Further Information:

Economics of precision livestock farming technologies in dairy systems

There is increasing demand for livestock products from emerging economies and increasing pressure on livestock systems to improve their efficiency of production and reduce their environmental footprint. Precision livestock farming (PLF) has emerged as a package of technology, process and decision support that can create a substantial step-change in livestock production systems. PLF is defined as the management of individual livestock by continuous automated real-time monitoring and control of production, health and animal well-being, and environmental impact.

With the ongoing development of cost reductions in sensors and their applicability to capturing diverse data, the capacity of innovative agri-tech to continuously and autonomously monitor and measure production, health and well-being of individual animals is expanding. Dairy cows are the most monitored individual animal in world agriculture and much of the developed technology has been focused on monitoring production, animal health and welfare. The challenge for decision makers and managers of dairy systems is the integration of these diverse monitoring systems to improve decision making about individual animal management and whole system performance. There is a need to develop data integration, analysis procedures, and data visualisation techniques that enable improved farmer decision making and capture the potential value of adopted technology.

The challenge also requires agri-tech to be cost effective and consideration to be given to the trade-offs in potential gains from making more or less precise decisions. It also requires consideration of embedded risk in decision making and what constitutes an optimal decision at any point in time.

The methodology will have the following steps:

1. Collect and integrate data – This includes the development of systems for the collation and integration of primary and secondary data that influences the productivity and economics of dairy farming systems. Biophysical data is currently being collected from Harper Adams University SMART Dairy which has a commercial herd of 60 cows milked through a robotic milking machine and a range of individual animal sensors. Data is also available through collaborators associated with HAS University of Applied Science in the Netherlands. Further data on the economic environment will need to be integrated and analysed.
2. Development of a whole farm dairy budget with individual animal sub-models – standard budgeting and farm economic procedures will be used to construct a framework for the assessment of individual animal and whole farm economic performance.
3. Development of machine learning and optimisation procedures to identify prescriptive solutions to constraints limiting individual animal performance and well-being, and whole farm profitability. This includes the identification, development and visualisation of key data and performance indicators that are appropriate to decision makers/managers of dairy systems.
4. Investigate the economics of different combinations of technology, capturing individual animal data, and the temporal resolution and accuracy of the data.

The outputs from the project will be:

i. Processes to integrate, analyse and forecast individual animal production, health and well-being.

ii. Processes to integrate, analyse and forecast real-time changes in the economic environment of dairy production systems.
iii. The development of decision support systems that identify economically optimal and prescriptive strategies for decision makers/managers of dairy systems.
iv. An assessment of the economic feasibility of different combinations of innovative agri-tech that aim to improve dairy farming profitability.

At Harper Adams University, the study will be supervised by Professor Karl Behrendt. Prof. Behrendt is an agricultural economist with expertise in bioeconomic modelling of agricultural systems and the development of decision support tools for farmers. Prof. Behrendt also has over 20 years industry experience working as an agricultural consultant and extension specialist. Co-supervision at Harper Adams University is provided by Professor Mark Rutter who has over 30 years research experience in animal welfare, precision livestock farming and computational biology. Additional collaboration is provided through Professor Lenny van Erp-van der Kooij at HAS University of Applied Science (Den Bosch, NL) who has over 20 years research experience in smart farming and precision livestock farming.

Starting dates

The studentship would commence in either April 2020 or September 2020 at Harper Adams University, depending on the students visa requirements for study in the United Kingdom.