The successful candidates will receive:

- A $33,000 p.a (tax-free) scholarship for up to three and a half years
- Professional development programs
- International travel opportunities
- Access to state-of-the-art technologies

The PhD research fellowships are part of a new Centre for Agricultural Innovation (CAI). The CAI is a joint initiative between The University of Melbourne and Agriculture Victoria. PhD research fellowships will be based at the following locations:

- Ellinbank Research Centre and SmartFarm
  Ellinbank, Victoria
- Hamilton Research Centre and SmartFarm
  Hamilton, Victoria
- AgriBio, the Centre for AgriBioscience
  Melbourne, Victoria

Successful applicants must meet Australian university entry requirements for a Doctor of Philosophy degree.

For enquiries and to apply, please forward a covering letter, your curriculum vitae (please include evidence of research writing) and academic transcripts to:

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Visitor and Student Coordinator
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PhD research fellowships

Preconditioning predictive models using remote and satellite derived data

This PhD candidate will integrate new remote sensed and satellite derived data into farming system models to develop management strategies to maximise farm profit under future seasonal climate conditions. Existing predictive pasture models will be revised and enhanced using machine learning techniques coupled with remote-sensed data to more accurately assess pasture mass at paddock and landscape levels, pasture nutritive characteristics and future pasture growth.

Integrating data streams on dairy farms for perennial pasture management decisions

This PhD candidate will utilise a range of existing and emerging farm data sets to create a dairy farm data cube. Using advanced spatial modelling techniques, a range of data mining and machine learning approaches will be investigated. The data cube will integrate multiple sources of farm data to generate dairy farm data streams for farmer use and to develop a tactical pasture management framework.

Within field spectral analysis of phenological state and leaf stage in perennial ryegrass under grazing

This PhD candidate will use field based multispectral and hyperspectral technologies to quantify changes in pasture nutritive characteristics in real time. Studies will be conducted to assess pasture phenology using traditional destructive measurements, non-destructive observations and using field spectral analysis, throughout a full grazing season across multiple paddocks/regions. This will enable quantification of changes in spectral response due to phenology and leaf stage in perennial ryegrass. A key component of this work will be the identification of the most suitable wavelengths (or combinations) for determining plant growth.
Estimating pasture nutritive characteristics and quantity using proximal to satellite scaled observations at farm scales
This PhD candidate will quantify pasture water content, nutritive characteristics and/or quantity using in-situ proximal observations. Current measurements of pasture nutritive attributes preclude the provision of real time pasture information, an essential element of modern dairy systems. Emerging technologies offer the opportunity to provide such information. This study will test, develop and identify different vegetation indices from multispectral images and synthetic aperture radar-based vegetation indices and compare these to the traditional NDVI measurements. A key component will be the determination of the best relationship between nutritive characteristics and quantity measurements and remote observations and the dependencies at scale using modern data mining and machine learning techniques.

Next generation pasture measurement in dairy farming systems through on-farm sensor data integration
This PhD candidate will create a ‘pasture sensor network’ using a wide range and variety of on-farm pasture data sensors. Farmers are challenged by the increasing number of data sets being generated, their lack of cohesion and integration and how to use the generated information. The candidate will utilise the array of existing and proposed sensors at the Ellinbank Smart Farm to develop physical and/or virtual connectivity protocols to enable real-time data upload and download through a cost effective on farm telemetry and for the development of dash boards for automated data visualisation and integration with on farm decision making process.

Developing a Forage Value Index for Italian and annual ryegrass
This PhD candidate will develop and identify forage value index/indices for short term annual and Italian ryegrasses for the dairy industry. The indices will value regional differences in dry matter across dairy regions, account for both grazed and conserved forage, incorporate nutritive characteristics and costs associated with resowing. Development of the FVI will require advanced statistical modelling techniques to manage multi-environment, multi-harvest data sets, field data collection including spectral data collection using sensors and the incorporation of economic data and correlated traits into an index for farmers.

Optimising the design, measurement and analysis of forage variety trials using multispectral data sources
This PhD candidate will develop and identify non-destructive methods for estimating pasture yield and composition based on vegetative indices derived from multispectral and hyperspectral data. The PhD candidate will evaluate a range of potential sensors, identify the effects of spatial, regional and genotypic variation and integrate data into a format to measure pasture mass and nutritive characteristics. During this project the PhD candidate will be trained in farm management economics and modelling, modern methods for the statistical analysis of data including: (i) advanced statistical modelling techniques to manage multi-environment, multi-harvest data sets; (ii) spectral data collection using sensors mounted on ground and aerial platforms; (iii) the ground truthing of sensor and image-based datasets.

Utilising genomic relationships during the estimation of perennial ryegrass performance
This PhD candidate will identify and quantify genomic relationships between elite perennial ryegrass cultivars and use this relationship matrix, or pseudo-pedigree to incorporate the performance of related cultivars into the estimation of cultivar performance. During this project the PhD candidate will be trained in farm management economics and modelling, modern methods for the statistical analysis of data including advanced statistical modelling techniques to manage multi-environment, multi-harvest data sets and genomic sequencing.
Determining the economic values of perennial ryegrass for different farm systems
This PhD candidate will further develop and refine the Forage Value index as a tool to assess perennial ryegrass performance across a more diverse set of environments and dairy systems. This PhD candidate will expand the FVI to include additional regions and account for herds with different calving patterns and where the pattern of animal metabolisable energy demand differs from a spring calving system. There is a need to assess the impact of different calving systems, such as split, autumn and year-round calving on the ranking of cultivars in the FVI. The PhD candidate will develop an economic framework to analyse strategic changes of the farm system in response to changes in pasture production, assess the effect of seasonal and price variability across different farm systems, both between regions and within regions, on the estimated economic value of important traits.

Integrating new pasture technologies into dairy farm systems in Victoria
This PhD candidate will develop an approach that enables quantification of improvements in trait efficiencies emerging from new pasture technologies that result in step change improvements in forage yield and nutritive characteristics. Using the existing Forage Value Index, the PhD candidate will (i) conduct field trials to quantify the key nutrient and water inputs required to achieve the benefits of elite perennial ryegrass genetics on-farm, (ii) develop scientific response relationships to underpin economic analysis of the profitability of elite perennial ryegrass cultivars and (iii) assess the ability of dairy farms with different production systems to capitalise on these significant increases in pasture production and/or nutritive characteristics.

Virtual fencing to improve pasture allocation and utilisation
This PhD candidate will integrate non-destructive technologies for measuring pasture attributes with pasture allocation at a herd scale while developing methodologies to ensure an even distribution of forage across the grazing herd. Recent developments in virtual fencing technology offer an opportunity to re-define how pasture is allocated and utilised in manner that enables the development of strategies to deliver a more uniform supply of nutrients across the herd. Implicit in the application of virtual fencing within rotational grazing systems will be a need to understand the impact on animal behaviour over time. The PhD candidate will investigate the economics of using virtual fencing to develop feeding regimes to supply consistent nutrient supply across the herd.

Using breath sensors to estimate respiration rate and daily dry matter intake of individual cows at pasture
This PhD candidate will identify sensors to measure changes in gas concentrations in dairy cow breath and use this information to estimate dry matter intake and respiration rate. Current methods to estimate pasture intake either provide an average intake across the herd or require expensive and intensive sampling and subsequent analysis. The proposed approach will compare estimated feed intake by gas sensor with other currently available methods and aims to provide near real time information on individual cow intake at grazing.

Factors affecting the rumen environment of lactating cows during heat exposure
This PhD candidate will improve our understanding of how key factors such as decreased feed intake, decreased rumination time, loss of saliva and altered eating pattern impact the rumen environment during periods of heat stress. Studies will use a range of nutrition interventions and measure changes in rumen pH, volatile fatty acids (VFA) concentrations, buffering capacity and redox potential. The information generated will contribute to guidelines for nutritional strategies to manage lactating dairy cows during hot weather.
Physiological responses of lactating cows to varied diet composition or feed additives during hot weather
This PhD candidate will measure the effects of different nutritional regimes on physiological responses of lactating cows experiencing hot weather and identify variation in the expression of genes during such conditions. Using a range of measurement technologies, the candidate will monitor core temperature data, dry matter intake, milk production and composition, skin temperature, respiration rate, and heart rate to develop an understanding of the metabolic responses to acute heat exposure when diets differing in concentrate or forage type and with the inclusion of specific dietary additives are offered. Biological samples will be collected to assess gene expression, metabolic profiles and milk microbiome. In addition, physiological responses in cows with high and low predicted heat tolerance will be compared.

Characterisation of 100,000L/lifetime cows from pasture based systems
This PhD candidate will develop a measure that can help to monitor the health and well-being of high producing dairy cows with extended longevity in the herd. This will be done by characterising very high producing cows that have achieved a high lifetime production (i.e. 100,000 L) with those of lower production. It is estimated that there is less than 200 out of 1.6 million dairy cows in Australia that have achieved a lifetime milk production of 100,000 L and farmers often say these animals go unnoticed because they have adequate fertility and production and do not require regular veterinary attention. The aim of this project is to improve our understanding of traits and genes that relate to these cows. A key aspect of this work will be how this trait compares to existing likeability, survival and residual survival breeding values and how these breeding values can be updated with this new knowledge.

Mitigation strategies to reduce direct and indirect greenhouse gas emissions from stored dairy manure and effects on nutrient use efficiency
This PhD candidate will investigate the effectiveness of various chemical and physical mitigants, characterise nutrient transformations, quantify direct and indirect greenhouse gas emissions of manure components in storage, and measure the nutrient use efficiency and losses when treated manure is applied to land. The studies will include methane reducing feed additives, chemical modifications and the use of bio-digestible polymers on stored manure. The PhD candidate will undertake studies using the Ellinbank SmartFarm, be trained in a range of laboratory techniques required for chemical characterisation and the quantification of gaseous emissions from manure, with activities undertaken at the laboratory, field and farm-scale.

Separation technologies to improve manure value
This PhD candidate will quantify chemical characteristics of manure and manure-separation co-products formed post application of physical and chemical separation and anaerobic digestion technologies. The PhD candidate will optimise a variety of separation technologies and quantify biogas generation. This project will address the requirement for improved manure management that meets the need for nutrient and water recovery and energy generation on dairy farms. The PhD candidate will undertake research at the Ellinbank SmartFarm and be exposed to different commercial dairy farms systems and undertake experiments at a range of scales.