



School of Environmental & Rural Science

Animal Science and Systems

*Annual Report
2016*

Globally, projections show that by 2050, 60% of the world's population will live in Asia and Africa. We need food production to rise by 70%, which may require 50% more water. Nationally, Australia is challenged with a depletion of our natural agricultural resources and associated threats of salinity, soil degradation, weeds, feral animals and climate change. Societal demands on the agricultural production system and its products, include factors such as human health, ethical and animal welfare issues and environmental footprints

UNE has an enviable reputation in research and tertiary education in agricultural sciences and their related fields, with ERA 5 rankings (*well above world standard*) for Agricultural Sciences, including Animal Production, Agriculture, Land and Farm Management, Ecology and Soil Sciences.

UNE's main strength is in the pastoral based production systems with sheep and beef, as well as poultry production systems, with disciplinary strength in Animal Genetics, Animal Science, Precision Agriculture and Soil and Environmental Science. The teaching curriculum has a strong element of an integrated approach to agriculture and agricultural systems. Opportunities arise for UNE to build a more data driven systems approach based on existing strength and increase the use of our facilities (incl. RP).

The key of the approach is to dramatically increase the use of measurement and data in experimentation and management of integrated agricultural systems, thereby providing understanding, decision support and improvement of productivity, animal health and environmental outcomes.

In the approach we are strengthening the collaboration between precision agriculture and soil, pasture and animal science to improve pasture management, utilization and productivity. We explore the use of information systems in food production and supply chains, combining expertise in genetics, health nutrition, and economics, as well as computer science to manage the large data. We build strategic collaborations with DPI NSW and CSIRO. We also collaborate in projects internationally, including the ACIAR regions.



Academic Staff

The Animal Science and Systems Theme is comprised of academic staff, emeritus professors, adjunct academics, and postdoctoral fellows. Together these researchers supported nearly 60 Higher Degree Research (HDR) candidates in 2016, across all of the areas of Animal Science and Systems research areas.

PROFESSORS

Professor Mingan Choct
Professor David Cottle
Emeritus Professor Aub Egan
Professor John Gibson
Professor Roger Hegarty
Professor Geoff Hinch
Emeritus Professor Brian Kinghorn
Professor Paul Iji
Emeritus Professor John Nolan
Professor Bob Swick
Professor Julius van der Werf
Professor Stephen Walkden-Brown

ASSOCIATE PROFESSORS

Associate Professor Cedric Gondro
Associate Professor Lewis Kahn
Associate Professor Julie Roberts

SENIOR LECTURERS

Dr Wendy Brown
Dr Geert Geesink
Dr Ian Godwin

LECTURERS

Dr Sam Clark
Dr Fran Crowley
Dr Emma Doyle

ASSOCIATE LECTURERS

Ms Lynette McLean
Mr Huw Nolan

RESEARCH FELLOWS AND POSTDOCS

Dr Hassan Aliloo	Dr Natalie Morgan
Dr Momen Bhuiyan	Dr Guiyan Ni
Dr Amanda Doughty	Dr Isabelle Ruhnke
Dr Naomi Duijvesteijn	Dr Saleh Shahinfar
Dr Tom Granleese	Dr Eva Strucken
Dr SangHong Lee	Dr Shubiao Wu
Dr Yan Laurenson	
Dr Nasir Moghadder	



Group of Animal Science staff at the Autumn Graduation 2016. Left to right: Professor Geoff Hinch, Associate Professor Cedric Gondro, Professor Julius van der Werf, Dr Tom Granleese, Dr Dr Andrew Swan (AGBU), Dr Sam Clark and Dr SangHong Lee.

Theme Leader's Review



In ruminants major research projects are in genetics and genomics (including species-independent basic research), methane emission reductions, improved prediction of welfare status, improving meat quality, management of parasitic disease, improved education delivery systems and international development with funding from the sheep CRC, the ARC and NHMRC, DAF, MLA, AWET and ACIAR. Amongst monogastric species, the research focus is on poultry with the majority of projects on chicken nutrition funded through the Poultry CRC, private companies and industry bodies such as AECL and RIRDC. The poultry nutrition group has one of the largest concentration of postgraduate students at UNE (29 in 2016) with most of those with an international background. Other important poultry research in the welfare of free range egg production systems, factors influencing egg quality, improved disease diagnostics and vaccine development.

International projects are still a large part of our research portfolio, with funding for cattle development from the Bill and Melinda Gates Foundation for work in Africa and India (Professor John Gibson), collaboration with Korea (Associate Professor Cedric Gondro) and Indonesia (Dr Fran Cowley). The year also saw new ACIAR initiatives in goat production in Fiji (Dr Fran Cowley) and Laos (Professor Steve Walkden-Brown)

The year 2016 has been a year of building the future group of Animal Science. Retirements were announced of Professor David Cottle, Dr Geert Geesink, Professor Geoff Hinch, and Dr Ian Godwin, the latter two having been with UNE for several decades. Fortunately, we have been able to fill the gap that was left and we attract a number of new staff with Dr Peter McGilchrist coming into meat science, Dr Peta Taylor UNE's first lecturer fully dedicated to animal behaviour are welfare and Professor Lewis Kahn taking over Geoff Hinch's role as program manager in the Sheep CRC as well as the role of Academic Manager of the UNE farms. With 2015 appointment Dr Fran Cowley establishing a strong research and teaching profile it is an exciting time of renewal for Animal Science. During 2016 staff enjoyed full use of Stage 3 of the Centre for Animal Research and Teaching, providing excellent new teaching and research facilities. During the year approval to fund Stage 4 of this UNE-funded development was also approved. This will provide a new large multipurpose research building and completely upgrade the existing intensive animal research facilities in the main W002 animal house building.

Some large research grants were awarded, to start in 2017, for example a AWET grant for the delivery of sheep and wool education resources (Walkden-Brown/Doyle), an MLA grant for the modelling of nematode control programs for sheep (Laurenson/Kahn), some large MLA grants will also come to UNE with Dr Peter McGilchrist while Dr Sang Hong Lee obtained a prestigious Future Fellowship form the Australian Research Council. We have also developed an important collaborative partnership for the livestock (red meat) industries with CSIRO and DPI NSW, to co-invest with the MLA donor company in research and development of sustainable and efficient livestock production systems.

Julius van der Werf
Research Theme Leader

Steve Walkden-Brown
Convenor

Doctor of Philosophy and Research Masters Graduates 2016

The following Doctor of Philosophy (PhD) students were supervised by Animal Science Staff and graduated in 2016:

DOCTOR OF PHILOSOPHY CHANCELLOR'S DOCTORAL RESEARCH MEDAL

Michelle Louise Dever "Improving the Effectiveness of Gastrointestinal Nematode Control for Meat-Bred Lamb Production Systems on the Northern Tablelands, New South Wales"

Principal Supervisor: Associate Professor Lewis Kahn

Christine Louise Morton "Vocal Behaviour as an Indicator of Lamb Vigour"

Principal Supervisor: Professor Geoff Hinch

DOCTOR OF PHILOSOPHY

Khalid Salem Al-Zahrani "The effect of Dietary Supplementation of Calcium Pidolate with or without Vitamin D Metabolite on Production Performance and Egg Quality in Commercial Laying Hens"

Principal Supervisor: Associate Professor Julie Roberts

Mohammad Hossein Ferdosi "Efficient Algorithms for using Genotypic Data"

Principal Supervisor: Professor Julius van der Werf

Tom Granleese "Optimised Livestock Breeding Programs Using Female Reproductive Technologies and Genomic Selection"

Principal Supervisor: Professor Julius van der Werf

Joanna Newton "Sexual Maturity and Yearling Reproductive Performance in Ewes: Genetic Analysis and Implications for Breeding Programs"

Principal Supervisor: Professor Julius van der Werf

Sithara Ralaopanawe "Efficacy of Rispens C1988 Vaccine Against Challenge with Masrek's Disease Viruses of Varying Virulence, Effects on Viral Kinetics and Field Application of a Rispens Specific qPCR Test"

Principal Supervisor: Professor Steve Walken-Brown

José Ignacio Velazco De los Reyes "Quantifying Daily Methane Production of Beef Cattle from Multiple Short-Term Measures Using the GreenFeed System"

Principal Supervisor: Professor Roger Hegarty

Brendan Douglas Sharpe "Epidemiological, Experimental and Diagnostic Investigations into an Acute Paralysis Syndrome of Broiler Chickens in Australia"

Principal Supervisor: Professor Steve Walkden-Brown

Jessica Louise Sparkes "Quantifying Effects of Wild Dogs, Domestic Dogs and Humans on the Spread of Rabies in Australia"

Principal Supervisor: Dr Wendy Brown

Elfira Kariane Suawa "Body Weight, Flock Uniformity, Production Performance and Egg Quality Over the Laying Period of Brown Egg-Laying Hens"

Principal Supervisor: Associate Professor Julie Roberts

Mariette van de Berg "Behavioural Mechanisms of Diet Selection by Horses"

Principal Supervisor: Professor Geoff Hinch

Weerasinghe Mudiyansealage Shalanee Priyanga Weerasinghe "Use of Genetic Polymorphisms to Assess the Genetic Structure and Breed Composition of Crossbred Animals"

Principal Supervisor: Professor John Gibson

MASTER OF RURAL SCIENCE

Colin Starkey "Quantification of the Biological Factors that Determine Lamb Tenderness".

Principal Supervisor: Dr Geert Geesink

MASTER OF SCIENCE

Aaron Ray "The Relationship of Eggshell Structure to Eggshell Penetration by Salmonella Typhimurium in Table Eggs"

Principal Supervisor: Associate Professor Julie Roberts



Dr Michelle Dever



Dr Joanna Mewtpm



Associate Professor Julie Roberts,
UNE Chancellor Mr James Harris and
Dr Elfira Suawa



Dr Jessica Sparkes and Dr Mariette
van de Berg

Postgraduate Students

The following Higher Degree Research (HDR) students were enrolled in 2016 and supervised by Animal Science Research staff:

HDR Student	Degree
ABDALLH, Medani	PhD
ACHARI, Robin	PhD
AHIWE, Uchenna	PhD
AKTER, Marjina	PhD
AL KALALDEH, Mohammad	PhD
ALI, Moreen	PhD
ALQAHTANI, Mohammed	PhD
ALSHARARI, Mamdouh	PhD
BARZEGAR NAFARI, Shahram	PhD
BROOMFIELD, Madeleine	MSci
CHANG'A, Edwin	PhD
CLOTHIER, Jane	PhD
DAKHLAN, Akhmad	PhD
DE LAS HERAS-SALDANA, Sara	PhD
DE RAPHELIS-SOISSAN, Victoire	PhD
DUFF, Christian	PhD
EMMANUAL, Ahiwe	PhD
ERDAW, Mammou	PhD
GAUSI, Harriet	PhD
GHARIB NASERI, Kosar	PhD
HABERECHE, Sarah	PhD
HARPER, Jo-Ann	MSci
HERRERA, Rommel	PhD
HILLIAR, Matthew	PhD
HOSSAIN, Mohammed	MRurSci
IQBAL, Zafar	PhD
JAYASUNDARA, Kanchana	PhD
KEARTON, Tellisa	MRurSc
KEERQIN, Chake	PhD

HDR student	Degree
LABEUR, Lea	PhD
LAKEW, Biniam	PhD
LEA, James	MRurSc
MABELEBELE, Monnye	PhD
MATTHEWS, Paige	PhD
MENDO TRIGO C RODRIGUES, Ines	PhD
MONK, Jessica	PhD
MUSIGWA, Sosthene	PhD
NGUYEN, Hung	PhD
NGUYEN, Thi	PhD
NOLAN, Huw	PhD
OMEDE, Apeh	PhD
PACKER, David	MRurSc
QASSIM, Sarbast	PhD
RALAPANAWA, Sithara	PhD
RICHARDS, Jessica	PhD
SAMIULLAH	PhD
SANTOS, Bruno	PhD
SHARMA, Nisha	PhD
SHARMA, Nishchal	PhD
TOGHYANI KHORASGANI, Mehdi	PhD
TONGSIRI, Siriporn	PhD
TORRES-VAZQUES, Jose	PhD
TUNNAGE, Jessica	MSci
VAN DEN BERG, Mariette	PhD
VILLAR, Laura	PhD
WARREN, Lyle	MSci
WU, Di	PhD
XUE, Guangda	PhD



Animal Breeding and Genetics

- The genetic improvement of animals has a very large impact on the productivity and efficiency of agricultural production systems. Nowadays, valuable animal protein and fibre is produced with many less resources than a few decades ago. This enables a more sustainable food production with healthier animals, a lower environmental footprint and a more viable rural industry.
- Animal breeding is based on the simple principle of selecting the best animals to breed from. However, this raises more difficult questions such as deciding on what is 'best', how to find the animals with the highest genetic merit and how to use these in breeding programs.
- The incredible advances in DNA technology have recently revolutionized the field of genetics. We can now 'read' DNA, and this genomic information provides us with a much better idea of what causes genetic variation in traits that we observe. Genomic information has great benefits in prediction of differences in phenotype due to genetic differences, and this can be used in the selection of breeding animals or plants. The same principles are also used in human genetics to predict disease risk based on genomic profiles, and this will increasingly lead to 'personalized medicine'.
- In animal and plant breeding it is critical to be able to predict genetic changes due to selection, not only for the traits of direct economic importance, but also for correlated traits that might affect animal health and welfare, product quality and resilience. Expression of genetic differences will depend on the environment.
- Armidale is one of the lead centres in the world in the area genetics of livestock. We have a large research portfolio and strong links with industry programs. We work very closely with the Animal Genetics and Breeding Unit (AGBU), who maintain the national genetic evaluations for beef, sheep and pigs. Our group has a strong presence in large industry programs in Australia around livestock genetics, e.g. the Sheep CRC and the MLA genetics consortium. We have also involvement in projects related to dairy, buffalo, poultry and plants and humans.



Genetic and Genomic Evaluation and Breeding Program Design

- Methods used to predict genetic merit are based on statistical and quantitative genetics. The use of genomic information in these methods provides interesting opportunities and challenges as we have now access to genotype information on millions of genetic markers to dissect the components of genetic variation and use these in prediction of differences in phenotype.
- The challenge of sustainable breeding programs is to define the breeding objectives, which requires socio-economic as well as biological assessment of trait improvement, and to implement effective breeding schemes to achieve genetic improvement.
- We work closely with industry programs to implement theoretical principles in tools that can be used for day to day decision making by breeders, farmers and practitioners.

Professor Julius van der Werf
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Computational Biology, Quantitative Genetics, Animal Breeding & Population and Conservation Genetics

My research activities/interests are in the development of computational methods for optimization of biological problems; statistical and functional analysis methods for high throughput genomic data (microarrays, SNPs, sequence); estimation of population genetics parameters using genome-wide data; and simulation of biological systems. I am currently involved in a wide range of projects, usually based on statistical analysis data on genetic markers, associated phenotypes and gene expression. I use population genetics for the modeling of epistasis, identification of signatures of selection.

Associate Professor Cedric Gondro
Email: cgondro2@une.edu.au



The Use of Genomic Information within Breeding Programs

I am interested in the prediction of breeding value and the optimal use of information within animal breeding programs. I'm currently involved in research regarding genetic evaluation and genomic selection in sheep, beef cattle and dairy cattle. Broadly, I am interested in factors that control genetic variation and how these can be utilised in animal breeding and quantitative genetics.

Specific research interests:

- design of experiments and reference populations
- genomic prediction
- genome wide association studies
- analysis and use of sequence data within breeding programs

Dr Samuel Clark
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Breeding Program Design

A good breeding program design can help maximize performance of animals and return on dollar invested. There are many tools to help select animals that best suit producers' breeding objectives. My role as post-doctoral research fellow at UNE is funded by the Sheep CRC. I focus on helping optimize sheep breeding programs in both wool and meat enterprises. My area of research in breeding programs covers best methods of using genomic selection, reproductive technologies, phenotypic measuring, introgression of genes, pedigree collection, group management, inbreeding management and cost-benefit analysis. Currently, I am heading the research and development of the "Flock Profile" project where cohorts of unknown sheep from a commercial flock are genotyped and a genomic "Flock Profile" is returned to the owner of the sheep. These results should help commercial producers make better mating decisions, ram purchases and track their genetic progress over years.

Dr Tom Granleese
Email: tgranle2@une.edu.au



Utilizing Genome Sequence Information in Sheep Breeding

I have done research using genomics in pig breeding (in the Netherlands), while currently I'm working with data from Sheep CRC as a Post Doc Research Fellow. Recently, many sheep have been sequenced (whole genome genotyped) and we are trying to use that data to improve the estimation of breeding values. We also use this data to better understand the function of genes on traits. For example I have tried to find the insertion which is causing horned and polled phenotypes in Merino sheep, and see whether we are able to give a better prediction for the hornstatus than what is currently being used. Further, I will investigate the presence of lethal recessives in sheep. These are mutations that if inherited from (often) both parents, the offspring has a major defect or doesn't survive gestation or birth. It is important that these defects are efficiently controlled in the population.

Dr Naomi Duijvesteijn
Email: nduijves@une.edu.au



Genetic Improvement of Smallholder Dairy Cattle



In many developing world countries, smallholder dairy production based on crossbred dairy cattle is the major source of milk and is improving the livelihoods of many millions of poor farmers. We are partnering with the International Livestock Research Institute (ILRI) in Kenya and BAIF in India to design and build sustainable systems that deliver the best adapted and most profitable genotypes to smallholder farmers in East Africa and India. As part of a total investment of close to \$35 million from the Bill and Melinda Gates Foundation we have combined genomic testing with on-farm recording in East Africa to show that intermediate to low-grade crossbred cows are more suitable for most smallholders than the high-grade cattle that industry and government are currently encouraging. We have also shown that it is possible to design a small and cheap genomic assay that could be used in the field to test cows and bulls for their (currently unknown) breed composition, allowing much more profitable breeding decisions to be made. This assay will be developed and field-tested with farmers in East Africa in 2017. Initial work indicates that it is possible to combine snp assays with phenotype data to obtain useful estimates of genetic breeding value of crossbred cow and bulls owned by smallholders, opening the prospect of the world's first sustainable genetic improvement programs in such systems. Current work is designing and testing in Ethiopia, Tanzania and India sustainable genetic improvement systems in smallholder crossbred dairy systems.

Professor John Gibson

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Genetic Diversity and Analyses of Cattle

My main research interests are genetic and genomic analyses of dairy cattle and other livestock, in particular genome-wide association studies (GWAS) for milk production traits.

At UNE, I was involved in parentage testing and breed diversity studies in Korean beef cattle. The brown Hanwoo cattle are the main livestock kept for large scale production purposes in South Korea. Their exceptionally high intramuscular fat content makes their meat a highly sought after and prized food product.

Currently, I am involved in genetic studies on East-African smallholder dairy cattle. Most East-African cattle have been cross-bred for many generations and the true content of a 'breed' in an animal is often unknown. Following on from these initial studies, we are interested in including production levels and adaption abilities to specific environments (feed quality, disease burden, climate,...), which will allow us to advise on breeds or breed-crosses to improve the livelihood of smallholder farmers.

Dr Eva Strucken

Email: estrucke@une.edu.au



Artificial Intelligence and Machine Learning for Optimization of Biological Problems

I am currently pursuing research needs surrounding the questions of best prediction methods, most informative training population design, and designing SNP panels for parentage and breed testing for different Australian, Korean and African cattle and sheep breeds. In livestock these researches will have a significant impact on the path to adoption of genomic technologies in industry as this will enhance the development to cheaper testing tools. I'm also involved in the implementation of an imputation pipeline for medium density and high density SNP data to sequence level for cattle and sheep and then subsequent analysis of imputed sequence data.

Specific research interests

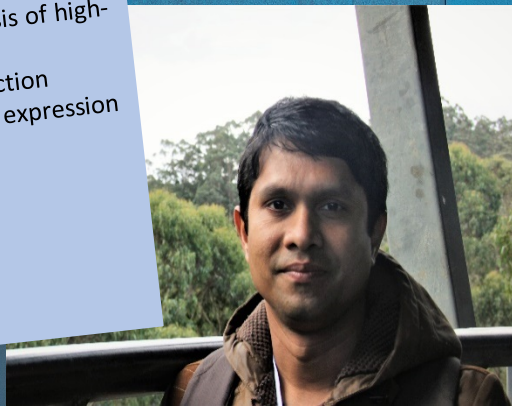
- Artificial intelligence and machine learning for optimization of biological problems
- Computational methods and statistical analysis of high-throughput genomic data
- Use of functional knowledge in genomic selection
- Functional integration of GWAS and gene expression data.

Dr Hawlader Al-Mamun;
Email: hawlader.almamun@une.edu.au

Genomic Technologies to Improve the Livelihoods of African Smallholder Dairy Farmers

In 2016, I completed my PhD in dairy genetic improvement at La Trobe University in Melbourne and joined UNE as a Junior Research Fellow. Since then, I have been involved in the Africa Dairy Genetic Gains project (ADGG), a project aimed at improving the livelihoods of smallholder farmers by improving the genetics of East African dairy cattle. Crossbred cows, that incorporate the indigenous cattle genetic adaptation to harsh environments can produce more milk and are also more resistant to disease. Genomic technologies have the potential to help the farmers to select the best animals to match their environment, which generates an improved income and a higher quality of life. I have been working on designing customized genetic marker panels for genetic evaluation of East African crossbred dairy cattle. Specifically, I am investigating the possibility of developing assays that are sufficiently cheap and accurate to be used routinely in genetic improvement programs. I will continue the work on developing methodologies for marker selection and designing panels that can be directly used in genomic selection or for imputation to higher densities. I will also look at the historical evolution of dairy cattle in East Africa to identify the signatures of selection in these populations that might be beneficial in future genetic improvement.

Dr Hassan Aliloo
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Animal Health and Welfare

Animal health and welfare are key issues that constrain production and limit efficiency and sustainability (both economic and social) of livestock production. The Animal Science group at UNE is making a significant contribution in a number of key areas:

- **Sheep Welfare.** Professors Geoff Hinch and Lewis Kahn and Dr Amanda Doughty (UNE PD fellow) with others are developing new auto-monitoring techniques and other tools for predicting the welfare status of individuals and flocks and enabling appropriate early interventions. These efforts are coalescing into a new application titled “Ask Bill” in honour of UNE Rural Science Founder Professor Bill McClymont.
- **Sheep and Goat Parasite Management.** Professor Lewis Kahn and Dr Deborah Maxwell continue to operate the world’s most comprehensive online resource for managing sheep and goat parasitic infections “ParaBoss”, supported by Meat and Livestock Australia and Australian Wool Innovation. The Wormboss, Liceboss and Flyboss sites contain not only key information, but a growing suite of practical decision-support tools. With 30-35,000 page views per month this is a widely utilised resource. Dr Yan Laurenson (UNE PD fellow) is developing improved models for predicting worm burdens and development of anthelmintic resistance.
- **Poultry Health.** Professors Mingan Choct, Bob Swick and Dr Shubiao Wu are continuing the important search for alternatives to antibiotic growth promotants in meat chickens, primarily used to control the disease necrotic enteritis. They are working closely with industry and are using the UNE developed necrotic enteritis experimental model to investigate this. Professor Steve Walkden-Brown continues research into improved detection and control of viral infections of poultry and in 2016 produced a new vaccine for haemorrhagic enteritis in turkeys. Dr Isabelle Ruhnke (UNE PD fellow) working with colleagues at CSIRO, Armidale has been investigating the impact of gastrointestinal nematodes on productivity of free range layer chickens.
- **Poultry Welfare.** Basic research into free-range chicken behaviour and welfare has been carried out by Professor Geoff Hinch and collaborators at CSIRO, Armidale, using UNE’s free range facilities at Laureldale Research station and individual RFID leg bands on chickens to track movement. Dr Isabelle Ruhnke is using similar technologies on a large scale in the field to address questions relating to range use, productivity and welfare.



paraboss
wormboss
flyboss
liceboss



Management and Welfare of Sheep

Professors Geoff Hinch and Lewis Kahn are leading a team with the Sheep CRC to develop a new approach that brings together farm data, weather and industry knowledge to inform analytical models that predict pasture growth, animal performance, flystrike, worm infection and weather stress at the mob and individual sheep level. Named ASKBILL in honour of the UNE Rural Science Founder Professor Bill McClymont, the web-based program is expected to be released to the public in early 2017. Dr Amanda Doughty (UNE PD fellow) with Professor Hinch and others are exploring the role of new automonitoring techniques and other tools for predicting the welfare status of individuals and flocks to enable appropriate early interventions.

Sheep and Goat parasite management. Professor Lewis Kahn and Dr Deborah Maxwell continue to operate ParaBoss, which is the world's most comprehensive online resource for managing sheep and goat parasitic infections. The WormBoss, FlyBoss and LiceBoss websites are developed to provide practical and procedural information to help sheep and goat producers better manage these major parasites. Supported by Meat and Livestock Australia and Australian Wool Innovation, ParaBoss draws nationally on technical experts to provide the basis for independent and up-to-date information and decision-support tools. With over 12,000 users of the sites each month this is a widely utilised resource. In response to industry need, Dr Yan Laurenson (UNE PD fellow) has been working with the Sheep CRC and Meat and Livestock Australia to develop improved models for predicting pasture infectivity, worm burdens and development of anthelmintic resistance.

Associate Professor Lewis Kahn
Email: lkahn3@une.edu.au



Mathematical Modelling in the Agricultural Sector

My main interests lie in the digitisation of research knowledge applicable to the agricultural sector with a particular focus on veterinary parasitology. This involves the construction of biophysical mathematical models and software development to provide decision support tools for use in research, industry and education. My current focus is on:

- Epidemiology and control of gastrointestinal nematode parasites of sheep (animal production, animal nutrition, anthelmintic treatment, drug resistance, ecology, management practices, selective breeding, ...)
- Epidemiology and control of viral diseases of poultry (thermodynamics of litter composting as a means of reducing viral load of poultry bedding)
- Body composition of beef cattle (image analysis of CT scan images)

Dr Yan Laurenson
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Managing Viral Diseases in Poultry

With the ongoing explosive growth of the poultry industry we are often dealing with population sizes of tens of thousands of birds per shed and hundreds of thousands of birds per farm.

This poses a significant diagnostic challenge for disease surveillance and monitoring for the many viruses that can adversely affect such large populations. Our group at UNE has pioneered routine surveillance of viral load in poultry dust using fully quantitative PCR as a commercially viable sampling procedure for improved management and control of Marek's disease virus which is shed in dander. More recently we have found that a range of faecally shed viruses are also detectable in dust samples from infective flocks. We are working to extend the principle of routine monitoring to these viruses following initial proof of concept studies.

We are also working on limiting transmission of viruses between flocks by appropriate treatment of reused litter and by limiting exposure to infective dust material.

In 2016 we successfully developed an Australian vaccine to control hemorrhagic enteritis in turkeys using new methods developed during the project. This immunosuppressive and occasionally severe disease is caused by a pervasive adenovirus for which previously few diagnostic or control methods were available in Australia.

Professor Stephen Walkden-Brown
Email: swalkden@une.edu.au



Loop-mediated Isothermal Amplification (LAMP) Tests to Detect Poultry Pathogens

While quantitative PCR methodology has revolutionised disease diagnosis, particularly for viruses, the cost of equipment can be prohibitive for some labs and developing countries. Loop-mediated isothermal amplification (LAMP) is a PCR method that can be performed at a constant temperature requiring comparatively inexpensive equipment to operate – including common equipment found in most laboratories such as a temperature controlled water bath. However the design of primers is complex. With industry funding, Dr Renz has successfully developed LAMP tests for a number of key poultry pathogens and demonstrated successful molecular diagnosis in a chicken shed!

Dr Katrin Renz
Email: krenz@une.edu.au



RIRDC funded research enables quick and accurate on-farm testing for Adenovirus

This paper describes the possibilities for accurate and speedy testing for Adenovirus but also the

was interesting to watch Katrin work on a steel bench in the machinery shed washing the birds used for organ

Canine and Equine Research

Animal management is a central focus of my research, and my specialty area is the canine. I lead the Canine and Equine Research Group which aims to *“increase our knowledge and understanding of the Canidae and Equidae, both wild and domestic, with a primary focus on improving health, welfare and management”*. A recently refurbished canine research facility supports on-campus research in a controlled environment, with a particular focus on nutrition, behaviour, and dental health. Complimenting this, our field research in wild and free-roaming dogs currently informs rabies preparedness and animal management in remote Indigenous communities. Investigating a non-lethal approach to wild dog control, we are presently researching the attributes of alpacas as guardian animals. Our equine research has primarily focused on feeding behavior and nutrition; whilst a new focus on prematurity is promising to inform best practice management of the premature foal.

Dr Wendy Brown
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Sheep and Wool Science

My research interests are dedicated to many aspects of the sheep industry including, sheep production, parasitology and education using the “Hub and Spoke” mode. The hub and spoke model offers specialised wool units based at UNE and delivered to other Universities across Australia. Research involves evaluation of the effectiveness of the model and career opportunities for the graduate students. My current parasitology research is working with the vaccine against Barbers pole worm, “Barbevax” and the effective of changing vaccination schedules in lambs. I am also working on production loss due to fasciolosis and nematode infection in beef cattle and identification of infective ‘hot spots’ using GIS mapping.

Dr Emma Doyle
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Animal Nutrition

- Animals are humanity's key protein source and with meat demand expected to increase 70% by 2050, improved feeding and management of livestock and poultry is a key to the school's vision to *"feed the world, save the planet"*.
- UNE has strong research groups in both poultry and ruminant nutrition. The poultry group have been major contributors to global advances in use of enzymes to overcome anti-nutritional factors (such as phytase and non-starch polysaccharides); in the development of a net energy feeding system for Australia; and in evaluation and utilisation of novel feedstuffs. In addition the group provides leadership in understanding the management and welfare of free-range poultry.
- UNE was the centre for the Poultry Cooperative Research Centre (CRC) and will continue that role as the new Poultry Hub takes over from the CRC.
- The ruminant nutrition team have taken leading roles in the measurement and management of greenhouse gases from sheep and cattle production and UNE has extensive capability for measuring emissions in housed, grazing and feedlot situations.
- The group increasingly works in advancing nutritional and welfare management through Precision Livestock Management techniques, developing and deploying electronic sensors in livestock production environments. Increasingly the nutrition team will be looking at modifying the gut microbiome as strategy to modify production
- The ruminant team is progressing grazing animal management and methane mitigation research into a larger theme of improving production efficiency and this is a central focus of the new Livestock Productivity Partnership and Ruminant Efficiency Networks. UNE is making major investment in its 1000 head "Tullimba" research feedlot and on-campus animal-house and feed processing facilities to support its ongoing leadership in industry-relevant nutrition research. In addition the team has strong current research activity in Indonesia, Cambodia, Fiji and China.

Evaluating alternative feed materials

The feedlot and supplement industries are continually searching for new cost effective feed materials and feed supplements to enhance the cost effectiveness of growing livestock. The animal science team frequently evaluates such innovations, from feed additives that modify rumen fermentation to bulk ingredients such as sprouted fodder and grape marc. These tests use both our research feedlot (40 min drive from UNE) and our on-campus animal houses in which UNE has invested more than \$7M in recent years. Facilities on-campus include a sheep research facility capable of measuring intake of over 200 sheep simultaneously, a new large-animal facility and respiration chambers for energetic and methane studies in both sheep and cattle facilities.



Optimising supplement use in northern Australia

The northern Australian rangelands are a challenging place to quantify or change the nutritional habits of grazing cattle. We are using remote monitoring of cattle weights and of supplement intake and will combine this with GPS tracking of their grazing habits to document the nutritional characteristics of high and low performing cattle. Such studies are revealing much about grazing animal behaviour and are expected to identify significant opportunities to change management of cattle to improve overall productivity among northern herds.

Professor Roger Hegarty
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Dietary nitrate as a tool to reduce livestock greenhouse gas (GHG) production

Nitrate is a powerful means of reducing emissions of the GHG methane from ruminants (currently 10% of Australia's total GHG emissions) but brings some risks to animal health. The Animal Science team continues to advance understanding of the use of nitrate to reduce emissions by targeting some of the key unknowns in nitrate metabolism within animals. These include the regulation of nitrate's conversion to the toxic intermediate, nitrite, as well as its recycling to the gut, excretion and interaction with other dietary tools to reduce emission (eg. Dietary oils).

Laura Villar, Postgraduate Student
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Poultry Research & Teaching Unit (PRATU)



Poultry meat and eggs are the number one consumed protein in human diets in Australia. Through the Poultry CRC and multinational company funding, the poultry nutrition research group has projects in several major areas:

Increasing Canola Meal Inclusion in Poultry Feed

Work examining canola inclusion in meat chicken and laying hen diets has been conducted. These results clearly show that meal quality is impacted by heat during processing and if this heat can be minimised, a higher inclusion rate would be possible in meat chicken diets. The results show that chicken growth and FCR is more related to available/reactive lysine than glucosinolate level in Australian canola meal. Feed conversion does appear to be negatively impacted when canola meal is included at high levels but economics strongly favour use at high levels. Feed enzymes based on protease and pectinase may offer an effective way to increase inclusion levels of canola meal. Solvent oilseed crushers may consider the feasibility of installing secondary ethanol extraction equipment to produce protein concentrates from canola meal. This findings have been beneficial to oilseed crushers, canola producers, the poultry industry and has had a positive impact on food security in Australia.

Implementation of a Net Energy System for Meat and Laying Chickens

Heat production and heat increment was measured in UNE's poultry calorimeter chambers in both meat and laying chickens fed many diet formulations. Using regression, equations have been developed to prediction the net energy values of individual feed ingredients. This research has demonstrated protein and ether extract are major predictors of heat increment in both meat and laying chicken diets. Non-nutritional factors such as disease challenge were found to impact energy partitioning in meat chickens. The results can now be used to formulate more efficient feed with significant cost savings. Diets formulated on a net energy basis also resulted in improvements in egg quality.

Evaluation of Alternatives to Antibiotic Growth Promoters

The poultry nutrition group has evaluated feed additives including enzymes, probiotics and acidifiers as alternatives to antibiotic growth promoters. Antibiotics have been added at low levels in meat chicken diets for the past 50 years to promote growth. The selectively limit growth of harmful bacteria thus allowing nutrients to be more easily absorbed across the gut wall. This application has come under scrutiny with the incidence of antibiotic resistant "super bugs" becoming prevalent in human medicine. Current thinking is that emergence of antibiotic resistant bacterial plasmids may be related to low level antibiotic use in animal feed. The feed industry continues to search for effective alternatives. Investigations into gut physiology, reduction in antinutritional factors and importance of the gut microbiome at UNE have furthered the poultry industry's understanding of how the diet and gut environment affects growth rate.



Professor Bob Swick
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Analytical Fibre

Fibre is a highly variable and complex component of feed ingredients. The analytical methods currently used to characterise fibre are unable to extrude all the carbohydrate fractions in a sample, so do not adequately relate to fibre utilisation in the animal. Measuring soluble and insoluble non-starch polysaccharides (NSP) content provides a more accurate system for estimating true fibre levels. The amount, structure and physiochemical characteristics of NSP vary greatly between different ingredients and batches. A database is currently being developed at UNE that will provide NSP values for commonly used ingredients that could replace crude fibre values in feed formulations.

Natalie Morgan, Post Doctoral Researcher
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Necrotic Enteritis

Necrotic enteritis (NE) is a devastating disease in poultry which causes annual loss of \$6 billion for the industry worldwide. Due to the ban, or voluntary removal, of antibiotics in livestock feeds, re-emergence of NE has become a pressing problem. The projects aim to understand the mechanisms underlying the disease by focusing on how the factors that predispose birds to NE affect their physiological, anatomical and microbial features. Our studies have shown significant changes of these features and the information will provide scientific basis for the finding of supplements or vaccines that can control NE in the post antibiotic era.

Dr Shubiao Wu
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We also have conducted research evaluating the effect of diet on odour emissions, use of algae in poultry feed and use of crystalline amino acids in poultry feed. All projects are applied research with deliverables directly used by industry. Poultry nutrition research at UNE is intended to benefit production efficiency and overcoming obstacles facing the industry. Our group uses state-of the art research facilities including a feed mill with steam pelleting capability and laboratories with NIRS, calorimetry and molecular genetics capabilities. In addition the group holds industry workshops in feed formulation.

Determination of egg shell colour

The quality of eggs produced is of vital importance to the Australian Egg Industry, with consumers becoming increasingly discriminating. One aspect of egg shell quality which is immediately obvious is shell colour, which can be negatively affected by a number of factors including disease and stress. Research conducted at UNE by PhD student Samiullah has shown that the pigment of brown eggshells is contained mainly within the calcareous part of the egg shell, with a smaller amount contained in the overlying cuticle. Molecular studies conducted in association with Dr Shubiao Wu have identified the steps in the biosynthetic pathway for the brown pigment that are adversely affected by the coccidiostat nicarbazin. Molecular studies have also elucidated the patterns of expression of genes related to pigment synthesis and deposition at different stages of egg shell formation.

Associate Professor Julie Roberts
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Laying Hens

Each production system has different impacts on layer health, welfare, and performance. Matching the rearing with the housing system, modifications of the hen house, and environmental enrichment can significantly reduce the stress level of the individual hen. My research focuses on sustainable, ethical and safe agriculture food production. In the past I investigated innovative energy efficient milling methods for grain processing, the use of sustainable feed protein sources such as insects, as well as various systems of chicken meat and egg production. My research addresses the environmental, welfare, ethical, social, and economical issues of the layer industry for a more natural, traditional and sustainable way of egg production that benefits the animals itself, the nutrition of humans, environment and soil. Feeding a growing population while ensuring food security in a free range system is a major long-term challenge.

Dr Isabelle Ruhnke, Post Doctoral Researcher
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Meat Birds

Our research in the past few years has focused on three main areas - reducing feed costs; improving the utilization of dietary minerals, and managing neonatal nutrition to enhance life-time productivity. Such research has examined the potential of alternative energy sources like triticale and sorghum, and protein sources, including cottonseed and raw soybeans. We have shown that many alternative ingredients can be utilized in poultry diets through application of microbial enzyme supplements while minimizing the costs of this intervention. We identified spray-dried porcine plasma and a processed soy product as excellent pre-starter supplements, and elucidated the nature of the relationships between macro and micro minerals and phytase.

Professor Paul Iji
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Research and Training for International Development

Animal Science at UNE has a long and strong commitment to helping improve developing world agriculture, through targeted training, research and development. In 2016 we ran our second six-week intensive training course for Indonesian professionals in beef production systems; taking to over 150 the total number of professionals from developing countries we have trained in livestock systems over the past few years. UNE academics led (or co-led) over \$30m of research projects on smallholder integrated beef systems in Cambodia and Laos, and on smallholder dairy systems in East Africa and India. Work continued to finalise the design of two large research projects on smallholder beef systems in Indonesia and also on two new projects on small ruminants in Laos and the South Pacific. Two pilot projects in Indonesia demonstrated the power of real-time data capture on handheld devices to transform data collection and project management under difficult field conditions. These data systems are also being employed by our partners in the smallholder dairy projects to collect longitudinal data on over 40,000 cows and over 200,000 breeding events in Africa and India, transforming our ability to analyse data and improve project design in close to real time.



Grants and Awards

The table below lists grants awarded to Animal Science staff in 2016. Where funding commences in 2017, the funded amount is not shown, and does not contribute to the total. This table does not include funds awarded before 2016 that may be ongoing.

In 2016,
Animal Science Research
involved more than \$7
million obtained from
competitive research funds

Principal Investigator	Title of Grant	Total Funding Awarded	2016 \$ awarded	Funding Body	Start date	Completion date
A/Prof Cedric Gondro	Breeding program design for the Hanwoo breeding herd using genomic selection	\$120,000	\$44,923	National Institute of Animal Science of the Rural Development Administration, Korea	01-MAY-14	31-DEC-16
A/Prof Cedric Gondro	Development of new strategies to improve genomic selection in Hanwoo (Korean cattle)	\$387,822	\$129,156	National Institute of Animal Science of the Rural Development Administration, Korea	01-MAR-15	01-MAR-18
A/Prof Cedric Gondro	omic prediction for internal parasite resistance in Australian sheep	\$120,000	\$40,000	CRC for Sheep (PhD stipend)	01-JAN-16	31-DEC-18
A/Prof Lewis Kahn	Expansion of WormBoss website to include goats	\$74,600	\$55,696	Meat & Livestock Australia	30-SEP-15	01-OCT-16
Dr Emma Doyle	Factors affecting the immune response to Barbervax vaccination in ewes - Masters Scholarship for Madeleine Broomfield	\$80,000	\$28,852	Australian Sheep Industry CRC	11-APR-16	13-APR-18
Dr Emma Doyle	Third Party Sponsorship Agreement	\$6,000	\$666	Australian Wool Network Pty	01-JAN-08	31-DEC-16
Dr Fran Cowley	Heifer-calf and fattening strategies - Indonesia	\$28,442	\$14,601	ACIAR	20-JAN-15	31-DEC-16
Dr Geert Geesink	Assessing the effect of oestradiol implants compared to oestradiol plus trenbolone acetate implants on beef carcass quality	\$94,000	\$36,423	Elanco Animal Health	01-SEP-14	31-MAR-17
Dr Geert Geesink	Quality based sheepmeat value chains	\$436,864	\$145,621	CRC for Sheep	01-JUL-14	30-JUN-17

Principal Investigator	Title of Grant	Total Funding Awarded	2016 \$ awarded	Funding Body	Start date	Completion date
Dr Isabelle Ruhnke	The Effect of Enzymes on Grass Impaction in Free-Range Layers	\$117,656	\$64,527	Poultry CRC	01-APR-15	30-NOV-16
Dr Isabelle Ruhnke	Determination of best practice range enrichment to improve layer bird welfare	\$97,656	\$64,007	Poultry CRC	01-JUL-15	16-DEC-16
Dr Isabelle Ruhnke	Practical implications of A. galli infection in Australian free-range poultry	\$101,216	\$56,610	Poultry CRC	01-APR-15	15-DEC-16
Dr Isabelle Ruhnke	Nutritional Management of Free-Range Laying Hens	\$425,116	\$131,053	Australian Egg Corporation Limited	01-JAN-16	30-MAR-19
Dr Isabelle Ruhnke	Nutritional Management of Free-Range Laying Hens	\$226,468	\$69,815	Poultry CRC	01-JAN-16	30-MAR-19
Dr Isabelle Ruhnke	Managing Fibre Intake in Laying Hens	\$25,000	\$12,500	Deutscher Akademischer Austausch Dienst (Australia-Germany Joint Research Cooperation Scheme)	01-JAN-16	31-DEC-17
Dr Katrin Renz	Loop-mediated isothermal amplification tests to detect poultry pathogens	\$388,755	\$97,029	Rural Industries Research & Development Corporation - PRP	01-JUL-13	31-OCT-16
Dr Natalie Morgan	Establishment of a soluble and insoluble NSP database by University of New England for all feed ingredients commonly fed in the pig and poultry industry to replace crude fibre value	\$80,000	\$75,812	Australian Pork Limited	04-JAN-16	20-JAN-17
Dr Sam Clark	Feed intake measurement of cattle in the Tullimba R&D Feedlot BIN Project - Hereford 2014-2015	\$48,818	\$28,061	Meat & Livestock Australia	25-APR-15	19-JAN-17
Dr Sang Hong Lee	Novel statistical algorithms and methods to quantify and partition pleiotropy between complex traits in populations	\$375,000	\$125,000	Australian Research Council - Discovery Early Career Researcher Award (DECRA)	01-JAN-15	31-DEC-17

Principal Investigator	Title of Grant	Total Funding Awarded	2016 \$ awarded	Funding Body	Start date	Completion date
Dr Sang Hong Lee	Advanced whole-genome approaches for causative variant detection and individual risk prediction of complex traits in human populations	\$350,151	\$123,364	National Health and Medical Research Council - Project grants	01-MAR-15	31-DEC-17
Dr Sang Hong Lee	Estimating genotype-environment interaction using genomic information	\$331,600	\$110,533	Australian Research Council - Discovery	01-JAN-16	31-DEC-18
Dr Shubiao Wu	Bacteriophages to control necrotic enteritis in broiler chickens	\$100,000	\$59,836	Poultry CRC	01-MAY-15	31-DEC-16
Ms Deborah Maxwell	New England WormBoss Producer Demonstration Site	\$52,384	\$14,340	Meat & Livestock Australia	15-FEB-16	29-APR-19
Prof Brian Kinghorn	Evolution, Selection and Estimation of Polygenic Epistatic Networks in Quantitative Traits	\$246,000	\$57,498	Australian Research Council - Discovery	01-JAN-13	30-NOV-16
Prof Brian Kinghorn	Identification and management of Alleles Impairing Heifer Fertility while Optimizing Genetic Gain in Angus Cattle	\$152,903	\$30,581	United States Department of Agriculture	01-JAN-13	31-DEC-17
Prof Geoffrey Hinch	Optimisation of the welfare of free range layer hens	\$286,864	\$122,894	Poultry CRC	01-SEP-14	31-DEC-16
Prof Geoffrey Hinch	Enhanced Sheep wellbeing and productivity	\$702,250	\$100,321	CRC for Sheep (PhD stipend)	01-JUL-12	30-JUN-19
Prof Geoffrey Hinch	Smart data management for Smart livestock production	\$539,000	\$335,725	National Landcare Programme National Scheme	26-JUN-15	01-FEB-17
Prof Geoffrey Hinch	Sheep CRC Postgraduate Scholarship - Tellisa Kearton	\$80,000	\$40,000	Australian Sheep Industry CRC	01-AUG-15	31-JUL-17
Prof Geoffrey Hinch	To Assess Resilience and its Genetic Basis in Sheep	\$41,136	\$8,962	Australian Sheep Industry CRC	01-MAR-16	31-DEC-19
Prof Geoffrey Hinch	Identification of resilient sheep - PhD top-up for Jessica Monk	\$21,000	\$6,405	Commonwealth Scientific and Industrial Research Organisation	01-FEB-16	31-JAN-19

Principal Investigator	Title of Grant	Total Funding Awarded	2016 \$ awarded	Funding Body	Start date	Completion date
Prof Geoffrey Hinch	Enhanced Sheep wellbeing and productivity	\$1,000,232	\$111,103	CRC for Sheep	01-JUL-08	30-JUN-17
Prof Geoffrey Hinch	Development of a self-medication methodology for pain relief in sheep and cattle.	\$33,136	\$5,626	Commonwealth Scientific and Industrial Research Organisation (CSIRO) - Postgraduate Studentship	04-FEB-13	05-AUG-16
Prof James Rowe	Coordination & Governance (James Rowe)	\$20,000	\$10,000	Australian Sheep Industry CRC	01-JUL-15	30-JUN-17
Prof James Rowe	Coordination & Governance (James Rowe)	\$50,000	\$5,554	CRC for Sheep	01-JUL-08	30-JUN-17
Prof John Gibson	Facility Restoration and Operation Agreement	\$400,000	\$80,000	Meat & Livestock Australia	01-JUL-12	30-JUN-17
Prof John Gibson	Delivering improved dairy genetics and sustained affordable access to sorted (sexed) semen technology to increase dairy productivity for poor smallholder dairy farmers	\$1,475,419	\$294,922	Bill & Melinda Gates Foundation - BAIF Development Research Foundation	21-NOV-14	21-NOV-19
Prof John Gibson	Platform for African Dairy Genetic Gains in Tanzania and Ethiopia	\$1,197,916	\$435,932	International Livestock Research Institute	01-JAN-16	30-SEP-18
Prof John Gibson	Identification of unique signatures of selection between Hanwoo (Korean cattle) and Holstein, Angus and Brahman	\$250,000	\$44,061	Hankyong National University (HKNU) of the Republic of Korea	01-MAY-11	31-DEC-16
Prof John Thompson (ADJP)	Development of genetic testing model for young bull selection and development of additional collaborations in meat science and nutrition	\$120,000	\$22,836	National Institute of Animal Science of the Rural Development Administration, Korea	01-OCT-11	31-DEC-16
Prof Julius Van Der Werf	Tactical approach to Prphenotyping and genotyping	\$262,056	\$43,081	Meat & Livestock Australia	25-JUN-13	30-JUN-16
Prof Julius Van Der Werf	Resource Flock 2014-2020	\$6,756,710	\$1,191,976	Meat & Livestock Australia	31-OCT-14	30-JUN-20
Prof Julius Van Der Werf	Faster affordable genetic gain	\$6,906,547	\$759,272	Sheep CRC	01-JUL-11	30-JUN-19

Principal Investigator	Title of Grant	Total Funding Awarded	2016 \$ awarded	Funding Body	Start date	Completion date
Prof Mingan Choct	Acylated xylo-oligosaccharides (resulting from xylanase application in feed) as an alternative to in-feed antibiotics	\$60,000	\$15,342	AsiaPac (Dongguan) Biotechnology Co Ltd	08-OCT-13	07-OCT-16
Prof Mingan Choct	Nutrigenomics related to energy expenditure of the gut and the gut microflora of chickens.	\$60,000	\$16,042	Phytobiotics Futterzusatzstoffe GmbH	09-SEP-13	04-NOV-16
Prof Mingan Choct	PhD Scholarship - Ines Rodrigues - Gut physiology and enzyme efficacy in broiler chickens	\$120,000	\$36,569	AB Vista	01-FEB-16	01-FEB-19
Prof Paul Iji	The effects of dietary minerals on phytase efficacy, nutrient utilisation and gut microflora of broiler fed maize-soya-based diets.	\$30,000	\$7,958	AB Vista	01-JUL-13	26-NOV-16
Prof Paul Iji	In ovo feeding of broiler chicks with a processed protein product	\$40,000	\$6,968	Hamlet Protein Denmark	01-APR-13	31-JUL-16
Prof Paul Iji	Maximizing the nutritional value of unprocessed soybean meal through supplementation with complex microbial enzyme products	\$60,000	\$12,341	DSM Nutritional Products Asia Pacific Pte Ltd	01-FEB-14	30-JUN-16
Prof Paul Iji	Improving the nutritional value of vegetable protein meals for broiler chickens using new generation microbial enzymes	\$24,000	\$14,129	Feedworks	15-JUN-15	24-FEB-17
Prof Paul Iji	Potential of new-generation microbial enzymes to improve energy value and ileal nutrient digestibility of cereal grains for broiler chickens	\$134,989	\$78,405	AB Vista	01-AUG-15	31-JUL-16
Prof Paul Iji	The effects of different phytases on performance of broilers	\$51,168	\$51,168	AB Vista	01-FEB-16	31-DEC-16
Prof Paul Iji	Effect of yeast and its components on performance and intestinal function in broiler chickens - PhD Scholarship for Emmanuel U Ahiwe	\$60,000	\$7,035	AB Vista	01-SEP-16	30-JUN-19

Principal Investigator	Title of Grant	Total Funding Awarded	2016 \$ awarded	Funding Body	Start date	Completion date
Prof Paul Iji	In vitro and in vivo digestibility or raw soy protein by ProAct and HiPhos	\$24,480	\$14,038	DSM Nutritional Products Asia Pacific Pty Ltd	01-SEP-16	31-MAR-17
Prof Paul Iji	Potential of new-generation microbial enzymes to improve energy value of tropical cereal grains for broiler chickens	\$106,437	\$53,439	AB Vista	01-SEP-16	30-APR-17
Prof Paul Iji	The nutritive value of sorghum grains in diets for broiler chickens - Scholarship for Monneye Mabelebele	\$24,000	\$4,422	AB Vista	01-MAR-13	22-AUG-16
Prof Robert Swick	Benefits of formulating feed use NE vs ME for broilers	\$49,280	\$16,427	Poultry CRC	01-MAY-14	30-APR-17
Prof Robert Swick	Pilot study on the nutritional manipulation of odour emission from poultry	\$350,000	\$139,770	Poultry CRC	01-JUL-14	31-DEC-16
Prof Robert Swick	Implementation of a net energy system for laying hens	\$707,923	\$353,962	Poultry CRC	01-JAN-15	31-DEC-16
Prof Robert Swick	Implementation of a net energy system for laying hens (postgrad scholarship)	\$8,302	\$4,335	Poultry CRC - Postgraduate Scholarship	01-AUG-15	30-JUN-17
Prof Robert Swick	Algae as a feed additive in broiler diets	\$47,674	\$23,804	Poultry CRC	01-APR-15	01-APR-17
Prof Robert Swick	Response of broiler chickens to difference levels of dietary lysine, MEn and available phosphorus - Scholarship for Nishchal Sharma (220106652)	\$26,000	\$26,000	Evonik Industries Singapore - Scholarship	01-JUN-16	09-DEC-16
Prof Robert Swick	To investigate the effect of supplemental amino acids on broiler performance - PhD scholarship for Matthew Hilliar (220097257)	\$102,525	\$22,867	Rural Industries Research & Development Corporation	01-MAY-16	30-APR-19
Prof Robert Swick	Services for conduction of a broiler necrotic enteritis experiment investigating the effect of L- glutamine	\$14,500	\$14,500	South Australian Research and Development Institute	07-JUL-16	15-NOV-16

Principal Investigator	Title of Grant	Total Funding Awarded	2016 \$ awarded	Funding Body	Start date	Completion date
Prof Robert Swick	Examination of broiler performance and metabolism when fed low protein diets with added amino acids	\$150,000	\$14,658	Evonik Industries Singapore - Scholarship	15-SEP-16	15-SEP-19
Prof Robert Swick	Industry Chair in Poultry Nutrition	\$441,981	\$56,984	Rural Industries Research & Development Corporation	31-JAN-11	01-NOV-18
Prof Roger Hegarty	Development of candidate management interventions to reduce foetal and calf loss in beef herds in Northern Australia	\$52,800	\$39,925	University of Queensland	30-MAR-16	30-MAR-17
Prof Roger Hegarty	Evaluation of a rumen bioactive	\$14,000	\$9,981	Anpario Plc	01-SEP-15	30-OCT-16
Prof Roger Hegarty	Genetics to reduce methane emissions from Australian sheep	\$810,314	\$226,120	Department of Agriculture, Fisheries and Forestry - Carbon Farming Futures - Filling the Research Gap	01-JUL-13	29-JAN-17
Prof Roger Hegarty	Genetics to reduce methane emissions from Australian sheep	\$279,000	\$77,856	Meat & Livestock Australia	01-JUL-13	29-JAN-17
Prof Steve Walkden-Brown	ParaBoss phase 1	\$431,609	\$142,956	Australian Wool Innovation Ltd	04-FEB-14	10-FEB-17
Prof Steve Walkden-Brown	Vaccine and Diagnostics for Haemorrhagic Enteritis of Turkeys	\$441,473	\$176,009	Poultry CRC	01-JUL-14	30-DEC-16
Prof Steve Walkden-Brown	Hub and spoke method for the delivery of sheep and wool education resources licensed to UNE by AWET to tertiary students Australia-Wide	\$760,000	\$138,938	Australian Wool Education Trust	01-FEB-16	01-FEB-21
		\$30,173,380	\$7,079,226			

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1	Bedford M, Choct M, and Masey O'Neill HV. Nutrition Experiments in Pigs and Poultry: A practical guide. CABI, Wallingford, United Kingdom, pgs.162 -- isbn: 9781780647005 -- doi:10.1079/9781780647005.0000.
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3	Al-Husseini W, Chen Y, Gondro C, Herd RM, Gibson J and Arthur PF. Characterization and profiling of liver microRNAs by RNA-sequencing in cattle divergently selected for residual feed intake. Asian-Australasian Journal of Animal Sciences, v.29 (10), p.1371-1382 -- doi:10.5713/ajas.15.0605.
4	Akter M, Graham H and Iji PA. Response of broiler chickens to different levels of calcium, non-phytate phosphorus and phytase. British Poultry Science 57, 799-809.
5	Ari, M.M., Iji, P.A. and Bhuiyan, M. (2016). Promoting the proliferation of beneficial microbial populations in chickens. World's Poultry Science Journal 72, 785-792.
6	Arthur PF, Donghue KA, Bird Gardiner T, Herd RM and Hegarty RS. Effect of measurement duration in respiration chambers on methane traits of beef cattle. Animal Production Science. http://dx.doi.org/10.1071/AN15425 .
7	Barekatain MR and Swick RA. Composition of more specialised pre-starter and starter diets for young broiler chickens: a review. Animal Production Science, v.56 (8), p.1239-1247 -- doi:10.1071/an15333.
8	Barnett M, Forster N, Ray GA, Li L, Guppy C, et al. Using portable X-ray fluorescence (pXRF) to determine fecal concentrations of non-absorbable digesta kinetic and digestibility markers in sheep and cattle. Animal Feed Science and Technology, v212, p.35-41 --doi:10.1016/j.anifeeds.2015.12.015
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10	Berk Z, Laurenson Y, Forbes AB and Kyriazakis I. Modelling the consequences of targeted selective treatment strategies on performance and emergence of anthelmintic resistance amongst grazing calves. International Journal for Parasitology: Drugs and Drug Resistance, v.6 (3), p.258-271 --3207 -- doi:10.1016/j.ijpddr. .11.002.
11	Beski, S.S.M., Swick, R.A. and Iji, P.A. (2016). Effect of dietary inclusion of spray-dried porcine plasma on performance, physiological and immunological response of broiler chickens challenged with <i>Salmonella sofia</i> . Journal of Animal Physiology and Animal Nutrition 100, 957-966.
12	Beski, S.S.M., Swick, R.A. and Iji, P.A. (2016). The effect of the level and feeding duration of spray-dried plasma protein on growth performance, digestive enzyme activities, nutrient digestibility, and intestinal mucosal development of broiler chickens. Animal Production Science 56, 1820-1827.
13	Bigdeli TB, Ripke S, Kirov G, McQuillin A, Gurling H, et al. Genome-Wide Association Study Reveals Greater Polygenic Leading for Schizophrenia in Cases with a family history of illness. American Journal of Medical Genetics. Part B: Neuropsychiatric Genetics, v171 (2), p.276-289--doi:10.1002/ajmg.b.32402.
14	Bolormaa S, Hayes BJ, Van Der Werf JH, Pethick DW, Goddard ME and Daetwyler, HD. Detailed phenotyping identifies genes with pleiotropic effects on body composition. BMC Genomics, v.17, p.1-21 -- doi:10.1186/s12864-016-2538-0.
15	Brown A, Ojango J, Gibson J, Coffey M, Okeyo M and Mrode R. Genomic selection in a crossbred cattle population using data from the Dairy Genetics East Africa Project. Dairy Science 99, p.7308-7312.
16	Campbell D, Hinch G, Downing JA and Lee C. Fear and coping styles of outdoor-preferring, moderate-outdoor and indoor-preferring free-range laying hens. Applied Animal Behaviour Science, v.185, p.73-77 -- doi:10.1016/j.applanim. .09.004.
17	Charmley E, Williams SRO, Moate PJ, Hegarty R, Herd RM, Oddy, VH, Reyenga, P, Staunton, KM, Anderson, A and Hannah, MC. A universal equation to predict methane production of forage-fed cattle in Australia. Animal Production Science, v.56 (3), p.169-180 -- doi:10.1071/an15365.
18	Cottle D. Estimation of the pasture intake of individual yearlings by controlled supplementation with natural 13C or alkanes and alcohols. Livestock Science, v.184, p.13-20 00 doi:10.1016/j.livsci.2015.12.001.
19	Cottle D and Cowie A. Allocation of greenhouse gas production between wool and meat in the life cycle assessment of Australian sheep production. International Journal of Life cycle Assessment, v. 21 (6), p.820-830 -- doi: 10.1007/s11367-016-1054-4.
20	Cottle D, Eckard R, Bray S and Sullivan M. An evaluation of carbon offset options for beef production systems on coastal speargrass in central Queensland, Australia. Animal Production Science, v.56 (3), p.385-392 -- doi:10.1071/AN15446.
21	Cottle D and Fleming E. Do price premiums for wool characteristics vary for different end products, processing routes and fibre diameter categories. Animal Production Science, v.56 (12), p. 2146-2160 --doi:10.1071/AN14744.
22	Cottle D, Gilmour AR, Pabiou T, Amer P and Fahey A. Genetic selection for increased means and reduced variance of twinning rate in Belclare ewes. Journal of Animal Breeding and Genetics, v. 133 (2), p. 126-137 -- doi:10.1111/jbg.12173.

23	Cottle D, Harrison Mt and Ghanramani A. Sheep greenhouse gas emission intensities under different management practices, climate zones and enterprise types. <i>Animal Production Science</i> , v56 (3), p.507-518 – doi:10.1071/AN15327.
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