers' days, popular press and scientific media. A new molecular screening protocol was also optimised to ensure accurate confirmation of the pathogen when present. Control strategies being considered include resistance breeding and screening of chemical fungicides.

Development of an integrated pest management strategy against insect pests of pecan nut trees

The South African pecan nut industry is currently experiencing rapid expansion, driven by a favourable price on the international market. In accordance with such growth, ARC entomologists were approached by the South African Pecan Producers Association (SAPPA) to assist with the development of an integrated pest management (IPM) strategy against selected insect pests of pecan nut trees.

The project entails, amongst other activities, bi-monthly surveys to characterise the species complex of both pest and beneficial insects associated with pecan nut cultivation. Thus far, pestiferous insects comprised mainly stinkbugs and snout weevils. Conspicuous beneficial insects included ladybirds, parasitic wasps, praying mantis and spiders. The bark stinkbug appears to be the most prevalent stinkbug.

The information gathered through this project is novel, presenting pecan farmers with insight into the identification, seasonal occurrence and biology of the insects found on pecan nut trees. Many farmers were unaware of these insects and can now, for the first time, scout their orchards to differentiate between pestiferous and beneficial species.

Bark stinkbug, Coenomorpha nervosa.

Virus diseases of sweet potatoes

Field surveys conducted in three major sweet potato production areas of South Africa (Gauteng, Mpumalanga and Limpopo provinces) showed that the ***potyvirus***, ***sweetpotato feathery mottle virus*** (SPFMV) and ***sweetpotato virus G*** (SPVG), and a ***geminivirus***, SPLCV, are present in all areas surveyed and are currently threatening the production of sweet potato in South Africa. All of these viruses have been reported to cause reductions in sweet potato yields of between 30 and 100%.

In collaboration with the ARC-Biotechnology Platform, the genetic diversity of these viruses was determined and the virus strains to be used in the evaluation of sweet potato cultivars for resistance to these viruses were fully genetically characterised. A field trial was planted to determine the effect of a co-infection of these viruses on the yield of twelve locally bred sweet potato cultivars. The field trial results indicated that co-infections with ***potyviruses*** and a ***geminivirus*** causes higher yield reductions, and are more damaging, with total

yield reductions of up to 82%, compared to single infections with either a ***potyvirus*** (55% reduction) or a ***geminivirus*** (50% reduction). At a market price of R3 650 per ton (2011/2012), a yield loss of 82% due to virus infections would mean a financial loss of R173 594 000 for the sweet potato industry.

The prevention of production losses through screening and identification of resistant cultivars will enable farmers to increase their production, allowing farmers to sell surplus produce to generate income, thus ensuring sustainable sweet potato production in South Africa.

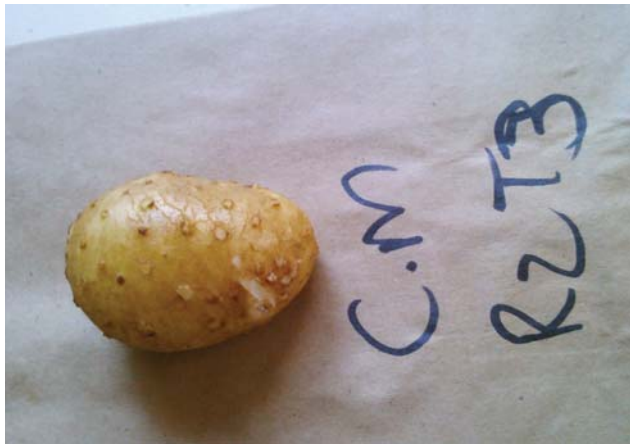
Sweet potato virus infection: Symptoms induced by potyviruses on sweet potato that was maintained in a glasshouse.

Sweet potato virus infection: Small roots produced by cultivar Blesbok as a result of a co-infection with a ***geminivirus*** *and* ***potyviruses****.*

Integrated nematode control on potatoes

Root-knot nematodes (*Meloidogyne* spp.) live inside potato roots and can cause serious economic damage. The withdrawal of fumigant synthetic nematicides from the market led to this study, funded by Potatoes South Africa, to develop a sustainable, alternative management system for root-knot nematodes in potato production. A combination of Nemarioc-AL (made from plant extracts), Biocult Mycorrhizae (commercial fungus to stimulate root growth) and Nemacur (commercially available synthetic nematicide) was tested on potato cultivar Mondial in small-scale field plots. The combined treatment reduced the occurrence of eggs and juveniles of the test nematode (*Meloidogyne javanica)* in potato roots and also the total nematodes present in potato plants. Shoot mass and plant height improved by 12-13% where the three products were applied. These findings will help the potato industry in decision-making to expand the use of integrated systems for managing *Meloidogyne* spp. in potato to other economically important nematodes.

Potatoes treated with a combination of Nemarioc-AL, Nemacur and Biocult.



Untreated potato showing blisters indicating root knot infestation.

New beet disease found

Beet necrotic yellow vein virus (BNYVV) causes devastating economic losses of sugar beet in combination with a soil borne fungus vector, *Polymyxa betae*. This virus occurs throughout the Americas, Asia and Europe, but had not yet been found in South Africa. During the 2014/15 production season, symptoms characteristic of Rhizomania disease were observed on red table beet in the Western Cape. Analysis of roots and molecular methods confirmed the presence of BNYVV. This is the first report of this virus in South Africa and the virus is a serious threat to present and future red table beet production. A comprehensive survey in all South African production regions is urgently needed to study the origin of the infection, reduce the risk of spreading the virus and to determine which varieties of red table beet are resistant to BNYVV.

Keeping grapevines virus free

Grapevines are susceptible to over 70 viruses, and the SA Plant Certification Scheme for Wine Grapes was set up to ensure that grapevine planting material is free of viruses. Currently, nuclear block vines, from which viruses are eliminated by heat therapy and meristem tip culture, are only tested for the six most important grapevine viruses in South Africa. A new method which uses illumina sequencing to detect virus genera now enables testing for 41 viruses within just 9 tests. This will significantly improve the chances of detecting any viruses which may have passed through the virus elimination phase, and is propagated in South African certified planting stock. The use of this technique in a certification scheme is novel and will make South Africa's wine grape certification scheme a world leader with regard to virus testing.

Typical Grapevine leafroll disease symptoms in a red grape cultivar.

The battle against alien invasive weeds

The battle against alien invasive plants that threaten our biodiversity, water resources and agriculture by displacing indigenous plants, clogging up our rivers, dams and water catchments, destoying grazing and infesting cultivated crops, is ongoing. After years of dedicated host-specificity testing of biological control agents in quarantine, the DAFF granted approval for the release of five new biocontrol agents in September 2015:

- A fly, *Hydrellia* sp., to control the submerged aquatic weed, *Hydrilla verticillata*.
- A flower feeding moth, *Cochylis campuloclinium*, to control the notorious pompom weed, *Campuloclinium macrocephalum*.
- A seed-reducing midge fly, *Dasineura pilifera*, to control two invasive Australian acacia species, *Acacia baileyana* and *Acacia decurrens*.
- A fungus, *Uromycladium tepperianum*, to control the stinkbean tree, *Paraserianthes lophantha*.
- A rust fungus, *Puccinia lantanae*, to control *Lantana camara*.

Some of these agents are the first to be approved for release against the target weeds, while others add to the suite of biocontrol agents already released on the target weeds. These new biocontrol agents will add to the impact of the biocontrol agents previously released to improve the levels of control achieved.

Before a biocontrol agent can be released, rigorous testing is done under quarantine to make sure that the organism will be effective and that it will not attack indigenous or crop plants. The value of the ARC's biocontrol testing is seen when although an agent may pass some of the quarantine tests, the researchers make an informed decision not to release the agent because of potential invasion of this pest to another country. In 2010 the ARC imported a biological control agent *Epiblema strenuana* into quarantine for testing against the parthenium weed (*Parthenium hysterophorus*), an aggressive weed that threatens crop and animal production, biodiversity conservation, and animal and human health in Asia, Australia, and Africa. However, in 2012 the researchers deprioritised this agent after concerns were raised that if released in South Africa, the moth could easily be dispersed from South Africa to Asia via commercial oil crops and could establish on several genera of crops there. Further studies will need to be undertaken to determine the host range and potential impact on non-target species in Africa.

*The flower feeding moth, **Cochylis campuloclinium**, on pompom weed, Campuloclinium macrocephalum.*

Monitoring and controlling macadamia pests ensures the industry remains globally competitive

Macadamia is one of South Africa's fastest-growing crops and the country is currently the largest macadamia nut producer in the world. However, there is an array of pests and pest complexes of economic importance which have a significant negative impact on nut quality and therefore prices obtained on international markets.

Research towards identifying, monitoring and controlling these pests has resulted in practical solutions for controlling stinkbugs. These solutions include monitoring when the pests are present in orchards, understanding their biology and developing sustainable control methods which are crucial for developing and maintaining this competitive industry. One example of the practical application of the research carried

out includes monitoring stinkbug penetration on the edges of orchards and spraying for these intrusions, rather than full blanket sprays across whole orchards. Research towards more environmentally-friendly control techniques will lead to practical guidelines for both chemical and biological control as well as integrated pest management practices to ensure that South African producers remain at the forefront of global macadamia nut production.

Stinkbugs cause damage to macadamia nuts.

Managing mango blossom malformation to ensure high yields

Mango malformation occurs in many mango-growing countries worldwide and is one of the most important diseases of this crop. The fungus causes abnormal growth of both flowers and vegetative shoots and the most affected flowers look like cauliflower heads. Mango malformation severely affects the crop in most of the mango-producing areas of South Africa with yield losses of up to 20%. Current methods of control, which include removal of the infected flowers and branches, have seen malformation escalate every year over the last few years. Researchers launched an investigation to determine when the fungus produces the infectious spores and also optimised spray applications so that practical solutions for optimum control of the disease in South Africa can be implemented by mango farmers.

Management practices in various mango production areas were investigated, evaluated and correlated to the incidence of mango malformation. Various treatments which included the removal of infected branches as well as chemical sprays at the right times resulted in up to an 80% reduction in blossom malformation. By implementing the guidelines for the management of mango blossom malformation, producers can significantly reduce the prevalence of malformation, leading to higher yields, better fruit quality and tonnage delivered to the market.

Mango blossom malformation caused by a fungus drastically reduces crop yields.

Controlling the spread of invader fruit fly

Several fruit fly species are known to attack commercially-grown crops, causing considerable damage. Losses are directly due to the larvae feeding and making the fruit unmarketable for any farmer. Losses are also indirectly due to quarantine restrictions and loss of market opportunities. In Mpumalanga, *Ceratitis* spp. are important fruit fly pests for fruit production. However, of even greater concern is the invasive Oriental fruit fly, *Bactrocera dorsalis* (Hendel), which was detected in the province for the first time in 2012. The Oriental fruit fly attacks over 200 cultivated and wild fruits including litchi, avocado, banana, citrus, coffee, guava, mango, papaya, peppers, cashew, apple, marula, pumpkin, wild fig and tomato. In many African countries, *B. dorsalis* is currently the dominant fruit fly pest species attacking commercial fruit crops with high damage levels being recorded and trade of fresh commodities in these countries has been severely affected. The ARC and the Mpumalanga Department of Agriculture, Rural Development, Land and Environmental Affairs (DARDLEA) are currently working together to combat the fruit fly problem, with most of the awareness, scouting and control activities taking place in the Bushbuckridge and Nkomazi municipalities. Producers are involved in monitoring and both the growers and their staff receive training to determine whether the fly is present on their farms and how to control it.

Growers and staff receive training on scouting, identification, monitoring and control of Oriental fruit fly.

Newly-developed assay detects avocado sunblotch virus

The presence of Avocado sunblotch viroid disease (ASBV) leads to massive losses in yield and fruit quality due to defects such as skin discolouration. Fruits produced from infected trees develop sunken white, yellow or pink blotches or streaks, and are usually small, deformed and unmarketable. This severely reduces the marketability of avocado fruits and ultimately profitability of the farmer. The detection of ASBV is important in controlling the spread of this disease, as symptomless trees pose a great danger to the distribution of ASBV within the industry. Interestingly, there is no report of ASBV detection on the fruits of Hass, one of the most popular avocado cultivars on the market, both nationally and internationally.

Researchers developed a rapid, highly sensitive method for the routine detection of ASBV in infected avocado tissues by using a biotechnological technique called qPCR. Contrary to previous findings that the viroid was not necessarily detected in the leaves of avocado trees showing ASBV symptoms, this assay detects ASBV in all tissues including leaves, fruits and seeds. This means that nurseries can ensure that material delivered to farmers is virus-free and that farmers obtain virus-free trees. The newly-developed assay allows the viroid to be detected in trees which appear symptomless, ensuring that only top quality material is planted to produce high yields and quality fruit.

Avocado fruits showing the unmarketable symptoms of avocado sunblotch virus.

Research focusing on Production Systems

Farmers can only realise the full yield potential of their crops and contribute to food production and food security if they use optimal production methods. To this end, the ARC conducts research on all aspects of crop production systems to ensure that South African farmers remain competitive in local and international markets.

High quality soft citrus produced under shade netting

Shade netting is increasingly being used by growers in South Africa to protect against sun damage and hail. Growers enjoy better export pack-out and increased income by using shade netting structures. However, shade nets change the micro-climate and light conditions of the orchard and therefore have an impact on tree physiology and phenology, but much of this impact is unknown. Since erecting a shade netting structure is an enormous capital outlay, growers need to understand the impact of shade nets on fruit production. Research on the effect of shade netting on the physiology, phenology, yield and post-harvest fruit quality of mandarins is critical to orchard management practices, yield and ultimately post-harvest quality.

Although shade netting had no negative effect on yield or rind thickness and firmness, the fruit had a better taste and were larger under the shade net – factors which are important for the export market. The shade net also provided protection against low temperatures and humidity so soft citrus such as Nadorcott mandarins could potentially be cultivated in colder, drier areas than is currently the norm – an enormous factor to be taken into account when the impact of climate change and changes in cultivation regions are considered.

The use of shade netting in soft citrus cultivation.

Managing water stress in avocado

To ensure optimal plant performance and prevent stress, it is important that the water status of any crop is known. It would therefore make sense to measure plant water status so that irrigation requirements are optimised. However, carrying out plant-based measurements on-farm is usually impractical due to cost, difficulty in automation, the fact that it is labour-intensive and requires skilled labour and difficulties in data interpretation. Researchers made use of calibrating midday stem xylem water potential as a potential stress indicator as it was shown to be a reliable indicator of plant water status and stress. The research focussed on calibrating the current soil-based irrigation norms using midday stem xylem water potential, other plant physiological indicators and tested the effect on fruit set, fruit size and yield.

By correlating midday stem xylem water potential with various physiological factors such as transpiration, stomatal conductance and photosynthetic rate, the water potential at which stress occurs as well as where fruit size and

post-harvest fruit ripening were negatively affected, was determined. Recommendations are provided to growers to ensure that their orchards are not water-stressed, resulting in excellent yields of good quality fruit which can be sold on export markets. This finding allows growers to react to climate change factors such as increased/decreased rainfall and heat units so that irrigation scheduling is optimised. Using midday stem xylem water potential as an indicator of stress can also be applied to other crops, thereby improving the efficient use of water – an increasingly scarce resource in an era of climate change.

Measuring midday stem xylem water potential in avocado.

Rainwater harvesting and conservation for improved dryland crop production

South Africa is a water scarce country, with generally low and erratic rainfall distribution and high atmospheric evaporative demand. This often limits crop productivity under dryland conditions, which affects the livelihood of underprivileged rural communities who rely on dryland crop production as their main source of income generation and subsistence. Thus, a project was conducted to develop simple and low-cost techniques for optimal use of rainwater through induction, collection, storage and conservation of surface runoff to improve the productivity of leafy vegetables in dry areas of South Africa.

Field trials were conducted for two consecutive growing seasons to test various rainwater harvesting and conservation practices on two leafy vegetables, Amaranth and Swiss chard. Results showed considerable improvement in crop productivity with the implementation of such practices in the semi-arid area of Roodeplaat, Pretoria. These results will be extrapolated to different climatic regions of South Africa through the use of crop modelling in order to improve the production of leafy vegetables in various arid and semi-arid regions, including Limpopo, North West, Northern Cape and Free State provinces.

Cultivation of Amaranth using the tied-ridge rainwater harvesting technique.

Cultivation of Swiss chard using the in-field rainwater harvesting technique.

Research focusing on Agro-Processing and Reducing Post-Harvest Losses

Processing adds value to agricultural crops and also creates employment, thereby contributing to poverty alleviation. The ARC conducts research on storage, packaging and increased shelf-life, and provides training in these aspects as well as in the processing of a wide variety of crops and medicinal plants.

Honeybush sensory wheels reveal aroma and flavour of honeybush tea

In the food and beverage industry, product quality is vital to satisfy the discerning consumer. Product-specific sensory wheels are a very useful tool for product quality control, describing the aroma or flavour of a product in a graphical format for easy reference, making it easier to ensure quality and consistency in processing and identify process mistakes. They also serve as a valuable communication tool since they describe the product in a common language that the processor, marketer and consumer understands.

First released in 2012, the generic honeybush sensory wheel, containing descriptors for flavour, taste and mouthfeel, has since undergone significant changes. Two wheels, one for aroma and one for flavour, taste and mouthfeel were released in 2015, following extensive descriptive sensory analysis of a large sample set, including the herbal tea, produced from a number of *Cyclopia* species. More than 6000 cups of honeybush tea were evaluated by a trained sensory panel to develop and evolve the honeybush sensory wheels. New descriptors were included, while redundant descriptors were removed. Another feature of the new wheels is that they illustrate, at a glance, the prominence of the respective aroma or flavour notes in terms of relative intensity and occurrence. Research on the honeybush sensory wheels was conducted by the ARC in collaboration with the Department of Food Science, Stellenbosch University.

The first honeybush sensory wheel that has undergone significant changes.

Improved storage protocol to maintain South Africa at the forefront of global macadamia nut production

The South African macadamia industry has experienced enormous growth in the last few years, making South Africa one of the top two macadamia producers in the world and earning more than R1 billion from foreign exports. With larger and larger volumes of kernel being produced there is a high demand for extended shelf life. Optimal nut storage conditions for kernel need to be determined to prevent wastage caused by rancidity. ARC researchers tested the storage profiles of whole and broken nuts at different temperatures and for different times to determine how best to store the nuts without losing quality and recommendations can now be given to growers and processors.

In order to avoid quality deterioration, the industry needs to consider reducing the temperatures currently used for storage, particularly during holding periods longer than 6 months, especially for broken nuts. Whole nuts can be stored for up to a year using existing storage protocols but should the nuts need to be stored longer, the temperature must be reduced even further. As a key supplier of macadamia nuts to Europe, the USA and China, South African producers cannot afford to become complacent, particularly as more countries are producing macadamia on larger scales. South Africa has a reputation as a producer of top quality kernel and current income streams will only be retained or increased as long as this reputation is safeguarded through continued good practices in terms of processing and storage.

South Africa is a major producer and exporter of macadamia nuts.

Preventing macadamia nut breakage increases profitability

Macadamia is the fastest growing tree crop industry in South Africa, with the majority of the crop being exported. Whole macadamia nuts command up to 40% higher prices on the markets compared with halves and even smaller pieces. Unfortunately, Beaumont, the most commonly planted cultivar in South Africa, is particularly prone to nut breakage and interventions aimed at increasing whole nuts during the crackout process will increase the profitability of this sector and increase foreign exchange.

Both nut in husk (NIH) and wet and dry nut-in-shell (WIS and DIS respectively) were exposed to physical impacts typical of those experienced in the field, on-farm storage facilities and processing facilities. NIH was also put through two types of commonly used dehusking machines on various farms to determine whether the settings which can be made to this equipment on-farm affected the nuts. DIS nuts of three varieties were also cracked using the three types of commonly used crackers to determine the effect of cracking on breakage. Lastly, curing trials were carried out determine whether drying rate and temperature affect breakage.

From the results obtained, researchers can make recommendations to growers and processors of the Beaumont cultivar. These include making the most appropriate selection and adjustment of the dehusking and cracking equipment used in processing to reduce nut breakage. More significantly, improvements in nut curing may also offer a practical means of increasing whole nut percentage at crackout at the processor.

Beaumont, the most commonly-planted macadamia nut cultivar.

Indigenous fruit conserve products – unlocking the potential within rural areas

Agro-processing can play a role in enhancing food security, increasing global competitiveness and increasing diversification of the agricultural sector and decreasing post-harvest losses. The enormous potential of indigenous fruits for producing niche products and adding additional value to other processed fruit products has not yet been unlocked.

A small agro-processing unit was established in the Vhembe district of Limpopo Province where beneficiaries were trained in indigenous conserve production, including jams, jellies and preserves. The beneficiaries were assisted in raw material sourcing, locating a suitable market and continuous training on product development as well as training in basic businesses skills. This has made it possible for the agri-entrepreneurs to produce safe conserve products of a high quality.

High quality niche conserve products produced using indigenous fruit crops in the Vhembe district, Limpopo.

Honeybush has potential for alleviating diabetes

Research is necessary to verify and support all the health benefits of honeybush tea with rigorous scientific evidence, so that this unique South African product can rightfully claim its positive health effects on tea markets around the globe. New potential uses for plants such as honeybush are discovered as knowledge of their chemical composition increases. Many of these uses focus on their health-promoting properties, including anti-diabetic properties. Diabetes is one of the world's most prevalent diseases, affecting millions of people world-wide and becoming increasingly prevalent in South Africa. Unfortunately, natural variation in chemical and, more specifically, phenolic content of plant extracts leads to a large variation in the efficacy of herbal therapeutics. There is therefore a critical need for a screening method to determine the efficacy of herbal therapeutics and to aid effective quality control by industry.

Similarity analysis of chromatographic fingerprints, a technique used in quality control of herbal medicines, was investigated as a potential screening tool to assess relative anti-diabetic activity of extracts of ***Cyclopia subternata,*** one of the species processed for production of honeybush tea. A collaborative study by researchers of the ARC and the Diabetes Discovery Platform of the South African Medical Research Council demonstrated that there were no clear patterns according to the phenolic chromatographic profile of the extracts in terms of their relative ability to enhance glucose uptake by cells. The assessment of the relative ***in vitro*** bioactivity of ***C. subternata*** extracts, therefore, cannot be replaced by analysis of their phenolic profiles alone. Used together, however, the flavone, scolymoside, was identified for the first time as a potential chemical marker for the glucose-lowering activity of ***C. subternata*** extracts. Demonstration of anti-diabetic activity for ***C. subternata*** extract could lead to development of an effective herbal alternative to anti-diabetic drugs. Such a value-adding opportunity will benefit the South African honeybush industry.

Honeybush research plantation.

Research and Services focusing on Sustainable Use, Conservation and Protection of Natural Resources

Conservation of South Africa's unique biodiversity requires control of invasive plant and animal species, taxonomic services to identify beneficial as well as pest organisms (insects, mites, spiders, fungi, bacteria) and the maintenance of reference collections and genebanks containing valuable plants and micro-organisms for breeding programmes.

Harnessing nature to control insect pests

The ARC is working on the development of bioinsecticides using indigenous microbes (entomopathogens), capable of causing infection and mortality in pestiferous insects. The term entomopathogenic comes from the Greek word ***entomon***, meaning insect, and ***pathogenic***, which means causing disease. These microbes include fungi, viruses, bacteria, protozoa and nematodes. The so-called entomopathogenic nematodes (EPNs) do not attack plants but utilise insects as host. These beneficial EPNs live in a mutualistic relationship with a bacterium. The bacterium is the actual pathogen causing mortality of the insect while the nematode acts as carrier or vector of the bacterium. Within the natural enemy fraternity, EPNs are one of the fastest killing entities, capable of causing insect mortality within 48 hours. Bio-prospecting of indigenous EPNs conducted at the ARC has resulted in four new species.

Researchers have developed a novel medium, based on common house fly larvae, combined with canola oil, for mass production of EPNs. To date, the ARC holds the largest (>180 isolates) and most diverse collection of EPNs in South Africa; this presents ample scope for commercialisation against insect pests, ***viz***. black cutworm, false wireworm, maize stem borer, sugarcane stalk borer, African pink stalk borer, spotted stalk borer, codling moth and diamondback moth.

Entomopathogenic nematode (Infective juvenile stage)

Masses of Infective juvenile stage emerging from insect cadaver.

Creating sustainable livelihoods using indigenous plant resources – *Aloe ferox*

Aloe ferox L. is an indigenous South African plant that occurs in southern KwaZulu-Natal, Eastern Cape and the drier parts of adjacent Western Cape. Most aloe products originate from plants growing in the wild, which like any other natural resource, needs to be protected from over-utilisation. *A. ferox* leaves are harvested for the extraction of aloe bitters (used in beverages and medicines) and gels used in skin and hair care products. Most commercial aloe products which are imported originate from the fast-growing Mexican species *Aloe vera.* However, the indigenous *A. ferox* has the potential to provide a source of these health products and a livelihood for local communities in a sustainable and organic manner.

Researchers focussed on investigating productivity of leaves as well as improving yield and quality using different cultivation practices including irrigation methods and plant nutrition in different climatic areas. They also looked at the best ways of propagating the plant so that farmers in communities are able to propagate their own planting material.

The key factors affecting plant growth are climate and irrigation and if these are optimal, successful formal cultivation of *A. ferox* is possible. This crop has potentially high value both for the economic development of communities in terms of job creation and agribusiness development and an increase in quality and quantity of indigenous plant product exports. Further research towards selecting the best mother material based on performance and biochemical quality is well underway and should lead to even more profitable agribusinesses.

*Plantation of indigenous **Aloe ferox**.*

Biosystematic services crucial to research

The sustained demand, from all parts of Africa and abroad, for specimen identification and biological information once again emphasises the fundamental importance of taxonomy to all fields of biological research. The rendering of these services is wholly reliant on the collections housed within the ARC Biosystematics Unit.

Researchers continually maintain and expand the national collections of insects, nematodes, mites, spiders and fungi. Over time the names and classifications of organisms may change or become outdated. Recently a new genus name had to be created for a number of small grasshoppers from KwaZulu-Natal. The original name *Whitea*, a tribute to famous locust specialist M.J.D. White, had already been given to a beetle from New Zealand. The new name given to the grasshoppers is *Ibonikawhite* – isiZulu for "White's grasshopper". This name is regularly used by the Ezemvelo KZN conservation authorities, who requested this research.

The collections are regularly reviewed by taxonomists in the Biosystematics Unit, who then update names, relabel and reorganise the specimens. Following the submission of a number of lady beetle species for identification by investigators from the Centre for Invasion Biology, Stellenbosch, and Harvard University, USA, names provided through services from the Biosystematics Unit were included in a publication that was submitted to an international journal. The validity of some of these scientific names was questioned by a reviewer on the editorial panel. A comprehensive report was compiled by the specialist who performed the identifications and sent to the journal editor to verify the ARC's identifications. The paper was subsequently accepted and published soon thereafter.

New specimens are also continually being added to the national collections of insects, nematodes, mites, spiders and fungi. The scale insect *Aulacaspis yasumatsui*, a new potential pest, was recently identified. This insect, which has already been found in Gauteng, KwaZulu-Natal and Limpopo provinces, is a pest from Southeast Asia, and may threaten South Africa's indigenous cycad species. These rare plants already face extinction in the wild, mainly due to illegal harvesting and habitat destruction.

The collection of long-horned beetles, like this egg plant stem borer, was recently revised and updated.

Taxonomic expertise is a very scarce skill and it is critical to create awareness and influence young researchers who are looking for career opportunities in this field. The Biosystematics Unit is therefore actively engaged in education and training. During the past year Green Matter and the World Wildlife Foundation arranged a 'Green Career Excursion' to the ARC's Biosystematics and Plant Microbiology units for thirteen 3rd year and Honours students from the University of Venda. The aim was to provide students from historically disadvantaged institutions an opportunity to access career information, gain exposure to the work environment and meet employers and professionals working in organisations and fields related to biodiversity, especially scarce skills such as taxonomy.

Students from the University of Venda discussing viruses and their importance on plants during a visit to the ARC Virology Unit.

Genebanks

The ARC-Vegetable and Ornamental Plants genebanks are a genetic repository for a variety of accessions comprising germplasm from various plant, insect, fungi and bacteria species, as well as DNA and gene constructs related to vegetable plants. Latest records reflect that a total of 11 045 accessions are currently maintained across the nine genebanks combined. The combined collection has grown within the last year, which is testament to the ARC's commitment towards the conservation and protection of natural resources and promotion of the sustainable use thereof.

The potato *in vitro* genebank is not only an integral part of the ARC's potato breeding programme, but is also the start of the entire potato seed certification scheme in South Africa, which ensures that quality potatoes are produced for the market. It is therefore essential that disease-free mother material is continuously supplied to the industry to ensure the production of quality potatoes. The gross value for the potato industry is estimated at R4.5 billion. One such industry client, McCain Foods, evaluated five potato lines that were bred by the ARC over the course of the last two years. This resulted in the signing of a contractual agreement between the ARC and McCain Foods granting the legal rights to make use of one of the bred varieties. The contract also stipulates that all *in vitro* material produced for the selected line under agreement be multiplied at the Roodeplaat *in vitro* genebank, which will contribute to the profitability of the tissue culture facility there. In addition to this, a material transfer agreement was signed

to evaluate four of the breeding lines from the ARC's potato breeding programme in Angola.

Two important projects were supported by the indigenous vegetable genebank during the past year, namely the ARC/CSIR/Nestlé collaborative project aimed at developing new products from indigenous and traditional vegetables, and a growth modelling project at the University of the Free State. These projects will help to commercialise indigenous and traditional vegetable production. Further support was also given to an urban farming project of the University of Johannesburg which aims to increase food security in urban areas though cultivation of indigenous and traditional vegetables.

Measuring soil health

Soil was traditionally seen as a "dead" agricultural medium but we now realise that only 6-8 cm of fertile soil was naturally formed over a period of 2000 years; that soil-life consists of thousands of different organisms; and that a teaspoon of fertile soil can contain a billion bacteria and almost 5 000 different species of bacteria per gram of soil. Nematodes (eelworms), fungi and bacteria are usually associated with crop yield losses, but in a healthy soil with high microbial diversity and activity, a very fine balance is maintained between beneficial and harmful organisms, where organisms harmful to crops are suppressed and vital soil processes are optimally executed to strengthen the soil's resilience and resistance.

After decades of collaboration with farmers, the main principles of conservation agriculture (CA) were promoted as continuous minimum soil disturbance, permanent organic soil cover and diversified cropping. The aims of CA are to improve or sustain productivity and increase profits and food security. The natural balance between soil organisms can be upset by injudicious ploughing and fertiliser applications, extended fallow periods or continuous planting of the same crop. Soil microbial populations can therefore be used as "early warning systems" that indicate whether soils are deteriorating or improving. Soil microbial analyses should be done at least twice per season over a period of 3-5 years to provide a complete soil health status report that could be used by farmers to monitor the impact of agricultural practices on soil health and yield. The ARC can provide these services to any person concerned about the health of their soils.

Intercropping maize and beans in a no-till system.

Kruger National Park spider list updated

The first checklist of spiders in the Kruger National Park was published by the ARC in 2003, with 152 species listed from 40 families. Continued field surveys and sampling have now expanded this list to 386 species from 49 families, an increase of 9 families and 234 species.

STOPRATS review workshop

The first annual review workshop of the STOPRATS project (Sustainable Technologies to Overcome Pest Rodents in Africa Through Science), funded by the EU and managed by the Natural Resources Institute in the UK, was hosted at the ARC Convention Centre. The ARC is one of seven project partners across the southern Africa region. The aim of STOPRATS is to link researchers across Africa and to develop wider networks with civil society organisations, businesses, and policy makers, to evaluate policies on rodent management, build staff capacity, and increase awareness about the problems rodents cause and their ecologically-based management.

Translating Research Results to Support Agrarian Transformation and Efficiency and Competiveness of the Agriculture Sector

Transformation in the agricultural sector will only be successful if new farmers are empowered with the necessary knowledge and skills to compete on local and international markets. The ARC is committed to support this transformation by providing training in primary crop production as well as in agro-processing to add value to crops. Training is based largely on knowledge generated by research done by the ARC. In the 2015/16 financial year the ARC supported more than 730 smallholder farmers of which the Crop Sciences division supported more than 395 farmers in a range of production systems. Details are provided below of a number of these initiatives.

The Integrated Village Renewal Programme – creating dynamic rural communities in the Eastern Cape

The aim of this programme is to create an awareness of the value and potential for the production of tropical and subtropical crops in the Eastern Cape and to develop integrated, sustainable farming systems based on high value production clusters which play a leading role in the development of the rural village. The project aims to facilitate capacity building and skills development which will lead to increased food security in the area and ultimately income generation and job creation.

Almost 10 000 fruit trees including mango, banana, citrus, macadamia and guava were planted in 47 rural villages. The fruit trees were planted as part of an integrated farming system where vegetable and maize production is also carried out. Ongoing technical training is undertaken to ensure that farmers are capacitated to produce high value crops in sustainable economic enterprises. Technical training includes

caring for trees, pruning, managing pests and diseases, cultivation practices, record keeping and intercropping. Training in business development and marketing is also undertaken so that farmers are fully capable of understanding the profitability of their enterprises.

This programme is instrumental in the development of an Integrated Village Renewal Programme with participation of villages in the OR Tambo, Amathole and Alfred Nzo districts. The villages were assisted to become fully organised and functional, and as a result, several co-operatives were developed and will be registered in the near future. A value-added product initiative (Noqhekwana jam co-operative) is already fully operational. This participatory approach resulted in the identification of a shortage of critical technical, organisational and administrative skills, and training resulted in the development of a functional rural village with a vibrant economy. The key to eradicating current poverty in rural areas is to focus on the creation of dynamic rural communities founded upon prosperous farming where economic development, job creation opportunities and community upliftment are key.

Value-added products using essential oils contribute to sustainable livelihoods in rural villages of the Eastern Cape

Essential oil crops have not traditionally been produced in South Africa and offer numerous opportunities for diversification and value adding. A number of these essential oil crops can be cultivated by smallholder farmers and offer additional economic opportunities as processing and value adding can be carried out on-farm. South Africa is a net importer of essential oils and this demand has shown considerable growth over the past few years. High-value essential oil products have good storage characteristics and are thus ideally suited for transport and export from areas where infrastructure is poorly developed. The development of essential oil agribusinesses, which incorporate both primary production of plant material and processing to extract oils, offers many opportunities for further economic development. The development of value-added products is based on previous research in the area which showed that it is ideal for the cultivation of essential oil crops producing a high quality product.

Farmers from three villages in the Eastern Cape, namely Hluleka, Xurana and Bulungula in the OR Tambo District Municipality, previously received training on herb cultivation and have now undergone additional training in the extraction of essential oils from the herbs as well as on the development of value-added products such as soaps and candles. The agri-entrepreneurs were also assisted with product labelling which facilitated marketing of their products.

One of the values of essential oils is that the oil must be extracted where the crop is produced, thus creating ancillary job creation opportunities. Numerous products can be manufactured including soaps, hand and body lotions, candles and insect repellents and these value-added products have niche markets. In fact, several farmers are marketing their products to local guesthouses. Essential oil production and processing thus offer many additional opportunities for development in the area, including agri-tourism.

Training in the production of value-added products such as soaps and candles has resulted in economic upliftment of communities in the Eastern Cape.

Community-based production model facilitates development of small-scale farmers in the Vhembe district

Subtropical fruit production is an important component of the agricultural landscape in South Africa, particularly in the Limpopo and Mpumalanga provinces. Emerging subtropical fruit farmers in the Vhembe district were assisted by the ARC in establishing a legal entity in the form of an agricultural co-operative (Vhembe Subtropical Fruit Co-operative Ltd.). This co-op serves as the farmer's representative and works hand in hand with project managers and other stakeholders such as the national and provincial Departments of Agriculture, ARC and Subtrop (Subtropical Fruit Growers Association).

The crops planted by the 244 farmers include mango, citrus, avocado, banana, litchi and macadamia on a total area of 297 ha. The farmers receive ongoing training directly related to specific crop production, with some farmers already reaping the benefits. Farmers are being trained on an ongoing basis in the production of specific crops and this has already led to the development of small-scale farmers in the Vhembe district.

Mr Chabelala's macadamia orchard in the Vhembe district.

Mr Maluleka in his banana plantation.

Production of African leafy vegetables

Indigenous vegetables, such as cowpea, amaranth, spider plant and jute mallow, have been essential sources of food for many years in South African rural communities, providing vital nutrients and vitamins. These crops are popular and have potential for commercial production in South Africa. The ARC collaborated with DST, Nestlé and the CSIR to develop products from indigenous vegetables.

Field trials were conducted at ARC-Roodeplaat and on a smallholder farm in Bronkhorspruit to optimise cultivation practices, estimate profitability and assess low input cost of production systems under smallholder and commercial farming conditions. During this phase, amaranth was identified as the best crop, a production manual was developed and the production costs monitored. The ARC is now investigating the possibility of using mechanical harvesters and also alternative planting and seedling production systems to reduce costs and increase profitability for the farmers. The Nestlé "Morogo 2-minute noodles" were launched in November 2015.

2-minute noodles containing amaranth, an indigenous leafy vegetable.

Enhancement of cotton production by smallholder farmers in South Africa

The ARC signed a service level agreement (SLA) with the Department of Rural Development and Land Reform (DRDLR) to the value of R 43 101 459 for the enhancement of cotton production by smallholder farmers in three provinces, viz. KwaZulu-Natal, Limpopo and Mpumalanga. Sub-agreements were entered into with Cotton SA and Ubongwa Cotton Development Services in KZN for the implementation of the SLA. Due to the late signing of the SLA and the drought conditions, the total area planted with cotton was smaller than predicted. Funds were used to purchase production inputs such as seed and agrochemicals. Tractors and implements were also bought to empower farmers to do their own land preparation and other activities. A total of twelve tractors with a 3-year service plan; two 7 ton trucks and high speed trailers with a 3-year service plan are helping smallholder farmers to transport harvested cotton to the gins. To increase the impact on smallholder farmers, different farming implements have been ordered and will be handed over to the farmer co-operatives. A pivot irrigation and pumping system is being installed in Limpopo. A total of 64 farmers have attended accredited training on cotton production and 1 556 farmers have been supported through mentoring and extension service by the ARC and its partners. Despite the late signing of the SLA, the ARC and its partners have successfully completed this project. Discussions are being held with the provincial DRDLR to continue this support to smallholder farmers to enable them to become independent cotton producers and even owners of gins.

The Makhathini Gin, currently managed by the farmer's co-operative, has been successful in the ginning and marketing of cotton that was produced for the past two seasons in the Makhathini area. The farmers, co-operatives, traditional leaders and local government departments have expressed their satisfaction on the success of the project. This has led to the DRDLR requesting the ARC to submit a five-year plan to continue this promotion of cotton production by smallholder farmers. The plan is in line with the Cotton Strategy of DAFF as well as the Cotton Cluster Strategy under DTI. The CEO of Cotton SA and DG of DRDLR requested that the roll-out of this plan should include all role players and government departments.

OVERVIEW AND HIGHLIGHTS OF THE ANIMAL SCIENCES

The **Animal Health, Production and Improvement Programme (AHPI)** of the Agricultural Research Council largely supports the following:

- Strategic Goal 2: To generate knowledge and technologies that will enhance the efficiencies in livestock 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 translate research outputs in order to generate knowledge, facilitate decision making and contribute to transformation in the agriculture sector.

The AHPI Programme is directed at the social and economic development of the entire livestock value chain, which is a key factor in South Africa's social and economic development. 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 manages certain national services on behalf of the (DAFF) and serves as the custodian of some national assets for the Department of Science and Technology (DST). The national services provided by the programme include the National Animal Improvement Schemes which include the Kaonafatso ya Dikgomo (KyD) Scheme, a special purpose vehicle to improve livestock productivity in the smallholder farming sector. The national assets under care of the programme include the national forage genebank, rabies laboratory, blood vaccine production unit, national tick and helminth collection and the collection of beneficial gastrointestinal and food fermentation micro-organisms, to name but a few.

Statutory obligations form a second channel for scientific services and research whose results have a wide application according to the objectives of the various animal improvement and health legislations (e.g. the Animal Improvement Act No.62 of 1998). Although the main sites of operation for the Programme are at Irene, in the south of Pretoria and at Onderstepoort, in the north west of Pretoria, it has satellite stations that are strategically positioned in almost all 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 2015/16 are highlighted below.

ARC National Milk Recording and Improvement Scheme recognises best performing farmers

The ARC National Milk Recording and Improvement Scheme has an established culture of recognising outstanding performance amongst farmers participating in the scheme. It is no wonder that participation in the milk recording and improvement scheme is an envy to dairy farmers. The Master Dairyman Competition of the ARC provides a unique platform for farmers to benchmark performance in all aspects of their dairy enterprise against their peers. Through this competition, those who performed exceptionally well, based on dairy production enterprise-wide performance during a particular year, are recognised. Finalists and winners in the different categories not only get recognition for their performances, but also wide exposure in both the media and annual newsletter of the Scheme. Beyond these benefits, funders have the opportunity to sponsor a specific award category which complements their business strategy.

The ARC's National Milk Recording and Improvement Scheme has been the main driving force for dairy cattle recording and improvement in South Africa for over 50 years and will continue to fulfil this function into the future. During the past few years, smallholder farmers have enrolled in the official milk recording scheme. Currently, there are 42 smallholder farmers participating in the scheme and receiving a full complement of services similar to their commercial counterparts. This initiative is aimed at expanding the base for commercial farming and eventually stud breeding in the dairy industry. The Master Dairyman competition offers the opportunity to all dairy farmers to excel and to be part of outstanding achievers. The presence of these farmers and the support they receive as a key stakeholder in the industry, are therefore of the utmost importance.

The regional as well as the national winners of the different categories were announced at the ARC Dairy Performers Awards held in conjunction with the annual Agri Dairy Expo at Sandringham, Western Cape.

The National Dairy Performers Awards categories were as follows:

- Regional Finalists and Regional Master Dairyman of the year.
- Regional Emerging Master Dairyman of the year.
- National Emerging Master Dairyman of the year.
- National Special Award for Performance Testing.
- National Herd with the Best Somatic Cell Count.
- National Herd with the Best Inter Calving Period.
- Best Milking Team of the year.

FLTR: Prof Bongani Ndimba (Senior Manager Research: ARC-Infruitec & Nietvoorbij), Mr Johannes Loubser from the PE Loubser Herd (ARC National Winner Master Dairyman of the year), Prof Norman Maiwashe (General Manager: ARC-Animal Production Institute) and Mr Johan Claase (Production Scientist: Dairy, DAFF).

FLTR: Prof Bongani Ndimba (Research Institute Manager: ARC-Infruitec & Nietvoorbij), Mr Monwabisi Daniels and Mr Masixole Tutu (ARC Small Scale winner from the Eastern Cape), Prof Norman Maiwashe (General Manager: ARC-Animal Production Institute) and Mr Johan Claase (Production Scientist: Dairy, DAFF).

Pig recording and genetic improvement for pig farmers in Gauteng province

Pork is an important source of animal protein for human consumption. The South African pork industry is an important component of the South African agricultural sector, contributing about 2.15% to the primary agricultural sector. Commercial pig farmers are estimated at 4000, stud farmers at 19 and the remaining being smallholder pig farmers (Department of Agriculture, Forestry and Fisheries, 2013).

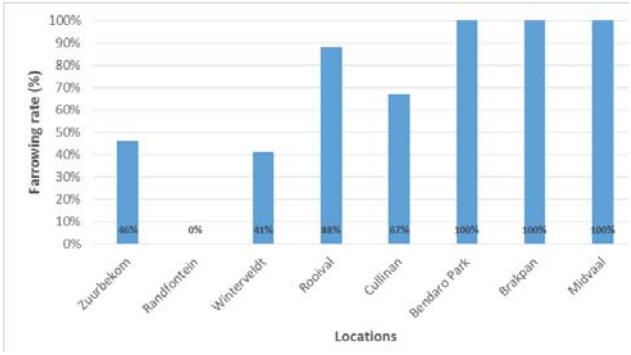
The smallholder pig farming sector has constraints that impedes its growth and ability to contribute meaningfully towards food security. Reproductive inefficiency is one of the major limiting factors in pig production; this is mainly attributed to lack of access to superior breeding stock. The application of reproductive biotechnologies may be an effective means to propagate superior genetics and increase herd quality. To date, artificial insemination (AI) remains the most widely used biotechnology tool applied to improve reproduction and genetics in livestock. As the leading livestock research institution in South Africa, the Agricultural Research Council, in collaboration with the Gauteng Department of Agriculture and Rural Development (GDARD), is making an effort to promote technologies that improve livestock productivity in the province. Implementing a capacity building programme to improve the skills and knowledge of this technology in resource-poor communities is crucial.

Piglets born following artificial insemination in Bendaro Park, Ekurhuleni.

Piglets born following artificial insemination in Winterveldt, Tshwane.

A total of 101 smallholder pig farmers from various district municipalities within the Gauteng Province were trained in pig reproduction and record keeping prior to the implementation of the project. Moreover, a total of 15 smallholder pig farmers across the province benefited from the project, with 73 sows receiving oestrus synchronization and artificial insemination. Pregnancy and farrowing rate of 89% and 68% was achieved, respectively. Furthermore, 491 piglets were born from the project.

The project demonstrated the feasibility of adoption of high-tech assisted reproductive biotechnologies by smallholder pig farmers in Gauteng Province. Overall, the project contributed to improving reproductive efficiency in herds owned by smallholder pig farmers in Gauteng Province.



Results of artificial insemination in smallholder farms in Gauteng Province.

Rehabilitation of grasslands after eradication of alien invasive trees

The research work on rehabilitation of land invaded by alien plants has to date focussed on riparian zones where trees dominate. However, eradication of invasive alien plants (IAPs) by the Working for Water project also takes place on grasslands. There has been extensive clearing of IAPs in the communal rangelands of the north Eastern Cape. Currently, insufficient knowledge is available to ensure that the productivity of grasslands is restored after clearing of alien trees. The ARC has undertaken several research activities to better understand the changes to the soil chemistry, plant cover and production that occur after the IAPs have been removed. Results indicate that soil pH declines, making already acidic soils more acid. In addition, nitrogen levels in the soil increase. The livestock are initially attracted to the cleared areas, where the higher nitrogen levels promote short, stoloniferous grasses.

In collaboration with Rhodes University, a large aperture scintillometer (LAS), which measures evaporation fluxes above a land surface, has been installed on both natural and rehabilitated grassland, and indicates that the rehabilitated areas continue to have lower net water use than natural grassland. The results of this first installation of a LAS by the ARC has made it possible to determine the water use of both rehabilitated and natural grasslands. When combined with rangeland production data being measured at the site, the evapotranspiration data from the LAS will enable the ARC to produce estimates of water use efficiency of this system and to guide future rehabilitation strategies.

Dr Tony Palmer and Dr Onalenna Gwate installing the scintillometer.

INTERGIS adds new functionality for data capturing using mobile technology

The ARC Intergis Developers in collaboration with the National Beef Cattle Improvement Scheme managed by the ARC developed a new mobile application for capturing performance data in real-time into the Intergis database. A web-based *mobile app* rather than a traditional *native app* (such as you would download from the Apple, Android or Windows app store) was used in the development of the new *app* in order to allow the mobile application greater exposure to a broad range of users, and not limit it to only those users who have smart phones. As a result, the new *mobile app* can run on any mobile device with a browser. Even older and cheaper devices are compatible with the new *app*. This feature is important and ensures flexibility in future enhancement initiatives of the new mobile *app*. The main advantage of the new *app* from the user perspective is that the time lag between data collection (i.e. performance recording) and submission of data into the Intergis is reduced considerably. The turnaround time for data capturing and generation of reports for the farmers is therefore significantly reduced. Furthermore, the new *app* will allow the ARC to provide performance recording services to farmers in an efficient and timely manner. The new application has already been implemented in all the ARC Beef Test Centres. The next phase of the project will be deployment for use by all farmers participating in the ARC Beef Cattle Improvement Scheme.

This important milestone has ushered a new era in the integration of mobile service provision in the farming community. This kind of development will undoubtedly rekindle interest in agriculture by the youth. ARC now has a mobile platform for the Intergis on which many other mobile applications could be developed. Opportunities also exist for delivery of information through *mobile app* to persons who may benefit from accessing information contained in the National Animal Database.

ARC mobile platform for INTERGIS.

Herd mortality and cattle off-take rates among smallholder producers in the North West Province of South Africa

It is a well-known fact that tick-borne diseases are the main cause of deaths in smallholder farming systems in many parts of Africa. High mortality of young stock indicates low productivity among smallholder producers in Africa. The objective of the current study was to determine the relationship between crude herd mortality and off-take rates.

Most herd mortalities resulted from diseases, with smaller herds incurring higher deaths than larger ones. The number of deaths of pre-wean calves as well as overall herd mortality suppressed herd off-take while the number of deaths of old animals as well as overall herd suppressed the off-take of steers. The implications of these observations is that the number of steers available for market is severely affected by both the death of cows, and the high death rates of calves probably because of management challenges. The inclusion of herd mortality data in animal recording systems may enhance the monitoring of smallholder production systems. The high mortality rates of old animals should receive focused extension efforts to improve disease management. The baseline data obtained in the current study provides a valuable resource that could be useful in assisting development practitioners in planning technological interventions and overall support packages to address challenges faced by smallholder farmers.

The Kaonafatso Ya Dikgomo (KyD) Scheme empowers smallholder farmers with knowledge on improved animal husbandry practices

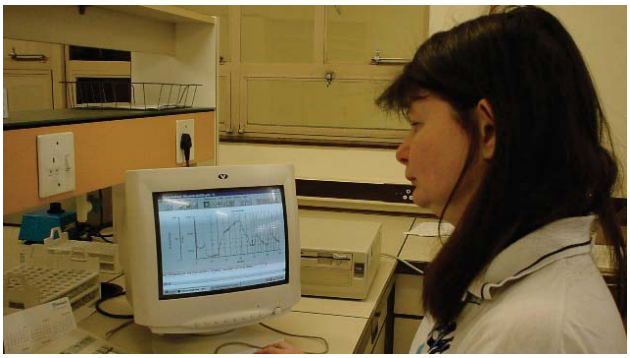
Farmers' days provide an ideal opportunity for disseminating information to farmers by introducing them to new technologies through demonstrations. The KyD farmers' days provide another advantage by collaborating with other state entities such as Onderstepoort Biological Products and Land Bank, to improve the quality of the farmer support kit. It also provides the private sector with the opportunity to raise farmers' awareness of new products. The relaxed environment at farmers' days also enables active interaction between farmers and experts.

The ARC held 9 farmers' days with a total attendance of 1508 farmers during the financial year under consideration, affording ARC experts an opportunity to disseminate information to farmers and to learn about farmers' needs and requirements. These farmers' days addressed topics relevant for the current drought situation. The lectures on breeding with emphasis on the selection of bulls and application of genomics to identify superior animals, addressed both the medium and long term needs for improving farmers' ability to mitigate effects of climate change. Lectures on drought feeding strategies through alternative feeding such as hay and silage making for preservation addressed the current drought challenge. Lectures on supplementary feeding addressed the correct use of ingredients such as urea to avoid poisoning. Lectures were reinforced with demonstrations, or veld condition assessment to facilitate appropriate stocking rates as well as the development of a fodder flow plan. Farmers were introduced to animal efficiency assessment including the use of ultrasound scanner to measure body condition. The farmers who participated in these farmers' days expressed appreciation and applauded the ARC for this initiative.

Mr Gilbert Pule demonstrating veld condition assessment at a farmers' day in Middelburg, Mpumalanga.

Determining the Ca^{2+}-dependent calpain proteolytic system profiles of springbok and wild geese

A number of factors play a key role in the ultimate tenderization process which occurs during postmortem storage of meat, one of which is the Ca^{2+}-dependent calpain proteolytic system. A standardized method has been in use at the ARC meat science research since 2000, to quantitatively determine calpains (proteases) and calpastatin (inhibitor) activities in the muscles of beef. The emerging industries such the game industry is likely to result in the expansion of the meat product range to the consumers. As a result, there is a need to know the values of the calpain enzyme activities and calpastatin in the meat of various other species to help explain the tenderization process or lack thereof. Thus, the methodology used in beef was adapted for other species. Specifically, the methodology was applied with a few minor adaptions to the analysis of springbok venison and wild geese breast profiles. The results showed that springbok longissimus had a similar calpain system profile as the beef longissimus, but that the wild geese breast lacked calpain-I. Based on these and other observations from similar studies, it is recommended that vacuum-packed springbok LTL and BF muscles are not aged for longer than five days at 0°C to 5°C.



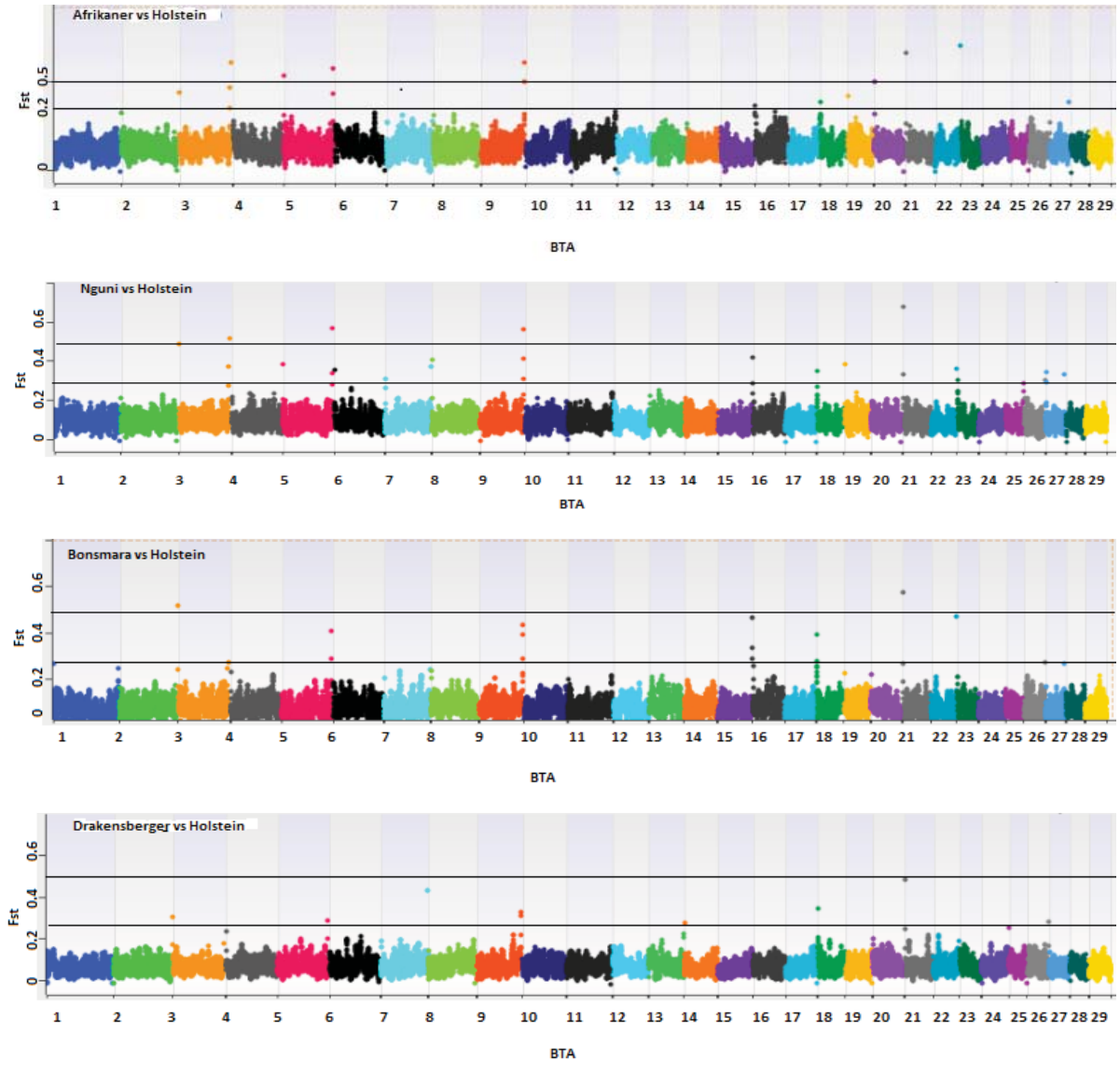
ARC Senior Technician at Meat Science section of the ARC-API, performs separation of calpain systems components.

A genome wide scan for signatures of selection among South African cattle breeds

South African indigenous and locally developed cattle breeds possess adaptive traits usually associated with tolerance to various diseases, extreme temperatures and humidity. These breeds are also adapted to low-input management systems and have shown the ability to survive, produce and reproduce under harsh environments. Thus, these breeds hold potential in the changing South African livestock production environments. However, little is known about the nature or extent of the genetic variation underlying these breeds. Detection of genetic selection signatures among cattle breeds may assist in locating regions of the genome that are, or have been, functionally important, which can be targeted by selection.

Researchers at the ARC have employed two approaches to detect signatures of selection within and between 6 cattle breeds in South Africa including Afrikaner (n=44), Nguni (n=54), Drakensberger (n=47) and Bonsmara (n=44). The first approach was based on the detection of genomic regions for which haplotypes have been driven toward complete fixation within breeds. The second approach identified regions of the genome exhibiting elevated population differentiation (F_{st}). A total of 48 genomic regions were identified as harbouring potential signatures of selection using both methods. 12 of the identified selected regions appear to be shared among breeds. 33 of the regions have been successfully annotated to identify candidate genes, some of which are associated with adaptation to tropical environments in Zebu cattle.

Results of this work represent the first attempt at locating genomic regions targeted by selection in South African breeds that should be prioritized for functional dissection. Information generated from this study form the foundation for the development of more appropriate utilisation, selection, breeding and conservation strategies of South African cattle, and form the basis for implementation of genomic selection in South African cattle breeds.



Smoothed F_{st} values for five breed comparisons across the autosomal genome.

Establishment of smallholder dairy value chain businesses

The triple challenges of poverty, inequality and unemployment remains a reality in South Africa. In an attempt to address the, the ARC is implementing a project to establish integrated village Dairy Value Chain (DVC) in partnership with the Rural Enterprise and Industrial Development (REID) Directorate of the Department of Rural Development and Land Reform (DRDLR). Rural smallholder dairy development has been the least dynamic source of economic growth for some time. The creation of robust capital raising structures through dairy was prioritized to improve rural livelihoods. Inception of the village dairy farming is occurring against a backdrop of low milk prices and low economic growth in South Africa. The number of commercial herds continues to decline yearly due to lack of sustainability. Larger dairies remain in business by increasing efficiency of production using advanced technologies; retail price of milk is however increasing and negatively impacting consumption of milk in villages.

A backyard semi-intensive forage-based dairy production system that utilizes low cost feeds, mainly climate-smart forages and least cost on-farm processing was established in areas with no history of dairy farming in four Prioritised District Municipalities of South Africa (Vhembe and Sekhukhune districts of the Limpopo Province; OR Tambo and Alfred Nzo districts of the Eastern Cape Province). Although substantial technical, economic and social challenges are anticipated, the village dairy model was adapted to suit the various environments. The value chain has three main components (i.e. forage, milk production, and milk processing and marketing) that are also supported by subsidy. Individual entrepreneurs run the milk businesses.

The DVC invested in low cost infrastructure, and climate-smart forages/dryland pastures of spineless cactus pear, grass and adaptable legumes to minimise expenditure. New village milk processing centres with office and milk selling outlets were established in areas which previously had no smallholder businesses. Training in dairy production, milk hygiene, animal health care, milk processing and farm records and practical exposure on dairy farms was provided. The project has contributed immensely to improving the nutritional status and incomes of rural people in the particular areas. Village level dairy farming, although in its early development stage, already demonstrate successful integration of the milk value chain in rural communities.

Climate-smart forages/dryland pastures of spineless cactus pear.

A backyard semi-intensive forage-based dairy production system.

The Agricultural Research Council's efforts to mitigate against or combat livestock diseases continue to make significant strides that contribute to the ideal of the country reaching self-sufficiency in livestock and poultry products. The following animal health highlights are examples of the support we give to the livestock industry to help to keep it competitive.

Potential new livestock vaccines for improved food security in Africa

Food security remains a major concern for most of the developing world but more so for those in Africa; for South Africa as a developing, middle-income country, levels of childhood malnutrition remain a concern too. According to the report entitled *20 Year Review*: *South Africa 1994-2014* issued by the Presidency, 21% of households in South Africa have difficulty in accessing food.

It is now well documented through various studies that the promotion of small-scale livestock farming in Africa provides one of the surest pathways to food security and sustainable livelihoods. However, the livestock sector remains vulnerable to devastating disease outbreaks, many of which have direct negative impact on the livelihoods of many resource-poor households.

Towards the end of 2014, scientists from the ARC-Onderstepoort Veterinary Institute in partnership with the University of Alberta, procured 2nd phase project funding with a total value of R60 million for the development and upscaling of a number of livestock disease vaccines in the fight against food insecurity in Africa from the Canadian International

Development and Research Centre (IDRC) and Global Affairs Canada.

The first vaccine under development is a multivalent Lumpy Skin Disease (LSD)-Rift Valley Fever (RVF) vaccine that will protect cattle against LSD and RVF. This vaccine intended to registered in South Africa for use in southern African countries. The second one is a LSD-RVF- ***peste des petits*** (PPR) vaccine for use in sheep and goats. This vaccine will be registered in Kenya for use in countries which are affected by these diseases (PPR is not present in South Africa). The third one is an African Swine Fever (ASF) vaccine, to protect pigs against ASF, a disease which is common in many countries including South Africa. All these diseases have been identified as those that severely affect small-scale resource-poor farmers.

Early stage vaccine trials in Phase I showed good promise, but additional refinement work is still required. This work is continuing in Phase 2 two, along with the development of communication and scale-up strategies, and larger-scale socio-economic studies involving scientists in Kenya.

Participants at the second Socio-Economic Policy Dialogue meeting of ARC-Canadian Project held at the HSRC.

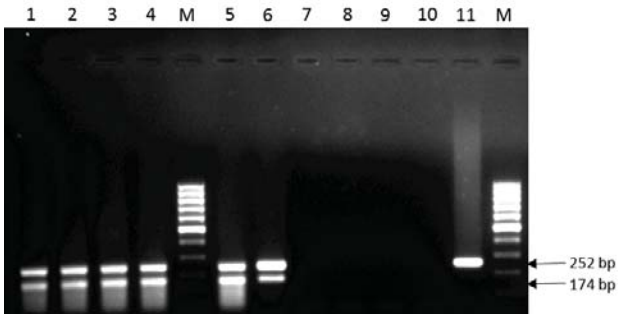
ARC organised Farmers' Day .

A number of key outcomes so far in this phase of the project includes the development of an adenoviral-vectored ASF vaccine construct which will be evaluated in small contained animal trials in South Africa and Canada. The LSD-RVF-PPR construct has been evaluated in sheep and goats and requires additional improvements.

The Agricultural Research Council hosted Ms Elissa Goldberg, the Canadian Assistant Deputy Minister for Partnerships for Development Innovations Branch of Global Affairs Canada. Other key events included hosting of the project annual meeting at the ARC, two policy dialogues co-hosted with the Human Sciences Research Council, various farmers' day presentations and five radio broadcasts.

Diagnostic development and services and residue/toxicology

ARC researchers developed a diagnostic Polymerase Chain Reaction (PCR) method for subtyping *Salmonella* Gallinarum, the causative agent of Fowl typhoid, a disease that severely affects poultry. Chickens are most commonly affected but it also infects turkeys, game birds, guinea fowls, sparrows, parrots, canaries and bullfinches. Infections still occur worldwide in non-commercial poultry but are rare in most commercial systems. This development will lead to quick, cheaper and more accurate diagnosis of Fowl typhoid and thus be of direct benefit to small-scale poultry farmers.



A typical gel result obtained when this technology is used on samples received for testing at ARC-OVI.

The gel picture above shows strains of biovars Gallinarum and Pullorum. PCR products of biovars Gallinarum and Pullorum, serovars Enteritidis, Typhimurium, Heidelberg and *Bacillus anthracis* are shown in the gel after analysis by electrophoresis on a 2% agarose gel. Reading from the top, lanes M, 100bp DNA marker; lanes 1-6 [biovar Gallinarum (252 bp and 174 bp); lane 7, serovar Enteritidis; lane 8, serovar Typhimurium; lane 9, serovar Heidelberg; lane 10, bacillus anthracis; lane 11 [control], biovar Pullorum (252bp).

The researchers also validated and adopted Real-Time PCR Assays for diagnosis of a number of food-borne pathogens including *Salmonella* spp, a Toxin *Escherichia coli* screening; *Escherichia coli* 0157:H7; *Listeria monocytogenes*; and *Listeria* spp.

Toxicology Diagnostic Services

The ARC operates one of the most advanced Toxicology laboratories in Africa. The main objective of this laboratory is to provide accurate, timely and cost effective diagnostic services to clients that include the Provincial State Veterinarians, DAFF, private veterinarians, commercial and rural farmers, research institutes and feed manufacturing

companies. A range of toxicological tests are performed on animal tissues, water, plant, food and feed samples received from various clients. These tests include pesticide, strychnine, urea, ammonium chloride, salt, trace elements, arsenic, electrolytes, hydrocyanic acid, nitrates, nitrites, ionophore antibiotics, mycotoxins, cardiac glycosides, plant identification, fungal identification, free gossypol, phosphine, lead analysis (whole blood), pH and inorganic phosphate.

The number of samples tested during the period April 2015 to March 2016 was 644, of which gossypol, mycotoxins, pesticides and trace elements accounted for 85% of tests.

An instance of malicious poisoning of food by pesticides.

FMD reverse genetics vaccine development

Foot-and-Mouth Disease (FMD), of which FMD virus (FMDV) is the causative agent, is a contagious viral disease which affects cloven-hoofed animals such as cattle, pigs, sheep, goats, and other artiodactyl species. The occurrence of the disease in Africa not only affects international trade in animal and animal products but also results in damaging consequences for the livelihoods of local farmers due to impacts upon productivity, food security and losses of income.

Foot-and-Mouth disease (FMD) viruses (FMDV), especially SAT2 serotypes, are unstable during heating leading to irreversible dissociation causing loss in immunogenicity (the ability of a particular substance, such as an antigen, to provoke an immune response in the body of an animal), and requiring frequent booster vaccinations. The hot climate in African regions necessitates improved stability with less reliance on a cold chain. To enhance vaccine effectiveness researchers at the ARC-OVI used reverse-genetics to develop SAT2 viruses that have increased stability. They then investigated whether the stabilised SAT2 antigen vaccine could improve immunogenicity in cattle. Two viruses with increased thermostability were shown to produce comparative immunological responses compared to the wild-type SAT2 vaccine in cattle. The two thermostable vaccines were capable of producing strong antibody titres and interferon gamma (IFN-γ) with full protection more than five months post-vaccination. This is the first step in proof of concept to now advance our knowledge to solve problems with regard to SAT2 vaccine stability that occurs from vaccine production to administration in the field. The result will be better and more efficient vaccination strategies for the country and the region.

Epidemiology of Corridor Disease

Corridor disease is caused by infection with buffalo-adapted protozoan parasites known as *Theileria parva* and can result in up to 90% mortality in cattle if not controlled. The Corridor disease designated endemic area in KwaZulu-Natal (KZN), Mpumalanga and Limpopo provinces, is inhabited by more than 200 000 head of cattle belonging to mostly communal farmers and the disease is considered the largest killer animals disease in the country. There has been an increase in the reported cases of Corridor disease outbreaks from about 4 outbreaks in 2004 to 19 investigated and confirmed outbreaks in 2015 by ARC-OVI in cattle population in these areas. Buffalo associated carrier state in cattle under natural situations as in eastern and southern African countries, has not been demonstrated but remained a subject of controversy. The current investigations in the carrier state followed a severe outbreak occurred in 2014 in KZN which caused 30% mortality in one herd of cattle before animals were moved and dipped. We attempted tick pick-up and transmission experiments to demonstrate the occurrence of the carrier state in surviving cattle.

The subsequent adult ticks from two groups; ticks derived from field carrier cattle (confirmed by molecular tools) and the experimentally produced carrier state under controlled conditions using the infection and treatment method, showed that both batches of ticks transmitted fatal infections in susceptible cattle. This is the first demonstration of cattle to cattle disease transmission which is related to establishment of carrier state after using oxytetracyclines (antibiotics) by the farmers in attempt to save their cattle. Corridor disease should be considered a potential emerging disease, requiring more stringent control methods. The current drought had major effects on the occurrence of this vector-borne disease as communal farmers tend to push their cattle to graze in and around game parks due to shortage of grazing. This constitutes a major disease risk at the game/livestock interface. It is noted that several dips are not in use due to shortage of water and communal farmers are advised to use pour-on acaricides.

Tick vaccines

The Tick Vaccine Project aims to develop anti-tick vaccines that will disrupt feeding at the tick-host interface. Since almost no data on tick antigens for South African ticks of economic importance are available, the first phase of this project focused on the generation of salivary gland transcriptomes (set of all messenger RNA molecules in one cell or a population of cells) using next-generation sequencing approaches and their validation using proteomics (the large-scale study of proteins, particularly their structures and functions). To date salivary

gland transcriptomes has been generated for all major economically important tick species and validated using proteomics. This part of the project is conducted for degree purposes and includes 2 PhD and 2 MSc students. The data indicate that the transcriptomes generated are of good quality and will be useful as databases to identify potential vaccine candidates. The next phase aims to determine how robust and reproducible differential expression across different feeding stages are and how transcriptome and proteome data correlate quantitatively within and among individuals. This will also allow us to identify interesting antigens for future characterization with regard to function at the vector-host interface and for assessment as vaccine candidates.

Attenuated Heartwater Vaccine

Heartwater, or cowdriosis, is an infectious, tick-borne disease of domestic and wild ruminants that occurs throughout sub-Saharan Africa and the Caribbean. It is caused by a rickettsia, *Ehrlichia ruminantium*, and is transmitted by ticks of the genus *Amblyomma*, with *A. hebraeum* being the main species in South Africa. The disease is fatal in susceptible herds and is regarded as one of the most economically important livestock diseases in the country with farmers losing an estimated R220 million annually in production and revenue. The only sustainable method of control is by vaccination. Live attenuated vaccine has been developed and recent results generated in sheep, Angora goats, and cattle vaccinated by the intramuscular (IM) route with the heartwater attenuated vaccine did not require antibiotic treatment after vaccination. Further, all vaccinated animals resisted disease and showed 100% protection and none of the animals needed treatment.

Female farmer at Siyabuswa Diptank.

Field trials on three Angora Farms in the Eastern Cape have demonstrated the safety of vaccination of one-week old kids, pregnant goats and ewes, and one-year old animals. It is concluded that the attenuated vaccine meets vaccine requirements as it is safe to use, no antibiotic treatment is required, it is cheap, no skills are needed to administer the vaccine by IM route, no after vaccination monitoring is required and a single delivery provides protection for six months after vaccination under tick-free conditions. Candidate attenuated heartwater vaccine production was done on bench scale at ARC-OVI with great success.

OVERVIEW AND HIGHLIGHTS OF RESEARCH AND INNOVATION SYSTEMS

The work done by the Research and Innovation Systems (RIS) division of the Agricultural Research Council 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 based agriculture.

Research in the RIS division focuses on biotechnology, agricultural mechanisation and engineering, and natural resources management (soil, climate and water). With a wide range of service, development and research functions, the division provides collaborative and support 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 2015/16 are highlighted below.

Research focusing on Biotechnology

Transcriptome analysis of nematode infected village chicken populations: Towards a genomic control strategy to gastrointestinal parasite infection

Village chickens *(Gallus gallus domesticus)* are the most important and major poultry species owned by village communities in rural areas of South Africa and other African countries and in the developing world. They play a vital role through their contribution to cultural and social-economic lives of smallholder farmers. Their role in national economies is to improve the nutritional status and income of many smallholder farmers and landless communities.

Gastrointestinal parasites have a negative influence on chicken productivity and flock size. Parasitic worms can damage the intestinal mucosa and reduce growth rate and/or egg production even to the best fed, housed and genetically improved chickens. Traditional control of gastrointestinal nematode infection depends on the use of anthelmintics. These strategies have a negative consequence of prompting variability among microorganisms and the appearance of drug-resistant strains. Coupled to this is the relatively high costs of anthelmintics which most village farmers cannot afford. Alternative control strategies such as the use of genetic differences in resistance of the chickens need to be investigated and adopted. The use of molecular tools such as transcriptome analysis provide new insight into the genetics of diseases and disease resistance. A good characterisation of the parasite and transcriptome of the host may lead to a better understanding of the parasite-host interaction and the development of new control strategies.

This study investigated the genes and mechanisms that are involved in the small intestine of village chickens' response to nematode infection using RNA-seq techniques. Total RNA was isolated from the intestines of village chickens naturally infected with ***Ascaridia galli*** and sequenced. The transcriptional networks and the genetic mechanisms controlling resistance of village chickens to nematode infection were uncovered. The finding forms the basis for the identification of biomarkers required in selection and breeding of animals with the right genotypes for environments infested by specific nematodes. Insight into gene expression profiles of infected chickens has also shed light on the genetic basis of other control strategies. This project supports the expansion of agricultural production, especially in the rural poverty nodes, which could increase the number of farmers and improve productivity in the smallholder sectors of the country. The ARC also focuses on research and development which generates technology and tools that will improve animal production.

The presence of nematode parasites in the small intestine of a village chicken.

ARC student collecting parasites from the intestines of village chickens for molecular biology analysis. A total of eight adult ***Ascaridia galli*** *worms were recovered.*

Gene expression analysis of cassava in response to mealybug infestation

Cassava, tapioca or manioc (*Manihot esculenta* Crantz) is a woody perennial plant that feeds over 500 million people living throughout the tropics. It is cultivated for its large, starch-rich roots, as well as its leaves which are used as a vegetable. Furthermore, cassava has also gained importance as an industrial starch in the pharmaceutical, textile and cosmetic industries. Although native to South America, it is the most widely cultivated tuber crop in sub-Saharan Africa, and is the most important food staple consumed. In South Africa, cassava is grown in Limpopo, Mpumalanga and KwaZulu-Natal as a secondary crop to supplement daily meals. In the neighbouring countries of Swaziland and Mozambique it is cultivated as both a staple food and for industrial starch production. Part of the ARC's mandate is to contribute to food security and industry, and it has therefore developed awareness of cassava as a crop that can play a role in poverty alleviation and for industrial purposes.

The status of cassava as a food security crop in sub-Saharan Africa is severely hampered by major herbivorous pests that threaten its continued production. Among the cassava pests, only whitefly (*Bemisia tabaci*), and cassava mealybug (*Phenacoccus manihoti)* are present in South Africa. This project focused on the control of cassava mealybugs which can cause yield losses as high as 80%. While biological control of mealybugs through the use of natural predators has been successfully practised, breeding for resistant cultivars remains an important means of control. Understanding plant responses to insect herbivory is a vital step towards the development of resistant cultivars. Determining and identifying differentially expressed genes is one of the major steps towards the understanding of molecular mechanisms of defence responses in plants. This project identified transcripts and gene pathways that play a role in early response to cassava mealybug infestation.

Mealybug isolates were collected from different cassava growing regions of South Africa and a detailed morphological and molecular characterisation of the pests was undertaken. The response of three cassava genotypes AR23.1 (multiple disease and green mite resistant), P40/1 (no known resistance) and 98/0581 (multiple pest resistance, CMD resistance) was investigated by analysing their transcriptome pre-mealybug infestation (0 hpi), and at 24 and 72 hours post-infestation (hpi). Jointly, morphological and molecular methods identified mealybugs infesting cassava in South Africa as *P. manihoti*. There was a significantly different response to mealybug infestation in the three genotypes studied with AR23.1 being partially resistant, 98/0581 as tolerant and P40/1 as susceptible. Furthermore, a high level of induction of defence-related genes such as 2-oxogluterate (2OG) and Fe (II)-dependent oxygenase superfamily protein, MYB domain proteins and CYP450 family proteins at both 24 and 72 hpi were observed for the partially resistant AR23.1 and tolerant 98/0581 genotypes, suggesting that these genotypes have a potential for breeding for resistance to mealybugs.

Overall, transcriptome profiling of AR23.1, 98/0581 and P40/1 interaction with *P. manihoti* in the present study suggests that the mealybug feeding affects a variety of morphological and physiological traits in the cassava plant at a very early stage of infestation and feeding. Comparison of transcriptome data from control and mealybug infested plants allowed for the identification of putative candidate defence-related genes involved in *P. manihoti*.

Mature cassava roots harvested and ready for consumption.

Cassava plant infested by mealybugs in a glasshouse.

Development of a plant containment facility with state-of-the-art environmental control and recording features

Worldwide biotechnology innovations are continuously being developed, refined and released. The ARC strives to keep abreast of the latest cutting-edge technologies, infrastructures and techniques, by establishing the relevant infrastructures and utilising them within agricultural research. One of the objectives of the ARC is to establish the latest genome-engineering techniques and technologies for subsequent use in research projects, such as putative gene confirmation studies, development of the latest plant breeding techniques and new biological product production systems. As more and more genomes are being sequenced, the ability to confirm or transfer traits will be increasingly in demand.

In recent years, plant growth lighting has also received much attention, with traditional lights being replaced by light-emitting diodes (LEDs). The newer LED plant growth lighting systems provide researchers with the opportunity to select the optimal light wavelengths to target specific light absorbing pigments, such as chlorophyll, thereby allowing more optimal plant growth conditions and better light energy utilisation. Furthermore, since wavelengths and their strengths could be altered, optimal plant growth requirements for different crops could easily be accommodated within a single growth room during subsequent growth experiments. Light is one of the major factors influencing plant growth and by using different light conditions, plant morphology could easily be influenced; for example, blue light will reduce internodes to produce shorter more stocky plants, while red light may encourage or induce flowering in some crops. LEDs are usually more efficient in converting electricity into light, i.e. they produce less heat, and together with the use of only selected wavelengths, utilise electricity more effectively than the older growth lights known for their energy losses through heat production and unused wavelengths. The ability to control and manipulate the lighting conditions within a growth chamber, together with additional control of growth parameters, like supplemented carbon dioxide, temperature, humidity and day length control, could also be drastically reduced plant growth cycles. Furthermore, the control of these growth parameters, especially carbon dioxide, temperature, light intensity and watering, will enable research projects related to climate change which is another key research area.

Combining containment, growth light control and other key environmental systems, such as carbon dioxide supplementation, would allow a wide range of research projects within a facility, from climate change and accelerated plant growth for breeding studies, to plant genome engineering and gene confirmation projects. A prefabricated, pilot plant growth facility, with the proper containment and environmental control systems, was therefore identified and established as a cutting-edge infrastructure required for future experiments in cutting-edge research areas.

The growth facility was designed from a shipping container, to have three larger growth areas (2.4 × 2.4 m), a small, multi-tier seedling area (1.2 × 2.4 m) and a small laboratory with an autoclave, laminar flow, water basin and fridge-freezer. The container was sealed by welding all non-required access points shut and/or through the application of the appropriate sealants. The appropriate mounting plates for utilities, internal barriers, air conditioning, etc. were installed to limit intrusions through the shipping container's outer wall. Where intrusions penetrated the outer wall, sealants were used on both sides to ensure containment. A secondary barrier was installed internally using a galvanised/Chromadek® insulated, interlocking walling and ceiling system. This provided an insulated growth room with better environmental control, while silicone sealant and expansion foam ensured containment. Recessed trunking was used for the utilities, thereby ensuring an easy to clean and decontaminatable facility. Floors were sloped toward accessible stainless steel floor drains with sieves within the growth area and vinyl was curbed onto the walls. All liquids from the facility, including air conditioning overflows, autoclave outlet, drain and irrigation runoff, were channelled to the draining system which ends in a chlorine decontamination tank. This tank was designed to be secure although easily accessible for treatment replacements. It also consists of internal baffles preventing untreated liquid from bypassing decontamination. This ensures treatment of all liquids from the facility. Air filters, together with an air lock and air pressure differentials, further ensures containment.

A four-bar LED light was designed with a total of 1 056 LEDs (3W each) that were distributed over three circuits (red, blue and "white" light), with each circuit individually controlled. The 3W LEDs selected provide the required light output, while maintaining the best electricity to light conversion ratio with least heat produced. The maximum energy requirement of each light unit was limited to 2 KW true LED consumption in an attempt to lower heat production and to ensure 30 000+ working hours per unit. Aluminium heat sinks, small circulation fans and electronic design features were installed to prevent heat buildup that will drastically decrease the life expectancy of the units. Four of these units were installed on a height adjustable control system in each of the larger growth areas. Together with the floating shelving, a growth area with a maximum height of 2 m could be obtained, thereby providing both flexibility and an ergonomic working environment independent of the crop to be grown.

A remotely accessible building management system is used to control the facility's features, from the airflow rates to maintain containment, to monitoring power supply, and managing the growth conditions within each of the growth areas. The temperature, humidity, day length (dawn and dusk) and additional carbon dioxide supplements could be programmed independently for each day in the growth cycle of a crop. Light wavelength control of the red, blue and white wavelengths is done manually for each LED growth light. The building management system also records all the actual growth conditions within each growth area, as well as all the facility alarms, such as the loss of air pressure, emergency door access, decontamination tank blockages, etc. Alarm notifications are e-mailed to the users, should anything go wrong, while automatic preventative programming firstly protects the experiments and then the infrastructure.

The facility was finalised towards the end of January and commissioned during February 2016. Plant growth parameters are being tested for selected crop species while the application process is underway for GMO containment facility certification.

The newly built plant containment facility. The building management control system and switches are housed within the distribution boxes (larger orange units) and linked with WiFi to the main Biotechnology Platform building from which this photo was taken. Climate control features, such as the carbon dioxide supplementing tanks and relays, humidification system and its relays (smaller orange unit), as well as the air treatment unit (large ducting) are visible in this front view. All the air conditioning and other utilities are cleverly hidden under corrugated cover plates. Heat reflective paint on the roof and 80% shade cloth helps with passive energy conservation.

Next Generation Sequencing as a genomic tool to detect species substitution and mis-labeling in meat products in South Africa

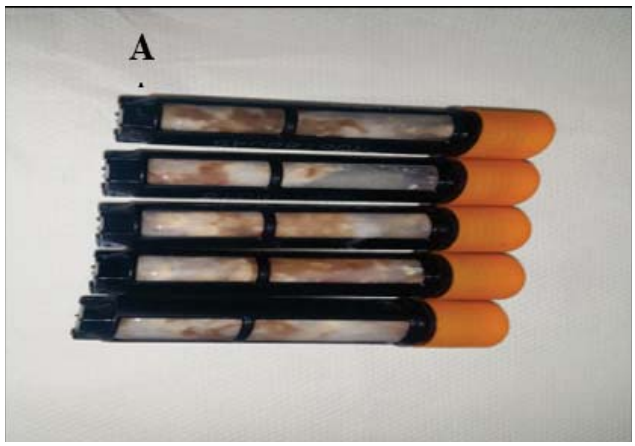
The global demand for meat products continues to rise with greater increases observed in developing countries. In South Africa, total meat consumption is estimated at 41.0 kg per capita per year, which is comparable to global meat consumption estimates of 41.2 kg per capita per year. South Africa has a broad meat products base and can select meat and meat products from the beef, sheep, goat, pork, poultry and game industries. Meat in South Africa comes from commercial and smallholder farmers who sell their animals to abattoirs which slaughter the animals, process the fresh meat and sell to either secondary processors or retailers. The choice of meat and meat products in this diverse industry is driven by quality and nutritional attributes. Religious beliefs also contribute to the choice of meat and by-products, particularly the South African Muslim community which requires pork-free meat and meat products that are processed according to the Halaal regulations. Other religious groups have specifications in terms of species that they can consume as well as processing standards. Based on such diverse preferences, it is important in such a consumer environment that meat and its products are properly labelled and consumers are well informed as to the origin, composition and safety of the foods they consume.

Cases of meat contamination accompanied by improper labelling and adulteration for financial gain have recently been reported. Meat species substitution and fraud is influenced by the rise in meat imports, price of meat commodities, growth of the food trade and the rise in prices for processed meat. The substitution of meat species can be intentional or unintentional.

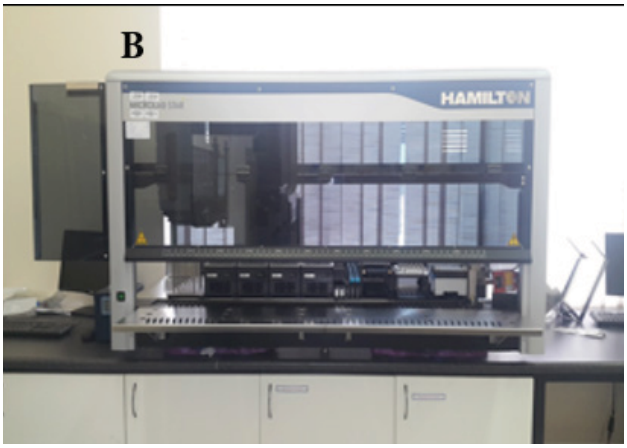
Identification of contaminated or substituted meat products is important to ensure general safety and compliance with a range of regulations and legislation that are in place to ensure that food is safe to eat, and appropriately labelled. In addition to ensuring that the food chain is supplied appropriately, it serves to protect allergic individuals and those who hold religious and personal lifestyle beliefs that specify intake of certain species and not others. In total, more than 25% of South Africans are affected by concerns about the species composition of food. The ability to detect less desirable or objectionable species in meat products is important not only for economic, health, religious and ethical reasons, but also to ensure fair trade and compliance with legislation. Furthermore, it is important in the protection of endangered species, which are otherwise vulnerable to poaching and incorporation into the food chain. The accurate and rapid identification of species in meat products is therefore an essential component of food safety.

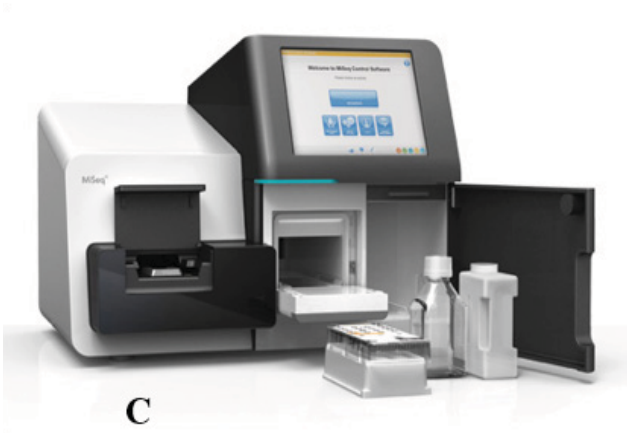
The ARC has established high throughput, state-of-the-art genomics and molecular biotechnology applications for agricultural research. To date the organisation has implemented Next Generation Sequencing using Illumina technologies that will allow high throughput whole genome sequencing workflows. In addition, Hamilton Liquid Handling Robotics systems have been commissioned to allow handling of high volumes of samples for either DNA or RNA extraction as well as sequencing preparation. The overall environment is managed with an advanced laboratory information management system (LIMS) package, and this is integrated with a high performance bioinformatics infrastructure set up to handle, store and analyse the DNA sequence data generated. This unique facility is the most advanced genomics infrastructure in Africa.

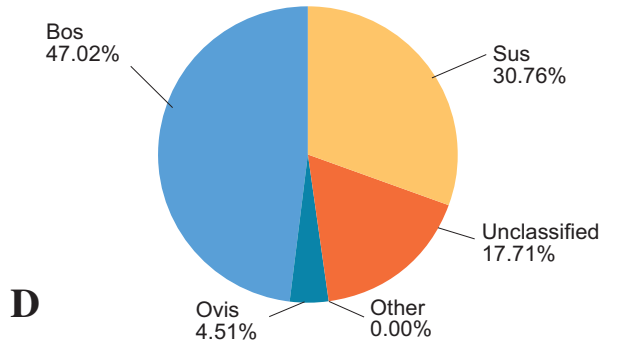
It is now feasible for the ARC to apply genomics and bioinformatics tools in food quality control and regulation of product safety in the meat industry. Infrastructure available allows adoption of Next Generation Sequencing in managing food safety in South Africa. The Next Generation Sequencing in meat species identification project demonstrated a universal diagnostic molecular and bioinformatics pipeline using NGS data from the Illumina MiSeq sequencing platform, targeting the 16S rRNA mitochondrial gene for use to identify any species present in a meat sample. A total of 781 processed meat samples were collected from butcheries, retail outlets and processing plants around South Africa. Results to date demonstrate the utility of next generation sequencing in food quality control and incidences of meat species substitution in the industry.



A: *Meat samples collected in individual tubes from butcheries, retail stores and processing plants around South Africa and frozen at -20°C prior to DNA extraction.*







B: *DNA extraction done using a Hamilton Liquid Handling Robotics platform.* **C:** *High throughput sequencing of mitochondrial 16S gene fragment done using the MiSeq sequencing platform.* **D:** *Analysis indicating incidences of meat species substitution in the industry.*

Research focusing on Natural Resources (Soil, Climate and Water)

Desertification, Land Degradation and Drought (DLDD) land cover mapping

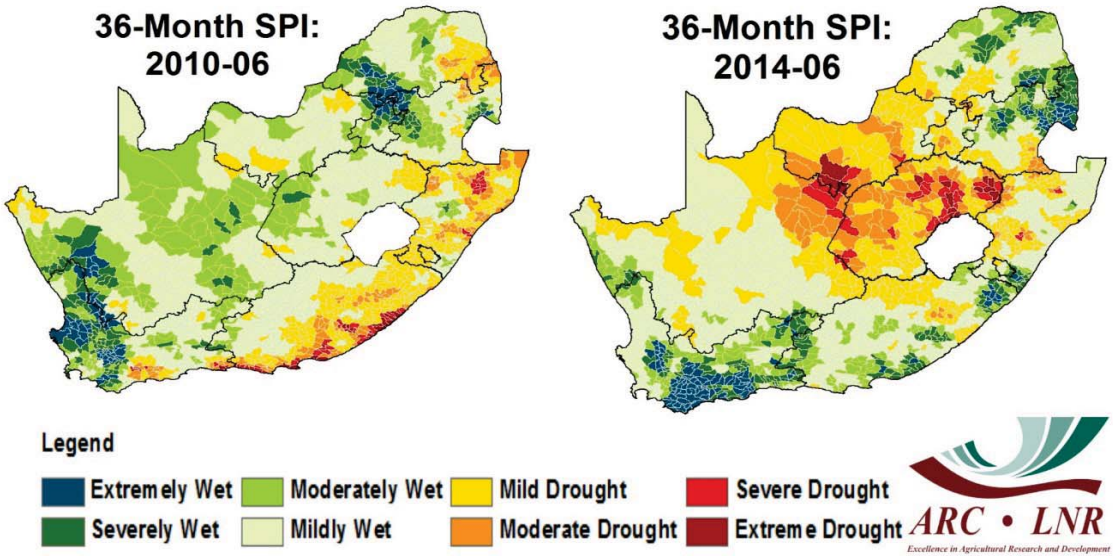
Land degradation, soil erosion, invader vegetation and drought have always impacted negatively on agricultural natural resources and food production. Much research in understanding these phenomena has been carried out over many years. Quantification and assessment of their impact on socio-economic life and ecosystem services has received renewed attention following South Africa's ratification of the United Nations Convention on Combating Desertification (UNCCD) in 1997 and other recent international environmental conventions. Developing countries, especially in Africa, insisted that particular attention be given to desertification during the UN Conference on Environment and Development (UNCED) held in Rio de Janeiro, Brazil in June 1992. In South Africa the Department of Environmental Affairs (DEA) is the focal point for the UNCCD and requires regular land degradation, desertification, erosion and drought assessments in order to inform policies, rehabilitation programmes, and strategies to monitor and reduce risks.

South Africa developed a National Action Plan in 2004. This is a strategy aimed at identifying factors contributing to desertification and seeking practical measures necessary to address issues related to desertification and land degradation and to mitigate against the effect of drought as well as alleviate rural poverty at national level. The DEA also developed the South African Dryland Research Programme in 2010. The Conservation of Agricultural Resources Act (CARA) provides for control over the utilisation of South Africa's agricultural natural resources in order to promote conservation of soil, water resources and vegetation and the combating of weeds and invader plants.

The DEA contracted the ARC to conduct research relating to mapping the impacts of desertification, land degradation and drought, and to investigate the change in status of land degradation between 2009 and 2013 in the dry regions of South Africa. The study objectives were to identify and quantify drought-affected land, degraded land and desertified land, and to assess whether progress is being made to combat land degradation in the country. The project generated the following maps: a land degradation map, a desertification map, and a drought-affected land map of South Africa.

The example drought maps show the spatial distribution of drought by way of the slowly varying 36-month standardised precipitation index (SPI). SPI is used to monitor the occurrence of droughts from rainfall data. The index quantifies precipitation deficits on different time scales and therefore also drought severity. It provides an indication of rainfall conditions per quaternary catchment (in this case) based on the historical distribution of rainfall.

Drought over the peripheries of the country (southern to eastern coastal areas and Lowveld in the northeast) during the early part of the period (2009-2010) was replaced by drought conditions over the central parts of the country by 2012 and 2013, whilst the eastern and southern parts received above-normal rainfall at that stage. The gradual shift in dry areas observed between June 2010 and June 2014 is clearly shown by the two SPI maps. The drought as delineated by the SPI maps did indeed have an impact on vegetation activity and therefore on agricultural production as well as having hydrological and water supply impacts.

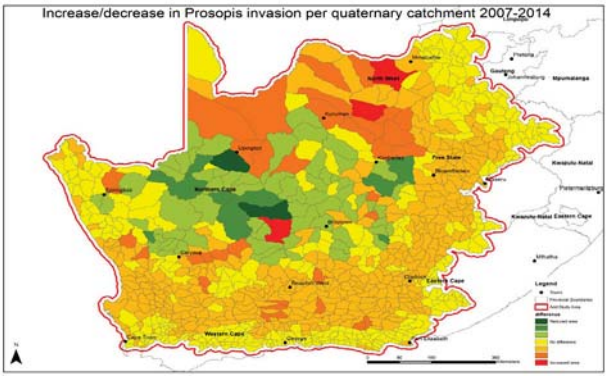


Standardised Precipitation Index (SPI) classes at 36-month time scale between June 2010 and June 2014.

Prosopis is a woody vegetation invader species that invades grazing land in the drier regions of South Africa and reduces the productivity of the rangeland. The *Prosopis* invader vegetation map indicates that there was a small decrease in the total affected area from 1.64 to 1.5 million hectares during the period 2007 to 2014. The results also show areas with increasing invader species which thus need urgent attention. Although the Northern Cape showed a marked decrease in *Prosopis* cover, the North West, Western Cape and Eastern Cape provinces all experienced increases in *Prosopis* cover.

Land degradation, desertification, erosion and drought impacts affect a number of stakeholders including both national and provincial government departments as decision and policy makers as well as commercial and small-scale farmers. The effects of the above-mentioned impacts include reduced food security, environmental degradation, long-term sustainability and various aspects of economic production both in the agricultural and commercial sectors.

The results of the project will be used as a planning tool for natural resources monitoring and characterisation and will assist decision makers in identifying areas affected by drought desertification, land degradation and invader species. The project will also indicate whether progress is being made to combat land degradation in South Africa.



Indication of which quaternary catchments increased or decreased in ***Prosopis*** *invasion during the 2007-2014 assessment period.*

Dynamics of climate variability over the all-year rainfall region of South Africa

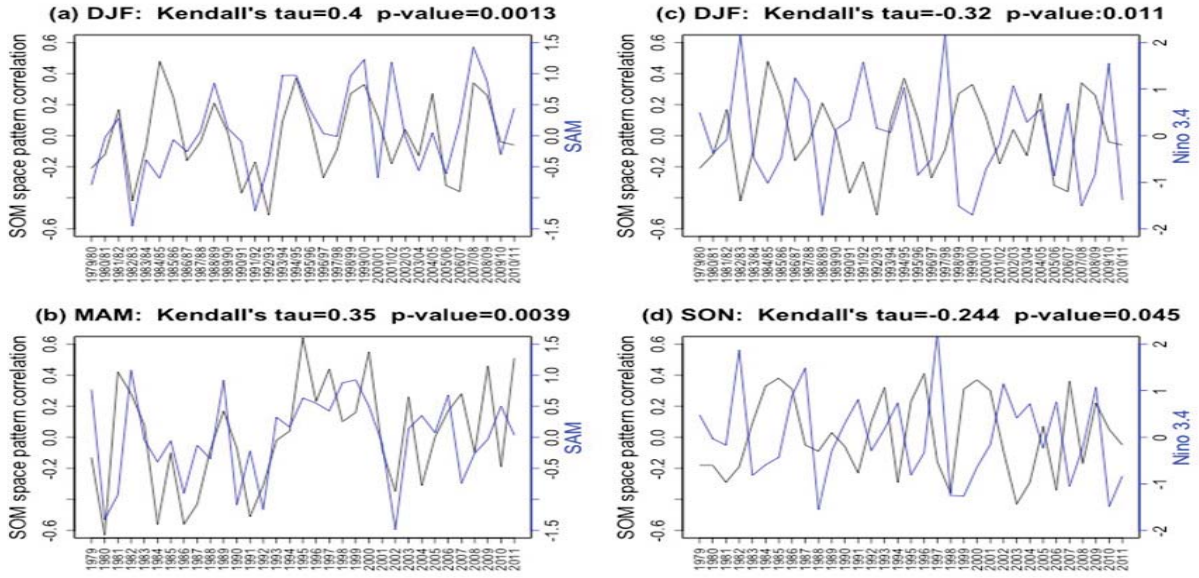
The all-year rainfall region of South Africa, located in a narrow strip along the Cape south coast, is an economically important agricultural region for the cultivation of fruits and vegetables as well as livestock farming. South Africa's second largest producer of citrus fruit is found in the Addo/Kirkwood region while the Langkloof Valley is well known for the production of deciduous fruits. Chicory is grown in the coastal area between Port Elizabeth and Port Alfred, which is the second largest producer of chicory in the world. Livestock farming has various sub-sectors but a significant portion of the South African dairy and red meat industry operates in this region.

Chicory land in the Alexandria region.

The study proceeded to explore the interannual variability of the synoptic types that bring rainfall to the Cape south coast region. It has been found that synoptic types that contribute to significant portions of rain during a specific season (e.g. summer) occur more frequently during wet seasons than during dry seasons. Using this insight, a new type of atmospheric circulation index was formulated, based on the pattern correlation between the average synoptic type

frequencies associated with wet seasons and the frequencies associated with a particular season. Correlating this value with the main modes of southern hemisphere variability, namely the El Niño Southern Oscillation (ENSO) and the Southern Annular Mode (SAM), revealed that the new index for spring and summer is negatively correlated to El Niño 3.4 sea surface temperature anomalies, whilst the summer and autumn index values are positively correlated with SAM. Since there is evidence that ENSO and SAM are predictable at seasonal time scales, these findings indicate the potential for skilful prediction of the intraseasonal variability of synoptic types over the Cape south coast region at the seasonal time scale. This result is important for obtaining reliable early warnings of seasons with anomalously high frequencies of high-impact weather events occurring over the region.

The study concluded with an investigation of the predictability of the intraseasonal variability of synoptic type frequencies at the seasonal time scale over the Cape south coast. The Global Seasonal forecasting system (GloSea5) administered by the UK Meteorological Office consisting of 12 ensemble members was applied for this purpose at a 1-month lead time, with a focus on the spring and summer seasons. Deterministic measures of skill of the ensemble average forecast of synoptic type frequencies reveal that the forecasts are skilful over persistence, particularly for spring. Moreover, the forecast frequencies are positively correlated to the observed frequencies over time, with the correlations being statistically significant for more than half of the period considered. Probabilistic estimates of the forecast skill reveal that the system can skilfully predict the occurrence of below-normal and above-normal frequencies of specific weather systems, for both the spring and summer seasons. The system has skill over persistence and climatological anomalies in identifying below-normal, normal and above-normal frequencies of specific weather systems. Although all the measures of skill indicate skill levels somewhat lower than those recorded for the prediction of summer rainfall totals over South Africa's summer rainfall region with its strong ENSO signal, the results still indicate that the forecast system is capable of producing skilful forecasts of intraseasonal variability in circulation. This new finding deserves further investigation for the larger southern African region, towards providing a variety of users with information of the intraseasonal occurrence of high impact weather events at the seasonal time scale.



Pattern correlation between the interannual frequency distribution of nodes within the SOM space and that of the average seasonal frequency distribution of nodes within the SOM space for the relevant wet season versus (a) the corresponding SAM index for DJF, (b) the corresponding SAM index for MAM, (c) the corresponding ONI for DJF, and (d) the corresponding ONI for SON. The Kendall's tau values and levels of significance are indicated in the respective title bars.

Communication of seasonal climate forecasts on public radio stations

The skill of seasonal weather prediction has improved substantially in South Africa over the past two decades. Water (i.e. rainfall) is the primary medium through which seasonal variation influences the ecosystem and therefore people's livelihoods. Besides seasonal variation, demographic and related land use changes have a direct impact on increasing demand for fresh water resources. However, the lack of understanding of the complexities of weather and climate change phenomena plays a major role in the acceptability of weather forecast information. Developing effective weather forecast dissemination and capacity development methods is a vital component in preparing farmers and society to cope with weather variability related disasters.

Currently in South Africa, several organisations and government institutions publish weather forecasts on different platforms including public television and radio stations. The question is, does this information reach the public on time and is it used accordingly? The Department of Agriculture, Forestry and Fisheries (DAFF) funded a project to investigate how effectively media is used in the dissemination of weather information to the public.

Two radio stations were selected based on the nature of their listenership: Thobela FM broadcasts in Sepedi in Limpopo Province and Motsweding FM broadcasts in Setswana in North West Province. A web-based questionnaire was developed to evaluate the impact of information discussed on talk shows on the respective radio stations. The questionnaire was hosted on the ARC's website and the seasonal weather forecast discussed during the talk show was also uploaded before the broadcast.

The majority of Sepedi respondents indicated that they would prefer to receive weather forecast information through radio and television whilst English respondents preferred to receive the information via radio or from agricultural extension officers.

The web-based survey indicated that language plays a significant role in acceptability and understanding of current published seasonal weather forecast information. There is a need to increase the number as well as the variety of languages in which weather forecasts are publicised on both radio and television. In-depth knowledge of the manner of information packaging can aid weather forecast developers on how to package the information in order to maximise the application impact.

Radio talk show at Thobela FM, Limpopo Province.

National Invasive Alien Plant Survey

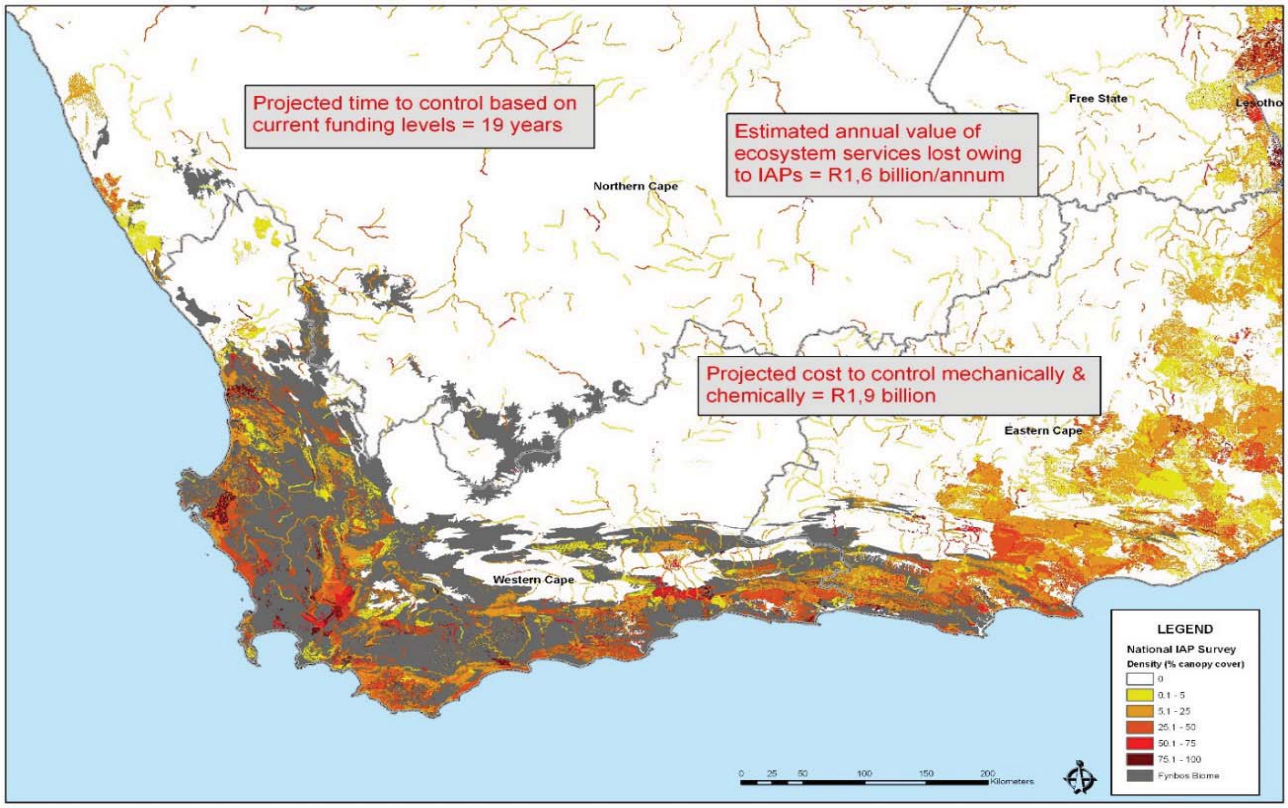
Alien plant invasions have a major impact on biodiversity, ecosystem services, agriculture, forestry, the economy and human welfare. These invasions are also recognised as having the largest impact on biodiversity after direct habitat destruction. Although the problems and threats associated with invasive alien plant (IAP) species and invasions have been widely researched, a shortcoming in the IAP field at a local and international level is accurate spatial distribution (range and abundance) data. Reliable IAP distribution data is required at a national and provincial level to assist with policy decisions and the strategic allocation of funding for their eradication and control. Decision makers and managers need objective IAP distribution data to determine clearing priorities and measure the outcomes of control efforts and implemented research and policy initiatives over time. The establishment and implementation of an objective and systematic IAP monitoring approach assists in establishing the spatial distribution of major IAP species and monitoring range and abundance changes over time due to natural occurrences or human induced actions. "You cannot manage what you cannot measure." This shortcoming of IAP range and abundance data has also been identified by the internationally recognised Working for Water Programme in South Africa, currently the largest poverty relief initiative by the South African government. Such an initiative requires objectively determined spatial distribution data of IAP species at the required scale to allow for effective planning, implementation and future monitoring of IAP spatial changes.

The National Invasive Alien Plant Survey (NIAPS) project was initiated by the Working for Water Programme to address the above-mentioned shortcoming and implemented by the ARC. The project's aim was to establish and implement a cost-effective, objective and statistically sound IAP monitoring system for South Africa at a quaternary catchment scale.

The traditional approach to such a project would be to conduct detailed field surveys of the geographic area of interest. However, the size of the study area (122 million hectares), wealth of biodiversity and the total range and abundance of alien plant invasions within this unique environment renders a detailed field survey or complete inventory impractical and unaffordable at the required scale. This can be attributed to (1) it not being economically viable, and (2) the time required for the enumeration of range and abundance of different IAP species would render the data outdated by the time it could be amassed, collated and summarised. The adopted innovative approach is the form of partial measurement or sampling that was applied in combination with a stratified study area (population) based on remote sensing. Careful measurement of a small percentage of the units in a population frequently gives more reliable information than rough estimates obtained from the entire population and therefore allows for better inferences about that population.

Different field survey approaches were simulated and the most suitable was an aerial approach using a combination of observations from fixed-wing aircraft and helicopters. An extensive field survey was conducted of the sample points. Field data is being analysed and extrapolated to produce the required IAP maps.

NIAPS project highlights include the spatial refinement of data from a 250 m resolution to 0.5 m due to access to affordable high resolution imagery, which allows for effective tree density determination. Data processing techniques have been developed for a distributed computing environment with "big data processing" capability. A number of statistical models and approaches have been established and calibrated that are also applicable to other datasets and applications such as bush thickening and rangeland degradation.



Example of an information product produced from IAP data that supports evidence-based decision making.

An observation of a sample point from a light aircraft used in the survey methodology.

Methodology for monitoring waterlogging and salt accumulation on irrigation schemes in South Africa

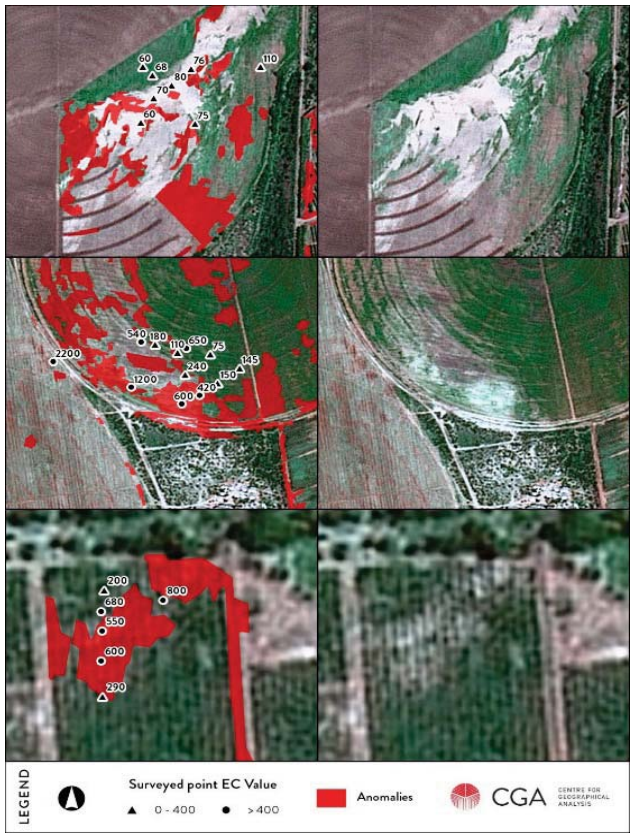
National monitoring of waterlogging and salt accumulation is a high priority since this leads to a decline in the productivity of irrigation farms and threatens the sustainability of food production. Until recently no verified methodology was available to undertake this task. However, the major capital investment in irrigated areas of South Africa will now be supported by a new technique developed by the ARC with Stellenbosch University. The technique not only produces accurate results but is also cost-effective as it can be applied on both vegetated and non-vegetated fields, requires no empirical data, makes use of freely-available Earth Observation imagery, and has the potential to be fully automated.

On request of the Water Research Commission (WRC), a methodological approach for identification, classification and monitoring of the extent and degree of waterlogging and salt accumulation at farm, irrigation scheme and national level was researched. Various data sources and methodologies for the identification of areas prone to salt accumulation and waterlogging were investigated. Both direct and indirect remote sensing approaches show promise as they can be applied to high resolution, multispectral satellite imagery. Statistical methods such as regression, partial least squares regression and multi-regression have been shown to be successful in a number of studies and should be investigated further.

The newly-developed within-field anomaly detection (WFAD) method is based on the principle that heterogeneous areas are in many cases indicative of waterlogging or salt accumulation. Affected areas often stand out as being spectrally different compared to the rest of a field, either because of a reduction in biomass due to salt or saturated conditions (in cultivated fields) or because of specific species of vegetation occurring in fallow fields. The WFAD technique was used to quantify the extent of affected areas on the nine largest irrigation schemes in the country. On average, 6.27% of the areas are considered to be salt-affected and waterlogged on South African irrigation schemes, which is much lower than the 15-20% originally estimated.

The project produced technology guidelines that will help to ensure sustainable utilisation of soil and water for irrigation in South Africa in the future.

Visual evidence of salt accumulation and waterlogging in the Sundays River irrigation scheme (Eastern Cape Province).



Anomalies detected with remote sensing that were confirmed to be related to flooding, waterlogging and/or salt accumulation.

Research focusing on Agricultural Mechanisation and Engineering

The programme promotes utilisation of modern tools, structures and equipment in the agricultural production system. It conducts research into agricultural mechanisation, irrigation and infrastructure technologies to increase the productivity and efficiency of agriculture. The aim of agricultural 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. Highlights of the work undertaken in this programme during 2015/16 include the following:

Surface and sub-surface drainage research

Comprehensive research on drainage in South Africa has been concluded and existing norms and standards have been revised, adjusted and updated. This was a targeted solicited externally funded project by the WRC to develop technical and financial standards and guidelines for assessment of the feasibility of surface and sub-surface drainage systems under South African conditions.

The project focused on acquiring, synthesising and transferring contemporary knowledge on drainage (surface and subsurface) in South Africa and the following were addressed:

- Review of internationally and nationally available norms and standards that provided an overview of current drainage systems, practices and technology.
- Evaluation of the interaction between irrigation, drainage practices and impact on the natural environment.
- Describing technical/physical/biological/financial requirements for drainage.
- Refining and developing of technical standards for drainage with reference to soil type, crops, irrigation method, water table, salinisation, water quality and management practices.
- Refining and developing of financial standards for drainage with reference to capital investment, financing methods, operation and maintenance expenditure and management practices.
- Evaluation of the technical and financial feasibility of drainage based on selected case studies.
- Developing guidelines for design, installation, operation and maintenance of drainage systems.

The project provided a fresh approach to design and costing of drainage systems (surface and sub-surface) that have a huge impact on the productivity of agricultural fields and the soil health.

Installation of a sub-surface drainage system in progress for improved soil health in Letsitele, Limpopo Province.

Water resource management services for provinces

In South Africa as a water scarce country, water resource management is of huge importance and ARC engineers have assisted a number of small-scale farmers with irrigation designs, complemented with specifications on either family drip systems or sprinkler systems, The aim is to assist them with the correct way of applying water to grow vegetables and to improve farmer productivity and food security in the local communities as well as for commercialising the production of the crops.

Experienced ARC engineers also provided a mentoring service to young engineers of provincial Departments of Agriculture as well as consulting firms. This mentoring service consisted of the evaluation of their irrigation system design and training and re-evaluating the irrigation design until it conformed with industry standards. The process has been a valuable tool to assist these young engineers to gain confidence and become more competent in the standard design principles that must be adhered to in the irrigation industry, to ensure that resources are used optimally.

Young engineers being mentored by an experienced ARC engineer (right).

Irrigation equipment evaluation

ARC-Agricultural Engineering is the only irrigation equipment testing facility in the SADC region and is well positioned to determine whether such equipment is suited for South African conditions to ensure optimal water use efficiency. It also protects the farming community from equipment that is not suitable for South African conditions. The demand on our already scarce water resources is increasing. The agricultural sector, which uses 60% of the country's water, must therefore take all possible steps to improve its water usage efficiency. Amongst the many ways to save water, efficient irrigation equipment and the correct use thereof is of utmost importance. To ensure functional efficiency and the ultimate success of irrigation systems, the equipment that is used in these systems must comply with certain performance standards.

Evaluation of irrigation equipment in the world class test laboratories of the ARC helps the designer to design an irrigation system that will enable the farmer to make optimal use of available water. ARC-Agricultural Engineering is an independent evaluation authority on the performance of irrigation equipment and systems. Both laboratory and field evaluations are carried out according to locally developed and internationally recognised standards and procedures.

The performance and quality of irrigation equipment such as sprinklers, drippers, micro-sprayers, filters and hydraulic valves are tested and evaluated. Reader friendly test reports enable the designer to make an optimal choice between various products.

Irrigation training for government officials and smallholder farmers

ARC-Agricultural Engineering has been involved in numerous training interventions during 2015/16 for clients including the Gauteng Department of Agriculture and Rural Development (GDARD) and the Limpopo Department of Agriculture (LDA). Different levels of training were conducted and courses and material were customised according to the target group's needs and their existing knowledge.

An intensive course on Maintenance and Evaluation of Irrigation Systems was presented to 14 officials from LDA in conjunction with the ARC's strategic partner, the South African Irrigation Institute (SABI). The course entailed lectures and hands-on practical sessions on both centre pivot and drip irrigation systems. Such a course is important since it helps to maintain and develop an appreciation for effective irrigation practices, which in turn leads to efficient use of energy and water.

The ARC combined with GDARD to train a total of 86 farmers in basic irrigation principles. The farmers were selected from Randfontein, Germiston and Pretoria surrounding areas to attend the training on Water Saving Irrigation Technologies. The training was divided into a lecture session in the morning, followed by practical demonstrations in the research field. The lectures outlined the availability of water resources in South Africa and the impact of irrigation on these resources was illustrated. During the practical sessions the practicalities of the family drip system were explained as well as the operation of the system. Further demonstrations revolved around micro-irrigation systems illustrating the need for such technology. Additional information dissemination included explaining the different irrigation systems which can be used when applying water to the land especially when energy and water resources are limited.

A total of 56 smallholder farmers were trained in the Operation, Installation and Maintenance of Irrigation Systems. They were required to complete practical work, learner workbooks and undergo a summative assessment to evaluate their competency. On completion of an intense 5-day course the farmers received an attendance certificate and returned home full of enthusiasm to implement what they had learnt in the classroom and the in-field practical sessions.

The training as described fulfils an important role in the ARC's primary mandate which includes:

- Promoting agriculture and related industries;
- Contributing to a better quality of life;
- Facilitating or ensuring natural resource conservation; and
- Alleviating poverty.

Small-scale farmers from Gauteng Province holding their certificates after completing training in the operation, installation and maintenance of irrigation systems.

Course participants listening attentively during an irrigation practical session.

Irrigation training beyond our borders for sustainable water use

The UNESCO-Institute for Water Education (UNESCO-IHE) based in the Netherlands presents different Masters degree programmes for prospective students on an annual basis. Each year, these programmes (which are subject to accreditation under Dutch law) are attended by hundreds of engineers, chemists, biologists, earth scientists and other professionals from all over the world and the graduates are awarded a Master of Science degree.

The mission of UNESCO-IHE is to contribute to the education and training of professionals and to build the capacity of sector organisations, knowledge centres and other institutions active in the fields of water, the environment and infrastructure, in developing countries and countries in transition. UNESCO-IHE is located in Delft, an internationally renowned centre of excellence in civil engineering and in water related sciences. They maintain intensive relations with national and international institutions to ensure a continuous exchange of knowledge and experience and to promote the sustainable use of water.

Sustainability is the ability to meet the needs of the present without compromising the ability of future generations to meet their own needs. Sustainable irrigation aims to develop ways of using scarce water resources most effectively to maximise food production while minimising the environmental impact of irrigation on the different land and water resources.

ARC-Agricultural Engineering lectured the module "Sprinkler and Drip Design" for sustainable irrigation to a group of 22 students who attended the Masters degree programme and came from 12 countries: Australia, Bangladesh, Benin, Eritrea, Ethiopia, Indonesia, Nigeria, Pakistan, Sudan, Tanzania, Zambia and Zimbabwe. Apart from the formal lectures they also undertook assignments to complete the module.

International UNESCO-IHE Masters degree students together with their ARC lecturer (standing extreme right).

AGRICULTURAL ECONOMICS & CAPACITY DEVELOPMENT

The Agricultural Economics and Capacity Development 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.

Building Capacity in the sector

A total of 10 551 smallholder farmers were trained in a variety of topics this year; including vegetable, grain and animal production. Specialised courses on seedling and hydroponic production, macadamia propagation, entrepreneurship, pest management, animal health care, mechanization, irrigation, meat and fruit processing, aquaculture, conservation agriculture, business planning and food safety were amongst courses offered. The ARC continues to improve the quality of its training programmes and ensures proper accreditation.

Extension training provides the ARC with a very valuable link to smallholder farmers and ensures sustainability of its capacity development initiatives. In strengthening extension capacity which eventually increases farmer performance, the ARC partnered Provincial Departments of Agriculture to train 1 839 extension Officer. Training modules ranged from statistical analysis, facilitation, mentorship, artificial insemination, gender awareness, entrepreneurship, extension principles, record keeping and project management.

Development and testing of extension models impacts positively on the adoption of ARC technologies and smallholder' success. Building capacity in extension inevitably benefits famers and activities undertaken aim at increasing productivity and timely information for decision support and risk mitigation.

Vegetable nursery and seed businesses development.

As part of the ARC's efforts to support smalholder farmers, a model vegetable seedling nursery was established at Shixini in the Eastern Cape. The model, which serves as a technology demonstration site makes use of basic equipment and material to build a nursery and storage for chemicals. The nursery stimulates development by providing reliable vegetable seedling and orange-fleshed sweet potato stock for the community and generates income through the seedling business.

As part of technology demonstration, the ARC partnered with Provincial Departments of Agriculture in Limpopo, KwaZulu-Natal and Eastern Cape, to establish dipping facilities, crush-pens and auction facilities. These demonstration sites are managed by farmers and public extension. So far, 13 dipping facilities, 2 crush-pens and 1 auction facility were built and during construction, 80 jobs were created. The auction facility in Ndawana, KZN has already facilitated the selling of 172 cattle and realisation of R1 117 400 income for local farmers.

A Collaborative Centre on Smallholder Farmer Development was set up this year which aims to stimulate smallholder participation in the economy through enhanced market opportunities and production efficiency. The partners, Universities of KwaZulu-Natal, Limpopo and Fort Hare and the ARC finalised project proposals and detailed planning on three thematic areas: food security; institutional support to smallholders; and technology transfer. So far, 36 MSc and 17 PhD students are working on the programme.

Establishing impact and supporting decision making

The Economic Analysis unit focuses on integrating agricultural economics into ARC programmes mainly through delivering reports and publications relating to market analyses and impact assessment in support of sound decision making. To improve monitoring and evaluation capacity, a Strategic Information Management (SIM) unit was also established this year to improve critical data management for analytical purposes, improving R&D impact measurement. All campuses were engaged and agreed on monitoring certain indicators.

Results of the national cultivar trials impact study, completed in 2015 and demonstrating high economic returns and results were presented to stakeholders, including seed companies. A study on the impact of the dry bean breeding programme from 1980 to 2014 was completed, indicating huge value to farmers and the country. Rate of return was estimated at ±9% annually, and benefits to dry bean farmers and consumers far outweighed programme costs. Other impact studies that progressed in 2015/16 included, evaluation of the ARC's citrus breeding programme; Plant Clinics initiative; Wheat cultivar evaluation; the Beef cattle recording and improvement scheme; as well as a combination vaccine development.

A Collaborative Centre on the Economics of Agricultural R&D was established with Universities of Pretoria, Limpopo and Fort Hare. Projects were conceptualised, a programme of action was collectively developed and research activities initiated, whilst 10 students will be supported in post-graduate studies.

Supporting SMME Development

Protection and commercialisation of intellectual property (IP) generated by the ARC's R&D is used to grow a competitive and sustainable sector. The Commercialisation unit facilitated ARC participation in the South African Breweries (SAB) Women-in Maize Programme, an initiative aimed at improving the livelihoods of rural women Agricultural cooperatives, run by women, producing a particular yellow maize for the SAB are being established and the ARC provides technical support to achieve the yields required. Extensive support to community based agricultural development programmes is facilitated and funding for this was sourced from Fruit & Veg City, the Masisizane fund, the SAB, DTI and others. Communities supported by these initiatives include the BaPhalane project; the uMzimkhulu Soybean initiative, an Eastern Cape Tunnel initiative; the Moengnyana Hydroponic Cooperative; and the Emsebenzini Omuhle Piggery. Two highlights among these efforts include the initiation of a Mega Agri Incubator at Clarkebury, in the Eastern Cape. Available but under-utilised land and an eager group of farmers prompted the ARC to lead this initiative which contributes to stimulating employment through SMME development. The incubator will deliver site-specific solutions, focusing on commercialisation by facilitating market access. The incubator will stimulate development beyond Clarkebury, towards greater eNgcobo, Mthatha and Dutywa. Similarly, an SMME Development Hub is being established at the IIC Campus in Rustenburg for local farmers to optimally utilise ARC resources. The local municipality is working with the ARC in reviving agriculture and the IIC Campus provides an ideal platform for collective innovation. The ARC will provide scientific services to stimulate economic growth and the unit is coordinating resources and interventions.

Transferring ARC Technologies through licensing

The transfer of technologies under licence is a key activity supporting the ARC technology transfer imperative. The value of the technology is protected while access is improved for the entire sector. This year, 27 technologies, mainly new cultivars were licensed, which ensures that ARC R&D is disseminated and used whilst providing royalty income that is reinvested into R&D. Proteaflora was granted licensing rights for 4 protea cultivars; Pannar Seeds was granted licensing rights for commercialising a fodder cultivar; whilst PGGW Seeds in New Zealand got the rights for 2 fodder lines. Magnus Kahl obtained global rights for an onion line; whilst Du Toit Vegetables got a licence for three onion lines. BASF (US) signed a global licence agreement for a biocontrol formulation; and Klein Karoo Seeds obtained rights for 12 wheat and oats cultivars. McCains obtained the rights for a potato line; Chr Hansen the rights for a wine isolate; and Nadorcott Protection Company the rights for two soft citrus cultivars.

Engaging our stakeholders and disseminating valuable information

Sharing information on ARC initiatives plays an important role in building capacity in the sector. Various platforms are utilised to respond to industry needs and create awareness about ARC services. These include famers field days and workshops and popular publications. In this manner knowledge developed by the ARC is provided to public and industry stakeholders. The organization hosted 479 information dissemination platforms including 71 farmers' field days, 37 farmers' workshops, and produced 368 popular publications during the year. An ARC YouTube Account featuring videos from across the spectrum of ARC R&D was successfully launched.

The ARC was well represented at the 2015 Agricultural Economists Association of South Africa (AEASA) conference. Staff presented 4 papers, contributed 2 book chapters, and won 2 awards. At the International Food and Agribusiness Management Association (IFAMA) conference in Minnesota in June, 4 papers were presented and 2 papers were presented at the Melbourne Business and Social Science Research Conference (MIBSRC) 2015 in Australia. Four of the unit's PDP students graduated with Masters degrees.

The Food and Agriculture Organisation (FAO) contracted the ARC to execute three consultancies this year. Crop Production and Conservation Agriculture policies were developed, and a scoping study of South-South Cooperation (SSC) in Agriculture and Food Security in South Africa undertaken. A multi-stakeholder policy evaluation process, entailing individual and group engagements as well as official workshops was facilitated. Stakeholders consulted included DAFF, organised agriculture, NGO and academics experts and farmers. SSC initiatives in Agriculture and Food Security were documented following a desk study, key informant interviews and a stakeholder workshop. The report profiled SSC initiatives in South Africa and suggested a roadmap to inform drafting of a SSC strategy for South Africa by DAFF.

Based on the Bio-economy strategy, DST contracted the ARC to investigate potential agri-innovation hubs, enabling stakeholders to combine forces in providing services to facilitate enterprise development. The report compiled by the SIM unit, includes a comparative analysis with the Agri-parks initiative and recommends where hubs can be optimally placed, what commodities they should explore and how to bring value chain stakeholders together.

Twelve issues of the newsletter ***Econ News*** were published on the intranet, receiving wide acclaim. The last Econ News of 2015 was the 46th edition since the inaugural edition in June 2012. The bi-annual economic outlook report was published twice, focusing on global and local economic development and agricultural subsectors. Trends in commodity markets are analysed, whilst economic projections and their impact on ARC business are considered.

The Agricultural Research Council was featured in 1 537 articles and interviews in various print, broadcast and online media this year, expanding the organisational footprint. 3 media campaigns which carried 34 ARC advertisements were undertaken, positioning the organisation in food and nutrition security and excellence in agricultural research. The ARC further showcased its expertise by participating at 54 exhibitions and trade fairs. Among these, were Grain SA's Nampo Expo, The Royal Agricultural Show, DST's Science Festival, Women in Agriculture, the Department of Education's Career Expo, the World Forestry Congress, Indigenous Knowledge System Expo, UNESCO African Engineering Week, World Food Day Celebrations and the Global Forum for Innovations in Agriculture. Through events such as ARC's National Beef Awards and the launch of a collaborative research project between SA and Australia, the ARC managed to utilise public platforms to engage stakeholders, including the media. Over 53 journalists were engaged to increase public awareness about ARC activities.

ARC Researcher, Rosemary du Preez engaging with a stakeholder during the Nampo Harvest Day Expo

ARC's Group Executive for Animal Sciences, Dr M. Andrew Magadlela addressing stakeholders during the ARC National Beef Awards

OVERVIEW AND HIGHLIGHTS OF HUMAN RESOURCES AND LEGAL SERVICES

Supporting the core business divisions, the Agricultural Research Council has several strategic functions, namely human resources; marketing and communications; finance; information technology and communication; facilities management; risk and planning; and internal audit, all organised under the Administration and Corporate Affairs division and led by different executives and managers. These groups operate from the Agricultural Research Council's main office in Pretoria and aim to achieve good governance, financial sustainability and a high performing and visible organisation.

The various units in this division operate mainly from the head office but have representatives in all other Agricultural Research Council locations. Achievements attained under the Administration and Corporate Affairs programme for the financial year 2014/15 are highlighted below:

Administration and Corporate Affairs Programme

Human Resource Division

During this reporting period the human resource division revised the HR strategy for the next 3 years. The revised HR strategy will allow ARC to create a workforce with a mix of talent having the skills and experience necessary to deliver on the strategy and mandate of the ARC.

Human Resources Development

The ARC creates and provides opportunities to develop capacity for the ARC, the agriculture, as well as science and technology sector. This programme was influenced by the scarcity of adequate qualified and skilled natural and animal scientists in the labour market. The programme is further intended to serve as pipeline development for succession planning within the ARC. All the student participants are engaged with postgraduate studies, which falls within the critical and scarce skills areas as identified by the organisation.

The table below reflects a summary of the current ARC PDP students per study programme, funded from the Industry, THRIP, the NRF and through the parliamentary grant.

ARC Professional Development Programme and Industry Postgraduate students (incl. Agricultural Engineering)

ARC PDP Program			
Study Program	**Male**	**Female**	**Total**
Post Doc	10	11	**21**
PhD	31	49	**80**
D Tech	0	4	**4**
MSc	38	92	**130**
M Tech	5	14	**19**
BSc Engineering	3	1	**4**
Total	**87**	**171**	**258**

Interns & Work Integrated Learners

The following list of internships and work integrated learning students are students hosted by ARC for training purposes and funded by external organisations within the industry. The following table gives a breakdown of the interns per gender and qualification:

Qualification	Male	Female	Total
MSc/ M Tech	0	2	**2**
BSc Hons	3	5	**8**
BSc	11	10	**21**
B Tech	0	2	**2**
N Diploma	1	5	**6**
Total	**15**	**24**	**39**

Staff Development

Formal Training

The ARC has **281** permanent staff members who are engaging in formal studies. The training numbers of employees studying for formal training has increased by 44% from the 155 in the previous financial year. The Table below gives an indication of the number of permanent staff members per study programme:

Study Program	Male	Female	Total
PhD	53	62	**115**
MSc	26	28	**54**
BSc Hons	7	7	**14**
BSc	1	3	**4**
D Tech	1	1	**2**
M Tech	5	6	**11**
B Tech	8	17	**25**
NDipl	9	3	**12**
MBA/MBL/MPHIL/Mcom	4	2	**6**
N Dipl Public Relations	1	4	**5**
B Degree	5	3	**8**
Prof Certificate	10	15	**25**
Total	**130**	**151**	**281**

Informal training

The table below gives an indication of the number of staff who enrolled for informal training courses during 2015/16 per quarter.

Quarter	Male	Female	Total
Q1	88	128	**216**
Q2	34	63	**97**
Q3	181	212	**393**
Q4	91	75	**166**
Total	**394**	**478**	**872**

Qualifications

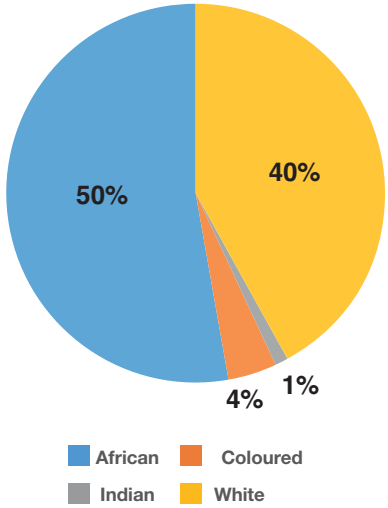
The following table outlines the qualification profile of ARC employees

Staff qualifications	2016/03/31	% of Permanent employees (2369)	% of Research staff (800)
Research staff and salaried students with PhD degrees (excluding Executives & Senior Managers: Research and Professional Veterinarians & Engineers)	222	9%	27%
Research staff and salaried students with Masters degrees (excluding Executives & Senior Managers: Research and Veterinarians & Engineers)	222	9%	27%
Professional Veterinarians & Engineers	20	0.84%	2.50%

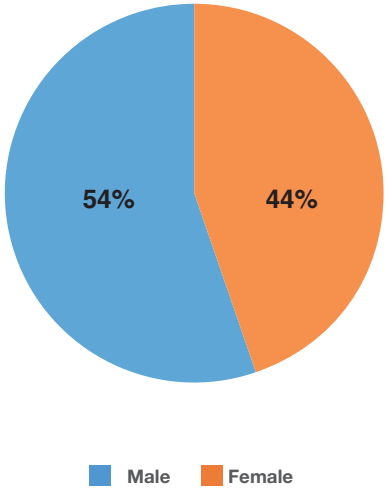
Equity Profile and HR Patterns

The ARC scientific capacity contributes 96% of the total demographics of the organization of which 54% is research core staff and 42% is other research support staff which includes research technicians and research assistants. Currently the ARC has 76.02% black employees and 41.03% female employees and 11% is non-designated employees from the permanent employee's pool, however it should be noted that 10% of our non-designated group is occupied by white males and 1% by non-south African employees. The challenge is the staff turnover of our black and female employees, which has a huge impact on the ARC employment equity figures.

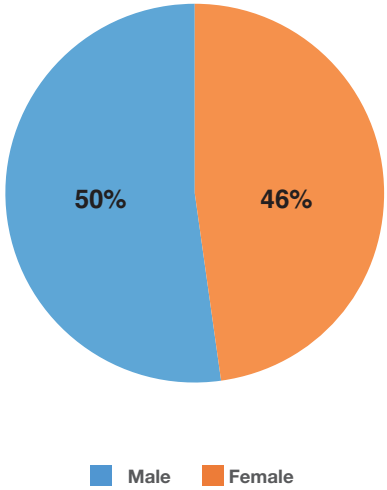
ARC Employment Equity Scientific Capacity per race



ARC Employment Equity Capacity per gender



ARC Employment Equity Scientific Capacity per gender



Appointments

For the period 1 April 2015 to 31 March 2016, the ARC appointed 91 permanent employees. During the 2015/16 financial year, 47.25% (43) of our total appointments were from the Research Core Business category of the ARC, which included Research Technicians. From the total number of permanent appointments, 90% were African and 10% were Indian.

Terminations

During the period, 1 April 2015 to 31 March 2016, 191 permanent employees exited the ARC. 50.7% of these exits were from the Core Business categories of the ARC. 23% were due to retirement and early retirement. 37% were due to voluntary resignation.

The staff turnover rate for 2015/16 is 3.48%. There is a slight decrease in the 2015/16 turnover rate as the rate for 2014/15 was 3.83%. The turnover rate for Researchers for 2015/16 is 4.95 and 5.97% for Research Technicians.

For the 2015/16 financial year, 20 PhD and 20 MSc degree holders exited the ARC.

Termination Reason Per Qualification: 01/04/2015 - 31/03/2016						
Termination reason	**PhD/ DSc**	**M-de-gree**	**Other degree**	**Diploma**	**Non degree**	**Total**
Death	1		2		11	**14**
Dismissal / Misconduct				2	8	**10**
Normal Retirement (Age 65)	4	3	1	1	21	**30**
Early Retirement		1	3	3	8	**15**
Medical unfit retirement			1	1	3	**5**
End of Contract	2	6	22	7	5	**42**
Voluntary resignations						
Better Salary and Service Conditions	4	6	12	7	5	**34**
Unpleasant Working Conditions / Personal problems	1		2		3	**6**
Management Practices	1		1	1		**3**
Moving / Emigration	5		1			**6**
Pursue different career / Own business	1	2	3	2	4	**12**
No specific reason provided	1	1	3		2	**7**
Limited career Opportunity / Organisational culture		1	1	1	1	**4**
Nature of work						**0**
Studies						**0**
Abscondment					1	**1**
Medical Reasons					1	**1**
Personal Grievance			1			**1**
Total number of Voluntary resignations	**13**	**10**	**23**	**11**	**15**	**72**
Total resignations	**20**	**20**	**53**	**25**	**73**	**191**

Union membership

The ARC remains highly unionized with 2014 employees out of a total of 2369 permanent employees belonging to the unions.

Union	Membership	% of permanent workforce (2369)
NEHAWU	1412	59.60%
Solidarity	602	25.41%
Sub total	**2014**	**85.01%**
Non-Unionised employees	**355**	**14.99%**

Employee Relations

The labour relations environment has been stable. On the collective side of matters, this can be witnessed by the fact that there has not been a dispute referral to any external body on matters of mutual interest between management and Organised Labour. The relationship with Organised Labour has been a cooperative one and a number of policies were agreed and signed as collective agreements. Management also received support from Organised Labour for a Ministerial Determination extending overtime in certain areas of the ARC business.

The table below contains a summary of labour relations activities for the quarter.

Case type	Year to date
Disciplinary actions	
Number of cases handled	27
Number of cases concluded	17
Number of cases not concluded	10
Acquittals	0
Warnings	11
Dismissals	6
Grievances	
Number of cases handled	9
Number of cases finalized	7
Number of cases not finalized	2
CCMA disputes	
Number of Conciliations	28
Number of Arbitrations	15
CCMA Disputes concluded	15
On review by Labour Court	4

ARC Retirement Funds

The ARC has 2 retirement funds, namely the Agricultural Research Council Pension Fund (ARCPF) and the NEHAWU National Provident Fund (NNPF) as participating employer in this umbrella scheme. Membership to the two funds is as follows:

ARCPF	NNPF	Employees with no pension fund membership
1302	855	212

In terms of the ARC policy, all employees appointed on a permanent basis, are compelled to obtain membership to one of the ARC Retirement Funds. However, employees who are appointed on a fixed term contract basis, are not compelled to join a fund. From the 212 employees who are not members of the ARC Retirement Funds, 51 employees are appointed on a contract basis. The rest of the permanently appointed employees decided not to join one of the ARC retirement funds, but submitted evidence of other retirement funds they belong to.

78 of the employees who did not obtain membership from one of the ARC retirement funds, are those contracted Research Support Assistants and Farm Assistants, who are absorbed permanently by the ARC as per collective agreement between the ARC and Organised Labour.

Recognition and Awards

- Ms. Lené Pienaar received Bronze medal for the year 2015 by the South African Society of Animal Science (SASAS) in acknowledgement of an exceptional contribution to the advancement of professionalism and knowledge in animal science 21-23 September 2015 Empangeni Kwa-Zulu Natal.
- Ms. Motshabi Mokolobate received Bronze medal for the year 2015 by the South African Society of Animal Science (SASAS) in acknowledgement of an exceptional contribution to the advancement of professionalism and knowledge in animal science 21-23 September 2015 Empangeni Kwa-Zulu Natal.
- Dr Cuthbert Banga received David Uys prize for the best publication in the South African Journal of Animal Science 21-23 September 2015 Empangeni Kwa-Zulu Natal.
- Mr Graham Buchanan received President's Award of the South African Society of Animal Science for exceptional contribution to animal science and the livestock industry on 21-23 September 2015, Empangeni Kwa-Zulu Natal
- Prof Giel Scholtz Re-elected as the President of SASAS 21-23 September 2015, Empangeni Kwa-Zulu Natal,
- ARC at Scifest Africa – won Best Exhibition Award 02 - 08 March 2016 Grahamstown, Eastern Cape.
- Mr Reinders, as chair of the Permanent Committee on Technical Activities of the International Commission on Irrigation and Drainage was appointed as a member of the International Technical Advisory Committee on the 2nd World Irrigation Forum that will be hosted in 2016 in Thailand.
- Ms Adri Nieuwenhuys successfully completed a Modular course in Table grape cultivation and was awarded a certificate for "Best student in the Modular Course in Table grape cultivation. This course was also completed successfully by 2 employees from the Table grape Division namely, Wilfred Dahli and Celestine Roberts.
- Felix Reinders was recently awarded the double honours of the SAIAE (South African Institute of Agricultural Engineers) by receiving a Gold Medal and Honorary Membership. The citation for his Gold Medal said: "Felix is very well known locally and worldwide as a specialist in irrigation engineering. Mr Reinders lectures, delivers papers and training courses in South Africa and abroad. His talents are also in demand to lead investigations and render assistance in planning and development of projects in irrigation and related fields. He is a past President of both SAIAE and SABI and he is also past chairman of SANCID and is Honorary Vice-President of ICID. "Felix's continued involvement in these organisations earned his acclaim and recognition as a specialist in irrigation engineering, extends to international level.
- Dr Isaiah Wakindiki has been appointed Professor Extraordinaire in the College of Agriculture and Environmental Science, School of Agriculture and Life Science, Department of Agriculture and Animal Health at UNISA for a period of 3 years from 1 November 2015 to 31 October 2018.
- A poster by Mr Manyako et al, on: "Investigating potential use of Grey-water Irrigation in peri-urban agriculture in Gauteng province, South Africa" that was prepared and presented at the 2015 Annual GDARD Symposium, won an award as the best poster at the Symposium.
- Dr Piet Nell was presented with a Silver Medal for Excellent Service to the Irrigation Industry by the South African Irrigation Institute at its SABI Congress 2015.
- Willemse S. 2015 Best Poster. 33rd Annual Congress of the South African Society for Agricultural Technologists. 8-11 September 2015. Hoedspruit.
- Human C.F. 2015. Best Paper. 33rd Annual Congress of the South African Society for Agricultural Technologists. 8-11 September 2015. Hoedspruit.
- Fellowship of the Southern African Plant Pathology (SASPP) was awarded to Dr Sandra Lamprecht.
- Chantelle Jansen, a PDP student at the Nematology Unit of Biosystematics Division, won an award for the best presentation at the 6th Diamond Route Conference held in Johannesburg, 20-21 October 2015.
- Dr Robert Nofemela and Dr Angela Bownes.received NRF scientific Y2 ratings awards.
- Mr E van der Walt, Mr P van Niekerk, Mr E Sgudhla, and Mr J Mooka received their Agriseta accreditation for "Application of Crop Protection Chemicals".
- Dr E Hajari has been awarded best poster prize in Horticultural Sciences for her poster presented at the Combined Congress in January 2016 with her poster entitled: "Relationship between morphological and molecular characterisation of macadamia cultivars in South Africa".

- Dr Jacobus Botha and Dr Kobus Anderson shared the SSSSA silver medal for Best Poster for their respective poster presentations entitled “In-field Rainwater Harvesting: Key to Smallholder Productivity” and “Evaluation of Sunflower, Soybeans and Maize Crop Rotation with Mono-cropping” at the Combined Congress in January 2016.
- When Grain SA celebrated the successes of its Farmer Development Programme during its annual “Day of Celebration” function held on 1 October 2015 in Bloemfontein. Mr Du Toit’s passion was noticed at this year’s Day of Celebration and was awarded a certificate of recognition for being a partner in its Farmer Development Programme. The certificate is a gesture by Grain SA to acknowledge his dedication to purposefully create mechanisms of collaboration between its successful development programme and related Institutions.
- The ARC Cultivar Development Technical & Research Team received Technical Support Excellence – at the ARC Employee Excellent Awards, Pretoria.
- Prof Elizabeth Joubert received Career Recognition Award at the ARC Employee Excellence Awards, Pretoria
- Dr Daleen De Beer received an Outstanding Contributions by an Individual Award at the ARC Employee Excellence Awards, Pretoria
- Ms Rendani Mutepe; First prize for the BEST PhD Oral Presentation Award at the ARC Excellence Awards, Pretoria.
- Ms Tracey Jooste; Third Prize for the BEST Oral Presentation Award at the ARC Excellence Awards, Pretoria.

INFORMATION COMMUNICATION TECHNOLOGY AND INFRASTRUCTURE

Background

The ICT & Infrastructure Annual Report provides an overview of the work performed during the 2015-2016 Financial Year against a set of performance indicators primarily directed towards the continued delivery of the ICT Strategy as well as the continued implementation of the asset management plan, as the key delivery areas for the division.

Information Communication Technology (ICT)

While 2015/16 was characterised by a lot of activities and initiatives in the ICT environment, the following represent key highlights and achievements during the period:

ICT Governance

The alignment of the Corporate Governance of ICT Policy Framework with the DPSA governance framework is complete and ICT Governance is now in normal operational mode. The continuous drive to improve operational efficiencies while achieving compliance also remained a focus area during the reporting period.

Enterprise Resource Planning (ERP) Solution

It has been over a year since the new ERP solution went live. The ARC has operated strictly on the new system for a full Financial Year. This has provided insights into areas of the solution requiring improvements. Continuous improvements in the functioning of the system have been made during the year; this process, as with end-user training, is set to continue as we seek to optimise system performance, improve functionality and assist users of the system to improve usage and proficiency. A support contract (Service Level Agreement) is retained going into the next Financial Year to ensure continuity.

Knowledge and Collaboration platforms

A number of initiatives were implemented towards the development of knowledge management and collaboration platforms. These include the following:

- a drawings and maps archive and a contract management workspace for Legal Services;
- finalisation of the Information Hub to facilitate information dissemination;
- digitisation of historical data sources, specifically the national collection of arachnids and cultivar databases, specifically stone fruits, pome fruits and grapes;
- implementation and activation of collaboration/ communication platforms (portals), namely Microsoft Lync, Contract and Compliance Portal, ARC Board Portal and various other portals to facilitate document sharing among other collaboration activities;
- development and activation of the INTERGIS Mobile Application; and
- implementation of the new web-based Employee Self Service with improved interactive functionality.

These initiatives are targeted towards achieving improving collaboration, knowledge preservation and sharing, as well as optimising the use of information resources within the organisation.

Network Switch upgrade

The implementation of new systems, particularly an ERP system, brings with it the twin challenges of security and performance. This has been the case with the new ERP system implemented in the prior Financial Year, thus necessitating upgrades to the corporate network. The network upgrade focused on selected and prioritised ARC campuses and also enabled the parallel upgrades to our wireless connectivity as well as new footprint for wireless connectivity in areas where this was not in place before.

INTERGIS Goes Mobile

An INTERGIS mobile application was developed for ARC Beef Test Centres to capture data in real-time on the Intergis (The National Animal Database) as they measure the various animal traits when doing central performance tests. As exciting as this new mobile application for capturing beef test data is, the bigger picture is that we now have a mobile platform for the Intergis on which we can develop many other mobile applications.

Research and Development Databases

The migration of Research & Development databases is ongoing with the Arachnida and some Cultivar databases having gone live on a new platform. The Stone and Pome Fruits cultivars went live during the year under review, and more cultivars are to be included in the coming period.

Desktop equipment refresh

Having completed the previous three (3) year desktop equipment rental cycle, a new rental cycle was initiated towards the end of the Financial Year. The new end-user equipment rollout project commenced to replace old equipment.

Roodeplaat Multipurpose Training Centre

As part of the construction of the Multipurpose Training Centre at Roodeplaat, ICT has completed the installation of the network infrastructure, inclusive of wireless connectivity and audio/video as requirements for the utilisation of the centre.

Infrastructure and Security Services

The Corporate Asset Management Plan has continued to provide primary focus for Infrastructure Services, among other topical issues such as increased costs of maintenance of infrastructure, construction of new facilities as well as upgrades to others. All in all, 2015/16 was a very busy period for Infrastructure services while Security also had its fair share of challenges to contend with.

The following is an overview of key work activities performed during the 2015/16 Financial Year, under the Infrastructure division and underpinned by the Corporate Asset Management Plan:

Asset Management Plan

A number of business cases contributing towards the implementation of the plan were developed and presented for approval during the year. The key proposals were particularly focused on disposal of non-strategic assets, that is, those that do not, and will not in future contribute towards Research and Development objectives, namely:

- disposal of staff houses, a school and crèche in Bohlokong Township in Bethlehem; and
- disposal of residential houses in the Nelspruit Central Business District (CBD).

The disposal envisaged in both cases is intended to yield some financial benefit based on competitive bidding processes, particularly in the latter case of residential houses.

Other initiatives were particularly focused on rental income generation, and to this end a number of rental opportunities were explored and approved for implementation, namely:

- leasing of space for installation of communications towers at two campuses, with the benefit of both rental income as well as improved mobile communications for ARC employees and visitors alike, the latter benefit coming in handy as communications signal coverage remains a problem at some of the ARC campuses; and
- signing up a long-term tenant at Umthiza Experimental Research Farm, following on the successful reclamation project that concluded at the end of the 2014/15 Financial Year. The key tenant is a privately owned and run agricultural training college.

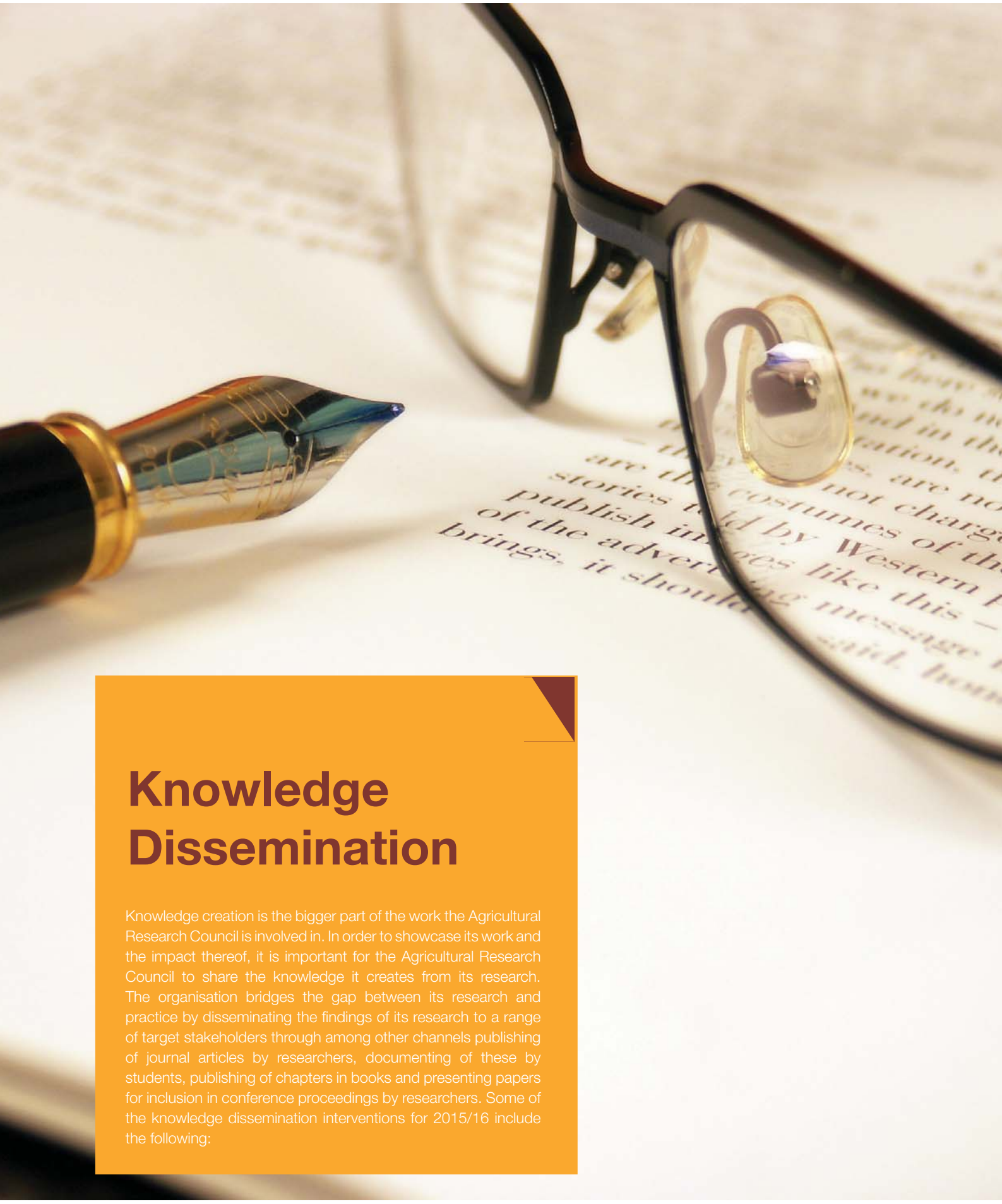
Perhaps the significance of the lease agreement with the entity is the agreed upgrade and refurbishment of the remainder of the buildings which the entity requires for training needs and student accommodation, an initiative that restores the site to full operation and recovery of asset values which were eroded by lack of use and vandalism. It is envisaged that some research and agricultural training activities under the ARC will commence in due course, in order to improve its presence in the Eastern Cape.

One of the driving objectives with regard to Umthiza is to ensure that the site can sustain itself financially, in addition to providing research capabilities.

Construction Projects

The Infrastructure division oversaw various construction projects during the reporting period, key amongst which were:

- the Multi-purpose training facility project at the Vegetable & Ornamental Plants Campus in Roodeplaat, involving the construction of a training facility as an extension to the existing main office building, in collaboration with, and funding support by the Department of Rural Development and Land Reform (DRDLR);
- Central Office security upgrade, which involved the remodelling of the entrance and exit points to the site, installation of Closed Circuit Television (CCTV) cameras, construction of guard houses at the entrance and exit points and a control room. This is part of an initiative to improve minimum Security measures at ARC campuses;
- upgrade to the Genebank at the Vegetable and Ornamental Plants Campus in Roodeplaat, aimed at alleviating pressure on some of the ageing infrastructure;
- office space upgrade at the Animal Production Campus in Irene, through conversion of old, unused laboratories to increase office accommodation for ARC employees. This process created capacity to accommodate over 40 people;
- security upgrades at the Animal Health and Biotechnology Campus at Onderstepoort, comprising of access control and CCTV cameras to improve surveillance in and around key sections of the campus;
- conversion of the Guest House at Central Office into office accommodation to alleviate capacity pressure in the main building, as well as minimising Occupational Health and Safety compliance challenges brought about by over-population of limited space; and
- the official opening of the new Quarantine Facility at the Plant Protection Research (PPR) Campus in Roodeplaat by the Honourable Minister of Agriculture Forestry and Fisheries, Mr Senzeni Zokwana. This project was particularly key in driving campus consolidation in that the current PPR staff located at Rietondale will be relocated to the PPR main Campus at Roodeplaat.



Knowledge Dissemination

Knowledge creation is the bigger part of the work the Agricultural Research Council is involved in. In order to showcase its work and the impact thereof, it is important for the Agricultural Research Council 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 researchers. Some of the knowledge dissemination interventions for 2015/16 include the following:

KNOWLEDGE DISSEMINATION

Journal Articles

Abraha, A.B., Truter, W.F., Annandale, J.G. & **Fessehazion, M.K.** 2015. Forage yield and quality response of annual ryegrass (Lolium multiflorum) to different water and nitrogen levels. African Journal of Range & Forage Science 32: 125-131.

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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 provisions 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)

Prof M Kahn Deputy – (Chairperson- appointed, effective from April 2015)

Dr W Jansen van Rijssen

Dr J Chitja

Prof F Swanepoel

Ms D Msomi (Resigned as of October 2015)

Mr M Dyasi

Prof L Hoffman

Mr G Martin

Mr R Nicholls

Ms J Mashiteng

Ms D Ndaba

Mr C Kneale

Mr A Bishop

Mr I Motala

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.

The Council is responsible inter alia for approval of the prepared Annual Financial Statements that accurately reflect the ARC's financial position and results at the end of the financial year, which is set at 31 March each year. The Office of the Auditor-General is responsible for auditing the Annual Financial Statements of the ARC.

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 judgments 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 21 of the notes to the Annual Financial Statements.

Board Members' Interests in Contracts

None of the Board members are involved in / have any interest in 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 Frame

In accordance with the PFMA and Treasury Regulation 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 the six (6) Council meetings scheduled:

Council member No. of meetings attended

Prof S Vil-Nkomo – Chairperson, wef 1September 2015	6
Prof M Kahn – Deputy Chairperson, wef April 2015	6
Dr W Jansen van Rijssen	5
Dr J Chitja	5
Prof F Swanepoel	5
Ms D Msomi	0 (Resigned October 2015)
Mr M Dyasi	4
Prof L Hoffman	5
Mr G Martin	5
Mr R Nicholls	5
Ms J Mashiteng	6
Ms D Ndaba	6
Mr C Kneale	6
Mr A Bishop	6
Mr I Motala	5
Dr SR Moephuli (President and CEO)	5

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 policymaking and control while the ARC President 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 operate as at 31 March 2015 together with their respective terms of reference in the form of Committee Charters:

Executive Committee

During the year under review one Executive Committee meeting was held.

Council member	No. of meetings attended
Dr SR Moephuli (CEO)	4
Prof S Vil-Nkomo - Chairperson	5
Ms D Msomi (Resigned)	0
Prof M Kahn - Deputy Chair	4
Ms J Mashiteng	4
Prof F Swanepoel	2

Human Resources & Remunerations Committee (Five (5) meetings held)

Council member	No. of meetings attended
Prof F Swanepoel (Chairperson) /no longer chair	3
Mr M Dyasi	3
Mr G Martin (Chair)	5
Ms D Ndaba	4
Mr C Kneale (Alternate)	3

Research, Development & Evaluation Committee (Five (5) meetings held)

Council member	No. of meetings attended
Prof M Kahn (Chairperson)/ no longer chair	3
Dr J Chitja	3
Dr W Jansen van Rijssen	5
Prof L Hoffman	4
Prof F Swanepoel (Chair)	2

Finance & Investment Committee (four (4) meetings held)

Council member	No. of meetings scheduled
Ms D Msomi (Chairperson) (Resigned in October 2015)	0
Mr I Motala	4
Ms J Mashiteng (Chair)	4
Mr C Kneale	5
Mr M Dyasi (Alternate)	1

Audit & Risk Committee

The Audit & Risk Committee comprised of five independent members and three members of Council. A specialist independent member chairs the Audit Committee.

The independent members are:

Mr V Naicker (Chairperson)

Mr L Mangquku

Mr H McBain

Ms J Bruinders

Ms K Mokoena

The Council members on the Audit & Risk Committee as at 31 March 2015 are:

Mr A Bishop

Mr R Nicholls.

During the year under review the following Audit & Risk Committee members attended six (6) scheduled meetings:

Mr V Naicker (Chairperson, reappointed)	6
Mr L Mangquku (Deputy Chairperson)	5
Mr H McBain	5
Ms J Bruinders	6
Ms K Mokoena	5
Mr A Bishop	5 (Board member)
Mr R Nicholls	4 (Board member)

Roles of Governance Committees

The ARC's Council Committees are charged with certain functions and operate within clearly defined terms of reference and continue to assist the Council's governance function on the following principles:

Ethical standards

In terms of its Code of Conduct, the ARC states its core values as: "The ARC is an organisation of **integrity**, which manages resources in a **responsible** and **accountable** manner through harnessing the **creativity** of its personnel to achieve excellence in its field of expertise."

The ARC has embarked on implementing its Code of Conduct across the organization, in a manner that would result in ethical standards being embedded in the culture of the ARC.

Internal control systems

To enable the ARC to meet its responsibility to provide reliable financial information, the ARC maintains accounting systems and practices adequately supported by a system of internal controls. These controls are designed to provide reasonable assurance that transactions are concluded in accordance with management authority and that the assets are adequately safeguarded.

The Internal Audit Function monitors the effectiveness and efficiency of the internal control systems, report their findings and make recommendations to management and the Audit Committee of the Council and monitor whether corrective action has been taken. These controls focus on critical risk areas in line with the principles of the cost of control versus the benefit thereof.

Stakeholders

The ARC has introduced structures of corporate governance on different strategic levels to manage the interface with its various stakeholders.

Employees

The ARC has a variety of structures for employee participation in respect of issues that affect them directly. These structures were established to ensure the disclosure of relevant information, consultation and negotiations on issues of mutual interest as referred to in the relevant Labour Legislation. A significant percentage of ARC employees are Unionized.

Environment, health and safety

The ARC strives toward compliance to all environmental, health and safety legislation in its activities. The majority of the activities of the ARC do not pose a significant threat to the environment. The ARC also has a corporate policy to address all environmental risks as a component of its risk management system.

Risk Management

Risk Management is one of the general responsibilities of the ARC Council as Accounting Authority and one of the main functions of the Executive Management Committee (EMC).

Council approved an updated Risk Management Strategy for implementation by Management.

Risk management in the ARC is an ongoing process and is focused on identifying, assessing, managing and monitoring all known forms of significant risk across all business units. This has been in place for the year under review and up to the date of approval of the annual report and financial statements. ARC systems have been put in place to review aspects of economy, efficiency and effectiveness. Management is involved in a continuous process of improving procedures to ensure effective mechanisms for identifying and monitoring risks, such as skills, technology, contracting, HIV/AIDS, reputation, Parliamentary Grant, legislative compliance, professional liability and general operating risks. Equal consideration is given to matters of safety, health and the environment as to the more obvious risks, such as financial risks.

There is a documented and tested process in place, which will allow the ARC to continue its critical business process in the event of a disastrous incident impacting on its activities.

Strategic Direction

The ARC Council approved a new Strategic direction for the ARC. The Strategic Direction took into account the Strategic objectives of the ARC, which have been adapted and refined in accordance with Government Policy as well as emerging local and international trends.

AUDIT AND RISK COMMITTEE REPORT

Report of the Audit Committee

We are pleased to present our report for the financial year ended 31 March 2016.

Audit Committee and Attendance

The function of the Audit and Risk Committee (Committee) of the Agricultural Research Council (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 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 2016 comprised of 5 (five) independent external members and two members of Council and their attendance is reflected in the table below.

Attendance at meeting

Name of Member:	10/02/15	18/05/15	28/07/15^{SP}	12/08/15	10/11/15	12/02/16
Mr VK. Naicker	√	√	√	√	√	√
Mr H McBain	√	√	√	√	√	√
Mr L Mangquku	√	√	√	√	X	√
Ms. J Bruinders	√	√	√	√	√	√
Ms. P Mokoena	√	X	√	√	√	√
Mr. A Bishop(ARC Council)	√	√	X	√	√	√
Mr. R Nicholls (ARC Council)	√	√	√	√	√	√

**SP refers to Special Meeting*

The CEO, CFO, Internal Audit Manager and the Chief Risk Officer have a standing invitation to attend the meetings of the Committee. For the year under review the Committee met five times to discharge its mandate outlined in its charter. These meetings were well attended by Committee members. The Auditor General and Internal Audit Service Providers are invited to attend all the meetings of the Committee. The ARC Company Secretary acts as secretary of the Committee.

The Committee hereby also, confirms that Members of the Audit 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. A number of 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 Committee confirms that it has complied with its responsibilities arising from section 38(1)(a) of the PFMA and Treasury Regulation 3.1.13. including the adoption of formal terms of reference as its Audit 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;
- Where relevant, the independence and objectivity of external auditors.

The effectiveness of internal control and Information and Communication Technology (ICT) Governance

In line with the PFMA and the recommendations from King III 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. There were improvements made in a number of areas with further improvements identified in human resource management with the implementation of policies and procedures. The ARC also improved its ability to implement Auditor-General and Internal Audit findings raised in previous years.

Per management commitment made in the previous financial year majority of the internal control weaknesses identified in the newly implemented ERP system were effectively implemented and the Committee is pleased with the progress made to date.

The Audit Committee also reviewed the progress with respect to the ICT Governance in line with the ICT Framework issued 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 has identified security protocols, disaster recovery and certain ICT internal controls that requires improvement and these will be top of the list for oversight in the coming financial year.

In conclusion the audit committee notes an improvement in the controls environment compared to last year however the auditor general has requested 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 an in sourced chief audit executive, who is assisted by an independent service provider acting as the internal auditors.

The Audit Committee was satisfied that the Internal Audit plan fairly represented assurance required in managing the risk profile and control environment of the of the Entity and identified a number risk-based, mandatory, performance, computer and follow-up audits to be performed during the year.

The Audit Committee has noted considerable improvement in the communication between the Executive Management, the AGSA and the Internal Audit Function, which has strengthened the assurance initiatives within the Entity.

Risk Management

The Audit Committee is satisfied that the risk management is at an advanced level within the organization 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.

Forensic Investigations

Investigations into alleged financial irregularities, financial misconduct and fraud were completed during the year under review. Various measures were recommended, including taking action against the identified officials and this was in the process of finalization. The recommendations are at various stages of implementation. The are no outstanding matters of significant nature which require to be requested here.

Evaluation of Annual Financial Statements

The Audit 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 accepts that there is further room for improvement in the accounting function and elements of the internal control environment. As in 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 on-going status of the ARC as this is highly dependent on the extent of support from Government and the extent of the Parliamentary Grant. The Committee considers that the statement relating to the on-going status of the organization contained in the Annual Financial Statements remains appropriate.

The Audit 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 most important factor impacting past and future performance is the under-funding

of the organization. Such continuous under funding places a considerable strain on the financial resources of the ARC, which in turn places at risk the ARC's ability to fulfill its mandates.

The monitoring of the organization'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 Committee has met with the Accounting Authority for the Council to address unresolved issues.

Each meeting of the committee is requested at council as an agenda item.

Auditor-General of South Africa

The Audit Committee has met with the AGSA to ensure that there are no unresolved issues.

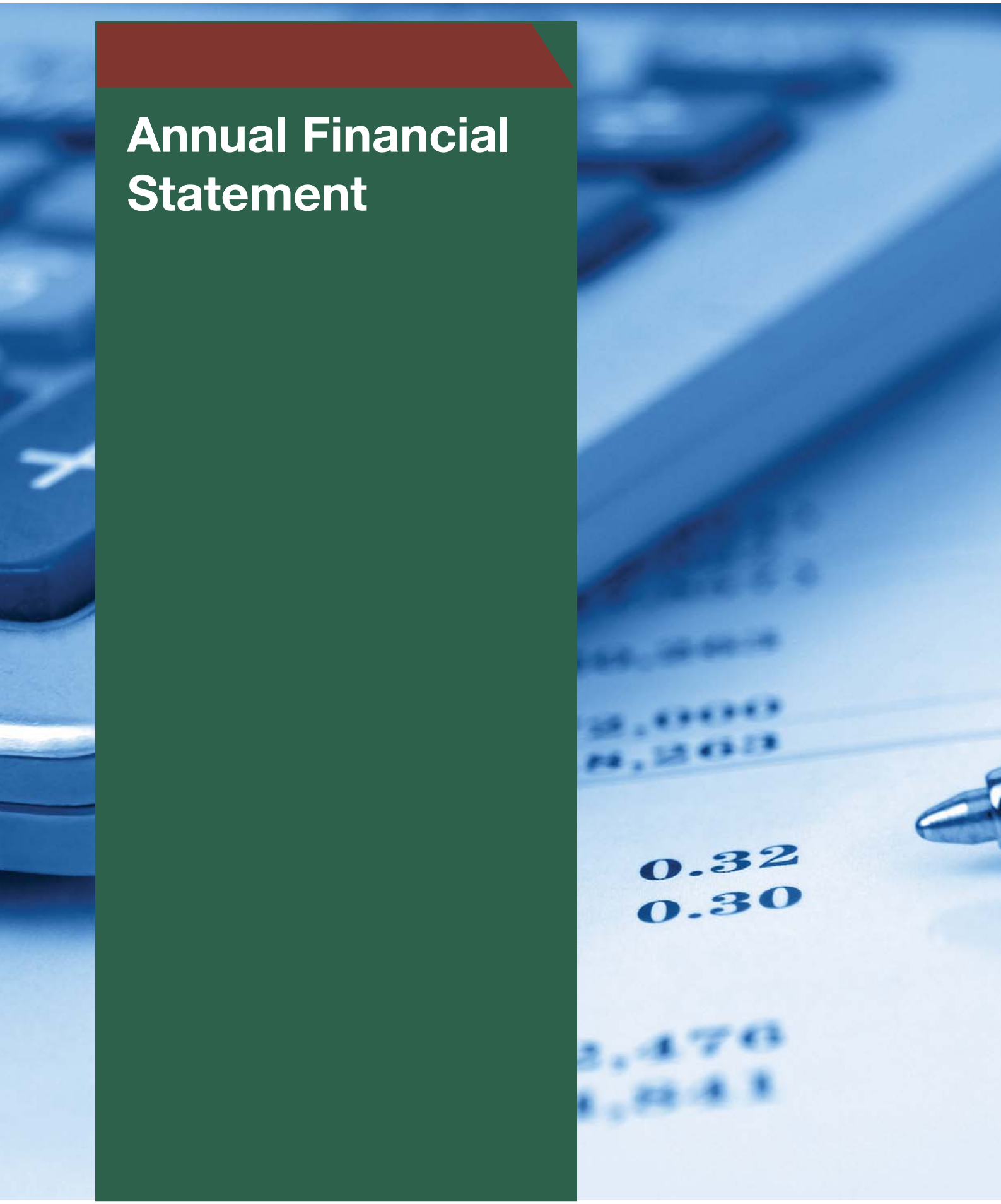
In Conclusion

The Committee congratulates Management on achieving an unqualified audit and wishes to express to the Council, CEO and staff of the ARC, its sincere appreciation for the commitment shown during the year. 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 March 2016



Annual Financial Statement

REPORT OF THE AUDITOR-GENERAL

Report of the Auditor-General to Parliament on the Agricultural Research Council

Report on the financial statements

Introduction

1. I have audited the financial statements of the Agricultural Research Council set out on pages 108 to 151, which comprise the statement of financial position as at 31 March 2016, the statement of financial performance, statement of changes in net assets, cash flow statement for the year then ended, as well as the notes, comprising a summary of significant accounting policies and other explanatory information.

Accounting authority's responsibility for the financial statements

2. The accounting authority is responsible for the preparation and fair presentation of these financial statements in accordance with the South African Standards of Generally Recognised Accounting Practice (SA Standards of GRAP) and the requirements of the Public Finance Management Act, 1999 (Act No. 1 of 1999) (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.

Auditor-general's responsibility

3. My responsibility is to express an opinion on these financial statements based on my audit. I conducted my audit in accordance with the International Standards on Auditing. Those standards require that I comply with ethical requirements, and plan and perform the audit to obtain reasonable assurance about whether the financial statements are free from material misstatement.

4. An audit involves performing procedures to obtain audit evidence about the amounts and disclosures in the financial statements. The procedures selected depend on the auditor's judgement, including the assessment of the risks of material misstatement of the financial statements, whether due to fraud or error. In making those risk assessments, the auditor considers internal control relevant to the entity's preparation and fair presentation of the financial statements 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 entity's internal control. An audit also includes evaluating the appropriateness of accounting policies used and the reasonableness of accounting estimates made by management, as well as evaluating the overall presentation of the financial statements.

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

Opinion

6. In my opinion, the financial statements present fairly, in all material respects, the financial position of the Agricultural Research Council as at 31 March 2016 and its financial performance and cash flows for the year then ended, in accordance with the SA Standards of GRAP and the requirements of the PFMA.

Emphasis of matter

7. I draw attention to the matter below. My opinion is not modified in respect of this matter.

Restatement of corresponding figures

8. As disclosed in note 33 and 35 to the financial statements, the corresponding figures for 31 March 2015 have been restated as a result of errors discovered during 2016 in the financial statements of the Agricultural Research Council at, and for the year ended, 31 March 2015.

Report on other legal and regulatory requirements

9. 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 findings on the reported performance information against predetermined objectives of selected programmes presented in the annual performance report, compliance with legislation and internal control. The objective of my tests was to identify reportable findings as described under each subheading but not to gather evidence to express assurance on these matters. Accordingly, I do not express an opinion or conclusion on these matters.

Predetermined objectives

10. I performed procedures to obtain evidence about the usefulness and reliability of the reported performance information of the following selected programmes presented in the annual performance report of the public entity for the year ended 31 March 2016:

- Programme 1: Crop production, improvement and protection, on page 153
- Programme 2: Animal health, production and improvement, on page 153
- Programme 3: Natural resource management, on page 153

11. I evaluated the usefulness of the reported performance information to determine whether it was presented in accordance with the National Treasury's annual reporting principles and whether the reported performance was consistent with the planned programmes. I further performed tests to determine whether indicators and targets were well defined, verifiable, specific, measurable, time bound and relevant, as required by the National Treasury's *Framework for managing programme performance information* (FMPPI).

12. I assessed the reliability of the reported performance information to determine whether it was valid, accurate and complete.

13. 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 resource management

Additional matter

14. I draw attention to the following matter:

Achievement of planned targets

15. Refer to the annual performance report on pages 153 to 155 for information on the achievement of the planned targets for the year.

Compliance with legislation

16. I performed procedures to obtain evidence that the public entity had complied with applicable legislation regarding financial matters, financial management and other related matters. My material finding on compliance with specific matters in key legislation, as set out in the general notice issued in terms of the PAA, are as follows:

Annual financial statements

17. The financial statements submitted for auditing were not prepared in accordance with the prescribed financial reporting framework as required by section 55(1)(b) of the Public Finance Management Act. Material misstatements of property, plant and equipment, receivables from exchange transactions, inventories, payables from exchange transactions, leave provision, and revenue from exchange transactions identified by the auditors in the submitted financial statements were subsequently corrected resulting in the financial statements receiving an unqualified audit opinion.

Internal control

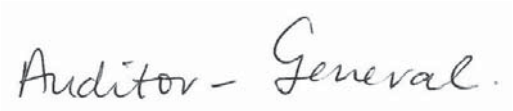
18. I considered internal control relevant to my audit of the financial statements, annual performance report and compliance with legislation. The matters reported below are limited to the significant internal control deficiencies that resulted in the findings on compliance with legislation included in this report.

Leadership

19. Inadequate oversight by management over financial reporting to ensure accurate financial records and information and compliance with laws and regulations are adequately monitored throughout the year.

Financial and performance management

20. Management did not implement adequate record keeping on a timely basis to ensure that complete, relevant and accurate information is accessible and available to support financial reporting. This is mainly due to inadequate controls over the compilation of financial statements. Management did not adequately review the annual financial statements for completeness and accuracy prior to submission for auditing.



Pretoria
31 July 2016

AUDITOR-GENERAL
SOUTH AFRICA

Auditing to build public confidence

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
Auditors	Auditor General of South Africa Chartered Accountants (S.A.)
Company secretary (acting)	Ayanda Ndamase

INDEX

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

ACCOUNTING AUTHORITY'S STATEMENT
AS AT 31 MARCH 2016

APPROPRIATENESS OF GOING CONCERN

The annual financial statements presented are prepared on the assumption that ARC is a going concern and will continue in operation for the foreseeable future. The ARC Council has reviewed the organisation's financial budgets for the period 31 March 2017 and is satisfied that adequate resources exist to continue business for the foreseeable future. The Council believes that the going concern basis is appropriate and confirms that there is neither the intention nor the need to liquidate or curtail materially the scale of ARC's operations. The ARC Council is of the opinion that the ARC is financially sound and will continue to operate as a going concern.

STATEMENT OF RESPONSIBILITY

The Council which is the Accounting Authority of the Agricultural Research Council (ARC) is responsible for the preparation, integrity and fair presentation of the annual financial statements of the ARC.

The annual financial statements for the year ended 31 March 2016 presented on pages 108 to 151 have been prepared in accordance with:

- The Agricultural Research Act No. 86 of 1990 as amended;
- The Public Finance Management Act No. 1 of 1999;
- Standards of Generally Recognised Accounting Practice.

They are based on appropriate accounting policies which have been consistently applied and which are supported by reasonable and prudent judgements and estimates.

The ARC Council is also responsible for the ARC's system of internal controls. These are designed to provide reasonable, but not absolute, assurance as to the reliability of the annual financial statements and to adequately safeguard, verify and maintain accountability of assets. These controls are monitored throughout the ARC by management and employees, in an attempt to address the segregation of authority and duties with available resources. Processes are in place to monitor internal controls, to identify material breakdowns and implement timely corrective action.

The Council and ARC Management treat corporate governance matters seriously and whenever any instances of non-compliance to regulation are uncovered or reported, appropriate disciplinary measures in terms of policy and legislation are instituted.

The annual financial statements for the year ended 31 March 2016 were approved by the Council on 26 May 2016 and are signed on its behalf:

Prof S Vil-Nkomo
Chairperson

Dr SR Moephuli
President and CEO

STATEMENT OF FINANCIAL PERFORMANCE
AS AT 31 MARCH 2016

Figures in Rand	Note(s)	2016	2015 Restated*
Revenue			
Revenue from exchange transactions			
Sale of goods in agricultural activities	3	59 494 389	50 619 713
Rendering of services	3	352 170 953	335 852 315
Royalty income	3	11 530 445	9 239 683
Rental of facilities and equipment	3	11 478 239	11 141 530
Interest received	4	26 732 350	32 193 291
Dividends received	4	45 855	48 328
Total revenue from exchange transactions		**461 452 231**	**439 094 860**
Revenue from non-exchange transactions			
Transfer revenue			
Government grants	5	782 261 139	919 260 611
Total revenue	3	**1 243 713 370**	**1 358 355 471**
Expenditure			
Employee costs	7	(768 053 041)	(779 286 282)
Depreciation and amortisation	7	(42 473 853)	(47 017 287)
Impairment	6	2 044 951	(530 601)
Finance costs	7	(29 993)	(3 939)
Lease rentals on operating lease	7	(11 098 681)	(15 051 913)
Debt Impairment	7	(127 054)	852 283
Operating and administrative expenses		(497 414 309)	(502 934 201)
Total expenditure		**(1 317 151 980)**	**(1 343 971 940)**
Operating (deficit) surplus	7	**(73 438 610)**	**14 383 531**

The accounting policies on pages 112 to 124 and the notes on pages 125 to 151 form an integral part of the annual financial statements.

STATEMENT OF FINANCIAL POSITION
AS AT 31 MARCH 2016

Figures in Rand	Note(s)	2016	2015 Restated*
Assets			
Current Assets			
Inventories	8	7 487 963	12 416 141
Receivables from exchange transactions	9	213 725 800	121 436 258
Cash and cash equivalents	10	301 526 198	508 235 613
		522 739 961	**642 088 012**
Non-Current Assets			
Investment property	11	98 648	98 648
Property, plant and equipment	12	966 191 869	897 823 148
Intangible assets	13	39 863 379	46 131 196
Heritage assets	14	223 167	223 167
Other financial assets	15	5 016 606	5 262 113
		1 011 393 669	**949 538 272**
Total Assets		**1 534 133 630**	**1 591 626 284**
Liabilities			
Current Liabilities			
Payables from exchange transactions	16	316 203 913	275 183 829
VAT payable	17	5 713 365	12 788 499
Provisions	18	91 774 710	106 184 704
		413 691 988	**394 157 032**
Non-Current Liabilities			
Employee benefit obligation	19	16 641 000	20 230 000
Unspent conditional grants and receipts	20	192 596 947	192 596 947
		209 237 947	**212 826 947**
Total Liabilities		**622 929 935**	**606 983 979**
Net Assets		**911 203 695**	**984 642 305**
Capital Fund	21	111 986 013	111 986 013
Insurance reserve		2 631 579	2 631 579
Accumulated surplus		796 586 103	870 024 713
Total Net Assets		**911 203 695**	**984 642 305**

STATEMENT OF CHANGES IN NET ASSETS
AS AT 31 MARCH 2016

Figures in Rand	Capital Fund	Insurance reserve	Accumulated surplus	Total net assets
Opening balance as previously reported	109 593 403	2 368 421	855 641 182	967 603 006
Adjustments				
Prior year adjustments (Note 33)	2 392 610	-	-	2 392 610
Balance at 01 April 2014 as restated*	**111 986 013**	**2 368 421**	**855 641 182**	**969 995 616**
Changes in net assets				
Surplus for the year	-	-	14 383 531	14 383 531
Increase in reserve	-	263 158	-	263 158
Total changes	-	263 158	14 383 531	14 646 689
Restated* Balance at 01 April 2015	**111 986 013**	**2 631 579**	**870 024 713**	**984 642 305**
Changes in net assets				
Deficit for the year	-	-	(73 438 610)	(73 438 610)
Total changes	-	-	(73 438 610)	(73 438 610)
Balance at 31 March 2016 (Note 21)	**111 986 013**	**2 631 579**	**796 586 103**	**911 203 695**

CASH FLOW STATEMENT
AS AT 31 MARCH 2016

Figures in Rand	Note(s)	2016	2015 Restated*
Cash flows from operating activities			
Receipts			
Sale of goods and services		378 358 449	370 072 286
Grants	3	744 677 901	955 361 630
Interest income		26 732 350	32 193 291
Dividends received		45 855	48 328
		1 149 814 555	**1 357 675 535**
Payments			
Employee costs		(768 053 041)	(779 286 282)
Suppliers		(485 102 111)	(440 483 381)
Finance costs		(29 993)	(3 939)
		(1 253 185 145)	(1 219 773 602)
Net cash flows from operating activities	22	**(103 370 590)**	**137 901 933**
Cash flows from investing activities			
Purchase of property, plant and equipment	12	(103 313 560)	(92 707 857)
Proceeds from sale of property, plant and equipment		(25 265)	1 226 334
Purchase of intangible assets	13	-	(18 394 862)
Purchases of heritage assets	14	-	(2 167)
Net cash flows from investing activities		**(103 338 825)**	**(109 878 552)**
Net increase/(decrease) in cash and cash equivalents		**(206 709 415)**	**28 023 381**
Cash and cash equivalents at the beginning of the year		508 235 613	480 212 232
Cash and cash equivalents at the end of the year	10	**301 526 198**	**508 235 613**

ACCOUNTING POLICIES
FOR THE YEAR ENDED 31 MARCH 2016

1. Basis of preparation

The annual financial statements have been prepared in accordance with the Standards of Generally Recognised Accounting Practice (GRAP), as 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 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.

1.1 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 Statements of Generally Recognised Accounting Standards (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:

Post-retirement medical benefits and defined pension 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 defined benefit pension benefit requires the Council to make certain assumptions that have a significant impact on the expenses and liabilities that are recorded for these employment benefits.

Property, plant and equipment

The entity 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. The residual values of all other assets are estimated to be zero.

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 plant and equipment accounting policy.

Post-retirement 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 pension 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 pension liability.

Other key assumptions for pension obligations are based on current market conditions. Additional information is disclosed in Note 19.

ACCOUNTING POLICIES
FOR THE YEAR ENDED 31 MARCH 2016

1.1 Critical accounting policies with key management judgement (continued)

Intangible assets

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

1.2 Government grants

Government grants (Revenue from non-exchange transactions).

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.

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.

Revenue from a non-exchange transaction shall be measured at the amount of the increase in net assets recognised by the entity.

1.3 Investment property

Investment property is property held to earn rentals or for capital appreciation or both, rather than for:

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

Investment property is initially recognised at cost. Transaction costs are included in the initial measurement.

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:

Item	Useful life
Property - buildings	40 to 70 years

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.

1.4 Property, plant and equipment

Property, plant and equipment is initially measured at cost and subsequently at cost less accumulated depreciation and impairment.

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.

ACCOUNTING POLICIES
FOR THE YEAR ENDED 31 MARCH 2016

1.4 Property, plant and equipment (continued)

Property, plant and equipment are stated at cost less accumulated depreciation and any accumulated impairment losses.

Depreciation is charged so as to write off the cost of assets to its residual value over their estimated useful lives, using the straight-line method. Property, plant and equipment is depreciated when it is in a location and condition for it to be operating in the manner it is intended. If the residual value exceeds the carrying amount depreciation will be stopped.

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

The useful lives of items of property, plant and equipment have been estimated as stated below.

Depreciation is calculated on a straight line basis over the useful life of the asset as follows:

Item	Average useful life
Land	Not depreciated
Buildings	40 to 70 years
Machinery & Farming Equipment	15 to 40 years
Office Furniture & Equipment	5 to 20 years
Motor vehicles and air craft	4 to 15 years
Computer equipment	3 to 10 years
Infrastructure	10 to 60 years
Laboratory equipment	15 to 40 years

Gains and losses on disposal are included in the statement of financial performance and are determined by comparing net sales proceeds with carrying amount.

The assets' residual values, useful lives and methods of depreciation are reviewed and adjusted if appropriate at each financial year-end.

The carrying amount of property, plant and equipment is derecognised on disposal or when no future economic benefits are expected from its use or disposals:

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 there are no further economic benefits or service potential expected from the use of the asset.

1.5 Intangible assets

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.

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.

Intangible assets are carried at cost less any accumulated amortisation and any impairment losses.

An intangible asset is regarded as having an indefinite useful life when, based on all relevant factors, there is no foreseeable limit to the period over which the asset is expected to generate net cash inflows or service potential. Amortisation is not provided for these intangible assets, but they are tested for impairment annually and whenever there is an indication that the asset may be impaired. For all other intangible assets amortisation is provided on a straight line basis over their useful life.

The amortisation period and the amortisation method for intangible assets are reviewed at each reporting date.

ACCOUNTING POLICIES
FOR THE YEAR ENDED 31 MARCH 2016

1.5 Intangible assets (continued)

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.

Computer software	3 to 10 years

Intangible assets are derecognised:

- on disposal; or
- when no future economic benefits or service potential are expected from its use or disposal.

1.6 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.

Class of heritage assets means a grouping of heritage assets of a similar nature or function in an entity's operations that is shown as a single item for the purpose of disclosure in the annual financial statements.

An impairment loss of a non-cash-generating asset is the amount by which the carrying amount of an asset exceeds its recoverable service amount.

An inalienable item is an asset that an entity is required by law or otherwise to retain indefinitely and cannot be disposed of without consent.

Recoverable service amount is the higher of a non-cash-generating asset's fair value less costs to sell and its value in use.

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. The ARC will identify heritage assets as assets that have a cultural, environmental, historical, natural, scientific, technological or artistic significance and are held indefinitely and mainly for the benefit of present and future generations.

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.

After recognition as an asset, a class of heritage assets, whose fair value can be measured reliably, is carried at a revalued amount, being its fair value at the date of the revaluation less any subsequent impairment losses.

If a heritage asset's carrying amount is increased as a result of a revaluation, the increase is credited directly to a revaluation surplus. However, the increase is recognised in surplus or deficit to the extent that it reverses a revaluation decrease of the same heritage asset previously recognised in surplus or deficit.

If a heritage asset's carrying amount is decreased as a result of a revaluation, the decrease is recognised in surplus or deficit. However, the decrease is debited directly to a revaluation surplus to the extent of any credit balance existing in the revaluation surplus in respect of that heritage asset.

Derecognition

The entity derecognises heritage asset on disposal, or when no future economic benefits are expected from its disposal.

The gain or loss arising from the derecognition of a heritage asset is determined as the difference between the net disposal proceeds, if any, and the carrying amount of the heritage asset. Such difference is recognised in surplus or deficit when the heritage asset is derecognised.

ACCOUNTING POLICIES
FOR THE YEAR ENDED 31 MARCH 2016

1.7 Financial instruments

Classification

The entity classifies financial assets and financial liabilities into the following categories:

- Financial instruments at cost
- Financial instruments at fair value through surplus or deficit
- Financial instruments at amortised cost

Classification depends on the purpose for which the financial instruments were obtained / incurred and takes place at initial recognition. Classification is re-assessed on an annual basis, except for derivatives and financial assets designated as at fair value through surplus or deficit, which shall not be classified out of the fair value through surplus or deficit category.

Initial recognition and measurement

Financial instruments are recognised initially when the entity becomes a party to the contractual provisions of the instruments.

The entity classifies financial instruments, or their component parts, on initial recognition as a financial asset, a financial liability or an equity instrument in accordance with the substance of the contractual arrangement.

Financial instruments are measured initially at fair value, except for equity investments for which a fair value is not determinable, which are measured at cost and are classified as available-for-sale financial assets.

For financial instruments which are not at fair value through surplus or deficit, transaction costs are included in the initial measurement of the instrument.

Transaction costs on financial instruments at fair value through surplus or deficit are recognised in surplus or deficit.

Subsequent measurement

Financial instruments at fair value through surplus or deficit are subsequently measured at fair value, with gains and losses arising from changes in fair value being included in surplus or deficit for the period.

Net gains or losses on the financial instruments at fair value through surplus or deficit exclude dividends and interest.

Dividend income is recognised in surplus or deficit as part of other income when the entity's right to receive payment is established.

Financial liabilities at amortised cost are subsequently measured at amortised cost, using the effective interest method.

Financial assets

Investments are recognised and derecognised on trade date where the purchase or sale of an investment is under a contract whose terms require delivery of the investment within the timeframe established by the market concerned, and are initially measured at fair value, plus transaction costs, except for those financial assets classified as at fair value through profit or loss, which are initially measured at fair value.

Effective interest method

The effective interest method is a method of calculating the amortised cost of a financial asset and of allocating interest income over the relevant period. The effective interest rate is the rate that exactly discounts estimated future cash receipts (including all fees on points paid or received that form an integral part of the effective interest rate, transaction costs and other premiums or discounts) through the expected life of the financial asset, or, where appropriate, a shorter period. Income is recognised on an effective interest basis for debt instruments other than those financial instrument designated as at FV.

1.7 Financial instruments (continued)

Financial assets are classified as at fair value through surplus and deficit (FVTSD) where the financial asset is either held for trading or it is designated as at FVTSD.

A financial asset is classified as held for trading if:

- it has been acquired principally for the purpose of selling in the near future; or
- it is a part of an identified portfolio of financial instruments that the ARC manages together and has a recent actual pattern of short-term profit-taking; or
- it is a derivative that is not designated but is effective as a hedging instrument.

A financial asset other than a financial asset held for trading may be designated as at FVTSD upon initial recognition if:

- such designation eliminates or significantly reduces a measurement or recognition inconsistency that would otherwise arise; or
- the financial asset forms part of an entity of financial assets or financial liabilities or both, which is managed and its performance is evaluated on a fair value basis, in accordance with the ARC's documented risk management or investment strategy, and information about the entitling is provided internally on that basis; or
- it forms part of a contract containing one or more embedded derivatives.

Financial assets at FVTSD are stated at fair value, with any resultant gain or loss recognised in profit or loss. The net gain or loss recognised in profit or loss incorporates any dividend or interest earned on the financial asset. Fair value is determined in the manner described in note 28.

Impairment of financial instruments

Financial assets, are assessed for indicators of impairment at each financial position date. Financial assets are impaired where there is objective evidence that, as a result of one or more events that occurred after the initial recognition of the financial asset, the estimated future cash flows of the investment have been impacted.

For unlisted shares classified as available for sale (AFS), a significant or prolonged decline in the fair value of the security below its cost is considered to be objective evidence of impairment.

For all other financial assets, including redeemable notes classified as AFS and finance lease receivables, objective evidence of impairment could include:

- significant financial difficulty of the issuer or counterparty; or
- default or delinquency in interest or principal payments; or
- it becoming probable that the borrower will enter bankruptcy or financial re-organisation.
- A significant or prolonged decline in an equity instrument below its cost.

For certain categories of financial instrument, such as trade receivables, assets that are assessed not to be impaired individually are subsequently assessed for impairment on a collective basis. Objective evidence of impairment for a portfolio of receivables could include the Entity's past experience of collecting payments, an increase in the number of delayed payments in the portfolio past the average period of 60 days, as well as observable changes in national or local economic conditions that correlate with default on receivables.

For financial instrument carried at amortised cost, the amount of the impairment is the difference between the asset's carrying amount and the present value of estimated future cash flows, discounted at the financial asset's original effective interest rate.

The carrying amount of the financial instrument is reduced by the impairment loss directly for all financial instrument with the exception of trade receivables, where the carrying amount is reduced through the use of provision for doubtful debts account. When a trade receivable is considered uncollectible, it is written off against the provision for doubtful debts account. Subsequent recoveries of amounts previously written off are recognised as income in the statement of financial performance. Changes in the carrying amount of the allowance account are recognised in profit or loss.

With the exception of AFS equity instruments, if, in a subsequent period, the amount of the impairment loss decreases and the decrease can be related objectively to an event occurring after the impairment was recognised, the previously recognised impairment loss is reversed through profit or loss to the extent that the carrying amount of the investment at the date the impairment is reversed does not exceed what the amortised cost would have been had the impairment not been recognised.

ACCOUNTING POLICIES
FOR THE YEAR ENDED 31 MARCH 2016

1.7 Financial instruments (continued)

In respect of AFS equity securities, impairment losses previously recognised through profit or loss are not reversed through profit or loss. Any increase in fair value subsequent to an impairment loss is recognised directly in equity.

Derecognition of financial assets

The ARC derecognises a financial asset only when the contractual rights to the cash flows from the asset expire; or it transfers the financial asset and substantially all the risks and rewards of ownership of the asset to another entity. If the ARC neither transfers nor retains substantially all the risks and rewards of ownership and continues to control the transferred asset, the ARC recognises its retained interest in the asset and an associated liability for amounts it may have to pay. If the ARC retains substantially all the risks and rewards of ownership of a transferred financial asset, the ARC continues to recognise the financial asset and also recognises a collateralised borrowing for the proceeds received.

Derecognition of financial liabilities

The Entity derecognises financial liabilities when, and only when, the Entity's obligations are discharged, cancelled or they expire.

1.8 Leases

A lease is classified as a finance lease whenever the terms of the lease transfers substantially all the risks and rewards incidental to lease. All other leases are classified as operating leases. The determination whether an arrangement contains a lease and the classification of the lease is based on the substance of the transaction at inception date.

Assets held under finance leases are recognised as assets of the ARC at their fair value at the inception of the lease or, if lower, the present value of the minimum lease payments. The determination of whether an arrangement contains a lease and the classification of the lease is based on the substance of the transaction at inception date. The assets are capitalised if the minimum lease payments are 85% or more of the assets' fair value at inception of the lease. The corresponding liability to the lessor is included in the statement of financial position as a finance lease obligation.

Lease payments are apportioned between finance charges and reduction of the lease obligation so as to achieve a constant rate of interest on the remaining balance of the liability.

Finance charges are charged to surplus or deficit, unless they are directly attributable to qualifying assets, in which case they are capitalised in accordance with the ARC's general policy on borrowing costs (see below). Leased assets are depreciated over lesser of the useful life and the lease period.

Rentals payable under operating leases are charged to surplus or deficit on a straight-line basis over the term of the relevant lease. Benefits received and receivable as an incentive to enter into an operating lease are also spread on a straight-line basis over the lease term.

Operating leases - lessor

Operating lease revenue is recognised as revenue on a straight-line basis over the lease term.

Initial direct costs incurred in negotiating and arranging operating leases are added to the carrying amount of the leased asset and recognised as an expense over the lease term on the same basis as the lease revenue.

The aggregate cost of incentives is recognised as a reduction of rental revenue over the lease term on a straight-line basis.

The aggregate benefit of incentives is recognised as a reduction of rental expense over the lease term on a straight-line basis.

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.

ACCOUNTING POLICIES
FOR THE YEAR ENDED 31 MARCH 2016

1.9 Inventories

Inventory is initially measured at cost. Consumable stores are subsequently measured at the lower of cost and current replacement cost. Livestock is valued at the lower of cost or net realisable value. 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 or consumables are valued at lower of cost and net realisable value.

Vaccines for foot-and-mouth disease are valued at lower of cost and net realisable value.

Net realisable value represents the estimated selling price less all estimated costs of completion and costs to be incurred in marketing, selling and distribution.

Obsolete or damaged inventory are written off to are recognised as an expense in the period they are incurred.

Inventories are initially measured at cost except where inventories are acquired through a non-exchange transaction, then their costs are their fair value as at the date of acquisition.

Subsequently inventories are measured at the 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.

1.10 Impairment of non-financial assets

At each reporting date, the ARC reviews the carrying amounts of its tangible and intangible assets to determine whether there is any indication that those assets have suffered an impairment loss. If any such indication exists, the recoverable amount of the asset is estimated in order to determine the extent of the impairment loss (if any). Where it is not possible to estimate the recoverable amount of an individual asset, the ARC estimates the recoverable amount of the cash-generating unit to which the asset belongs.

Recoverable amount is the higher of fair value less point of sale costs to sell and value in use. Fair value is determined by reference to the market. In assessing value in use, the estimated future cash flows are discounted to their present value using a pre-tax discount rate that reflects current market assessments of the time value of money and the risks specific to the asset.

If the recoverable amount of an asset is estimated to be less than its carrying amount, the carrying amount of the asset is reduced to its recoverable amount. An impairment loss is recognised immediately in surplus or deficit.

Where an impairment loss subsequently reverses, the carrying amount of the asset is increased to the revised estimate of its recoverable amount, but so that the increased carrying amount does not exceed the carrying amount that would have been determined had no impairment loss been recognised for the asset in prior years. A reversal of an impairment loss is recognised immediately in surplus or deficit, unless the relevant asset is carried at a revalued amount, in which case the reversal of the impairment loss is treated as a revaluation increase.

1.11 Cash and cash equivalents

For the purpose of the cash flow statement, 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. These are initially and subsequently recorded at fair value.

1.12 Capital Fund

The capital fund represents the cost of land when the ARC was transferred out of the Department of Agriculture, Forestry and Fisheries.

ACCOUNTING POLICIES
FOR THE YEAR ENDED 31 MARCH 2016

1.13 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 cost of all short-term employee benefits is recognised during the period in which the employee renders the related service. The provisions for employee entitlements to wages, salaries and annual leave represent the amounts for which the ARC has a present obligation to pay as a result of employees' service provided to the reporting date. The provisions have been calculated at undiscounted amounts based on current wage and salary rates.

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 the 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 are recognised when the entity is demonstrably committed to curtailment or settlement.

When it is virtually certain that another party will reimburse some or all of the expenditure required to settle a defined benefit obligation, the right to reimbursement is recognised as a separate asset. The asset is measured at fair value. In all other respects, the asset is treated in the same way as plan assets. In surplus or deficit, the expense relating to a defined benefit plan is presented as the net of the amount recognised for a reimbursement.

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.

Long-term employee benefits

Long service leave

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.

ACCOUNTING POLICIES
FOR THE YEAR ENDED 31 MARCH 2016

1.13 Employee benefits

Retirement benefits

Pension fund

The ARC contributes to one defined benefit plan and two defined contribution plans. The contributions to the defined contribution plans are charged against income as incurred.

The projected unit credit method is used to determine the present value of the defined benefit obligations, the related current service cost and, where applicable, past service cost.

Actuarial gains and losses are recognised as income or expense when the net cumulative unrecognised actuarial gains and losses for each individual plan at the end of the previous reporting period exceeded 10% of the higher of the defined benefit obligation and the fair value of the plan assets at that date. Recognition of asset is limited to contribution refunds or reduced contribution.

These gains and losses are recognised over the expected average remaining working lives of the employees participating in the plans.

Past service costs are recognised as an expense on a straight-line basis over the average period until the benefits become vested. To the extent that the benefits are already vested, past service costs are recognised immediately. Any asset resulting from valuation of this plan is limited to unrecognised actuarial loss and present value of available refunds and reduction in future contribution plans.

Post-retirement medical benefits

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.

Actuarial gains and losses are recognised as income or expense when the net cumulative unrecognised actuarial gains and losses for each individual plan at the end of the previous reporting period exceeded 10% of the higher of the defined benefit obligation and the fair value of the plan assets at that date.

The amount recognised in the statement of financial position represents the present value of the post-retirement medical aid contribution as adjusted for unrecognised actuarial gains and losses and reduced by the fair value of the plan assets. Any asset resulting from this calculation is limited to unrecognised actuarial losses and the present value of available refunds and reductions in future contribution plans.

1.14 Provisions

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.

Contingent assets and contingent liabilities are not recognised. Contingencies are disclosed in note 24.

Provisions are recognised when the ARC has a present legal or constructive obligation as a result of a past event, and it is probable that the ARC will be required to settle the obligation and the amount can be estimated reliably. Provisions are measured at the Council's best estimate of the expenditure required to settle the obligation at the reporting date, and are discounted to present value where the effect is material.

ACCOUNTING POLICIES
FOR THE YEAR ENDED 31 MARCH 2016

1.15 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.

1.16 Research and development expenditure

Expenditure on research is recognised as an expense when it is incurred. Development costs incurred will be capitalised when they satisfy the definition of an intangible asset as contemplated in GRAP 31 (Intangible Assets).

1.17 Related parties

The entity operates in an economic sector currently dominated by entities directly or indirectly owned by the South African Government. As a consequence of the constitutional independence of the three spheres of government in South Africa, only entities reporting to the parent department are considered to be related parties.

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.

Only transactions with related parties not at arm's length or not in the ordinary course of business are disclosed.

1.18 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.

ACCOUNTING POLICIES
FOR THE YEAR ENDED 31 MARCH 2016

1.19 Revenue from exchange transactions

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.

Investment income

Investment income comprises of interest income and is accrued on a time proportion basis, taking into account the principal outstanding and the effective interest rate over the period to maturity.

Dividends income

Dividends income comprise of dividends accrued. The dividends income is recognised when the shareholders right to receive income is established.

1.20 Foreign currency

Transactions in foreign currencies are recorded at the rate of exchange ruling at transaction date. Monetary assets and liabilities denominated in foreign currencies are translated at the rate of exchange ruling at the reporting date. Gains and losses arising on translation are credited to or charged against income.

1.21 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 accumulated surplus in the year in which it originated and any surplus is carried over to the following year.

ACCOUNTING POLICIES
FOR THE YEAR ENDED 31 MARCH 2016

1.22 Irregular, fruitless and wasteful expenditure

Irregular expenditure means expenditure incurred in contravention of, or not in accordance with, a requirement of any applicable legislation, including:

- The Public Finance Management Act 1999 (Act No 1 of 1999) as amended, or
- Any legislation providing for procurement procedures in Government.

Fruitless and wasteful expenditure means expenditure that was made in vain and could have been avoided had reasonable care been exercised.

All irregular, fruitless and wasteful is accounted for as expenditure in the statement of financial performance and where recovered, it is subsequently accounted for as income in the statement of financial performance.

1.23 Conditional grants and receipts

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.

1.24 Offset

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.

NOTES TO THE ANNUAL FINANCIAL STATEMENTS
FOR THE YEAR ENDED 31 MARCH 2016

Figures in Rand	2016	2015

2. New standards and interpretations

2.1 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 2016 or later periods:

Standard/ Interpretation:	Effective date: Years beginning on or after	Expected impact:
• GRAP 20: Related parties	01 April 2016	Immaterial
• GRAP32: Service Concession Arrangements: Grantor	01 April 2016	Immaterial
• IGRAP17: Service Concession Arrangements where a Grantor Controls a Significant Residual Interest in an Asset	01 April 2016	Immaterial
• DIRECTIVE 11: Changes in measurement bases following the initial adoption of Standards of GRAP	01 April 2016	Immaterial

NOTES TO THE ANNUAL FINANCIAL STATEMENTS
FOR THE YEAR ENDED 31 MARCH 2016

Figures in Rand	2016	2015
3. Revenue		
External earnings	59 494 389	50 619 713
Rendering of services	352 170 953	335 852 315
Royalty income	11 530 445	9 239 683
Rental of facilities and equipment	11 478 239	11 141 530
Interest received - investment	26 732 350	32 193 291
Dividends received	45 855	48 328
Government grants	782 261 139	919 260 611
	1 243 713 370	**1 358 355 471**
The amount included in revenue arising from exchanges of goods or services are as follows:		
External earnings	59 494 389	50 619 713
Rendering of services	352 170 953	335 852 315
Royalty income	11 530 445	9 239 683
Rental of facilities and equipment	11 478 239	11 141 530
Interest received - investment	26 732 350	32 193 291
Dividends received	45 855	48 328
	461 452 231	**439 094 860**
The amount included in revenue arising from non-exchange transactions is as follows:		
Taxation revenue		
Transfer revenue		
Parliamentary grant	782 261 139	919 260 611
(a) Parliamentary grant		
Grant received during the financial year	744 677 901	955 361 630
Allocated to income received in advance	-	(80 400 615)
Received in prior year	37 583 238	44 299 596
	782 261 139	**919 260 611**
(b) External earnings		
Gross revenue	514 681 970	510 577 909
Less received in advance (note 16)	(80 007 944)	(103 724 668)
	434 674 026	**406 853 241**
External earnings		
Total exchange revenue	461 452 231	439 094 860
Interest and dividends received	(26 778 205)	(32 241 619)
	434 674 026	**406 853 241**
4. Investment revenue		
Dividend revenue		
Listed financial assets - Local	45 855	48 328
Interest revenue		
Bank	26 732 350	32 193 291
	26 778 205	**32 241 619**

NOTES TO THE ANNUAL FINANCIAL STATEMENTS
FOR THE YEAR ENDED 31 MARCH 2016

Figures in Rand	2016	2015

5. Government grants

Operating grants

Government grant (operating)	699 651 135	840 280 217

Capital grants

Government grant (capital)	82 610 004	78 980 394
	782 261 139	**919 260 611**

6. Impairment of assets

Impairments

Property, plant and equipment	(2 044 951)	530 601

An impairment review was completed during 2015 financial year.The review revealed impairments to land and buildings which are either not in use or maintained inadequately.

Impairment reversal year relate to impairment conditions which do not exist any more.

7. Operating deficit

Operating deficit for the year is stated after accounting for the following:

Remuneration, other than to employees, for:		
Council Fees	1 828 907	2 074 757
Auditors remuneration	5 583 150	5 092 494
	7 412 057	**7 167 251**
Operating lease charges		
Premises		
• Contractual amounts	932 404	4 636 428
Motor vehicles and air craft		
• Contractual amounts	112 391	958 339
Equipment		
• Contractual amounts	10 053 886	9 457 146
	11 098 681	**15 051 913**
Amortisation on intangible assets	5 458 796	2 740 441
Bad debts	127 054	(852 283)
Depreciation on investment property	-	26 786
Depreciation on property, plant and equipment	37 015 057	44 250 060
Employee costs	768 053 041	779 286 282
Finance costs	29 993	3 939
Impairment on property, plant and equipment	(2 044 951)	530 601

8. Inventories

Work in progress	204 426	372 325
Finished goods	7 283 537	12 043 816
	7 487 963	**12 416 141**

NOTES TO THE ANNUAL FINANCIAL STATEMENTS
FOR THE YEAR ENDED 31 MARCH 2016

Figures in Rand	2016	2015

9. Receivables from exchange transactions

Trade debtors	197 128 370	100 046 713
Staff debtors	10 439 010	7 491 015
Deposits	293 897	287 831
Provision for bad debts	(11 976 978)	(10 669 031)
Prepaid expenses	2 127 200	729 319
Other debtors	15 714 301	23 550 411
	213 725 800	**121 436 258**

Services rendered by the ARC are generally on a cash basis and mostly settled in 30 days. Trade receivables are stated at amortised cost.

Of the receivables balance at the end of the year, R 54 million is due from the largest customer and R 49 million is due from second largest customer and the R 29 million is due from third largest customer, the fourth and fifth largest customers owe 9% and 6% of the total balance respectively. There are no other customers who represent more than 5% of the total balance of trade receivables.

Staff debtors are made up of travel advances and salary advances. These are recovered on a monthly basis by employees paying back the amount owed or ARC deducting the amount owed from the employee salary.

Trade receivables past due but not impaired

The ageing of amounts past due but not impaired is as follows:

30 to 59 days	20 165 685	17 499 479
60 to 89 days	2 070 371	3 025 359
90 to 119 days	9 546 224	1 061 033
120 to 149 days	6 907 874	3 156 997
150+ days	69 855 855	2 180 833
Balance at the end of the year	**108 546 009**	**26 923 701**

Reconciliation of provision of impairment of trade and other receivables

As at 31 March 2016, receivables at nominal value of R11 976 978 (2015: R10 669 031) were impaired and provided for. Receivables that have passed 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 is regarded to be low. Movement in the provision for impairment of receivables were as follows:

Opening balance	10 669 031	11 741 972
Raised during the year	1 307 947	-
Reversed during the year	-	(1 072 941)
Balance at the end of the year	**11 976 978**	**10 669 031**

The receivable's 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.

NOTES TO THE ANNUAL FINANCIAL STATEMENTS
FOR THE YEAR ENDED 31 MARCH 2016

Figures in Rand	2016	2015

10. Cash and cash equivalents

Cash and cash equivalents consist of cash on hand and balances with banks and investments in money market instruments.

Cash and cash equivalents included in the cash flow statement is made as follows:

Cash on hand	42 868 053	133 665 660
Short-term bank deposits	258 658 145	374 569 953
	301 526 198	**508 235 613**

11. Investment property

	2016			2015		
	Cost	Accumulated depreciation and accumulated impairment	Carrying value	Cost	Accumulated depreciation and accumulated impairment	Carrying value
Investment property	125 435	(26 787)	98 648	125 434	(26 786)	98 648

Reconciliation of investment property - 2016

	Opening balance	Total
Investment property	98 648	98 648

Reconciliation of investment property - 2015

	Opening balance	Transfers	Total
Investment property	-	98 648	98 648

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. This property was transferred from equipment, land and buildings to investment property in 2015 financial year.

Figures in Rand

12. Property, plant and equipment

	2016			2015		
	Cost	Accumulated depreciation and accumulated impairment	Carrying value	Cost	Accumulated depreciation and accumulated impairment	Carrying value
Land	120 040 673	(5 012 085)	115 028 588	120 040 673	(5 012 085)	115 028 588
Buildings	494 430 008	(149 135 057)	345 294 951	489 829 714	(148 883 038)	340 946 676
Machinery & farming equipment	93 196 722	(35 890 930)	57 305 792	88 789 277	(31 616 234)	57 173 043
Motor vehicles and aircraft	81 589 291	(47 505 762)	34 083 529	77 530 226	(40 445 532)	37 084 694
Office equipment	35 314 894	(28 503 352)	6 811 542	34 853 727	(26 174 248)	8 679 479
Computer equipment	54 214 257	(38 278 417)	15 935 840	51 551 393	(32 464 338)	19 087 055
Infrastructure	26 241 260	(3 897 549)	22 343 711	23 589 031	(3 209 838)	20 379 193
Laboratory equipment	350 254 330	(112 964 599)	237 289 731	313 218 336	(98 589 327)	214 629 009
Assets under construction	132 098 185	-	132 098 185	84 815 411	-	84 815 411
Total	**1 387 379 620**	**(421 187 751)**	**966 191 869**	**1 284 217 788**	**(386 394 640)**	**897 823 148**

Figures in Rand

Reconciliation of property, plant and equipment - 2016

	Opening balance	Additions	Disposals	Write off	Transfer to investment property	Depreciation	Impairment reversal	Total
Land	115 028 588	-	-	-	-	-	-	115 028 588
Buildings	340 946 676	4 600 294	-	-	-	(2 296 970)	2 044 951	345 294 951
Machinery & farming equipment	57 173 043	4 430 936	25 267	-	-	(4 323 454)	-	57 305 792
Motor vehicles and aircraft	37 084 694	4 187 421	(2)	-	-	(7 188 584)	-	34 083 529
Office equipment	8 679 479	461 167	-	-	-	(2 329 104)	-	6 811 542
Computer equipment	19 087 055	2 662 864	-	-	-	(5 814 079)	-	15 935 840
Infrastructure	20 379 193	2 652 226	-	-	-	(687 708)	-	22 343 711
Laboratory equipment	214 629 009	37 035 878	-	-	-	(14 375 156)	-	237 289 731
Assets under construction	84 815 411	47 282 774	-	-	-	-	-	132 098 185
	897 823 148	**103 313 560**	**25 265**	**-**	**-**	**(37 015 055)**	**2 044 951**	**966 191 869**

Reconciliation of property, plant and equipment - 2015

	Opening balance	Additions	Disposals	Write off	Transfer to investment property	Depreciation	Impairment	Total
Land	115 028 588	-	-	-	-	-	-	115 028 588
Buildings	342 866 095	9 341 079	(230 052)	-	(98 648)	(10 401 196)	(530 602)	340 946 676
Leasehold property	2 504	-	-	-	-	(2 504)	-	-
Machinery & farming equipment	52 307 991	9 458 114	(21 804)	(315 229)	-	(4 256 029)	-	57 173 043
Motor vehicles and air craft	35 793 250	8 814 103	(404 641)	(6)	-	(7 118 012)	-	37 084 694
Office equipment	9 443 140	1 295 777	(13 124)	(990)	-	(2 045 324)	-	8 679 479
Computer equipment	22 884 259	2 326 518	(21 658)	(72 606)	-	(6 029 458)	-	19 087 055
Infrastructure	15 706 276	5 591 914	-	-	-	(918 997)	-	20 379 193
Laboratory equipment	201 539 917	26 829 405	(53 032)	(181 955)	-	(13 505 326)	-	214 629 009
Non-current assets held for sale	482 023	-	(482 023)	-	-	-	-	-
Assets under construction	55 764 464	29 050 947	-	-	-	-	-	84 815 411
	851 818 507	**92 707 857**	**(1 226 334)**	**(570 786)**	**(98 648)**	**(44 276 846)**	**(530 602)**	**897 823 148**

NOTES TO THE ANNUAL FINANCIAL STATEMENTS
FOR THE YEAR ENDED 31 MARCH 2016

Figures in Rand	2016	2015

12. Property, plant and equipment (continued)

Other information

Property, plant and equipment fully depreciated and still in use (Gross carrying amount)

Buildings	833	866
Computer equipment	3 843	1 959
Infrastructure	2	25
Laboratory equipment	11 392	13 294
Machinery and farming equipment	4 318	3 203
Office furniture and equipment	36 456	34 067
Vehicles	507	458
	57 351	**53 872**

ARC is using some assets that have reached end of economic life as they cannot be replaced due to budget constraints.

Reconciliation of assets under construction 2016

	Buildings	Laboratory equipment	Computer Equipment	Infrastructure	Other PPE	Total
Opening	36 299 829	5 125 093	13 627 765	5 146 084	24 616 640	84 815 411
Additions	34 927 297	-	-	-	12 355 477	47 282 774
Subtotal	71 227 126	5 125 093	13 627 765	5 146 084	36 972 117	132 098 185
	71 227 126	**5 125 093**	**13 627 765**	**5 146 084**	**36 972 117**	**132 098 185**

Reconciliation of assets under construction 2015

	Buildings	Laboratory equipment	Computer equipment	Infrastructure	Other PPE	Total
Opening Balance	30 381 696	5 104 818	13 414 444	5 027 646	1 835 860	55 764 464
Additions	5 918 133	20 275	213 321	118 438	22 780 780	29 050 947
Subtotal	36 299 829	5 125 093	13 627 765	5 146 084	24 616 640	84 815 411
	36 299 829	**5 125 093**	**13 627 765**	**5 146 084**	**24 616 640**	**84 815 411**

NOTES TO THE ANNUAL FINANCIAL STATEMENTS
FOR THE YEAR ENDED 31 MARCH 2016

Figures in Rand	2016	2015

13. Intangible assets

	2016			2015		
	Cost	Accumulated amortisation and accumulated impairment	Carrying value	Cost	Accumulated amortisation and accumulated impairment	Carrying value
Computer software	48 062 616	(8 199 237)	39 863 379	48 871 637	(2 740 441)	46 131 196

Reconciliation of intangible assets - 2016

	Opening balance	Write off	Amortisation	Total
Computer software	46 131 196	(809 021)	(5 458 796)	39 863 379

Reconciliation of intangible assets - 2015

	Opening balance	Additions	Amortisation	Total
Computer software	30 476 774	18 394 862	(2 740 440)	46 131 196

14. Heritage assets

	2016			2015		
	Valuation	Accumulated impairment losses	Carrying value	Valuation	Accumulated impairment losses	Carrying value
Historical buildings	223 167	-	223 167	223 167	-	223 167

Reconciliation of heritage assets 2016

	Opening balance	Total
Historical buildings	223 167	223 167

Reconciliation of heritage assets 2015

	Opening balance	Additions	Total
Historical buildings	221 000	2 167	223 167

Heritage assets consists of a building which is currently a museum displaying Sir Arnold Theilers office and the equipment which he used when he started veterinary science in Onderstepoort. Arnold Theiler is regarded as the father of veterinary science in South Africa.

The equipment used by Sir Arnold Theiler has not been valued as ARC is still in the process of determining the value of the equipment used by Sir Arnold Theiler.

NOTES TO THE ANNUAL FINANCIAL STATEMENTS
FOR THE YEAR ENDED 31 MARCH 2016

Figures in Rand		2016	2015 Restated*

15. Other financial assets

Designated at fair value			
Capevin (KWV unbundling)		4 536 711	4 726 388
510 409 shares market price R 8.89 (2015: 510 409 shares at R 9.26)			
KWV Holdings LTD (KWV unbundling)		276 447	332 277
51 041 shares market price R 5.42 (2015: 51 041 shares at R 5.42)			
		4 813 158	**5 058 665**
Residual interest at cost			
De Doorns Winery		5 434	5 434
9 880 shares at R0.55 (2015: 9 880 shares at R0.55)			
Lutzville 2009 Co-operative Limited		1 070	1 070
107 000 shares at R0.01each (2015: 107000 shares at R0.01 each)			
Burpak Limited		1 948	1 948
1 948 shares at R1.00 each (2015: 1 948 shares at R1.00 each)			
Lutzville Vineyard Co-operative		44 867	44 867
44 867 shares at R1.00 each (2015: 44 867 shares at R1.00 each)			
Lutzville Vineyard Co-operative		10 700	10 700
1 070 000 shares at R0.01each (2015: 1 070 000 shares at R0.01 each)			
Hex Valley Coolrooms		8 046	8 046
16 092 shares at R0.50 each (2015: 16092 shares at R0.50 each)			
Mcgregor Co-operative Limited		110 320	110 320
110 320 shares at R1.00 each (2015: 110 320 shares at R1.00 each)			
Lanko Co-operative Limited		21 063	21 063
21 063 shares at R1.00 each (2015: 21 063 shares at R1.00 each)			
		203 448	**203 448**
		5 016 606	**5 262 113**
Non-current assets			
At fair value	28	4 813 158	5 058 665
At cost		203 448	203 448
		5 016 606	**5 262 113**

16. Payables from exchange transactions

Trade payables	60 907 371	68 244 624
Payments received in advanced - contract in process	80 007 944	103 724 668
Other payables	175 288 598	103 214 537
	316 203 913	**275 183 829**

Trade payables are settled within thirty days. Exceptions may arise where an account is settled after thirty days.

Payables ageing

Current	58 951 520	40 305 314
Up to 60 days	392 177	4 564 203
90 days	59 534	2 036 607
91-120 days	53 661	20 729 780
121-150 days	426 950	409 104
150 days	1 023 531	199 616
	60 907 373	**68 244 624**

NOTES TO THE ANNUAL FINANCIAL STATEMENTS
FOR THE YEAR ENDED 31 MARCH 2016

Figures in Rand	2016	2015 Restated*

17. VAT payable

VAT payable	5 713 365	12 788 499

18. Provisions

Reconciliation of provisions - 2016

	Opening Balance	Additions	Utilised during the year	Total
Leave provision	58 941 300	12 764 447	(14 931 037)	56 774 710
Bonus provision	47 243 404	19 867 563	(32 110 967)	35 000 000
	106 184 704	**32 632 010**	**(47 042 004)**	**91 774 710**

Reconciliation of provisions - 2015

	Opening Balance	Additions	Utilised during the year	Total
Leave provision	57 485 925	23 848 913	(22 393 538)	58 941 300
Bonus provision	35 000 001	35 000 001	(22 756 598)	47 243 404
	92 485 926	**58 848 914**	**(45 150 136)**	**106 184 704**

The leave pay obligation is the balance of employee leave days outstanding at year-end, reflected as a rand value. The amounts are based on total cost of employment and leave days due.

Bonus provision is the amount that is payable to ARC staff members and is based on the performance rating and affordability.

NOTES TO THE ANNUAL FINANCIAL STATEMENTS
FOR THE YEAR ENDED 31 MARCH 2016

Figures in Rand	2016	2015 Restated*

19. 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 (Categories A, B & C), operating as a defined benefit fund
- ARC Pension fund (Category D), operating as a defined contribution fund
- ARC Provident fund, operating as a defined contribution fund

The defined benefit fund covers 1.0%(2015: 1.0%) of the employees whilst 99.0 % (2015: 99.0%) are covered by the two defined contribution funds.

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.

Defined benefit fund

The defined benefit fund was actuarially valued at least every three years on the projected unit credit method. All defined benefit fund members were converted to defined contribution fund as at 1 April 2015.

Membership of the fund at 31 March 2016 and employer contributions for the year were as follows:

	Working members		Employer contributions	
	2016	2015	2016	2015
ARC Pension Fund (Options A to C)	-	11	-	516 000

Employer contribution for the next financial year are estimated at R 506 618.

Estimates were made by the actuary based on the actuarial valuation as at 31 March 2016.

Principal actuarial assumptions (expressed at weighted averages) were as follows:

	2016 %	2015 %
Pre-retirement discount rate	-	6,28
Post-retirement discount rate	-	4,78
Expected real after-tax return on fund's assets	-	6,28
Future general and merit salary increases	-	5,78
Expected rate of return on assets	-	6,28

The ARC responsibility is to fund the shortfall on the defined benefit. This is sufficiently covered by the employers surplus account. The ARC is responsible to appoint some of the Trustees who are charged with governance and administration of the fund. The Trustees administer the fund independent of ARC's management.

The following table summarises the components of the benefit

Net benefit gain		
Current service cost	-	(1 012 000)
Interest on the benefit obligation	-	(3 139 000)
Expected return on plan assets	-	5 367 000
Net benefit (loss)/gain	**-**	**1 216 000**
Defined obligation	-	(42 792 000)
Fair value of plan assets	-	65 900 000
Net asset	-	23 108 000
Unrecognised asset	-	(23 108 000)

NOTES TO THE ANNUAL FINANCIAL STATEMENTS
FOR THE YEAR ENDED 31 MARCH 2016

Figures in Rand	2016	2015 Restated*

19. Employee benefit obligations (continued)

Benefit asset/liability	-	-

The pension plan assets consist primarily of equity, interest-bearing stock, cash deposits and overseas financial assets.The assets are diversified to guard against change in any economic factors. Change in one of the economic factors will result in a insignificant change in the plan assets.

Reconciliation of plan assets		
Fair value at the beginning	-	60 191 000
Expected returns on the asset	-	5 367 000
Member contributions	-	192 000
Risk premiums	-	(123 000)
Benefits paid	-	(644 000)
Actuarial gains	-	401 000
Employer contributions	-	516 000
	-	**65 900 000**

Changes in the defined benefit obligation		
Benefit obligation at beginning of the year	42 792 000	34 804 000
Service cost	-	1 012 000
Members contributions	-	192 000
Interest cost	-	3 139 000
Actuarial gain (loss)	-	4 412 000
Benefits paid	-	(644 000)
Risk premiums	-	(123 000)
Change to DC membership	(42 792 000)	-
Benefit obligation at end of the year	-	**42 792 000**

	2014	**2013**	**2012**	**2011**
Benefit obligation	(34 804 000)	(28 575 000)	(22 840 000)	(20 368 000)
Fair value - benefit asset	60 191 000	43 748 000	40 475 000	33 825 000
Unrecognised surplus	**25 387 000**	**15 173 000**	**17 635 000**	**13 457 000**

Defined contribution Funds

Membership of the fund at 31 March and employer contributions for the year were as follows:

	Working members		**Employer contributions**	
	2016	**2015**	**2016**	**2015**
ARC Pension Fund (Option D)	1 278	1 400	38 184 569	34 844 392
ARC Provident Fund	864	956	6 155 937	11 289 157

Due to the nature of these funds the accrued liabilities by definition equate the total assets under these funds.

Management estimated that ARC will contribute R 40 475 643 to option D pension fund and R 6 525 293 the provident fund in 2017.

Post-retirement medical benefits

This includes current and past employees of ARC who are currently members of the medical aid fund. Membership to the fund is voluntary.

NOTES TO THE ANNUAL FINANCIAL STATEMENTS
FOR THE YEAR ENDED 31 MARCH 2016

Figures in Rand	2016	2015 Restated*

19. Employee benefit obligations (continued)

The Council attempted to restructure the defined medical aid scheme, in terms of which the ARC had obligations to provide certain post-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). This restructuring was not completed and the defined benefit obligation remained. 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 2016. 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.

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 2016. The obligation is fulfilled as the employees exit this fund.

The principal assumptions in determining the post-retirement medical aid liability are as shown:

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:

Present value of obligations	16 641 000	20 230 000
Post-retirement benefit obligation	16 641 000	20 230 000
Net discount rate applied	6.00%	6.28%
Membership of the fund at 31 March	454	486
Amounts recognised in respect of the scheme are as follows:		
Current service cost	683 000	545 000
Interest cost	1 168 000	843 000
Annual expense	**1 851 000**	**1 388 000**
Changes in the benefit obligation		
Opening balance	20 230 000	16 641 000
Service cost	683 000	545 000
Interest cost	1 168 000	843 000
Expected benefit settlements	(2 904 974)	(2 459 685)
Expected liability as at 31 March	19 176 026	15 569 315
Actuarial (loss) gain	(2 535 026)	4 660 685
Closing balance	**16 641 000**	**20 230 000**

NOTES TO THE ANNUAL FINANCIAL STATEMENTS
FOR THE YEAR ENDED 31 MARCH 2016

Figures in Rand	2016	2015 Restated*

20. Unspent conditional grants and receipts

Government grants received that will be recognised in future accounting periods. These conditional revenue will be recognised in future period upon completion of the Exotic disease and the Wild suide facilities . The construction of the Exotic disease and Wild suide facilities is in progress.

Movement during the year

Balance at the beginning of the year	192 596 947	192 596 947

This grant relates to construction of the Exotic Disease and Wild Suide facilities.

21. Capital Fund

Issued		
Balance	111 986 013	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.

22. Cash (used in) / generated from operations

(Deficit) surplus	(73 438 610)	14 383 531
Adjustments for:		
Depreciation and amortisation	42 473 853	47 017 287
Reversal/(impairment)	(2 044 951)	530 601
Movements in retirement benefit assets and liabilities	(3 589 000)	3 589 000
Movements in provisions	(14 409 994)	13 698 778
Other non cash items	-	263 158
Assets written off	809 020	570 789
Change in investments fair value	245 508	(934 559)
Changes in working capital:		
Inventories	4 928 178	6 452 509
Receivables from exchange transactions	(92 289 542)	806 370
Payables from exchange transactions	41 020 082	46 538 033
VAT	(7 075 134)	4 986 436
	(103 370 590)	**137 901 933**

23. Operating lease

The 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.

The future minimum lease payments under non-cancellable operating leases are as follows:

2016	**Up to 1 year**	**2-5 yrs**	**More than 5 yrs**	**Total**
Commitment	19 790 766	35 587 152	-	55 377 918

2015	**Up to 1 year**	**2-5 yrs**	**More than 5 yrs**	**Total**
Commitment	5 770 588	2 446 745	-	8 217 333

NOTES TO THE ANNUAL FINANCIAL STATEMENTS
FOR THE YEAR ENDED 31 MARCH 2016

Figures in Rand	2016	2015 Restated*

24. Contingencies

There are contingent liabilities in respect of		
Guarantees on municipal and electricity accounts	1 075 360	1 075 360
Pending labour dispute	7 336 241	4 919 191
Surplus generated from commercial activities	-	33 305 632
Litigation	2 068 246	2 118 296
	10 479 847	**41 418 479**

The guarantee on municipal and electrical accounts relate to the City of Tshwane municipality to ensure a continued service to the ARC- Onderstepoort Veterinary Institute. The timing of these contingent liabilities is not known and ARC does not expect any reimbursement of the contingent liabilities.

Labour dispute contingent liability relate to outstanding labour matters that are at CCMA and labour court.

Litigation relate to civil matters against ARC for which the outcome of the court cannot be determined reliably.

25. Commitments

This committed expenditure relates to property and will be financed by available bank facilities, retained surpluses, rights issue of shares, issue of debentures, mortgage facilities, existing cash resources, funds internally generated, etc.

25.1 Capital Commitments

Building	2 765 177	6 344 326
Infrastructure	1 746 758	660 677
Machinery and farming equipment	1 231 724	613 792
Laboratory equipment	8 276 914	12 588 050
Office furniture and equipment	75 018	50 468
Computer equipment	882 490	97 002
Motor Vehicles	2 321 724	1 067 386
	17 299 805	**21 421 701**

Capital expenses commitments relate to various capital items for which orders have been placed.

NOTES TO THE ANNUAL FINANCIAL STATEMENTS
FOR THE YEAR ENDED 31 MARCH 2016

Figures in Rand	2016	2015 Restated*

26. Related parties

Relationships	Name of the related party
Executive managers are regarded as related parties	
Controlling entity	Department of Agriculture, Forestry and Fisheries
National department - (under common control with controlling entity)	Department of Tourism
Public entity - (Under common control with ARC)	Perishable Products Export Control Board
National Department - (under common control with controlling entity)	Department of Environmental Affairs
Public entity - (Under common control with ARC)	Onderstepoort Biological Products
National Department - (under common control with controlling entity)	Department of Science and Technology
National Department - (under common control with controlling entity)	Department of Rural Development and Land Reform
National Department - (under common control with controlling entity)	Department of Water Affairs
National Department - (under common control with controlling entity)	Department of Public Works
National Department - (under common control with controlling entity)	Department of Basic Education
National Department - (under common control with controlling entity)	Department of Arts and Culture
National Department - (under common control with controlling entity)	Department of Transport
Public entity - (Under common control with ARC)	National Agricultural Market Council

During the year the entity in the ordinary course of business entered into various transactions with related parties. Transactions entered into and balances outstanding between these parties are as follows:

Related party balances

OBP	2 287 977	-
Department of Rural Development and Land Reform - Other Grants	-	(244 896)
Department of Agriculture Forestry and Fisheries - Other Grants	29 621 323	-
Department of Agriculture Forestry and Fisheries - Other Grants	-	12 374 997
Department of Public Works	232 167	12 703
OBP	(17 593)	139 079
Department of Agriculture Forestry and Fisheries	(4 877 451)	(4 877 451)
Department of Agriculture Forestry and Fisheries FMD	(126 790 987)	(129 524 909)
Department of Agriculture Forestry and Fisheries Economics Competitiveness support	-	(80 400 615)
Department of Water Affairs	8 816	8 816
Department of Science and Technology	(13 491 455)	(16 109 088)
Department of Environmental Affairs	54 974 222	25 960 011
Department of Education	36 018	27 662
Department of Rural Development and Land Reform	49 783 381	60 850 678
Department of Water Affairs	964 947	-
Department of Water Affairs and Forestry	(10 330)	-

Related party transactions

Department of Rural Development and Land Reform -Services	(128 393 097)	(175 162 343)
Department of Environmental Affairs - Services	(30 573 524)	(34 596 641)
Department of Agriculture forestry and Fisheries - PBR registrations	1 749	-
Department of Science and Technology - Parliamentary Grant	(39 473 685)	(52 543 859)
Department of Science and Technology - Other Revenue Grants	(53 652 326)	(11 396 000)
Department of Agriculture Forestry and Fisheries - Parliamentary Grant	(705 204 212)	(902 762 842)
Department of Agriculture Forestry and Fisheries - Services	(133 257 303)	(16 717 354)
Department of Education	(162 132)	(63 185)
Department of Public works - Services	(347 089)	(16 141)
Department of Water affairs -Research services	-	(8 267 464)
OBP - Services	166 314	-
OBP -Utilities recovery	(4 469 942)	(11 459 161)
Perishable Products Export Control Board - Training Services	802 369	-
National Agricultural Market Council -Services	750 000	-
Department of Public works - Services	141 118	-
Department of Water Affairs and Forestry	112 663	-
Department of Water Affairs	131 216	-

NOTES TO THE ANNUAL FINANCIAL STATEMENTS
FOR THE YEAR ENDED 31 MARCH 2016

Figures in Rand	2016	2015 Restated*

26. Related parties

The balances are payable and collectable within 30 days. Executive Managers' remuneration is disclosed in note 27.

NOTES TO THE ANNUAL FINANCIAL STATEMENTS
FOR THE YEAR ENDED 31 MARCH 2016

Figures in Rand	2016	2015

27.Council, Executive Managers and Audit Committee remuneration

Executive

2016

	Salaries	Subsistence and travel	Pension	Bonus	Leave payout	Medical aid	Total
Dr SR Moephuli	2 344 438	30 421	302 400	189 000	-	53 162	2 919 421
Mr GM Maluleke	1 912 932	7 197	209 269	141 289	-	57 684	2 328 371
Dr M Jeenah	533 950	50 446	36 509	-	255 965	-	876 870
Dr DJG REES	1 487 189	7 074	221 631	112 226	-	22 672	1 850 792
Dr MA Magadlela	1 483 535	46 277	93 334	86 450	-	34 398	1 743 994
Mr F Monkwe	1 531 740	2 015	166 223	80 162	-	33 529	1 813 669
Ms MH Umlaw	1 557 227	3 438	149 931	105 765	-	-	1 816 361
Dr N Motete	380 958	-	40 979	-	-	4 924	426 861
Dr LL Magingxa	1 512 104	93 404	166 223	112 226	-	53 162	1 937 119
	12 744 073	**240 272**	**1 386 499**	**827 118**	**255 965**	**259 531**	**15 713 458**

2015

	Salaries	Subsistence and travel	Pension	Bonus	Medical aid	Total
Dr SR Moephuli	2 146 847	2 548	273 888	167 059	48 478	2 638 820
Mr GM Maluleke	1 792 381	1 876	193 767	140 819	52 602	2 181 445
Dr M Jeenah	1 999 777	36 895	135 219	147 405	-	2 319 296
Dr MA Magadlela	1 393 897	6 914	79 039	86 162	31 442	1 597 454
Mr F Monkwe	1 438 851	5 897	153 850	111 795	26 579	1 736 972
Ms MH Umlaw	1 403 993	34 479	121 881	105 413	-	1 665 766
Dr DJG REES	1 392 145	7 247	205 213	47 995	20 675	1 673 275
Dr LL Magingxa	1 416 398	20 289	153 910	-	48 478	1 639 075
	12 984 289	**116 145**	**1 316 767**	**806 648**	**228 254**	**15 452 103**

NOTES TO THE ANNUAL FINANCIAL STATEMENTS
FOR THE YEAR ENDED 31 MARCH 2016

Figures in Rand	2016	2015

27.Council, Executive Managers and Audit Committee remuneration (continued)

Non-executive

2016

	Committees fees	Subsistence travel	Total
Prof S Vil Nkomo (Chairperson)	147 356	2 584	149 940
Ms J Masiteng	215 136	8 651	223 787
Mr M Dyasi	64 640	1 995	66 635
Prof L Hoffman	87 264	3 483	90 747
Mr A Bishop	87 568	9 405	96 973
Ms FW Jansen van Rijssen	122 816	1 358	124 174
Dr JM Chitja	78 176	1 668	79 844
Ms D Ndaba	153 728	16 609	170 337
Mr C Kneale	67 872	8 643	76 515
Prof MJ Kahn	297 083	33 466	330 549
Prof FJC Swanepoel	103 424	7 118	110 542
Mr G Martin	113 120	11 419	124 539
Mr R Nicholls	47 320	5 911	53 231
Mr I Motala	77 568	13 526	91 094
Dr NS Msomi	40 000	-	40 000
	1 703 071	**125 836**	**1 828 907**

2015

	Committees fees	Subsistence fees	Total
Prof S Vil Nkomo (Chairperson)	252 222	1 719	253 941
Mr JWA Godden (Former Chairperson)	133 970	1 392	135 362
Ms J Masiteng	213 136	8 529	221 665
Mr M Dyasi	115 744	2 476	118 220
Prof L Hoffman	45 248	2 412	47 660
Mr A Bishop	70 753	7 638	78 391
Ms D Msomi	64 640	7 641	72 281
Ms FW Jansen van Rijssen	142 208	5 714	147 922
Dr JM Chitja	77 568	2 795	80 363
Ms D Ndaba	109 536	10 417	119 953
Mr C Kneale	80 096	9 505	89 601
Prof MJ Kahn	213 601	14 272	227 873
Prof FJC Swanepoel	193 568	9 281	202 849
Mr G Martin	67 520	8 156	75 676
Mr R Nicholls	74 468	12 830	87 298
Mr I Motala	96 784	18 918	115 702
	1 951 062	**123 695**	**2 074 757**

NOTES TO THE ANNUAL FINANCIAL STATEMENTS
FOR THE YEAR ENDED 31 MARCH 2016

Figures in Rand	2016	2015

27.Council, Executive Managers and Audit Committee remuneration (continued)

Audit committee

2016

	Fees	Subsistence and travel	Total
Mr VN Naicker (Chairperson)	83 625	382	84 007
Mr LM Mangquku	41 875	1 745	43 620
Ms K Mokoena	67 500	2 995	70 495
Mr JH Mcbain	45 000	894	45 894
	238 000	**6 016**	**244 016**

2015

	Fees	Subsistence and travel	Total
Mr VK Naicker	72 375	1 588	73 963
Mr LM Mangquku	65 625	1 623	67 248
Ms K Mokoena	71 806	3 038	74 844
Mr JH Mcbain	48 681	4 664	53 345
Ms G Bruiders	74 306	806	75 112
	332 793	**11 719**	**344 512**

NOTES TO THE ANNUAL FINANCIAL STATEMENTS
FOR THE YEAR ENDED 31 MARCH 2016

Figures in Rand	2016	2015 Restated*

28. Risk management

Category of financial instruments and maturity profile

2016	**Notes**	**0-1 Years**	**>1 year**	**Total**
		R	**R**	**R**
Assets				
Investments:				
Investments	15	-	5 016 605	5 016 605
Assets at amortised cost:				
Cash and cash equivalents	10	301 526 198	-	301 526 198
Trade and other receivables	9	201 159 590	-	201 159 590
Liabilities				
At amortised cost:				
Payables	16	(236 195 970)	-	(236 195 970)
		266 489 818	**5 016 605**	**271 506 423**
Percentage profile		98,15%	1,85%	100,00%

2015	**Notes**	**0-1 Years**	**>1 year**	**Total**
		R	**R**	**R**
Assets				
Investments:				
Investments	15	-	5 262 113	5 262 113
Loans and receivables:				
Cash and cash equivalents	10	508 235 613	-	508 235 613
Trade and other receivables	9	113 215 924	-	113 215 924
Liabilities				
At amortised cost:				
Payables	16	(171 459 161)	-	(171 459 161)
		449 992 376	**5 262 113**	**455 254 489**
Percentage profile		98,84%	1,16%	100,00%

Capital risk management

As the ARC is not exposed to debt, there is no meaningful debt to equity ratios such as gearing ratios to be disclosed.

Financial risk management objectives

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 and price risk), credit risk, liquidity risk and cash flow interest rate 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.

Market risk

The entity's activities are of such a nature that limited transactions expose the ARC to financial risks of changes in foreign currency exchange rates. Market risk exposures are closely monitored by the Council members. Market risk arises on international trade.

There has been no change to the entity's exposure to market risks or the manner in which it manages and measures the risk. The market risk is managed by not taking any volatile instruments as the ARC activities do not materially expose ARC to market risk.

NOTES TO THE ANNUAL FINANCIAL STATEMENTS
FOR THE YEAR ENDED 31 MARCH 2016

Figures in Rand	2016	2015 Restated*

28. Risk management (continued)

Foreign currency risk management

The ARC incurs currency risk as a result of purchases and sales in foreign currencies, hence exposure to exchange rate fluctuations arise. The currencies in which the Council primarily deals are US Dollars and Euro's. No forward cover is taken out for these transactions. The Council members consider the foreign currency risk to be insignificant.

Interest rate risk managemen

ARC is exposed to interest rate risk as it places funds at both fixed and floating interest rates. The risk is managed through investing the surplus funds at fixed and floating interest rates with reputable banks.

The following demonstrates the sensitivity to a reasonable change in interest rates, with all being constant and the impact on net surplus:

South African Rand (ZAR):		
Increase by 50 base points	1 507 631	2 539 691
Decrease by 50 base points	(1 507 631)	(2 539 691)

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:

March 2016	
Current cash balances	42 868 053
Short-term cash deposits	258 658 145
	301 526 198
March 2015	
Current cash balances	133 665 660
Short-term cash deposits	374 569 953
	508 235 613

Other price risks

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.

Credit risk management

Credit risk refers to the risk that counterparty would default on its contractual obligations resulting in financial loss to the entity. The entity has adopted a policy of only dealing with creditworthy counterparties and obtaining sufficient collateral, where appropriate, as a means of mitigating the risk of financial loss from defaults.

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 5% 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.

NOTES TO THE ANNUAL FINANCIAL STATEMENTS
FOR THE YEAR ENDED 31 MARCH 2016

Figures in Rand	2016	2015 Restated*

28. Risk management (continued)

Liquidity risk management

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.

Fair value hierarchy

As at 31 March 2016, 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:

Assets measured at fair value		31 March 2016	Level 1	31 March 2015	Level 1
Financial assets at fair value	15	4 813 158	4 813 158	5 058 665	5 058 665

29. Irregular expenditure

Opening balance	648 209	1 461 128
Add: Irregular Expenditure - current year	-	648 209
Less: Amounts condoned	(648 209)	(1 461 128)
	-	**648 209**

Analysis of expenditure awaiting condonation per age classification

Current year	-	648 209

Goods and services

The irregular expenditure relates to goods and services expenditure incurred in 2015 as a result of a ARC's non compliance to procurement policies and Public Finance Management Act 1 of 1999 (as amended by Act 29 0f 1999).

2016

The 2015 irregular expenditure was condoned during the year under review. There were no irregular expenses in 2016.

2015

Management investigated the 2015 irregular procurement of goods and services and applied for condonement, disciplinary action was recommended. The amounts that are not condoned are still under investigation and appropriate action will be taken based on the outcome of the investigation.

NOTES TO THE ANNUAL FINANCIAL STATEMENTS
FOR THE YEAR ENDED 31 MARCH 2016

Figures in Rand	2016	2015 Restated*

30. Fruitless and wasteful expenditure

Fruitless and wasteful expenditure	265 258	15 447

R34,111 expenses were incurred as a result of work performed twice. Disciplinary action has been initiated against the official involved.

R148,626 relates to SARS interest of late declaration and R82,521 relates to employees paid after termination of service.

The 2015 fruitless and wasteful expenses were incurred by paying interest charged on late payment.

31. Events after reporting date

The Council members are not aware of any significant matters or circumstances arising since the end of the financial year which need to be reported as part of these financial statements.

32. Taxation

The ARC is exempt from Income Tax in terms of section 10(1) (a) of the Income Tax Act no.58 of 1962.

NOTES TO THE ANNUAL FINANCIAL STATEMENTS
FOR THE YEAR ENDED 31 MARCH 2016

Figures in Rand	2016	2015 Restated*

33. Prior period errors

During the 2016 financial year it was noted the historic leave balances were not included in the leave pay provision calculation thus resulting in an understatement of R18,922,102.

There were pieces of land transferred to the ARC at R1. This land was adjusted to reflect the estimated fair value on transfer of this land to the ARC.

The errors have been corrected by restating each of the affected financial statement line items for the prior periods, as follows:

Statement of financial position	Property, plant and equipment	Provision for leave pay
Previously reported	895 430 538	40 019 198
Prior period adjustment	2 392 610	18 922 102
	897 823 148	**58 941 300**

Employee costs	Provision for leave pay
Previously reported - Provision for leave pay	760 364 180
Prior period error - provision for leave pay	18 922 102
	779 286 282

Impact on Changes in Net Assets	Accumulated surplus	Capital fund
Previously reported	888 946 815	109 593 403
Prior period error	(18 922 102)	2 392 610
	870 024 713	**111 986 013**

Impact on Statement of Financial Performance	Prior year surplus
Previously reported	33 305 632
Prior period error	(18 922 102)
	14 383 530

34. Change in estimate

Property, plant and equipment

Useful lives of assets in the accounting policy were reviewed as follows:

	Old	**New**
Buildings	40-50 years	40-70 years
Manufacturing & Farming Equipment	15-35 years	15-40 years
Office Furniture & Equipment	5-15 years	5-20 years
Motor vehicles and aircraft	4-10 years	4-15 years
Infrastructure	10-50 years	10-60 years
Laboratory equipment	15-35 years	15-40 years

NOTES TO THE ANNUAL FINANCIAL STATEMENTS
FOR THE YEAR ENDED 31 MARCH 2016

Figures in Rand	2016	2015 Restated*

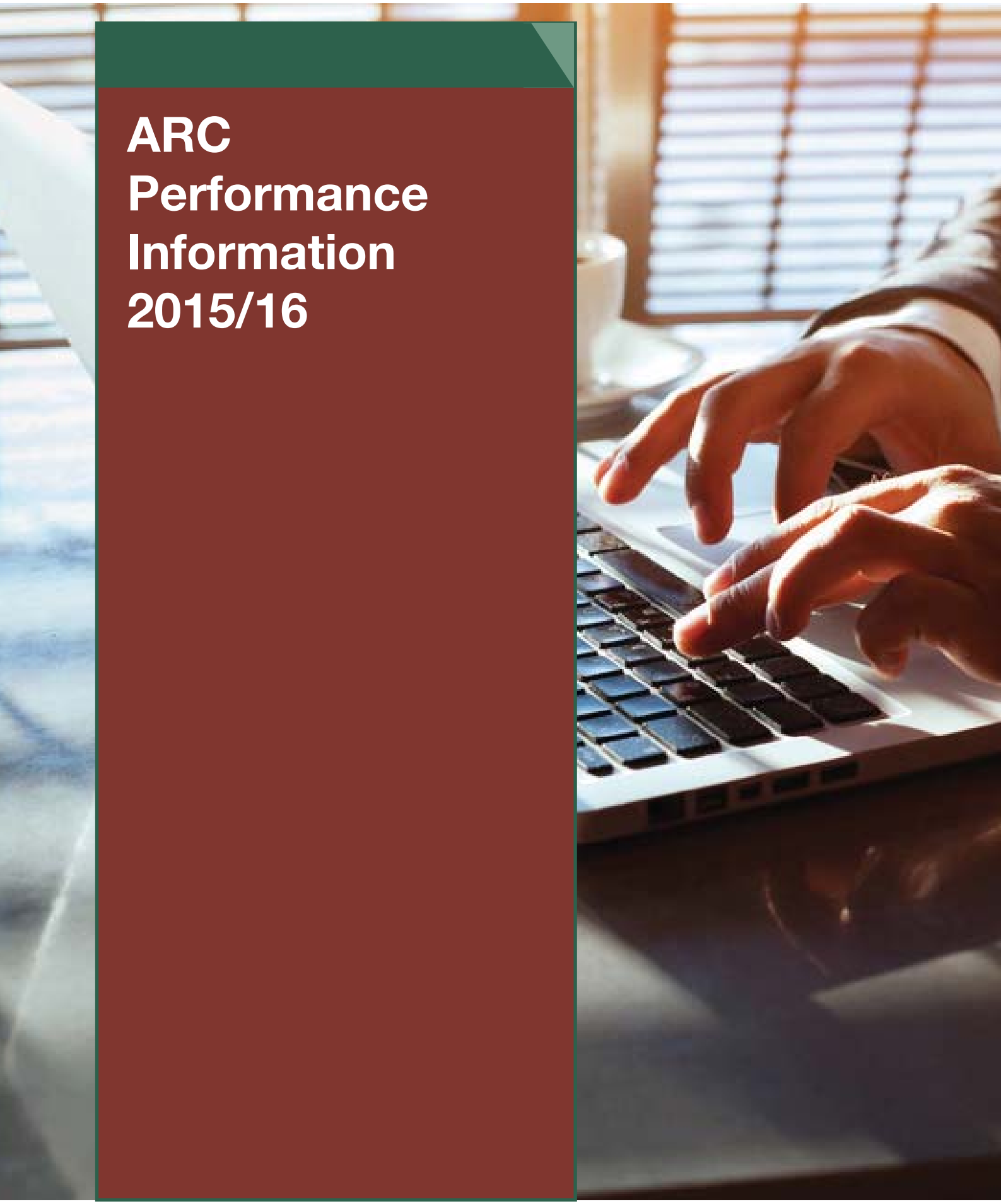
35. Comparative figures

Certain comparative figures have been reclassified.

The net WIP account was in credit thus reclassified to payables from exchange transactions.

The effects of the reclassification are as follows:

Statement of financial position		
Receivables from exchange transactions	-	7 465 331
Payables from exchange transactions	-	7 465 331
Categories of financial instruments		
Trade and other receivables	-	10 694 715
Payables	-	(7 291 823)
Assets measured at fair value		
Financial assets at fair value	-	(65 841)



ARC Performance Information 2015/16

PROGRAMME	KEY OUTPUTS	INDICATOR 2015/16	TARGET	ACTUALS	VARIANCE	REASON FOR VARIANCE
GOAL 1 TO GENERATE KNOWLEDGE AND TECHNOLOGIES THAT WILL ENHANCE THE EFFICIENCIES IN CROP BASED AGRICULTURE						
Crops	Knowledge generated	Number of scientific publications	94	**137**	**43**	Publications accepted faster than anticipated
	Technologies Developed	Number of Cultivars registered	12	**23**	**11**	Registration process faster than anticipated
	Scientific Services rendered	Number of Diagnostic and Analytical services rendered	664	**802**	**138**	Higher demand for ARC services
	Information Disseminated	Number of technical reports and manuals	679	**447**	**(232)**	Fewer technical reports and manuals developed
		Number of field trial sites	453	**389**	**(64)**	Fewer field trials as a result of the drought
GOAL 2 TO GENERATE KNOWLEDGE AND TECHNOLOGIES THAT WILL ENHANCE THE EFFICIENCIES IN LIVESTOCK BASED AGRICULTURE						
Livestock	Knowledge generated	Number of scientific publications	90	**90**	**-**	
	Scientific Services rendered	Number of Diagnostic and Analytical services rendered	24 600	**17 667**	**(6 933)**	Lower demand for ARC services
	Information Disseminated	Number of technical reports and manuals	16	**18**	**2**	More technical reports and manuals developed
		Number of farmers participating in animal improvement scheme	400	**362**	**(38)**	Fewer farmers participating in animal improvement scheme than anticipated
GOAL 3 TO GENERATE KNOWLEDGE AND TECHNOLOGIES FOR THE CONSERVATION AND UTILISATION OF NATURAL RESOURCES						
Natural Resources	Knowledge generated	Number of scientific publications	79	**92**	**13**	Publications accepted faster than anticipated
	Scientific Services rendered	Number of Analytical and Advisory services rendered	1 815	**1 193**	**(622)**	Lower demand for ARC services due to drought conditions
	Information Disseminated	Number of technical reports and manuals	380	**179**	**(201)**	Low demand for technical reports and manuals
		Number of field trial sites	316	**84**	**(232)**	Fewer field trials as a result of the drought
Mechanisation and Engineering	Knowledge generated	Number of scientific publications	7	**4**	**(3)**	Slow delivery of publications, due to staff constraints, caused by the resignation of a specialist researcher
	Technologies Developed	Number of prototypes developed	4	**6**	**2**	Prototypes developed faster than anticipated
	Scientific Services rendered	Number of Analytical and Advisory services rendered	10	**10**	**-**	-
	Information Disseminated	Number of technical reports and manuals	24	**41**	**17**	More technical reports and manuals developed

PROGRAMME	KEY OUTPUTS	INDICATOR 2015/16	TARGET	ACTUALS	VARIANCE	REASON FOR VARIANCE
GOAL 4 TO GENERATE KNOWLEDGE, SOLUTIONS AND TECHNOLOGIES FOR FOOD SAFETY, QUALITY AND IMPROVED EFFICIENCIES IN THE AGRICULTURE VALUE CHAIN						
Agro-processing, food technology and safety	Knowledge generated	Number of scientific publications	35	**51**	**16**	Publications accepted faster than anticipated
	Scientific Services rendered	Number of Analytical and Advisory services rendered	137	**161**	**24**	Higher demand for ARC services
	Information Disseminated	Number of technical reports and manuals	30	**67**	**37**	More technical reports and manuals developed
GOAL 5 TRANSLATE RESEARCH OUTPUTS IN ORDER TO GENERATE KNOWLEDGE, FACILITATE DECISION MAKING AND CONTRIBUTE TO THE TRANSFORMATION IN THE AGRICULTURE SECTOR						
Agriculture Economics & Commercialisation	Knowledge Generated	Number of scientific publications	4	**6**	**2**	Publications accepted faster than anticipated
	Technologies released to the agriculture sector	Number of technologies transferred under license	30	**27**	**(3)**	Finding companies and negotiating favourable licensing conditions took longer than expected
Smallholder Agricultural Development	Scientific Services Rendered	Number of smallholder farmers supported	1 506	**730**	**(776)**	Lower demand for ARC training
		Number of smallholder farmers participating in KyD	7 500	**8 430**	**930**	More farmers participating in KyD than anticipated
Training and Extension	Information Disseminated	Number of farmer field days	107	**74**	**(33)**	Many farmer days cancelled due to drought
		Number of farmer workshops	22	**37**	**15**	Higher demand for ARC training
		Number of popular publications	165	**368**	**203**	More publications developed than expected
	Training	Number of farmers trained	10 947	**10 551**	**(396)**	Lower demand for ARC training
		Number of extension officers trained	613	**1 839**	**1226**	Higher demand for ARC training

PROGRAMME	KEY OUTPUTS	INDICATOR 2015/16	TARGET	ACTUALS	VARIANCE	REASON FOR VARIANCE
GOAL 6 APPLY RESOURCE MANAGEMENT PRACTICES, TOWARDS A HIGH PERFORMING AND VISIBLE ORGANISATION						
Administration & Corporate Affairs	Improved Postgraduate SET Base	Number of students obtaining postgraduate degrees, with: Masters	43	**27**	**(16)**	Fewer students graduating than anticipated
		Doctoral Degrees	16	**28**	**12**	More students graduating than anticipated
		Number of employees appointed with: Masters Degrees	10	**14**	**4**	More employees graduating than anticipated
		Doctoral Degrees	7	**10**	**3**	More employees graduating than appointed
	Improved staff profile	Number of employees with: Masters	257	**222**	**(35)**	Fewer/More employees graduating than anticipated
		Doctoral Degrees	213	**222**	**9**	-
		Percentage staff turnover	3.50%	**3.48%**	**(0.02%)**	Fewer employees leaving employment of ARC
		Percentage increase in employment equity ratio's in the designated groupings in core business, in respect of: Black	5%	**2.02%**	**(2.98%)**	Fewer appointments made, within designated groupings in core business, than expected
		Female	3%	**1.03%**	**(1.97%)**	
		Disability	1%	**0.63%**	**(0.37%)**	
	Optimal investment in training and development	Training spend as a % of salary bill	1.5%	**4.7%**	**3.2%**	More training undertaken than originally planned
Administration & Corporate Affairs	Funding and Revenue Generation	Rand Value of external income	R 365 mil	**R 461 mil**	**R 96 mil**	External income was higher than expected
		Rand Value of royalty income	R 9 mil	**R 11.5 mil**	**R 2.5 mil**	Royalty income was higher than expected
		Current Ratio	1:1	**1.3:1**	**0.3**	Current total assets was higher than expected
		BEE spend	R 138 mil	**R 222 mil**	**R 84 mil**	Increased spending on BEE suppliers
		ARC BBBEE rating	Level 4	**Level 3**	**1 Level**	Rating results were higher than expected
	Optimal use of information resources	Number of initiatives implemented towards the development of a KM platform	2	**3**	**1**	More initiatives implemented than was expected
		Number of national assets collections digitised	2	**4**	**2**	More national assets digitised than was expected
		Number of stakeholder-interactive platforms developed	2	**4**	**2**	More platforms developed than was expected
	Optimal utilisation of assets	Percentage increase in rental income	5%	**10.8%**	**5.8%**	Rental income was higher than anticipated
		Number of business cases developed for implementation of Asset Management Plan	4	**5**	**1**	More business cases developed, than was expected

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