Institution: Royal Agricultural University.

Unit of Assessment: Agriculture Equine and Veterinary Science

Context: The submitting unit is based in the School of Agriculture and Food and comprises two research groups:

The Sustainable Agriculture, Food and Rural Economy Group's rationale is to promote higher yield and quality food within sustainable agricultural practices and social systems; more specifically it focuses on :

(i) **Sustainable intensification**

- developing novel integrated farming systems combining legumes for nitrogen accumulation with reduced cultivation systems to promote soil conservation; this is the focus of a series of related PhD projects which are providing farmers and other stakeholders with valuable information on how to maximise the value of such practices (e.g. six papers at "Rethinking Agricultural Systems in the UK" conference, Oxford, Dec 2013) and in the longer term will inform government policy.
- wireless telemetry and biosensors to monitor dairy cattle health and performance; developing novel technology for environmental sensors. This is an emerging aspect of research following the appointment of the Bomford Chair in Applied Agricultural Engineering in 2012 which will be aligned with the government's Agri-Tech Strategy. Professor Mottram developed rumen telemetry boluses (marketed by www.ecow.co.uk) and previously other robotic systems for improved dairy cow yield, health and welfare.

(ii) **Food security, quality and safety**

- benchmarking, risk assessment and enhancing quality assurance in national and international food supply chains: (see impact case study for details) – main impact has been the development of environmental and social standards for food quality along with audit checklists and guidance for farmers and food businesses. These standards have been combined into the Safe Food Quality Institute SQFi Ethical Sourcing Code (2010) supported by global retailers including M&S and Sainsbury's; also used in Canada, Australia, and USA. Development of risk based systems for fresh produce and aquaculture sectors in the UK. (FRAM-P and AQUA FRAM)
- farmer engagement; application of social science to rural issues and building social capital in rural communities; its importance in knowledge exchange, including farmer attitudes to policy areas such as bovine tuberculosis (bTB) control, greenhouse gas (GHG) emissions from livestock; developing agronomy with 250 farmers in Zambia, Tanzania and S Africa; engagement with poultry farmers in the UK, Scottish salmon farmers, and the Chilean Salmon Farmers Association
- Environmental Policy: factors influencing biodiversity in both organic and conventional farming systems, evaluating effectiveness of CAP and agri-environment schemes to deliver economic and environmental objectives. This area of work has impacted on policy but is not based on research papers but on direct, commissioned reports to bodies like Defra & Natural England.

The Equine Research Group's main focus: improving health, nutrition and behaviour through studies on digestion and processing of forage, in particular putative links between hind gut health and behaviour, and behavioural and physiological consequences of feeding a diet rich in fibre coupled with pro-biotic supplements such as live yeast. The work of Hemming and Moore-Colyer has supported the development of feed additives and better nutritional advice for horse owners including an award winning IPhone application and the Haygain hay-steamer device [for full details see case study]. Main beneficiaries have been the Haygain company; Lesaffre Feed additives Ltd.; horse owners (information presented at various conferences (see b below)).

b. Approach to impact

Impact is driven by continual close engagement with industry stakeholders in all RAU activities, from undergraduate and graduate programmes to our research and knowledge exchange programmes. Engagement with industry is a feature of all of our degree courses, with formal extended placements, regular visiting speakers, and farm and industry visits. The translation of research is facilitated by the extensive alumni network within the industries we serve. Staff have been actively involved in policy discussions around translation and knowledge exchange (Gaskell as Chair of Government Chief Scientific Advisor's Food Research Partnership Translation Sub Group and Manning [see Outputs]. Innovation and entrepreneurship is important across the institution (e.g. the School of Business and Entrepreneurship), and is being strengthened by the appointment (February 2014) of a senior academic in this area. The Student Enterprise Club

encourages individual students, providing mentoring and pump priming, for which funds are generated through profits from a previously developed enterprise [Muddy Wellies beer], and members have been recent winners at the SW University Awards and other competitions. The RAU organises and hosts an annual 'New Shoots' inter-university enterprise competition for land-based students in higher education.

The work of the RAU focuses on applied, near-market or contract research in agriculture and land-based studies. The institution has been at the forefront of this specialist knowledge exchange since its inception. As a result key users, beneficiaries, or other audiences approach the RAU for information and advice on science or policy through consultancy or contract research proposals. Academic staff are involved in their specialist areas with such relationships which can readily be pursued to create impact for their work.

The RAU has various methods for engaging with people and organisations that can sponsor research, collaborate on projects, or be participants in knowledge exchange / translational research and assist in the dissemination of the results of its research.

- The Business Development Centre (BDC) employs research-capable staff with formal project management (PRINCE2) training and ISO 9001 certification, to scan for funding opportunities, to build relationships with potential clients and provide quality assurance in project management.
- Each School has an Advisory Board whose members are drawn from industry; each also retains various visiting professors and research associates to provide direct links, in the case of SoAF, to the agricultural and equine industries.
- RAU 100 Club: a nearly 20-year-old network of over a hundred national and international companies that meets annually with policy makers and diplomats to hear presentations and network together and with staff and students, and organises a fellowship programme in collaboration with industry partners.
- Governors: a number of members of the Governing body have direct connections with agricultural and related industries (poultry, farming, food manufacturing and retail, and equine industries)
- The RAU organises, hosts and delivers a number of prestigious one to three week courses for the industry with partners (eg. the Worshipful Company of Farmers Advanced Business Management Course; the John Edgar Trust Management Development Programme; the Institute of Agricultural Management Leadership and Management Programme. Other bespoke courses are provided for RICS, financial institutions and other industry groups on a regular basis.
- Natural England, Environment Agency and Defra are also a beneficiary of our research. A three day training course was delivered at the RAU in 2013 for Defra for 18 of their employees entitled 'Introduction into Agriculture'. Previously one day courses had been provided. The course included, for example, findings from Defra funded research [Dr Rhiannon Fisher on bovine tuberculosis and the social context of current policy]. Beneficiaries of other on-going research projects include the Food Standards Agency and Gloucestershire and Herefordshire County Councils.
- Bledisloe Annual Lecture; the opportunity for several hundred senior members of the agricultural community to attend the lecture (given in recent years by David Willetts MP, (Minister of State, DBIS); Professor Sir John Beddington FRS; Professor Sir John Sulston FRS; Professor Sir David King FRS; Professor Sir David Baulcombe) which provides an excellent networking event for staff and postgraduate students.
- One of the main audiences for the RAU's research are individual farmers and farmer groups who attended seminars (some funded as part of Rural Development Programme England SW knowledge transfer). The circulation RAU network includes 2,000 farmers throughout the SW. Academics from the RAU use these events to translate their research into relevant and practical advice for farmers [e.g. climate change, renewable energy, farm trees, CAP, crop and livestock management]. Research projects also have their own farmer groups or are linked with specific groups. An interactive web-based engagement system is being built at present.
- The Equine Research Group have organised three major conferences to promote their research, with keynotes from Hemmings and /or Moore-Colyer: 2010, European Workshop on Equine Nutrition, (200 delegates from over 10 countries) in conjunction with the European Association of Animal Production (EAAP) and the British Society for Animal Science (BSAS); 2012 and 2014 Horses Inside Out Annual Conferences (150 delegates from the UK and Ireland).

c. Strategy and plans

The RAU has a strategy of employing research active staff who can engage with stakeholders to identify research needs and exchange knowledge. They will explore funding initiatives and deliver research outputs to the widest audience through publications, conference presentations, organised conferences and seminars hosted on campus, and visits to stakeholder groups in their own locations. Our Annual Report documents a wide range of such dissemination activities.

Specific initiatives to develop high quality research include

(i) Developing an **Agri-technology Research Centre (ARC),** to develop the next generation of devices (particularly sensing and data management), agri-business and entrepreneurship. This will help address the gaps identified in the Agri-technology Strategy document (BIS, 2013). The ARC will form a part of a wider vision (e.g. CTR and RIC below). It will be the first of its kind in the UK in the way it uses advanced digital technology together with the associated knowledge and understanding of its use and application to improve agricultural husbandry as well as business and supply chain productivity. A focus for the centre will be the recognition that technology cannot drive improved performance alone; farmer engagement and knowledge sharing are crucial elements.

Research and teaching activities in areas of:

Digital, Sensory and Communication: biosensors, wireless telemetry, digital communications, computing [for mathematical analysis], prototype and testing the latest equipment, such as new materials for soil drainage, sensors (plant nutrient and water) for use with agronomy;

Sustainable Agri-Food Programmes: the development of sustainable global food supply chains through the development and implementation of Key Performance Indicators [KPIs].

(ii) The **Centre for Translational Research (CTR)** will promote effective knowledge exchange and agricultural and food chain innovation, entrepreneurship and human development in order to meet the challenges of a sustainable global food supply. The Centre will facilitate the translation global knowledge to local knowledge to create value for individual farmers, localities, countries and global regions; it will identify and cascade global best practice in knowledge exchange and diffusion of innovation to the agri-food supply chain; and it will develop and facilitate mechanisms of enhancing global human capital in the agri-food supply chain.

(iii) The **Rural Innovation Centre (RIC),** visited at its inception by Prince Charles in Nov 2013, is a £1.2M investment on **Harnhill Farm** (235ha purchased in 2009 for £2.4M) primarily for practical research, demonstration and knowledge exchange.

(iv) **Farmer First** – a web based farmer engagement system being developed by a post-doctoral researcher to formalise the interaction with farmers developed during her [and other] PhD projects.

(v) Investment at **Fossehill Farm** to provide further equine facilities [£102k, 2013] as a venue for connections with the equine industry through research and practical education.

d. Relationship to case studies

(i) Nutrition, health and welfare of stabled horses

These impacts resulted from interaction with animal feed companies, who had noted the research publications of two key academics. Further, targeted research was commissioned which was then disseminated to the horse-owning community via further research papers, conferences presentation, and the development of a free i-Phone application. The Unit encourages academics to develop such business relationships and especially to generate published reports / papers. In the case of Dr Hemmings, it provided sabbatical time to complete and develop his work. Dr Moore-Colyer was originally employed to specifically to develop equine research and mentor existing staff.

(ii) Food Safety, Quality and Sustainability

This impact case study resulted from the research and consultancy work of Dr Baines for private certification bodies and national governmental organisations which attracted two PhD students [a self-funded consultant and one sponsored by the Malaysian Government] to work with specific sectors [poultry and fish] leading to a range of publications which has attracted further engagement with both industry and farmers directly. The Unit's support for research students and its wide ranging contacts with food industries and with farmers facilitated this level of engagement and the subsequent widespread impact on food safety.