Impact case study (REF3b)

Institution: BRUNEL UNIVERSITY (H0113)

Unit of Assessment: 19 – Business and Management Studies

Title of case study: Informing DEFRA's development of environmental policy relating to climate change

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

Brunel researchers assisted practitioners within the Department of the Environment, Food and Rural Affairs (DEFRA) to develop and explore a range of climate change policy scenarios in agriculture as part of the UK government's climate change strategy to reduce greenhouse gas (GHG) CO_2 emissions by 3 million tonnes to 2020. This led to:

Environmental and Policy Impact through:
- the novel application of the Fuzzy Cognitive Mapping (FCM) technique, to enable effective scenario modelling at DEFRA in pursuit of improved management of environmental risks;
- enhanced capacity and capability within and across climate change mitigation project teams and experts, allowing DEFRA practitioners to add the FCM technique to their repertoire of futures modelling.

Practitioner Impact through:
- Improved professional standards, guidelines and training – along with the development of DEFRA resources to enhance their professional practice.

2. Underpinning research (indicative maximum 500 words)

Research conducted by Professor Amir Sharif (Professor of Operations Management) and Professor Zahir Irani (Head of Brunel Business School) over the last 14 years has explored the impact of decision-making in manufacturing and service organisations. By investigating the causal and cognitive basis for management decision-making in organisations, this body of research has identified a range of methods to represent inter-relationships between elements of management decisions (which are often centred on causal links between management, employee, financial and resource commitment factors). A pertinent research theme initiated by the researchers between 1999 and 2006 (and on-going) has been to investigate how investments in manufacturing, as well as information technology, have been impacted by management decisions in UK-based manufacturing SMEs (Irani *et al*, 2002; Sharif and Irani, 1999; Sharif and Irani, 2006a; Sharif and Irani, 2006b). In addition to this in 2009, the context of carrying out such modelling of decision-making behaviour was also extended to the public sector in terms of evaluation of electronic government projects (Sharif *et al.*, 2010).

Specifically, by using the artificial intelligence technique of Fuzzy Cognitive Mapping (FCM), the researchers have been able to explore and assess the inherent inter-relationships involved in a range of decision-making scenarios across organisations. This technique, often classified as "computing with words", allows inter-relationships between objects, situations or outcomes to be described such that causal links can be identified.

The above work by Sharif and Irani lead to research engagement with DEFRA in June 2011. This research involved a series of knowledge transfer and "systems modelling" and "futures" / "scenario planning" workshops with a range of DEFRA participants in order to explore scenarios relating to common agricultural policy (CAP) and the effect that such agribusiness policies will have on the UK farming industry and associated stakeholders. This has and is continuing to identify has identified additional techniques which DEFRA can use to develop environmental policy.

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

The paper and hence research that DEFRA made reference to in terms of engaging with the researchers was:

Sharif, A.M., Irani, Z., and Weerakkody, V. (2010). "Evaluating and Modelling Constructs for E-Government Decision Making". *Journal of the Operational Research Society,* **61 (6)** : 929 – 952. http://dx.doi.org/10.1057/jors.2010.11

Additional papers which underpin this research are also listed below:

Sharif, A.M. and Irani, Z. (2006a). "Applying a Fuzzy-Morphological approach to Complexity within management decision-making". *Management Decision*, **44** (7) : 930 – 961.
http://dx.doi.org/10.1108/00251740610680604

Sharif, A.M., and Irani, Z. (2006b). "Exploring Fuzzy Cognitive Mapping for IS Evaluation". *European Journal of Operational Research,* **173** (3) : 1175 - 1187*.*
http://dx.doi.org/10.1016/j.ejor.2005.07.011

Irani, Z. **Sharif, A. M.**, Love, P.E.D., and Kahraman, C. (2002). "Applying Concepts of Fuzzy Cognitive Mapping to model IT/IS Investment Evaluation". *International Journal of Production Economics*, **75** (1-2) : 199 - 211.
http://dx.doi.org/10.1016/S0925-5273(01)00192-X

Sharif, A.M., and Irani, Z. (1999). "Research note: Theoretical Optimisation of IT/IS Investments". *Logistics Information Management,* **12** (2) : 189 - 196.
http://dx.doi.org/10.1108/09576059910256673

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

DEFRA practitioners have used the application of the FCM technique in order to understand and explore how causal inter-relationships influence decisions and drivers relating to incentives to mitigate climate change - and the subsequent downstream effect this has on the UK farming industry and society in general.

Three workshops were delivered to DEFRA participants over 2011 and 2012 to show, enhance and advance the process by which DEFRA planners and policy makers develop the agribusiness element of UK climate change policy (GHG abatement at farm level). These workshops involved collaboration between Brunel and DEFRA participants in order to shape and identify pertinent farming scenarios, through the application of FCM techniques. Scenarios included:

- Abolition of CAP pillar 1 in preference of pillar 2 payments (direct / indirect payments to farmers).
- Introduction of a purchase tax on manufactured mineral fertiliser.
- Banning all types of conventional agricultural practices in preference for adopting wide-scale organic farming practices from 2013.

The benefits of the research and the workshops are as follows:

Environmental and Policy Impacts

DEFRA statisticians, economists, operations researchers and project managers have used this research to widen and explore the driving factors which may lead to the abatement of greenhouse gases from the agribusiness sector (i.e. farms, on-farm practices and the wider agribusiness supply chain).
DEFRA can now carry out more effective scenario modelling through knowledge transfer, collaboration and engagement between the Brunel researchers and DEFRA in pursuit of improved management of environmental risks.

This is based upon the "*Climate Change Mitigation for Agriculture and the Food Change Evidence Plan 2011/12*" report by DEFRA and set against the backdrop of proposed changes to the European Union Common Agricultural Policy (CAP), 2014-2020. The context for the driving policy factors are shown below in Figure 1. Hence, the impact of applying the research techniques and expertise to these factors, are identified in the light shaded ovals below, with the triangles signifying those aspects which were used specifically in the knowledge transfer sessions with DEFRA practitioners.
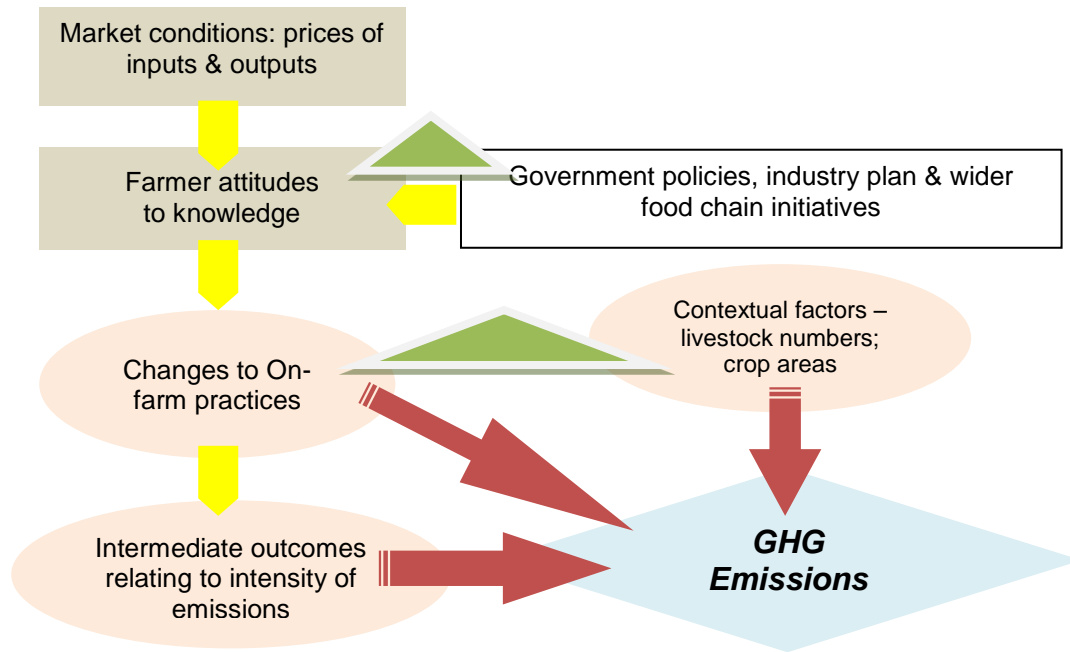
Where:
- ▨ Measures which inform understanding
- ▨ Measures which provide context
- ▨ Areas which are the focus of this impact case

Figure 1.   Relationship between key factors driving UK agribusiness GHG abatement (source: adapted from DEFRA, Climate Change Mitigation, Agriculture and Food Chain unit)

Thus, the engagement and transfer of knowledge to DEFRA has resulted in enhanced capacity and capability within and across climate change mitigation project teams and experts (which as a result of this research and collaboration, has allowed DEFRA practitioners to add FCM modelling to their collection of futures techniques).

According to DEFRA, this allowed impact in terms of improved "*understanding, development and adoption of alternative economic models (using political, economic, social, technological, legal and environmental perspectives relating to EU/UK agribusiness policy).*"

DEFRA also commented that through "*an improved design / implementation of environmental policy or regulation*", the research impact allowed DEFRA to expand the range of policy modelling techniques they currently use and to put "*GHG abatement/UK agribusiness farming policy and behaviour into a wider context*".

Practitioner Impact

In addition to the above, the research has had an influence on professional standards, guidelines and training – along with the development of DEFRA resources to enhance their professional practice.

These impacts are significant given the size and potentially damaging environmental effects of UK agribusiness: the sector contributes over £80 billion in revenue to the UK (approx. 10% of GDP) and the food system as a whole is responsible for 18% of UK greenhouse gas emissions. The UK food chain alone creates 19 million tonnes of CO_2 per year (DECC UK Emissions statistics). Against this background, Brunel research made significant impact through a) the influence on environmental policy relating to the UK agribusiness as well as on DEFRA practitioners leading to changes in environmental awareness of environmental products (i.e. livestock, foodstuffs) and

practices b) the usage of the FCM technique in general within the climate change mitigation unit as an alternative modelling technique that they can now add to their repertoire of scenario planning and c) the potential to include the technique as part of their practice of environmental planning across climate change-related project teams within DEFRA (which involves upwards of 20 individuals).

The reach of this impact is in adding to the modelling of policy scenarios that can influence how UK farming and the agricultural sector may operate in the future and in turn how any future climate change policy changes will affect the population on general. Through the facilitated workshops delivered to DEFRA practitioners this research has enabled a wide range of policy makers to come together and to think more holistically about those factors which are important in changing agribusiness practices, through a shared policy modelling approach*.*

As a result of this research relationship Professors Sharif and Irani were appointed as advisors on climate change mitigation, agriculture and food chain (appointment letters attached in addendum).

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

DEFRA's Operational Researcher (at the time of the research) has provided a letter testifying that the research conducted by Brunel made the following impacts;

Contribution to improved social, cultural and environmental sustainability;
Understanding, developing and adopting alternative economic models;
Specific changes in public awareness or behaviours relevant to the environment;
Improved design or implementation of environmental policy or regulation;
Influence on professional standards, guidelines or training;
Development of resources to enhance professional practice;
Practitioner debate has been informed or stimulated by research findings;
Research has challenged conventional wisdom, stimulating debate among stakeholders;
Shaping or influence on policy made by government, NGOs or private organisations, and
Enabling a challenge to conventional wisdom.