Institution: University of Leeds

Unit of Assessment: UoA5 Biological Sciences

Title of case study: CS7 Sustainable agriculture: influencing policy-making and industrial practice for food security

1. Summary of the impact (indicative maximum 100 words)

Food security and the sustainable production of food for the human population is a critical issue politically and economically. **Benton**, **Cornell** & colleagues have developed and validated a conceptual framework to underpin sustainable agriculture, recognising that land can be specialised to producing food or "ecology" and does not need do both equally everywhere. This challenges current approaches to land management and is influencing the development of new policies for sustainable agriculture (UK, EU, G-20), the food industry's approach to, and public perceptions of, sustainable agriculture. The profile of this work directly contributed to **Benton** being appointed as the cross-government "Champion" for Global Food Security.

2. Underpinning research (indicative maximum 500 words)

This research explored the conceptual framework for sustainable agriculture: in particular how what is seen as "sustainable" at the scale of the farm may not, when scaled up to a larger spatial area, create "sustainable landscapes". **Cornell** developed a mathematical landscape model that balanced land management attributes of food production, with the ecological factors for biodiversity, and published this with a team of ecologists in Cambridge (Green, R.E., Cornell, S.J., *et al.* (2005) Farming and the Fate of Wild Nature. *Science* **307**(5709):550-555 DOI: 10.1126/science.1106049), completing this work following his move to Leeds.

With funding from BBSRC-ESRC-NERC (Rural Ecology and Land Use Programme project SCALES (RES-227-25-0006)), **Benton**, **Kunin** and **Sait** (Leeds) examined different farming systems in the UK (intensive=conventional vs extensive=organic) to investigate how "sustainability" at a landscape scale is related to conventional ideas of sustainability at the farm/field scale in developed world agriculture in Europe **(1-3)**. This study was the most rigorous study to date in comparing farming systems: over a year was spent in randomly selecting comparable farms, paired on 32 variables, differing only in farming practice. Fieldwork, over three years, assessed biodiversity more comprehensively than previous studies. The statistical analysis and modelling was cutting edge and allowed detailed dissection of the factors influencing biodiversity. Further studies with **Cornell** and **Hamer** (Leeds), examined the models of sustainable agriculture in the developing world (SE Asia: **4)**.

This empirical work, especially references **(1-3)**, provided the first rigorous tests of the conceptual model, and being focussed on EU agriculture are most informative to sustainable agricultural policies in the developed world. The principal conclusions are (a) what appears sustainable practice depends on the spatial scale at which it is viewed, (b) at a landscape scale, it is possible to produce more food, and more wildlife, by farming intensively in some places and managing land specifically for wildlife in others, rather than by farming in a way typically seen as "sustainable" across the landscape. These results arise because intensive farming is typically higher yielding than extensive farming, and thereby requires less land to produce the same amount of food. Reduced land pressure allows ecological benefits if the "spared" land is managed well. In extensive systems, as they are lower yielding, they require more land to produce the required food, reducing the land available for wildlife. Finally, the work shows (c) that an intervention can have very different impacts depending on the place (and the way the neighbours farm). Overall, therefore, sustainable agriculture requires landscape-level approaches sensitive to place.

Results from Europe are consistent with work in the developing world (e.g. Phalan *et al*., *Science* **333**, 1289, 2011) that shows that intensive agriculture *reduces* the pressure on converting new land to agriculture; and that at a large scale, a mixture of unconverted land, managed for nature, and intensive farming, provides more yield and more wildlife, than a larger area of extensive land management with the associated greater land conversion **(1-4)**. These conclusions are clearly at odds with previous decades of thinking about sustainable agriculture, and, given the rising global

demand for food, imply that policy (public and e.g. supermarket sustainable purchasing) should concentrate (a) on managing landscapes and (b) that where food is produced is perhaps as important for sustainability as how it is produced.

Co-PIs at School of Biology, Leeds: Benton, TG (Professor 2005-present; 2011-present UK Global Food Security Champion); **Cornell**, S (University Research Fellow 2004; Reader, 2008-13); **Hamer**, KC (Senior Lecturer, 2002-2004, Reader 2004-2013, Professor 2013-present); **Kunin**, WE (Lecturer, 1996-2006; Reader, 2006-2009; Professor 2009-present); **Sait**, SM (University of Leeds Research Fellowship, 2002-2007; Reader 2007-present).

3. References to the research (indicative maximum of six references)

1. Gabriel D, Sait SM, Hodgson JA, Schmutz U, Kunin WE, and Benton TG. (2010) Scale matters: the impact of organic farming on biodiversity at different spatial scales. *Ecology Letters*, **13**:858–869. DOI: 10.1111/j.1461-0248.2010.01481.x [Scopus citations to 30/08/2013: 64]
2. Hodgson JA, Kunin WE, Thomas CD, Benton TG, and Gabriel D. (2010) Comparing organic farming and land sparing: optimizing yield and butterfly populations at a landscape scale. *Ecology Letters* **13**:1358–1367. DOI: 10.1111/j.1461-0248.2010.01528.x [Scopus citations to 30/08/2013: 24]
3. Gabriel D, Sait SM, Kunin WE, and Benton, TG. (2013) Food production vs biodiversity: comparing organic and conventional agriculture. *Journal of Applied Ecology* **50**:355-364. DOI: 10.1111/1365-2664.12035
4. Edwards DP, Hodgson JA, Hamer KC, Mitchell SL, Ahmad AH, Cornell SJ, Wilcove DS (2010) Wildlife-friendly oil palm plantations fail to protect biodiversity effectively. *Conservation Letters* **3**:236-242. DOI:10.1111/j.1755-263X.2010.00107.x [Scopus citations to 30/08/2013: 35]

Grants: BBSRC/NERC/ESRC RELU grant: An integrated analysis of scale effects in alternative agricultural systems (S Stagl, Sussex, PI). £849,944 (£395k through Leeds Biology: "Ecology Work Package" led by Benton, with Kunin and Sait), 2006-2010.

4. Details of the impact (indicative maximum 750 words)

Context: The global food industry is the world's largest industry (the UK sector alone is worth £189bn), land- and water-user and polluter. Demand for food is increasing rapidly and there is little ability, globally, to use more land or water. At the same time there is growing recognition that any increase in production needs to conserve ecological function. Thus, across the world, the policy focus on "sustainable intensification" is intense: how can we grow more on the same land whilst reducing environmental harm? Our work is viewed as a "thought leader", influencing thinking in policy, industry and public, by indicating that allowing land to specialise appropriately in producing food or ecosystem services can produce more of both than a "one size fits all" approach of managing everywhere to produce both simultaneously, and that concentration should be on delivering sustainable landscapes rather than sustainable agriculture *per se*.

Appointment to high profile position: Benton has prosecuted the translation of the scientific advances (section 2) to policy-makers in government (UK, EU, G-20), to the public and to decision-makers throughout the food industry. The translation of this work to society arose, originally, from strategic investment of his time supported by Leeds specifically to promote the impact of this body of work (refs **1-3**). The profile generated was contributory to the appointment of **Benton** to the post of UK Global Food Security Champion in 2011 (0.8 fte for 5 years) **[A]**. This post involves the coordination of research spend in food security across the UK's public funders, the provision of evidence to government, and the translation of the evidence to wider society (industry and the public).

Dissemination strategy: A deliberative dissemination strategy has helped generate impact beyond academia. An original press release was followed by publications in a range of stakeholder-facing outlets including **journals** (**Benton** *et al*. *World Agriculture* **2**: 14-21 2011), **magazines** (**Benton** TG (2012) Sustainable intensification and the UK. In *Food Ethics Council* magazine special edition on "Sustainable intensification: unravelling the rhetoric*",* Jul 12 2012) and **blogs** (e.g. Seeds, feed, food Jan 2012; Plantwise: Mar 2012 GFS: on the meaning of sustainability: June 2012; Landscapes for people, food and nature: Resilient landscapes June 2013). These pieces have raised the work's profile and led to invitations to **speak** or **advise** as

detailed below.

Influence on UK government: Parliamentary impact has been delivered within select committees, within government departments (e.g. DEFRA) and through **Benton's** appointment as the Global Food Security Champion by the UK government **[A]**.

1. In the House of Commons Select Committee report – Environmental, Food & Rural Affairs Committee: Greening the common agricultural policy **[B]**, there are references to oral (pages Ev11-Ev15) and written submissions (pages Ev90-Ev94) from **Benton**, and to discussion of the issues raised by **Benton** (paragraph 26, page 14; paragraph 64, page 24).
2. In July 2012, DEFRA published its Green Food Project, which acts as a framework for developing agri-environment policy up to mid-century. **Benton** was invited onto the "Synthesis Group" for his expertise on sustainable landscape management **(1-3)**, and paragraphs 4.37-4.41 of the report discuss the need for landscape-level approaches and stem from appreciation of this work **[C].** A commitment from the Green Food Project is to invest in Farm Platforms to allow investigation of the landscape-level responses around the UK (a direct outcome from the corpus of work represented here). DEFRA has announced an initial £4.5m of funding to support this (and **Benton** has contributed to the design of the call).

Influence on UK Food Industry: **Benton** has informed stakeholder groups in the agricultural sector of the scientific evidence for redefining sustainable food production in the UK. This has been through discussion with high-level industry groups, and the publication of articles widely read by trade, plenary addresses at trade conferences **[D, E]** and detailed consultancy work the output of which was published **[F].**

1. Influence on farmers. **Benton** presented to the National Farmers' Union and many other farming conferences and meetings, and has subsequently contributed to a range of debates in public and press. The work by **Benton** has been favourably received by the NFU and the NGO "Linking environment and farming". Following publication of the original research, **Benton** was recruited to advise the Soil Association's Duchy Original's Future Farming programme aiming to improve organic farming methodologies and this includes providing printed advice on conducting experiments to 50,000 UK farmers as a poster supplied with the NFU's British Farmer and Grower **[D].**
2. **Benton** presented to the Food and Drink Federation alongside the Secretary of State for the Environment in May 2012. Subsequently he was invited to discuss sustainability with the Institute of Grocery Distributors' "Sustainability Group" (Dec 2012 and March 2013), and their Chief Executives' Group (2013). The Institute of Grocery Distributors comprises the 30 leading food supply and retail companies in the UK. This work has led to re-assessment of the food industry's sustainability strategies e.g. Mack Multiples (£200m turnover fresh produce supplier) is "greatly benefitting" from **Benton's** input in its developing sustainability strategy and has subsequently employed a **Benton** group postdoc on a 6 month contract to operationalise the work **[E]**.
3. Consultancy work for the US-based RESOLVE (US based organisation specialising in informing public policy, funded by Mars Inc and charitable foundations), which commissioned a review of the efficacy of certification schemes in driving sustainability benefits. This review is acknowledged in their final report (see note on pA-125) and the review was subsequently published as a working paper of the National Resource Institute with a quote from Forum for the Future on its insights **[F]**.

International Influence: **Benton** has sought to influence the global sustainability agenda through both public and private policy fora:

1. Common Agricultural Policy. The Common Agricultural Policy (responsible for 30-40% of the EU's budget) is currently undergoing reform, and is being finalised for the next 7 year spending cycle in summer 2013. **Benton** was asked to provide advice on "sustainability" in the following ways: (a) invited presentation at the Directorate-General Environment (to the Deputy Head of Agriculture, Forests and Soils, and team) (Dec 2010), (b) presentation in the EU Parliament (Dec 2010) to a mixture of MEPs and industry, (c) subsequently, the Chair of the EU's Agriculture Committee invited **Benton** to write a policy paper published in a journal edited by him, published in 2012 **[G].**

2. As Champion for the UK's Global Food Security programme, **Benton** is frequently invited to fora where he can advise on the sustainability and production agendas. For example he presented at a side meeting at the Rio+20 conference in June 2012 on assessing sustainability; he led the official UK delegation to a G20 meeting of agricultural chief scientists in Mexico, Sept 2012, and attended G8 meetings on data sharing for sustainable agriculture. The impact he made at the G8 meeting was to move the arguments on from sharing genetic data to sharing environmental data to allow landscape-level optimisation, as exemplified by ref **(3) [H].**

Influencing public choices

Benton has delivered many public lectures on sustainability, written blogs, contributed to panel events and has advised the author of the book "A greedy man in a hungry world" (Spring 2013). The author recently said publically, and this is echoed in the acknowledgements in his book, that **Benton's** work on sustainability completely reshaped his views and his book **[I].**

5. Sources to corroborate the impact (indicative maximum of 10 references) *copies available on request for all sources*

[A] Global Food Security Champion appointment.

[B] House of Commons Environment, Food and Rural Affairs Committee, Greening the Common Agricultural Policy. (2012-13 HC170)

[C] DEFRA Green Food project final report.

[D] Email from LEAF; Presentation to NFU conference (see http://www.flickr.com/photos/nfupics/6774033222/in/photostream/); influence on farming community through media releases – e.g. Farmers' Weekly: 6th Mar 2012, 16th April 2012, 10th Sept 2012. Also presentation at Centre of Excellence for UK Farming, Birmingham, Jan 2013 on assessing sustainability and reported in the farming press. The advisory group for the Duchy Originals Future Farming is online. The poster on "Carrying out your own trial" was published April 2013 in the NFU magazine British Farmer and Grower.

[E] Report of presentation to Food and Drink Federation; Letter from Director of Sustainability, Mack Multiples; Emails from chair of the IGD sustainability group about input to IGD Industry Sustainability Group.

[F] We wrote a review of the efficacy of certification schemes in driving sustainability benefits for RESOLVE (US based organisation specialising in informing public policy). This review is acknowledged in the report (see note on pA-125) and the review was subsequently published as a working paper of the National Resource Institute. The Director of Forum for the Future, commented that it contained "some really important insights" and forwarded it, with a strong endorsement, to the companies he advises, including Marks and Spencer and Unilever.

[G] Letter of corroboration from Deputy Head of Agriculture, Forests and Soils, at DG Environment) (Dec 2010);presentation in the EU Parliament (Dec 2010) to a mixture of MEPs and industry (see p12 in www.hucpa.hu/files/20378_ed_october2010_january2011.doc);letter from Chair of the EU's Agriculture Committee; policy paper published following personal invitation from chair of the EU Agriculture and Rural Development committee.

[H] Rio+20 conference presentation e.g. see http://www.irinnews.org/Report/95670/RIO-20-The-landscape-approach); invitation letter and final communiqué of G20 MACS (Meeting of Agricultural Chief Scientists); invitation letters to G8 open data meetings from USDA.

[I] Public lectures and panels, for example a report on **Benton's** public lecture in Norwich, Oct 2012, and involvement in the City Food Lecture in the Guildhall, London. The book "A greedy man in a hungry world" was published May 23rd 2013. The author acknowledges **Benton's** input in the book and online in an interview.