Institution: University of Reading

Unit of Assessment: 6 Agriculture, Veterinary and Food Science

a. Context

Research in the Unit covers environmental management of agricultural systems, crop and animal production systems in temperate and tropical agriculture, the economic and social science of the food chain, food science, safety and processing, and the use of food by the human body. The wide spectrum of research enables impact in many areas including through: i) direct increases in profitability of producers with reduced or improved effects on the environment and animal welfare, ii) increased or stabilised yield or quality of animal products, horticultural and arable crops, iii) more efficient use of inputs and better food chain policy decisions, iv) improved industrial processes, and v) improved nutrition and, consequently, human health. The research informs and influences stakeholders along the food chain, including consumers, as well as government policy advisors, regulators and private advisors.

Beneficiaries of the Unit's research include international organisations (e.g. United Nations, WHO, FAO, OECD, OIE, World Bank, European Commission), governments and associated bodies (e.g. in the UK, Defra, DoH/HPA, DfID, Food Standards Agency (FSA)), industry bodies (e.g. NFU, agricultural producer bodies, FDF) and companies (e.g. ranging from farm businesses to food manufacturers and major retailers such as Marks and Spencer).

Staff in the Unit are largely employed in two University Schools, with research sub-divisions focussing on food production and quality; biodiversity, crops and agro-ecosystems; economics and social science; food & bioprocessing; human nutrition and food microbial science. Three University Centres (the Walker Institute for Climate System Research (WI), the Centre for Food Security (CFS) and the Institute for Cardiovascular and Metabolic Research (ICMR)) help bring together diverse knowledge and expertise to facilitate multi- and inter-disciplinary applied research spanning organisational units, thereby fully exploiting our research and maximising its impact.

b. Approach to impact

The Unit's research effort is largely applied and oriented to work leading to practical solutions to societal challenges along the whole food supply chain. Impact is central to our research from design to delivery. The Unit's purposeful long-term associations and collaborations with government bodies, industry bodies and individual commercial companies, including farm businesses and wider society (for example, through the research surveys of citizens), ensures the policy, industrial/commercial and societal relevance of the research. The many opportunities for working in and with industry ensures that the research training of PhD students and PDRAs is well aligned with the R&D priorities of employers and thereby most likely to have impact, including through their subsequent employment in the user industries.

Impact from research is facilitated within the University by, for example, the coordinating role of Directors of Enterprise, underpinning financial allocations (internal grants, seed corn money etc), planning and administrative support from the University Research and Enterprise Directorate, the Knowledge Transfer Centre (KTC), and the Staff Development Review process, where plans for realising impact from individuals' research activities are agreed.

Outlined below are the main stakeholder groups benefitting from the impacts of our research and a description of how we ensure that impacts flow from this research.

Government : Research by members of the Unit contributes to government policy formulation and public debate by evaluating strategies and policies, the provision of greater knowledge and understanding in relation to policy issues, new methods/ways of working or innovative policies, and the provision of both science and social science perspectives. Examples in the 2008-13 period include Traill's work on fat taxes and their impact on food expenditure and diet; Bennett's work on public attitudes and people's willingness to pay to improve farm animal welfare; Swinbank and Tranter's work on a European Bond Scheme under the Common Agricultural Policy; Shaw's work on the Defra tree health and plant biosecurity task force, Potts's work on bee decline in Europe and

Williams' work on trans fatty acids and health (FSA). Over the 2008-2013 period the UoA has received in excess of £17 million from government for research in support of policy. The Unit's strategy is to ensure, through University support and review processes that expert staff can serve on government, advisory and regulatory bodies. Examples include Dunwell's position on the Advisory Committee on Releases to the Environment [ACRE], Wagstaff's role as strategic Advisor for the FoodPlus Programme Malaysia; Lovegrove's role on the Scientific Advisory Committee on Nutrition, Bennett's role on the Farm Animal Welfare Committee, Wheeler's role as Deputy Chief Scientific Advisor at the Department for International Development and Williams' membership of the Government Office of Science's Food Research Partnership Committee. Through these positions the Unit maintains awareness of, and responsiveness to, the needs of policy makers and society.

Food supply chain: The Unit fosters continuing, long-term associations with industry, using a mix of funding to conduct and disseminate commercially relevant research directed at particular areas with both long-and short-term goals. For example, Unit staff have participated in 12 Knowledge Transfer Partnerships (KTPs) and were awarded a BBSRC-funded Advanced Training Partnership (Food Quality and Health) in the review period. Over the 2008-2013 period the UoA has received over £9 million funding for research from industry.

Farming and primary production: The areas the Unit focuses on include animal production, arable crops, fruit, tropical tree crops, and all areas of small-holder agriculture. Impact in these areas is engendered in a number of ways of working with industry and other beneficiaries. For example, as well as KTPs, the University offers Reading researchers opportunities for matched funding of industry-sponsored research, both to encourage industry collaboration and to provide a vehicle by which Reading research has a high likelihood of having impact. Impact on this industry is also achieved through service on influential industry bodies. For example, Bennett's chairing of the UK Veterinary Development Council (2010 onwards) due to his research on the economics of livestock disease control, has had impact through strategy development for the veterinary profession, which in turn has impact on livestock farmers and the food supply chain.

The Centre for Agri-Environmental Research works on the linkages between land use, biodiversity, the provision of ecosystem services (for example food production, pest regulation, nutrient cycling, pollination, carbon storage, etc.) and the values/benefits people derive from these services. This work underpins the development of management strategies designed to improve the sustainability of land-use and food production. For example, Pott's research on pollination services has highlighted for policy makers and others the importance of bee health and the maintenance of bee populations.

The Unit's plant cacao research is an example of a strategic international collaboration developed over many years. Although aimed at improving small farmer incomes, it has been largely funded by industrial bodies interested in stable food supply (Cadbury/Kraft, Mars, Nestle, Cocoa Research UK, Biscuit, Cake, Chocolate and Confectionery Alliance, Cocoa Research Institute Ghana and the USDA). Among other long-term research programmes, Reading provides a quarantine facility and on-line descriptive catalogue (www.icgd.rdg.ac.uk) for safe long-term curation of living specimens of cacao clones free of pests and diseases for the developing world. As an example of its use, the on-line catalogue received an average of 12786 visits per month from 469 unique visitors from 80 countries in 2012/2013 (to end July), The research has helped to ensure continued supplies of cocoa globally and helped safeguard the incomes and livelihoods of cacao producers.

Manufacturing, processing and distribution industries: Over the 2008-2013 period the UoA has undertaken research in support of the commercial activities of food supply chain organisations. Impact includes direct product and process development (e.g. development of a new mascarpone product with sales of over £2 million per year), provision of market information (e.g. producing a research dossier which enabled commercial licensing of seleno-yeast products in Europe for Alltech worth several millions of pounds each year), and impact on improving company capacity (e.g. KTP with Promar International, which has used Reading research to commercial advantage to increase the company's consultancy services). These collaborations improve efficiency, sales and profitability of companies and value-for-money for customers. For example, two KTPs between Blackmore Vale Cream Ltd and the Food & Nutritional Sciences Department (Grandison) have resulted in new sales of £2.5 million of specialist Italian cheese and the introduction of lean

manufacturing techniques to reduce manufacturing costs and improve environmental performance. The Unit also achieves impact on industry through service on industry bodies. For example, Gibson's role as President of the International Scientific Association for Probiotics and on advisory Boards for Clasado (UK), Kellogg's (USA), Ganeden (USA), General Mills (USA), GSK (USA), and Fugeia (Belgium), and Williams' role on the Pepsico Advisory Board.

Consumers, diet and health: The UoA's strategies for food science research have put increasing emphasis on food, diet and health, while retaining interests in food engineering and chemistry. For example, in association with health professionals, researchers in the Unit have developed science-based strategies for improving diet and nutrition using sensory science to improve food intake and reduce malnutrition in elderly hospital patients. Research on dietary fats has led to producers marketing improved products (particularly in the reformulation of fats used in processing and catering) and better dietary advice has been promulgated to the general public, leading to desirable changes in behaviour. Reading research on the role of gut bacteria in certain clinical conditions and the relationship to diet is also starting to significantly improve the prospects of people with certain bowel disorders.

During the assessment period staff in the Unit has undertaken over 30 industrially sponsored research projects on dietary based modulation of the gut microbiome. Prebiotics were invented by the Reading team and are now worth over EUR300 million per annum to the EU economy, with an annual growth rate of 14%. This has shown positive impacts in persons with irritable bowel syndrome and the disturbances in the gut microflora associated with autism, obesity and gastroenteritis. Several new products are being marketed because of our research (e.g. the BiMuno prebiotic range). Similarly, collaborative research for Mars has culminated in the production of CocoaVia and 'Cirku', flavonoid rich supplements that have been marketed and sold successfully in the US since 2010. They were developed, in part, from a Mars funded programme of basic research conducted at Reading, which demonstrated their beneficial effects on cardiovascular and gut health. Reading's research has therefore had considerable impact not only on company sales and profits but also in relation to consumer dietary and health benefits.

c. Strategy and plans

The university has recently launched a new ten year strategy with a number of high level projects which will develop the strategy outcomes; one of these projects is entitled: 'Developing Excellent Research Impact'. Part of this work will operate through our existing processes in which School's strategies for research and enterprise are reviewed annually, then co-ordinated across the University and used to manage staff and guide recruitment. At School level strategic planning is informed by consideration of potential and likely scenarios which may affect the food supply chain 5-50 years ahead, and research priorities and strategic alliances formulated accordingly. Three-year rolling operating plans provide the means of implementing strategic plans at School level, outlining resource requirements and ways of working. Although these strategies and plans presently include consideration of impact – especially regarding creation of impact opportunities and pathways – future strategy and planning documentation will require these to outline more explicit plans for pursuing targeted impacts or impact categories.

In addition, a significant part of the Unit's future strategy will be focused around the work to be done for the University's submission to the BBSRC's Excellence with Impact competition (see http://www.bbsrc.ac.uk/business/impact-incentive/excellence-impact.aspx) and building on the learning that has been gained through the development of our case studies for REF2014. The BBSRC competition encourages participating universities to transform their research cultures by embedding impact as a central plank of their overall research strategy. To this end, the University is developing a range of policies and procedures that seek to maximise impact from research. These central initiatives, overseen by the University Board for Research and Innovation, will be exploited by this Unit and include: appointment of School Directors of Impact; emphasising impact as a criteria for recruitment and promotion; training programmes to inform and equip researchers to generate impact from their research; and enhanced central resource to focus on the development of impact.

Within this institutional framework, the Unit will proactively pursue continued external engagement

with industry, government and other bodies through influential committee work and leadership roles likely to have impact. Networking will be encouraged and staff duties arranged so as to allow staff to continue to sit on and chair policy-informing committees, as well as to take up longer term industry and government secondment opportunities.

Staff will continue to engage, build strategic alliances and work closely with food supply chain organisations and companies, but with a more explicit impact-related strategy and associated targets. For example, the £3.2 million BBSRC funded Advanced Training Partnership (Food Quality and Health) will substantially increase our opportunities for engagement with industry and will deliver high-quality and real–world relevant training informed by our research, which has been specifically designed to result in impact. Activities will be supported through School Directors of Enterprise and Impact, central pump-priming monies, the Research and Enterprise Development department and the Knowledge Transfer Centre. Funding for travel and meetings will be made available to support staff engagement with industry.

Specific initiatives are planned in many areas. For example, the Centre for Food Security was set up in 2010 to synergise existing areas of research excellence to provide a platform for real-world research into the challenges of ensuring global food security. This new centre, with administrative and infrastructure support funded by the University, will help to focus multi-disciplinary research across the University to impact on targeted food security issues around the world. In addition, staff in the UoA work through the Walker Institute to engage with stakeholders concerned with the implications of climate change. A further example is the Process Research Centre, set up in 2012, which carries out product and process development directly for food companies.

Similarly, to assure continued and longer-term support, we will improve links to farming groups, advisors and agro-industrial groups to ensure relevance of our research. This will involve, for example, links via shared PhD students with agro-chemical companies and organisations such as ADAS (Agricultural Development Advisory Service), the National Institute of Agricultural Botany and Teagasc (the Irish Agriculture and Food Development Authority).

d. Relationship to case studies

The case studies reflect the UoA's approach to impact and provide examples of the applied and inter-/multi-disciplinary nature of our research, which is often directed at addressing specific real-world problems of importance to society generally (e.g. diet and health) or sections within society (e.g. milk supply chain). Each of the case study impacts have been enabled, supported and enhanced through the structures and activities outlined above.

The case studies of reduced saturated fatty acids (SFA) in milk marketed by Marks and Spencer, and of prebiotics, acrylamide and flavanols research applied to users, highlight the outstanding impact for companies and their customers (in terms of new products offering improved diet and health and safety benefits to consumers) achieved by this Unit's active promotion of collaborations with industry and commercial companies. The horticultural film case study highlights how the Unit has undertaken inter-disciplinary research (involving horticultural science, chemistry and engineering) and sustained long-term association with industry to achieve tangible impact of benefit to both producers (film manufacturer and growers) and consumers of soft fruit and other products.

The case study of research on the value of uncultivated field margins for biodiversity and ecosystem services highlights the outstanding impact that the UoA's research has on informing and influencing government policy, in this case to the benefit of farmers, the environment and society.

The case studies on crops and climate change highlight the outstanding international impacts associated with the research of the Unit where, in this example, varieties of rice capable of withstanding the temperature increases associated with climate change can be identified, developed and disseminated to rice producers around the world safeguarding growers' livelihoods and the security of a vital food commodity globally. These case studies further highlight the impact of the UoA's research on national and international policy and how this can be engendered through public service (e.g. Wheeler's role as the Deputy Chief Scientist of the UK Department for International Development). These impacts were enabled through Reading's collaborations nationally and internationally with key global organisations and stakeholders.