

## PhD Project Advertisement

**Project title:** Application of machine learning to genomic selection of dairy cattle through improved feed efficiency complex prediction

**Project No:** FBS2023-42-Mooney-qa

**Lead supervisor:** Mark Mooney, Biological Sciences, Queen's University Belfast

**Email:** mark.mooney@qub.ac.uk

**Co-supervisors:**

Faisal Rezwan, Aberystwyth University; Hui Wang, Queen's University Belfast; Masoud Shirali, Agri-Food and Biosciences Institute

### Project description:

The sustainability and profitability of the dairy livestock sector is dependent on a balanced interplay between the production of produce that can meet consumer expectations, the maintenance of animal health and wellbeing, and the efficient management of resources and inputs. Feed efficiency (FE) complex in animals, as defined by the production of the same quantity of dairy product using fewer feeding resources, is a key productivity indicator with an estimated 60% of the total costs of dairy production being associated with feeding. Given current international concerns regarding greenhouse gas emissions, nutrient losses, and water quality, facilitating improvements to FE complex is an important focus of dairy-based production systems. FE complex is affected by many factors, including pedigree, physiological, environmental, and genomics variations, and therefore traditional methods based on linear approaches that quantify FE complex have limited statistical power and accuracy. Alternative more comprehensive approaches such as machine learning (ML)-based methods offer the potential to integrate heterogeneous variables and utilise high dimensional data more efficiently. ML techniques can highlight the most important factors influencing FE complex and these selected variables can be used to develop improved models that can more accurately predict FE complex and provide new knowledge on the biological processes underlying the FE complex. This project will seek to utilise a data-driven approach using ML by combining pedigree, physiological, environmental, and genomics information to provide improved prediction accuracy in the FE complex. High precision datasets, captured within a specially constructed database, collated at the Agri-Food and Bioscience Institute (AFBI) over the last 20 years will be made accessible to this work through the Northern Ireland Farm Animal Biobank (NIFAB). These datasets, containing pedigree, weekly feed intake and feed analysis, management and other environmental data, daily production records, and genomics information, present a unique opportunity to better understand the FE complex in dairy cattle, and improve our knowledge on genomic influence on FE complex by identifying key genes and associated biological pathways. This information will ultimately allow dairy farmers in the UK to select the most efficient cows within the herd from which to breed replacements, and the most food efficient sires to use on these cows. As a consequence, feed costs will be reduced and profitability improved, mitigating inefficiencies in production systems and nutrient losses. As a CASE studentship, this project will provide a unique opportunity to work directly with AFBI and learn about the needs and research gaps of the agri-food sector.

### Training opportunities:

The successful applicant will have the opportunity to work with researchers at Queen's University Belfast, Aberystwyth University and Agri-Food and Biosciences Institute (AFBI) and benefit from research underpinned by strong applied and industrial-focused collaboration, contributing to transferable and professional skill development in preparation for a career within academia, industry or the policy sector. The student will benefit from QUB involvement in the QUADRAT NERC DTP facilitating additional training (e.g. data analytics) and opportunities for cross-disciplinary interaction. The QUB Postgraduate Research Development Programme will develop transferable skillsets whilst QUB/AFBI will provide bespoke training in quantitative genetics, bioinformatics and genomic data analysis, with the opportunity to enrol on relevant components of PGT modules at QUB and Aberystwyth University. The research infrastructure, scientific expertise, and

regional diversity that this project encompasses aims to train a data analytic scientist with the unique skillsets and expertise needed to address a spectrum of research questions within the agri-food and animal health field. As a CASE studentship, the project provides a unique opportunity for the student to work directly with AFBI and learn about the needs and research gaps of agri-food, and how research can address these needs through both governmental and commercially directed research.

#### **Student profile:**

This project would suit a student with good quantitative skills and a strong interest in modelling biological systems with a degree in Biological Sciences, Computer Sciences, Statistical Sciences or similar. Demonstrable knowledge of biological systems and processes, and some research experience in at least one of quantitative genetics, bioinformatics, metabolomics, or data sciences would be an advantage but not essential.

#### **Stipend (Salary):**

FoodBioSystems DTP students receive an annual tax free stipend (salary) that is paid in instalments throughout the year. For 2022/23 this will be £17,668 and this will increase slightly each year at rate set by UKRI. This is a CASE PhD studentship project with in-kind support from AFBI.

#### **Equality Diversity and Inclusion:**

The FoodBioSystems DTP is committed to equality, diversity and inclusion (EDI), to building a doctoral researcher(DR) and staff body that reflects the diversity of society, and to encourage applications from under-represented and disadvantaged groups. Our actions to promote diversity and inclusion are detailed on the [FoodBioSystems DTP website](#).

In accordance with UKRI guidelines, our studentships are offered on a part time basis in addition to full time registration. The minimum registration is 50% FT and the studentship end date will be extended to reflect the part-time registration.

**For up to date information on funding eligibility, studentship rates and part time registration, please visit the [FoodBioSystems website](#).**