Institution: 10007857 (Bangor University)

Unit of Assessment: 07 Earth Systems and Environmental Sciences

Title of case study: Enhanced carbon footprinting of food products

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

Bangor research has significantly affected vegetable sourcing and distribution policies and practice of major fresh producers and UK supermarkets. Using a novel carbon footprinting model that incorporates all components of the production chain, the research demonstrated that footprints of vegetables vary with season, origin, production processes, transport and storage. The application of this model by industry partners has resulted in measures by food producers, suppliers and supermarkets to reduce carbon footprints, providing direct economic and environmental benefits through both waste reduction and technology implementation. Furthermore, the findings have impacted on sustainability policy development by the World Bank, international NGOs and Welsh Government, and influenced consumer awareness and debate on the environmental impact of food.

2. Underpinning research (indicative maximum 500 words)

Background

Professor Gareth Edwards-Jones (GEJ, at Bangor 1998-2011) led research into the **social and environmental benefits of food grown locally and overseas** (2005-2008. ESRC grant of £869,067, GEJ Principal Investigator) funded by the Rural Economy and Land Use (RELU) programme. Other Bangor researchers working on the project include Prof. David Jones (1996-present), Ian Harris (Lecturer at Bangor since 1993) and Dr Paul Cross (then PhD student, Research Officer 2008-2011, Lecturer 2011-2013, Senior Lecturer 2013-present). At the time, there was considerable uncertainty regarding the environmental impacts of food production in different countries, and an absence of reliable methods for comparison. “Food miles” were a commonly used and widely accepted indicator of the carbon footprint of food products. Accompanied by a strong lobby for local food, food miles were symbolic of the negative environmental effects of eating imported foods, despite the almost complete absence of scientific evidence to support or refute these claims.

Bangor led the **first ever rigorous Life Cycle Assessment of the entire crop production chain**, including farming, transport, storage and cooking. It included measurements of greenhouse gas emissions (GHGE) from cabbage and broccoli; peas and beans; lettuce and leafy salad grown in different locations in the UK, Spain, Kenya and Uganda; interviews with focus groups in rural areas and a large-scale survey of urban consumers; assessment of farmer/worker health status, and the nutritional quality of food produced. Life Cycle Assessment was jointly undertaken by Bangor and Surrey Universities to test whether environmental impacts of UK-grown food were different to those grown overseas. Through the RELU project this was reported first in working papers and project reports (e.g. 2, 6) and then in peer-reviewed papers (e.g. 3, 5).

Major findings

The production of vegetables such as lettuce in the UK was shown to produce higher GHGE than other types of crops such as wheat (6, 5). The rigorous LCA showed that there is **no straightforward relationship between transport distance and the environmental impact of food or its nutritional status** (2). The widely accepted concept of “food miles” was shown to be an inaccurate indicator of GHGE or overall environmental impact of produce (2, 3). For example, although intercontinental transport of vegetables contributes significantly to GHGE, growing vegetables in the UK in greenhouses throughout the winter was found to be less energy efficient than transporting them from Spain where they are grown outside (5). Furthermore, the research showed that the health of farmers in developing countries was enhanced by their participation in commercial agriculture for export of vegetables to the UK (1). This research thus evidenced the

ethical issues on the usefulness of carbon labelling and on encouraging UK consumers to preferentially buy UK grown food, if this leads to no obvious environmental benefits (4).

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

Bangor authors are in **bold**. Citation counts obtained through Google Scholar (October 2013).

1. **Cross, P., Edwards, R.T.,** Opondo, M., Nyeko, P. & **Edwards-Jones, G**. (2009) Does farm worker health vary between localised and globalised food supply systems? *Environment International,* 35, 1004-1014. DOI: 10.1016/j.envint.2009.04.009. In peer-reviewed journal, 10 citations

2. **Edwards-Jones, G**. et al. (2008a). Comparative Assessment of Environmental, Community & Nutritional Impacts of Consuming Fruit & Vegetables Produced Locally: Full Research Report. *ESRC End of Award Report*, RES-224-25-0044. Swindon: ESRC.
ESRC grant (£869,067) P.I. Edwards-Jones

3. **Edwards-Jones, G.,** Milàl Canals, L., **Hounsome, N., Truninger, M., Koerber, G.R., Hounsome, B., Cross, P., York, E.H., Hospido, A., Plassmann, K., Harris, I.M., Edwards, R.T., Day, G.A.S., Tomos, A.D.,** Cowell, S.J. & **Jones, D.L.** (2008b). Testing the assertion that 'local food is best': the challenges of an evidence based approach. *Trends in Food Science & Technology,* 19, 265-274. DOI: 10.1016/j.tifs.2008.01.008. In peer-reviewed journal, 119 citations

4. **Edwards-Jones, G., Plassmann, K., York, E.H., Hounsome, B., Jones, D.L**. & Milà i Canals, L. (2009) Vulnerability of exporting nations to the development of a carbon label in the United Kingdom. *Environmental Science and Policy*, 12, 479–490. DOI: 10.1016/j.envsci.2008.10.005. In peer-reviewed journal, 52 citations.

5. Hospido, A., MilàiCanals, L., McLaren, S., Truninger M., **Edwards-Jones, G.,** and Clift. R. (2009). The role of seasonality in lettuce consumption: a case study of environmental and social aspects. *International Journal of Life Cycle Assessment*, 14, 381-391. DOI:10.1007/s11367-009-0091-7. In peer-reviewed journal, 22 citations

6. Milàl Canals, L., Munoz, I., Hospido, A., **Plasmann, K.,** McLaren, S. (2008). Domestic vs Imported Vegetables. Case studies on broccoli, salad crops and green beans. Centre for Environmental Strategy Working Paper 01/08, ISSN: 1464-8083. University of Surrey.
Available at: http://www3.surrey.ac.uk/ces/files/pdf/0108_CES_WP_RELU_Integ_LCA_local_vs_global_vegs.pdf

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

Impacts on production and industry

Results were presented to Technical Directors of all major supermarkets in 2008, and as a result a number (e.g. Waitrose, Marks & Spencer) used the findings as an **evidence-base to modify sourcing policy and production chains** to account for complex relationships between food production and GHGE[2,8]. For example, Marks & Spencer's then Technical Director (now retired) highlighted that: "involvement with such a proactive programme has influenced how a company such as Marks & Spencer approaches crop and product development. […] For example, work on water resources in the lifecycle analysis of food crop production has made us rethink our approach to developing crops in North Africa"[8]. RELU highlighted the project as an exemplary case study for researchers linking to industry bodies[6].

This research created a spin-out company (Footprints for Food – F4F) in 2009. The activity to date

of F4F identifies the major hotspots of energy waste and has calculated GHGE for commercial clients on over 200 horticultural products and production pathways worldwide. This continues to feed directly into the practices of major producers, distributors and supermarkets, catalysing policy changes and measures to **reduce carbon footprints and improve food production efficiency**[1,2].

Specific examples of impact of the Bangor research and consequent F4F activity include changes in policy implemented by G's Fresh, the UK's largest fruit and vegetable production and distribution company (yearly turnover £350M)[1]. For example, in 2008/9 G's developed its salad onion production in Senegal with transport by ship to replace air-freight supply from Mexico and Egypt. This **reduced GHGE by nearly 8000 kg CO_2/tonne of produce (over 90%)**[1]. In collaboration with Marks & Spencer, G's introduced a **new plastic grocery jar** for 18 products in 2010, **that the Bangor methodology shows to reduce GHGE by 50%** compared with traditional glass jars. As a further impact, informed by the Bangor carbon footprinting model, in 2011 G's improved storage efficiency by their UK onion growers: this has already delivered reductions of up to 10% in carbon emissions for numerous growers. The Bangor carbon footprint analysis has also increased the focus on waste reduction and recycling which has resulted in a reduction of landfill waste of over 15%. Combined, these and other measures resulting from the Bangor research and carbon footprinting analyses **provided the catalyst for, and made a major contribution to, G's progress towards a target of 30% reduction in GHGE** by 2020, through improving production efficiency and sustainable, low-carbon product sourcing and transport[1].

The benefit of this research perceived by its commercial beneficiaries is indicated by their investment in further Bangor research: (1) G's funded a Bangor PhD (2010-2013) investigating GHGE reduction and enhancing economic and environmental sustainability[1]. (2) Waitrose Supermarkets have funded since 2008 Bangor research and extension of carbon footprinting into glasshouse crops, air freight legumes and tropical fruit. Evaluation of a total of 50 fruit, vegetable and horticultural products by F4F has **led to reductions in the carbon footprint of Waitrose and its suppliers**[2]. In 2010, Waitrose disseminated the research findings to its entire supply base, e.g. through specific meetings with growers, suppliers and Waitrose managers, with presentations by Bangor scientists and F4F to adapt methods of crop production and handling to minimise GHGE. The research also provided evidence to **justify long-term investments in environmental improvements made by Waitrose**, such as changing refrigerant gases used to chill products[2].

Impacts on the process of policy development

Bangor's research was presented to the Welsh Assembly Government[9] (2010) and the House of Commons[3] (2012), and was part of the RELU response to the Defra discussion paper on shaping the nature of England[10] (2010). Findings on the use of food miles and the implications of carbon labelling for sustainable and ethical aspects of food sourcing were highlighted as future challenges to reduce the UK's footprint and **formed part of the policy recommendations presented** in these documents[3,9,10]. Because of the relevance of the research, since 2008 GEJ was further invited by NGO's to write documentation that informed policy, including Fairtrade International, the Horticultural Development Society**,** International Institute for Environment and Development and Food Ethics Council (e.g. ref. 6). GEJ was invited to co-author the UK National Ecosystem Assessment 2011, that underlies many of the recommendations being used by Defra and adopted in the Natural Environment White Paper[5], and commissioned for several World Bank publications in 2010 with recommendations on how to make emerging carbon labelling schemes fairer for developing countries[4]. As a direct impact of the research and its findings, since 2008 he joined several Defra committees, including the Food Policy Council, the Fruit and Vegetable Task Force and the Rural Climate Change Forum.

Impacts on consumer awareness and debate

The research was broadly disseminated to the public, e.g. through regular RELU briefing papers, media coverage (e.g. by BBC, Channel 4 and national newspapers), and because of its significance for a range of policy-, industry- and public stakeholders, since 2008 GEJ was invited to speak on **various radio shows** (e.g. on New Zealand radio, Mar 2009[11]), **at conferences** (e.g. at Food Security and Environmental Change, 2008 and The Nutrition Society, 2009) **and debates** (e.g. RELU's "Power & Responsibility–Who decides? You decide"), creating enhanced media and

public understanding of issues surrounding calculation and use of carbon footprints of food. RELU also promoted the project as one of its major achievements in its publications both for stakeholders and the general public[7,8].

5. Sources to corroborate the impact (indicative maximum of 10 references)

People who have provided factual statements to corroborate claims:

1. A formal statement from G's Fresh and Food Production Consultant's Group Technical Director can confirm all claims on Footprints for Food and the research's applications in policy changes and implementation at G's Fresh and is available upon request.
2. A formal statement from Waitrose Supermarkets Senior Food Technologist can confirm any claims on the importance of the research for changes in sustainable food sourcing and low carbon policy by Waitrose and is available upon request.

Examples of policy advising documents available in the public domain

3. Sustainable Food. *Eleventh Report of Session 2010-12*. Volume 1: Report, together with formal minutes, oral and written evidence. House of Commons Environmental Audit Committee. May 2012. Available at: http://www.parliament.uk/documents/TSO-PDF/committee-reports/cmenvaud.HC879.pdf
4. Carbon Footprints and Food Systems. *Do Current Accounting Methodologies Disadvantage Developing Countries?* World Bank report by Brenton P., Edwards-Jones G. and Jensen M.F., 2010. Available at: https://openknowledge.worldbank.org/handle/10986/2506
5. UK National Ecosystem Assessment. 2011. The UK National Ecosystem Assessment: Synthesis of the Key Findings. UNEP-WCMC, Cambridge.
   GEJ Lead author Chapter 15 "Provisioning Services", Available at: http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx.
6. Hallgren, L. 2009. Food Miles and Fairtrade: How Does the Current 'Food Miles' Concept Disconnect Consumers from Disadvantaged Producers? Fairtrade International. Available at: http://www.fairtrade.net/fileadmin/user_upload/content/2009/resources/pp_fairtrade_food-miles_2011.pdf

RELU publications and policy recommendations:

7. Societal and Economic Impact Evaluation (REFERENCE PS110020). Part ONE. Dr L.R. Meagher, Technology Development Group, Rural Economy and Land Use Programme. June 2012. Available at: http://www.esrc.ac.uk/_images/Relu%20Impact%20Evaluation%20Final%20Report-%20307_tcm8-22271.pdf pp. 25-27
8. Societal and Economic Impact Evaluation part TWO. Available at: http://www.esrc.ac.uk/_images/ESRC_RELU_REPORT_%20Part_TWO_tcm8-22270.pdf. pp. 4-6.
9. Response to the Welsh Assembly Government Consultation Document: "A Living Wales – a new framework for our environment, our countryside and our seas." RELU, Dec. 2010. Available at: http://www.relu.ac.uk/news/Consultations/Relu%20response%20WAG%20NEF%20consultation.pdf
10. Response to the Defra Discussion paper: "An invitation to shape the nature of England". RELU, October 2010. Available at: http://www.relu.ac.uk/news/Consultations/Relu%20White%20Paper%20response%20final.pdf
11. An mp3 copy of the radio interview with GEJ in New Zealand is available on request