

<p>Institution: University of Hertfordshire</p> <p>Unit of Assessment: Panel A (6): Agriculture, Veterinary and Food Science</p> <p>a. Overview</p> <p>The Agriculture, Veterinary and Food Sciences (AVFS) submission comprises staff from the Department of Human and Environmental Sciences in the School of Life and Medical Sciences. The School is incorporated into the Health and Human Sciences Research Institute (HHSRI), one of the university's three Research Institutes, which provides the wider organisational structure and support for research. In 2011, following the appointment of a new Vice-Chancellor, a strategic decision was made to invest in education, research and development in agriculture, given its national and global importance. AVFS research builds on a previous well-established track record at the university. There has been agricultural research here for over 40 years, and since 1994 there has been a dedicated Agricultural and Environment Research Unit (AERU), which specialises in agricultural policy research. In addition, new research has been established since 2011 in areas including climate change adaptation, food security and agricultural biotechnology. A new Centre for Agriculture, Food and Environmental Management (CAFEM) is also being launched in partnership with the Royal Veterinary College and Rothamsted Research. The centre will draw on the combined expertise to lead research and teaching into some of the most pressing issues affecting every aspect of food production in the UK, from the farm to our table.</p> <p>b. Research strategy</p> <p>The university's overarching Research Strategy 2011–15 aims to achieve research excellence in specific areas that demonstrate the capability to create a dynamic culture and environment, raise the university's international profile, excel in impact, exploitation and dissemination and develop the next generation of researchers. The research strategy of this unit has been shaped by these aspirations.</p> <p>There are six research groups. They represent the core strengths in AFVS, both historically and as a result of the investments and appointments since 2011. They were established to respond to external drivers including governmental initiatives, EU priorities and also the BBSRC Strategic Plan, Age of Bioscience. They provide a mechanism for collaboration both across the university and with national and international bodies. For example, members of the unit are currently working with colleagues from the university's Science and Technology Research Institute on crop disease forecasting. There are also plans for joint research on food security with the university's Centre for Sustainable Communities. The unit is a member of the UK–China SAIN (Sustainable Agriculture Innovation Network) project.</p> <p>The research groups in the unit are:</p> <ol style="list-style-type: none"> i. Crop and Environmental Protection, led by Fitt. Research focuses on sustainable, environmentally benign strategies for control of crop pests, nematodes and diseases, including crop resistance against pathogens, combatting pesticide resistance, climate change adaptation and climate change mitigation, with particular reference to oilseed rape, wheat, strawberry and potato crops. ii. Microbiology and Biotechnology, led by Baines. One research focus is on the pathogenesis of <i>Clostridium difficile</i> and tuberculosis infections (aimed at improving the efficacy of BCG vaccine and its effect on pathogenesis). Another is environmental biotechnology (exploitation of the properties of plants, bacteria and fungi to solve environmental problems). iii. Water and Environment, led by Crook. The current research focus is on water resources, traditional water harvesting and irrigation systems in upland environments in the context of landscape resilience, contemporary development, community sustainability, glaciology and climate change. A second research focus is on water governance and demand management in Western Europe. There is also an interest in aquatic ecology, including a breeding programme for native crayfish, research on water pollution in urbanised systems, development of an
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identification key for the Hydroptilidae (micro caddis), and on catfish.

- iv. **Ecology**, led by **Denholm**. Research covers terrestrial and fresh-water habitats and focuses on mosses, lichens and higher plants, herbivore-plant interactions, dispersal and foraging strategies, and ecology of freshwater species.
- v. **Agricultural and Environmental Research (AERU)**, led by **Lewis**. AERU specialises in agri-environmental science and whole-farm sustainability assessments. It is seeking to increase chemical regulatory work, particularly for botanical food and feed additives. In the future it will include research concerned with the pre-evaluation of the dossiers prepared by industry in support of usage authorisations. It also is seeking to broaden the range of substances to which AERU currently applies its environmental risk assessments – for example, conducting environmental risk assessments for human and veterinary pharmaceuticals. Postgraduate research in this area and links with companies such as Syngenta will be strengthened. Also AERU plans to further develop its data service provision, expanding its database suite and providing online facilities for data analysis
- vi. **Food and Nutrition**, led by **Madden**. One stream of work focuses on food in relation to diet and its impact on disease. A contrasting theme concerns food sociology and the urban environment. A third aspect is the Mediterranean-style diet for the prevention and management of chronic disease in the UK.

A further area of strategic importance in the unit, and one that bridges the consultancy/research interface is a consultancy centre, [Biodet](#), that performs microbiological analysis and investigation (including water quality testing) for clients across the globe. Biodet profits are fed back into research.

For each of the research groups, the aims for 2014–20 are to:

- i. Build a critical mass of research-competitive staff and enrolment of new PhD students. The momentum for new staff appointments (nine since 2011) was established in 2013 with the initiation of CAFEM. Funding will enable the unit to recruit and retain internationally leading scientists whilst nurturing and developing new researchers and providing exemplary supervision and facilities for research students. Funding has already been identified to appoint a new chair in agriculture to start in 2014.
- ii. Give added financial support to those research groups that can make a substantial impact on public/communities and government through engaging in consultancy, networking and overseas partnerships.
- iii. Develop the collaborative partnership with Rothamsted Research and the Royal Veterinary College to make a substantial contribution to the research profile of the unit by 2020 through increased collaboration on grant applications to RCUK, Defra and other funding bodies. In part, this objective will be achieved through several academic partnerships: for example, joint teaching on the undergraduate agriculture degree; six new PhD students in the next two years recruited to research projects that entail cross-institutional collaboration, and a commitment within the partnership to make four new PhD student appointments each year from 2015.
- iv. Exploit the new MSc in Environmental Management for Agriculture introduced in 2013 and the new BSc degree in Sustainable Agriculture and Food Security, which is planned to admit students in September 2014, as recruitment pools for PhD work in these areas.

The AVFS unit is part of the HHSRI, which is led by a Director of Research and a Management Group that oversees and agrees research policies, implements strategies and ensures the development of infrastructure. The HHSRI supports the development of related activities, with particular focus on the provision of knowledge exchange within the Institute and with business and the professions. The HHSRI was involved in the strategic development of research and development following RAE 2008 through the allocation of university research funds and following approval of Research Delivery Plans for each Unit of Assessment including, since 2011, AFVS. These plans are monitored annually via an annual report.

c. People, including:**i. Staffing strategy and staff development**

Key appointments have been made to strengthen research in our priority areas. For example, **Fitt** in plant pathology, **Davies** to develop nematology research, **Denholm** to lead agro-ecology research, **Vafeiadou** to develop molecular food research, **Baines** to develop animal disease work, **Mutasa-Gottgens** to develop biotechnology, **Stotz** to develop molecular plant pathology, and **Huang** to study resistance against crop pathogens.

The university was one of the first to receive the European Council HR Excellence in Research Award, following the April 2010 launch of the [Concordat to support the career development of researchers](#). The Award was extended for a period of two years in 2013. The Concordat has been implemented through mapping of provisions for researcher development to the Research Development Framework and Statement, ensuring our researchers have an opportunity for training and career development in all of the *Vitae* four domain areas. All research staff, including postdoctoral researchers, are encouraged to access staff development programmes provided centrally by our HR Development group, as well as the [Generic Training for Researchers](#) programme. This central provision includes CPD courses in career management, leadership and management, personal effectiveness, specialist research skills and techniques, doctoral student supervision, and public engagement. The university participated in the 2010, 2011 and 2013 Careers in Research Online Survey (CROS). The 2013 results show that in 12 out of 18 categories UH responses are above or more positive than the national average. The survey provides valuable feedback to the unit on its staff development strategy.

The unit places great importance on staff development and on providing high-quality facilities. At research institute, school and departmental levels, support is provided via established mentoring and training schemes through which new staff can integrate into their specialist areas and benefit from the opportunity to develop into independent researchers. This entails active collaborations with lead researchers and an emphasis on team building. All research-active staff are provided with dedicated time for research which is factored into their annual overall workload. Early career researchers (ECRs) are supported through a mentoring scheme that includes incorporating ECRs as co-investigators on research projects/networks; introducing them to relevant contacts; providing advice on publications/ presentations/applications; and peer-reviewing all grant applications and giving opportunities for discussing work-in-progress with senior researchers. They also have access to financial support to allow conference attendance and access to other relevant training opportunities. They have full access to assistance from staff within the unit/university with a proven track record of success in writing grant applications, research articles and patent applications. These opportunities revolve around small grant funds that are allocated on a competitive basis to support fellowships and studentships. Career progression and development, together with performance targets, are monitored at annual appraisals with six-monthly reviews. Personal development plans are supported through internal staff development budgets. Career development is also enhanced through a fee-waiver policy, allowing staff to study for higher degrees by research (MSc, MPhil, or PhD). Once enrolled, individuals are integrated into one of the specialist research areas.

The unit, which is ethnically diverse and well-balanced in terms of gender and fractional and full-time staff, fully supports the university's equality and diversity principles across all relevant protected characteristics. All new staff to the university, including researchers, receive mandatory equality and diversity training as part of their induction to ensure the delivery of considerate and inclusive services. In developing its approach to staffing and staff recruitment the unit is supported by the university's [Equality Office](#) and Disability Services, which advise on legal issues surrounding equality and disability, and on best practices. The university promotes 'family friendly' policies such as flexible working, has an on-site children's nursery and offers support for staff with caring responsibilities. The university is a member of the Athena Swan Charter and is a Stonewall Diversity Champion.

Actively engaging with the university's business-facing agenda, the unit facilitates links with businesses and external bodies through such activities as knowledge exchange initiatives and the

appointment of non-academics as visiting fellows to the unit. An example of the former is a Knowledge Transfer Partnership with Challs International to develop and embed microbiological and environmental expertise in microbial communities from drainage systems and to improve product development for existing and new markets.

ii. Research students

The unit has implemented a capacity-building strategy for postgraduate researchers, creating a vibrant community of 19 PhD students and a further 11 MPhil/MSc by research students presently studying for full-time and part-time degrees. These students come from a diverse range of backgrounds from the UK, EU and overseas. There is also a matched funding scheme available to all staff whereby the Department will match external funding in support of a research programme and associated student.

Research degrees are coordinated by the Doctoral College, which oversees quality assurance and training for all key milestones of the research degree process. Each student receives an individually assessed Training Needs Analysis and access to a comprehensive programme of Generic Training for Researchers (GTR) informed by RCUK guidelines and designed to provide the knowledge and skills to help students progress successfully through research degrees into research and other careers. The analysis includes an understanding of the process of research degrees, personal development and employability. All programmes are designed to meet the Research Councils' Joint Skills Statement.

An experienced team of at least two supervisors with successful supervisory records is appointed for each research student. Good supervision is implemented through (i) quality assurance of the research expertise and experience in the supervisory team; (ii) time allowances for supervisors; (iii) supervisor training in agreement with the university's code of good supervision practice; and (iv) monitoring of students' progress at several levels, including a three-monthly progression report from each student and an annual progression examination using an assessor external to the supervisory team and overseen by the Doctoral College. Students are engaged through Doctoral College and Research Institute fora, where issues and needs are identified and addressed.

Students receive discipline-specific training tailored to their needs and participate in fortnightly multidisciplinary seminars and monthly discipline-specific meetings within a collegial research culture that brings students, staff and other researchers into regular contact. Students actively participate by presenting their research at national/international meetings supported by external travel grants or internal travel bursaries. This is in line with our policy of ensuring that each student attends at least one external scientific conference during the course of their studies, to present their findings and to network.

The effectiveness of these combined arrangements is evidenced by the fact that the university achieves consistently good results in the Postgraduate Research Experience Survey (PRES) with above average scores. This trend has continued in 2013, with supervision and research skills being particularly highly rated.

d. Income, infrastructure and facilities

Research awards obtained by members of the AVFS unit since it was established in 2011 has exceeded £3.2 million. The income sources have included Research Councils (BBSRC, NERC), the EU, Leverhulme Trust, Defra, Lottery Heritage Fund, Royal Geographical Society, and a range of private sector organisations such as Veolia Water and Waitrose. The unit's ambition to increase research grant income has been realised in a number of ways, including the collaboration with Rothamsted and the RVC and the recruitment of nine staff with past success in securing responsive mode grants from research councils. Santander grants have also been awarded to the unit through the HHSRI to enable staff to carry out fieldwork in Brazil and India.

Applied research awards have, since April 2011, exceeded £750,000, and reflects the unit's aim of engaging with users in industry and the public sector through its commitment to research and

development based on relevant-to-user expertise. Some of this has been in the form of KTPs with SMEs, but a large part is through the operations of Biodet and AERU. AERU has received competitively awarded grant income of over £1.3 million since 2008. Since then it has completed a wide variety of research, consultancy and technology transfer projects funded by central and local government, the European Union and UK industry.

The university has recently invested £40,000 in environment chambers and new plant growth facilities to strengthen research facilities, and has committed over £200,000 for improved glasshouse facilities at the Bayfordbury Field Station near Hertford in 2014. Bayfordbury comprises extensive glasshouses, a range of habitats, a nationally significant pinetum, artificial stream, lake, a suite of wet and dry laboratories, and over 40 hectares of fields, grasslands and woodland. The £120 million 2020 Estates Masterplan will also have a positive impact on the research environment, with additional space planned for research students and staff. A new, £53 million Science Building for the School, incorporating research and teaching laboratories, will be completed by 2015. This new building will house dedicated laboratories for the AVFS unit and space for the planned new staff that form part of the collaborative Centre for Food, Agriculture and Environmental Management.

The unit has also benefited from internal funds totalling about £150,000 since 2011. Small grants are available on a competitive bidding basis through HHSRI to support conference attendance, research equipment, open access publications and fieldwork. Additionally, funds have been used to appoint three permanent part-time research staff, and to refit the plant pathology laboratory in 2013 to enable molecular biological work to be undertaken. This particular investment has meant Biodet and plant pathologists can now work together on new areas of research and consultancy. A £6,000 proof-of-concept grant from the university awarded in 2013 has enabled Biodet to expand into the molecular diagnostics field and will allow further commercial spinoffs to be explored over the next few years.

Engagement with and maintenance of a research culture within the unit is promoted internally through multidisciplinary seminar programmes involving external speakers, special interest groups meetings and annual research events. The unit's research also benefits from an in-house Biological Services Unit and two Learning Resource Centres with facilities that include dedicated postgraduate study rooms and extensive electronic and paper journal collections. Locally, there is a Geographical Information Systems suite with over 70 computers, a geosciences laboratory equipped for pedological and hydrological research, a microscopy suite and an exhaustive map collection. To respond to recent data management requirements of the principal research funding bodies (RCUK, EU, etc), Information Hertfordshire collaborated with the university's three Research Institutes in two successful JISC grants in 2012 (£295,000), and subsequently a series of mini-projects with staff in this unit to develop research staff competencies in data management planning, looking after data, and longer-term data sharing. In addition, the university strengthened its data policy with regard to data curation and extended the Research Archive to support this work. The unit also benefits from a Research Information System that allows researchers to publicise their portfolio of work and research outputs.

The unit benefits from access to a central Research Grants Team and a Knowledge Transfer Team. Together, they provide a comprehensive grant application advisory service and advice on industrial R&D collaborations, especially KTPs. The university also assists the unit by providing an Intellectual Property and Contract Support Service (IPACS), which includes legal and other commercial advice, to ensure well-formed contracts. The Research Grants Team also helps to source suitable funding (with, for example, two dedicated EU grants co-ordinators), cost all grant applications, and advise on ethical issues. The university is a full member of the RCUK Research Integrity Office and has approval processes for studies involving human participants and potentially problematic ethical issues relating to research.

e. Collaboration or contribution to the discipline or research base

The unit's collaboration and established links with Defra and other national and international bodies

including HGCA (the cereals and oilseeds division of the Agriculture and Horticulture Development Board), the Chinese Government and the European Commission means that it is responsive to national and international priorities. Mechanisms have been established within the unit to promote collaborations that include joint PhD supervision with researchers at other institutions, joint research grant bids with other research institutions, the appointment of visiting research fellows, an annual research conference, and maintaining links with alumni.

Collaboration in the unit is extensive and covers private sector companies (SMEs and blue chip), other universities, public bodies and international organisations. Selected major collaborations are listed below:

Staff Submitted	Collaborators
Baines	Univ. Leeds (Prof. M. Wilcox); Procarta Biosystems (Dr M. McArthur); Royal Veterinary College (Dr M. Nevel).
Crook	Univ. Exeter (Dr Richard Jones); Univ. Southampton/PAGES Focus 4 (Prof. John Dearing); St Antony's College, Oxford (Prof. Mark Elvin); LECA, Univ. Joseph Fourier, Grenoble (Dr Jacky Girel); CLIMASILAC (Fernand Berthier); Nanjing Univ., CAS (Prof. Shen Ji); Indian Water Portal (Shree Padre); DHAN Foundation Madurai (Mr. M.P. Vasimala); St John's College Palayamkottai (Dr S. Suthakar Isaac).
Davies	Indian Agricultural Research Institute, India (Dr Sharad Mohan and Dr Uma Rao); Biochemistry, Univ. Oxford (Prof J Hodgkin); EMBRAPA, Brazil (Dr Regina Carneiro); Institute of Tropical Agriculture, China (Prof Shixiang Bao).
Denholm	Syngenta Crop Protection, Switzerland (Dr Russell Slater); ADAS Boxworth (Dr Neil Paveley); Bayer Healthcare (Dr Norbert Mencke); Bayer Crop Science (Dr Ralf Nauen); Aquaculture Research Institute, Bergen, Norway (Dr Frank Nilsen).
Fitt	ADAS Boxworth (Dr Peter Gladders); Food and Environment Research Agency, York (Dr Judith Turner); Imperial College (Prof. Mat Fisher); KWS UK (Dr Peter Werner); James Hutton Institute (Prof. Adrian Newton); John Innes (Dr Chris Ridout); Anhui Academy of Agricultural Sciences, China (Prof. BaoCheng Hu); CAAS Oil Crops Res Institute (Prof. Sheng-Yi Liu); Inner Mongolia Acad Agric Sciences (Dr Ziqin Li); Instytut Genetyki Roslin, Poland (Dr M Jedryczka); North Carolina State Univ., USA (Prof. Jean Ristaino).
Huang	Univ. Melbourne, Australia (Prof. Barbara Howlett); Huazhong Agricultural Univ., China (Prof JinLing Meng); DSV UK (John Sweatman); Monsanto UK (Matthew Clarke); Grainseed (Neil Groom).
Lewis	European Environment Policy Institute, Brussels (Dr Kaley Hart; Dr Jana Poláková); IFC GHK International (Matt Rayment); Solagro, France (Philippe Pointereau; Brigitte Langevin); Wroclaw Univ., Poland (Dr Wieslaw Fialkiewicz; Dr Dorota Olearczyk) ; Food Ethics Council, UK (Tom Macmillan); Waitrose (Stefan De Cristoforo); East Malling Research (Michelle Fountain); Danish Environmental Protection Agency (Dr Lise Samsøe-Petersen); European Food Standards Agency (Dr Jaume Galobart); Harper Adams Univ. (Eric Howell); Institut National de la Recherche Agronomique (INRA), France (Dr Hayo van der Werf; Dr Aurelie Wilfart-Monziols); SIU Crop Production Institute, Szent István Univ., Hungary (Prof. Márton Jolánkai); Univ. Ljubljana, Slovenia (Dr Rok Mihelic); Centro Ricerche Produzioni Animali (CRPA SpA), Italy (Prof. Giuseppe Bonazzi).
Mashanova	East Cape Parks and Tourist Agency, South Africa (Jan Venter); Maydencroft Rural, Hertfordshire (John Phillips); Royal Holloway Univ. London (Prof. Vincent Jansen); St George's, Univ. London (Prof. Derek Macallan); Nottingham (Prof. Ian Connerton).
Stotz	INRA – Rennes, France (Dr Regine Delourme, Dr Hortense Brun); INRA – Thiverval-Grignon, France (Dr Thierry Rouxel); ETH Zurich Univ., Switzerland (Prof. Bruce McDonald).

Visiting research positions: Honorary Professor, Inner Mongolia Academy of Agriculture; Honorary Professor, CAAS Oil Crops Research Institute; Honorary Professor, Anhui Academy of Agricultural Sciences (**Fitt**).

Invited keynote presentations: **Davies** at 11th Fitopathologia Congress Ouro Preto Brazil (October 2013) and Chinese Academy of Tropical Agricultural Sciences, Hainan (November 2013); **Denholm** at Italian Academy of Entomology, Florence, Italy (October 2012) and national launch of RSPB 'State of Nature' report, Natural History Museum, London (May, 2013); **Lewis** at 'Producing More for Less', Birmingham, UK (January, 2013).

Membership of Research Council committee: BBSRC panel B (**Fitt**).

University research advisory panels/review boards: six, including Member of International Research Output Vetting Panel (five visiting professors from English Language Unit – UK, US, AUST) at Khon Kaen University, Thailand; RERAD (Scotland) advisory board (2006–10, **Fitt**); ENDURE consortium to write EU policy paper on pest/pathogen invasions and climate change (Brussels, Nov. 2011, **Denholm, Fitt**); European Commission's Joint Research Centre, Member of international advisory board for the Aquaculture Research Institute, Bergen, Norway (**Denholm**).

Leading positions in professional subject associations and learned societies: **Denholm** is President of the Botanical Society of the British Isles, other fellowships held by the unit are with the Royal Entomological Society (**Denholm**); the Linnean Society London (**Davies, Denholm**); GCIRC Paris, Society of Biology (**Fitt**); British Ecological Society, European Society of Nematology (**Davies**); Institute of Environmental Management and Assessment (**Lewis**). **Fitt** is a Trustee Director of the Perry Foundation and a UK Member, Groupe Consultatif International de Recherche sur le Colza, Paris; **Lewis** is an expert consultant to the European Food Standards Agency. **Coutts** is Leverhulme Emeritus Research Fellow 2013–15, and Member, ICTV study group on Closteroviridae and Chrysoviridae.

Editorial positions: *Phytoparasitica*, *Outlooks on Pest Management* (**Denholm**); *Plant Pathology*, *International Journal of Food Security* (**Fitt**); *Archives of Virology* (**Coutts**, since 2008).

Examination of doctorates: 27 examined by Unit members since 1 January 2008 (e.g. **Davies**, Univ. Reading, 2010; Univ. Leeds, 2013; **Coutts**, MAICH, Crete, Greece, 2008, 2010, 2013, and Imperial College, London, 2009, 2010; **Fitt**, Paris universities: Orsay, July 2010, and AgroParis Tech, March 2012, Feb 2013).

Organisation of conferences/scholarly encounters: **Denholm**, organiser, session chair, International Congress of Entomology, Daegu, Korea, August 2012. **Lewis**, symposium organiser and speaker at OSCAR workshop, hosted by the European Commission's Rural Development Programme, Brussels, 22 Nov. 2012; and organiser, European Water and Waste Water management conference, 2012. **Fitt**, co-organiser, International Society for Plant Pathology Climate Change Conference, Evora, Portugal (2010); and GCIRC Rapeseed Congress, Prague (2011).

Externally organised/co-organised events: 2009 FOOTPRINT Conference and 2010 Defra Labelling Workshop (**Lewis**); Society General Microbiology (SGM) Food Security, House of Lords and SGM Climate Change Presentation, House of Lords (**Fitt**).

Refereeing academic publications: 165 reviews by unit members since 1 January 2008.

Refereeing academic research proposals: 31 proposals reviewed by unit members since 1 January 2008.

Promotion/tenure reviews for scholarly awards and fellowships (selection): 10 reviewed by unit members since 1 January 2008.