Celebrating a hundred years of agricultural science at the University of Pretoria

As one of South Africa's oldest universities, the University of Pretoria (UP) reaches yet another milestone in 2017. This year marks one hundred years of agricultural science at our University, which has long been recognised as a leader in the field. The centenary celebrations of agricultural science at UP encompass the three founding departments in the former Faculty of Agriculture, namely Phytopathology, Soil Science and Livestock Breeding. Today, two of these departments form part of the consolidated Department of Plant and Soil Sciences, which comprises botany, plant production (horticulture, agronomy and pasture science) and soil science. The third is the Department of Animal and Wildlife Sciences.

Centenary celebrations give us an opportunity to reflect on the past, take stock of the present and consider the future. Therefore, as we celebrate our centenary we also look ahead at future challenges and opportunities, with a focus on how we can continue to make a difference nationally, regionally and globally. Our commitment to the Sustainable Development Goals (SDGs) and the imperative for sustainable food production and food security on the African continent provides the framing context for informing our priorities.

The Faculty of Natural and Agricultural Sciences, with its specialised cluster of agricultural and food sciences, is well-positioned to respond to contemporary and future imperatives. It aims to conduct research that matters – research that makes an impact. An important characteristic of the Faculty is its multidisciplinary approach. The science of agriculture is not studied and practised in isolation, but in conjunction with all the natural sciences and with particularly close ties to fields such as biochemistry, genetics and microbiology.

The Faculty has built up a well-deserved reputation through its commitment to the University's vision of being a research-intensive university. Its achievements in this regard include the continued growth, over the past five years, in the number of staff members who have received National Research Foundation (NRF) ratings (from 137 in 2012 to 179 in 2016) and the increase in research output (including research graduates) per capita (from 1.7 in 2012 to 2.2 in 2016). The inclusion of no less than 18 faculty members out of a total of 33 UP scientists among the top 1% in the Thomson Reuters Essential Science Indicators (ESI) in the fields of Agricultural Sciences, Plant and Animal Science, Microbiology and Ecology and the Environment shows conclusively that the Faculty is well-positioned to make significant contributions to the Sustainable Development Goals.

Further confirmation of the Faculty's research standing and performance include its position in the ISI Web of Science (WOS) field rankings in Plant and Animal Sciences, Agricultural Sciences, and Environment and Ecology Sciences, against growing competition worldwide, at positions number 72/1148, 292/775 and 259/849 respectively. It was recognised for Forestry and Agriculture and for Biological Sciences in the 2017 QS subject rankings, which placed it among the top 150 institutions globally in the former, and among the top 350 in the latter. In the 2017 Centre for World University Rankings the research conducted by the Faculty's Forestry and Agricultural Biotechnology Institute (FABI) earned UP the second position in the world for the study of mycology.

With such a proud record of research excellence, the Faculty, and specifically agricultural sciences, richly deserve the accolades and congratulations accompanying its centenary celebrations.

As we contemplate the next hundred years, I am confident that with the current quality of leadership and the commitment and hard work of staff and students, agricultural sciences at the University of Pretoria will continue to grow in stature and research impact.

Prof CM de la Rey
Vice-Chancellor and Principal

Agriculture: its future and opportunities

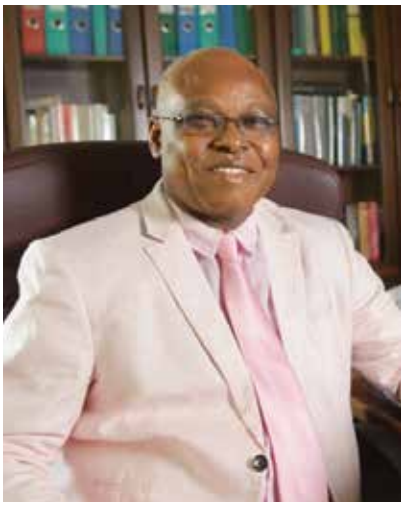
Over the past century, agriculture has played a major role in the development of South Africa, and particularly of the rural sector. The University of Pretoria, through its teaching, research and partnerships with key role players, has had a major influence on these developments. Today, agriculture is much more complex as it no longer has to deal with only farming-related issues, but also with issues that address a wider eco-system.

Agriculture has grown from mainly on-farm food production to incorporate much wider issues and composite disciplines that include, among other things, water use, the environment, sustainability, food security, food safety, biotechnology, marketing, distribution, storage and finance. The result is that agriculture today creates many more opportunities away from the farm than on the farm due to extensive income and employment multiplier effects, and its role in economic development is widely recognised. Going forward the challenge is therefore not only disciplinary in nature, but will also require 'systems' thinking and solutions.

There are a few megatrends that will shape and influence society in general, and the role of agriculture specifically, even more in the future. These include the formation of megacities, advances in biotechnology and the fourth industrial revolution due to artificial intelligence and the replacement of workers by machines. All of these technologies are driven by the massive computing capacity that has become readily available on people's desks and which, when combined with demographic trends, will result in drastic change and a new normal. In agriculture, the challenges are centred on training and research, and the University of Pretoria is well placed to continue playing a leading role not only in South Africa, but also increasingly in the rest of Africa and the world.

Dr Johan van Zyl
Current Chairperson of Sanlam and CEO of African Rainbow Capital, as well as member of UP Council
Former Rector of UP, Dean of the Faculty of Agricultural Sciences and Professor in Agricultural Economics

Message from the Dean



The Faculty of Natural and Agricultural Sciences is proud to celebrate a hundred years of agricultural science at the University of Pretoria (UP). This year marks the centenary of agricultural science at the University. A faculty of agriculture was established at the former Transvaal University College (TUC) on 20 January 1917. The then faculty consisted of three departments: Phytopathology, Soil Science and Livestock-breeding.

The Faculty of Agriculture progressed with leaps and bounds from those early years. In 1969 it changed to the Faculty of Agricultural Sciences, then to the Faculty of Biological and Agricultural Sciences in 1994. In 1999 it merged with the Faculty of Science to become the current Faculty consisting of 15 departments and more than 20 research entities.

The marriage between agriculture and other sciences has been a significant development and agricultural science is highly ranked on international metrics. This is reflected in the Faculty's favourable placement on the ISI Web of Science field rankings for the Plant and Animal Sciences and Agricultural Sciences, the 2017 QS subject rankings for Forestry and Agriculture and Biological Sciences, as well as the 2017 ARWU subject rankings for Agricultural Sciences and Biological Sciences. The visibility of agriculture on its own is a priority for the Faculty, given the growing challenges of sustainable food production and security on the African continent within the United Nations' Sustainable Development Goals.

Following on this good trajectory of the last hundred years, the Faculty is continuously working on strong partnerships with government, industry and agriculture, forging international collaborations, improving postgraduate supervision and undergraduate success, as well as ensuring that the Faculty has state of-the-art equipment and facilities to further contribute to the Faculty's continuous achievements.

Last, but not least, the Faculty aims to improve the citation profile of its publications and to target high-impact journals in agricultural science in order to contribute to the UP vision of being a leading research-intensive university in Africa.

The future contains endless possibilities and the Faculty of Natural and Agricultural Sciences is ready to face the next hundred years.

Prof Jean Lubuma
Dean: Faculty of Natural and Agricultural Sciences

Overview and reflection on 100 years of Agriculture at UP

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The Faculty of Natural and Agricultural Sciences, with a dedicated cluster for agriculture and food sciences, aims to be a leading faculty of its kind in Africa. We focus on research which makes an impact and matters. We want to improve the quality of human life in South Africa and on the African continent.

Working for food security

Over the course of the last century, the name of the department within which plant pathology is located, changed five times. What has remained consistent, however, is the staff's commitment to using its research and discoveries for the improvement of South African lives. During this time plant pathology has been a separate department and part of a dual department with microbiology. It is currently part of a large consolidated Department of Plant and Soil Sciences comprising botany, plant production (which includes horticulture, agronomy and pasture science) and soil science.

The **Department of Plant Pathology (Phytopathology)** was established in 1917 when Prof JM Hector was appointed as Professor and Head of Department (HOD). In 1944, Prof BJ Dippenaar became HOD with his field of interest being common scab of potatoes.

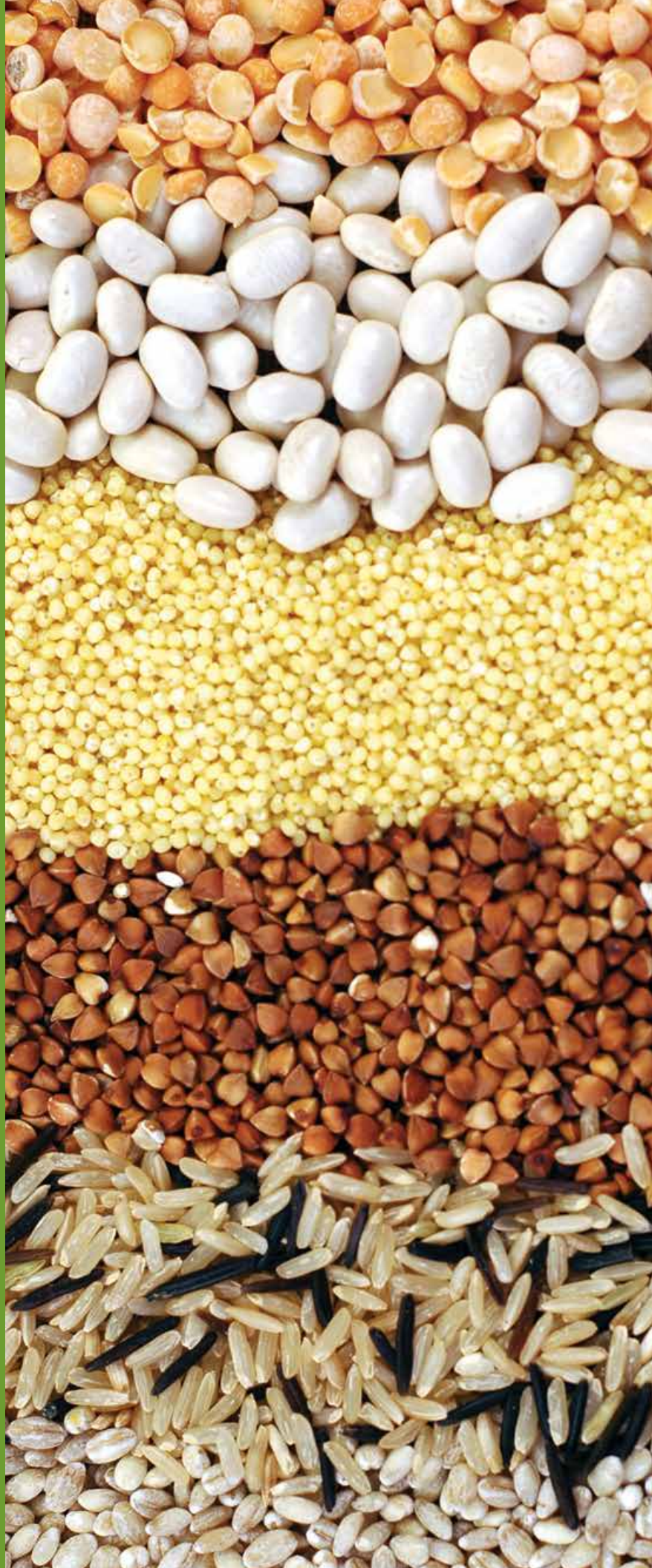
Graduates with this four-year degree have been in high demand by the industry and agricultural sector at large. As a scarce skill and professional degree, many plant pathology graduates have been highly sought after and have become tremendously successful in their careers.

Many staff members linked to other departments (such as Microbiology, Genetics) and institutes (Forestry and the Agriculture Biotechnology Institute (FABI) among others), are also actively working in the field of plant pathology and related research at UP. As such, they not only contribute to research outputs, but also to postgraduate training in plant pathology. These researchers are involved in a variety of research projects, many of which form part of FABI and contribute richly to the national heritage of our discipline and field of study.

Plant pathology studies the diseases which affect plants, whether they are fungal, viral or bacterial infections. This field of study is of particular importance to agricultural and forestry industries and to small-scale farmers because diseases can obliterate whole industries and cause widespread food supply problems.

South Africa has a dual agricultural economy, with a large industrial farming industry and a sizable culture of subsistence farming in rural areas. However, only around 12% of South Africa's land is suitable for crops (as opposed to grazing and pasture lands) and of that only 22% is fertile enough for crop growth. As a result, arable soil is fairly limited and it is essential to manage a healthy soil environment to minimise disease. To assist farmers, the Potato Pathology Programme @ UP has a diagnostic clinic which helps farmers to pinpoint possible causes of poor crops.

100 YEARS



A substantial amount of research is focussed on looking at measures to ensure plant and soil health for sustainable farming and agriculture through reducing losses and producing better crop yields on the limited amount of arable land that we have available. It is becoming increasingly apparent that conventional agriculture, based on high input of synthetic chemical pesticides and fertilisers, is unsustainable in the long term. Plant pathology investigates ways of integrating biological control methods with commercial pesticides to minimise environmental harm, but also ways of protecting crops.

Plant health is crucial to food security, and in this regard, another research group is focussed on understanding and developing ways of ensuring factors like climate change, biological impediments and disease will not undermine Africa's food supply. To address this global problem of food security, the research team has embarked on a programme which forms part of the NRF/DST Centre of Excellence in Food Security. The programme focuses on sustainable food production based on the tenets of healthy soil, which is soil that is productive and resilient. Healthy soils and clean water contribute to healthy plants and safe food which provides the overarching theme for the group working in the field of crop protection.

Research conducted within the Department is also focused on contaminated water that could potentially introduce microbial contaminants in the plant. In this programme researchers are tracking antimicrobial resistance (AR), such as the prevalence of bacteria resistant to antibiotics in the water-plant-food intersection. They also investigate the contribution of agro-ecosystems to the spread of AR resistance in South Africa. In this context it is important to keep in mind that access to safe, drinkable water and food is a basic human right. The microbiological quality of water sources, especially surface water, is seriously compromised by municipal waste water discharge, sewage from settlements with inadequate sanitation, wastes from animal husbandry, industrial companies, hospitals and the mining sector. By polluting strategic resources the risk to the consumer increases, with potential negative effects on human health, the environment and food security.

Healthy seeds and good soil result in vibrant plants that produce quality fruit and vegetables. However, postharvest diseases caused by external contaminants pose an immediate threat to the national food supply. Researchers conduct research on all factors which influence disease spread and focus on points where postharvest pathogens are introduced to the crop, either in the field or during postharvest handling and distribution. Controlling these pathogens remains a key priority to curb postharvest losses. In order to address this, research is spread across a wide variety of intersecting fields which deal with production, transport and storage logistics, fresh produce, and ready to eat foods, as well as how disease is spread, minimised or eradicated to ensure overall quality safe food for all.

Plant pathology at the University of Pretoria celebrates its centenary, but its future is decided. Improved research and constant innovation, backed by the credibility and integrity of work done over the last century, is the benchmark for the Department to extend its findings to industry, farmers, government and the general public. In so doing, the Department makes its mark on South Africa on a daily basis by improving our ability to grow, generate and buy quality fruit, vegetables and grains. With the Department's commitment and passion to the field, UP might one day be able to say with pride that its research has helped to solve famine and world hunger.

Multidisciplinary department focused on the future

South Africa has a rich biodiversity that stems from the wealth of its ecosystems, one of its greatest assets. The conservation of soil and plant life is non-negotiable for the quality of human life and the country's socio-economic development. A commitment to conserving the environment for current and future generations by providing quality training and enriching research has always been a priority of the Department of Plant and Soil Sciences.

The Department of Plant and Soil Sciences (more specifically the disciplines Plant Pathology and Soil Science) celebrates its centenary this year. Though it has undergone a number of changes, the Department has shown innovation and progression from its early days.

In 1944, Prof Margaretha G Mes, a plant physiologist, was appointed as Head of Department (HOD). She was only the second woman to have been appointed as professor at UP at the time. In 1949, the Bateman Lab, containing one of the world's first phytotrons and an enclosed research greenhouse used for studying interactions between plants and the environment were constructed. The Manie van der Schijff Botanical Garden was also established and became an integral part of the history of the Department, providing new and varied research opportunities, particularly on cycad conservation. The HGWJ Schweickerdt Herbarium was established in 1925 and is an open research facility. With approximately 110 000 specimens, it is the third largest university herbarium in South Africa.

What is now known as the Department of Plant and Soil Sciences has undergone many changes over the past 100 years, and was at one point even divided into smaller and more specific departments. In the mid-1990s the departments of Plant Production and Soil Science merged, and Botany changed its name to Plant Science. In 2014 the Plant Pathology lecturers from the Department of Microbiology and Plant Pathology were moved to the Department of Plant Sciences to create a bigger plant focussed department and in 2015, the Department of Plant Production and Soil Science were also integrated to become the multidisciplinary department now known as the Department of Plant and Soil Sciences. This Department boasts over 50 academic and support staff, some of whom are global experts in their fields of interest. There are more than 200 postgraduate students (more than half of these students are from other African countries) who contribute to the Department's impressive volume of research output.

With such a rich pool of experts in a variety of fields, this multidisciplinary department has evolved to focus on six main areas of research, namely biodiversity (ecology, taxonomy), medicinal plant science, plant pathology, plant biotechnology, soil science and agricultural sciences (which include horticulture, agronomy and pasture science). The Department is linked to UP's Institutional Research Themes in Genomics and Food, Nutrition and Well-being, and its research groups are also part of the internationally acclaimed FABI and the Centre of Excellence in Food Security, the South African National Biodiversity Institute, and the South African Forestry Companies Limited. The Department also hosts the NRF SARChI Chair in Indigenous Knowledge Systems.

Research across the disciplines that now form the Department of Plant and Soil Sciences has always been focussed on minimising negative impacts on natural resources and conserving their environments. A number of staff members are applied scientists, addressing issues that are nationally relevant. Highlights in historical research areas includes developing technology that enables irrigation with mine-impacted waters, thus addressing the pernicious problem of acid mine drainage in South Africa and other parts of the world in a cost-effective manner. Projects have been initiated to reduce the movement of pollution from field to catchment area. As most waste water treatment processes produce a sludge that must be disposed of, UP research monitored and modelled the responsible usage of sewage sludge in agriculture.

It is firmly believed that the only way to successfully build on the rich legacy of the Department is through research and teaching and learning that has a tangible impact on improving the lives of all South Africans. The pool of potential and promise is huge. Departmental facilities like the experimental farm, which includes greenhouse facilities and field trials in the vicinity of the new Future Africa development, are a strategic asset and will result in a facility where leading scientists and scholars from across the world come together to leverage the benefits of multidisciplinary research.

The Department's facilities at the experimental farm are currently undergoing renovations and with new equipment it will enable the mainstreaming of climate change research. With this new facility and equipment, crops could be grown in walk-in chambers where everything can be controlled, from temperature and humidity to the amount of light and carbon dioxide. This will enable cutting-edge research on the response of crops and pathogens to climate change. With adequate funding and support in the medium and long term, the Department will be able to expand and realise its vision and continue to train students in research fields that are relevant and transformative. Plant-based agricultural research is not dead – it is simply being reinvented at UP.

Leading the way in livestock research

From 1917 to 2017 major changes have occurred in animal and wildlife sciences. Over this century the **Department of Animal and Wildlife Sciences** has not only been leading the way, but has had a significant impact on academia and the livestock industry.

Today, the Department is the largest of its kind in South Africa and regarded as a leader in the field on the African continent, particularly in terms of training professional animal scientists and conducting livestock and poultry research. What began as the Department of Animal Production has undergone changes over the century of its existence to ensure its continued relevance. While it is focused today on being research intensive, the initial objective was to train scientists in different applied fields through practical and applied research.

One of the most important outcomes of the developments of the past 100 years was the establishment of an Animal Science programme which has a strong scientific basis and a well thought out integration of the three major disciplines of animal breeding and genetics, animal physiology and animal nutrition.

Over time research has developed from focusing exclusively on southern African issues, to producing relevant research for the whole continent. This makes the Department one of the UP specialisation fields that is ranked among the top 200 fields of specialisation on the Thomson Reuters list of Essential Science Indicators. The Essential Science Indicators database includes emerging international science trends, as well as influential individuals, institutions, papers, journals and countries in different fields of research.

Today, multidisciplinary collaboration across the University has resulted in research that aligns with the focus of the Department and which is relevant, has a high impact and makes a difference. It supports the University's Institutional Research Theme (IRT) of Food, Nutrition and Well-being and represents a vital line in the transformation of food production. It is not just about the provision of sufficient food and water, but about providing it in a sustainable way that yields animal products that are nutritious and of good quality.

Staff members in the Department have always been revolutionary. In the 1930s, staff realised that a cattle breed which was well adapted to South Africa was lacking, so they created one. Former HOD, Prof Jan Bonsma and his team, inspired by Prof Bosman (the previous HOD), started a breeding project to produce cattle that are efficient and effective and this resulted in the Bonsmara and Bovelder cattle breeds. The Bonsmara is regarded as a highly prolific synthetic beef breed and the Bovelder is a composite beef breed. The Bonsmara has become the breed of choice in South Africa for beef production.

Credit: Bonsmara SA

The South African beef, lamb and pig carcass classification systems currently employed in South Africa were developed based on research by the Department. Water quality guidelines for livestock were also developed by the Department.

To a large extent researchers in this Department coordinated the establishment of the South African Society of Animal Science, which is housed within the Department. Research output continues to be published in journals like the *South African Journal of Animal Science* and other ISI-listed (internationally rated peer review) journals that compete with the best in the world.

Impact remains a driver of research today. With radical changes to the environment, such as climate change, increased poverty and human population growth, the Department focuses on food production that has a maximum output with a minimal impact on the environment. Through collaborative research projects, the Department contributes to research that focuses on a One Health system, further evidence of relevance and impact on the ground, particularly in rural areas.

Furthermore, considering the pressure to find efficient ways of food production in Africa, the Department's research continues to have a strong focus on nutrition for both ruminant (beef and dairy cattle and small stock) and monogastric animals (poultry and pigs).

The Department was the first in the country to take note of the developments in genomics and established a research programme in the application of molecular genetics in livestock. As a result, it was the first department to contribute to the application of DNA markers in South African livestock and poultry. It also hosted the first genomic workshop in South Africa, resulting in a collaborative effort among universities and research institutes to establish the beef and dairy genomic programmes, respectively. The Dairy Genomic Programme (DGP) is managed within the Department and funded by the Technology Innovation Agency.

The Department continues to be a leader in curriculum development in the animal sciences and in livestock research. It trains about 60% of all animal science graduates in the country. The highly acclaimed curricula of the Department today are largely thanks to learning from past experiences.

With a strong focus on ensuring that students are able to master content adequately, close attention is given to not overloading coursework and always being ready to adapt in order to stay relevant. Academic programmes in the Department are closely aligned with prescriptions of the South African Qualifications Authority (SAQA). The Department strives to educate and train future animal scientists for the South African and African livestock industry, exposing students to the varied career opportunities.