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**Agri-food supply chains and sustainability-related issues: evidence from across
the Scottish agri-food economy**

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Summary or abstract of the paper (no more than 200 words)

This paper examines the influence of agri-food supply chains on the sustainability-related activities and decisions of Scottish farmers, as well as the treatment of sustainability issues by food processors and retailers themselves. It is based on 8 whole chain case studies covering some of Scotland's major agricultural products.

The cases identify differing levels of understanding and activities related to sustainability, but widespread acknowledgement that sustainability involves the development of chains within which all parties can achieve acceptable profits. Indeed, collaborative supply chains, which seek improved economic performance, frequently assist environmental and social sustainability. The main drivers of sustainability are found to be the cost of key inputs, product markets where customers increasingly seek sustainability in products, the ethos and values of the businesses and people involved, and legislation and strategies of industry bodies. At the farm level, many farmers are seeking more sustainable production systems, particularly in economic and environmental terms, but there is a need for greater guidance and assistance.

The paper presents a review of several key food supply sustainability issues, the methods and concepts used in compiling and analysing the cases, as well as the principal findings and implications for agri-food supply chain and policy development.

Keywords: Sustainability, Food, Supply chain

JEL codes: Q13, Q18

I. Introduction

The Scottish Government has pursued the issue of sustainability within all areas of policy since 2005, when it published “Choosing our future: Scotland's sustainable development strategy” (Scottish Executive, 2005) and committed Scotland to building a sustainable future. In 2007 the Scottish National Party formed a minority government and set five strategic objectives that encompass sustainable development, with sustainable economic growth as its principle target. A key element of sustainability policy was introduced with the Climate Change (Scotland) Act 2009 which set an interim target for greenhouse gas emission reduction of 42 per cent by 2020, and an 80 per cent reduction target for 2050. This ambitious target reflects a strong political will to advance the issue of sustainability in all areas of Scottish life.

The food and drink supply chain represents a major part of the Scottish economy, accounting for almost 20% of total Scottish GVA and employing 360,000 people across Scotland. As such, it is not surprising that the issue of sustainability has been embraced within Scotland's food and drink policy. “The aim of Scotland's first National Food and Drink Policy is to promote Scotland's sustainable economic growth by ensuring that the Scottish Government's focus in relation to food and drink, and in particular our work with Scotland's food and drink industry, addresses quality, health and wellbeing, and environmental sustainability, recognising the need for access and affordability at the same time” (Scottish Government, 2008).

Considerable research effort and political debate has gone into issues relating to the overall sustainability of the food supply system (see for example Foresight, 2011), and what is meant by a sustainable food system (Defra, 2006; Fresco, 2008) or even sustainable food (Aiking and de Boer, 2004). Our own research in Scotland (Leat et al., 2011) has shown the importance of social and economic sustainability, as well as environmental sustainability, to a broad cross-section of Scottish society (citizen consumers, food chain businesses and organisations), with issues such as diet and nutrition, the importance of local food, building sustainability on sound economic performance, the power of supermarkets, food chain regulation and the building of human and technical capabilities all being of major importance. What is undeniable is that the issue is multidimensional and multifaceted, with the three pillars of economic, social and environmental sustainability possessing complimentary issues as well as conflicting ones, as well as being joined by a time dimension (the welfare of the present generation versus those of future generations) and a place dimension (the welfare of Scottish society versus those in other parts of the world).

Considerable research effort has been put into sustainability issues at the farm level because in relation to the agri-food supply chain it produces a high environmental impact (Filson, 2004; McNeeley and Scherr, 2003). However, any assessment of sustainability issues at the farm level needs to take account of the whole supply chain. On the one hand, ‘the benefits of improvements in the environmental performance of farming systems could be lost if subsequent processing or distribution stages result in increased waste or environmental risk’ (Vasileiou and Morris, 2006). On the other hand, decisions and practices, as well as market pressure from further down the supply chain, may well influence the sustainability-related decisions of farmers (find a ref - Vorley).

This paper reports the findings of research undertaken for the Scottish Government which aims to determine the influence of agri-food supply chains on the sustainability-related activities and decisions of Scottish farmers. In doing so, it considers the treatment of sustainability issues by food processors and retailers themselves and their

interaction with, and influence on, farmers. The research has involved the development of 8 detailed case studies, which have been produced through a total of 45 semi-structured face-to-face interviews, which were carried out in 2010 with farmers, packers / processors and retailers (primarily multiple retailers).

The cases cover products which are of major significance to the Scottish agri-food economy and include: beef, pigmeat, malting barley/whisky, potatoes, poultry, eggs, soft fruit and organic vegetables. Within each case the issues considered include: the meaning of sustainability for the participants concerned; sustainability issues and indicators; drivers of sustainability concern and action; challenges and conflicts faced in achieving greater sustainability; the development and implementation of sustainability strategies within the businesses and chains, the influence of chain governance (inc. collaboration); and the facilitation of greater sustainability (responsibilities and support).

Whilst individual cases give rise to specific issues and findings, this paper focuses on the findings of a qualitative cross-case analysis so as to identify a set of key themes and findings which may contribute to future policy development. Following this introduction, section II presents some basic conceptual issues in relation to sustainability and the food chain, section III briefly introduces the case studies, while section IV provides key findings, before the concluding section identifies the policy implications of the findings.

II Literature and concepts

This section reviews some of the key issues in developing food system sustainability and ends by setting out a framework of issues to be considered in the case studies.

(i) Understanding of sustainability and sustainability priorities

Sustainable development is widely recognised as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (United Nations, 1987, p.54). Whilst this seminal definition is somewhat vague, it embraces two key issues; those of environmental degradation and the growth necessary to alleviate poverty (Adams, 2006).

The mainstream of sustainability thinking has embraced the idea of three main dimensions. In very broad terms, the economic dimension relates to efficient resource use, industrial competitiveness and viability, as well as the economy’s contributions to society (jobs, wealth creation, etc.). The environmental dimension refers to the managed use of natural resources to ensure their future availability and the social dimension relates to questions of labour opportunities, individual and community development, equity and human welfare.

There is an inter-dependency and overlap between these different dimensions. Thus, for example, strengthening the economic viability of different groups (e.g. farms or small food businesses) may provide the means of preserving their social and environmental features (e.g., farming and rural communities, and natural rural eco-systems). Social implications, such as the maintenance of a strong, healthy and just society, result from the provision of employment and income generation within for example the food chain (giving rise to an equitable situation without imbalances between rural and urban areas, or the respective food chain stakeholders). Similarly,

preserving environmental quality, such as through the prudent use of farmland, is also a precondition for maintaining economic potential in many rural areas (European Commission, 2001). There are also issues of place and time that come into play. Activities that maintain society's present welfare should not jeopardise that of the future, neither should the acts of our own society adversely affect the welfare of others.

Recognition of this connectivity gives rise to two important issues. First, the notion that trade-offs can be made between the economic, environmental and social dimensions of sustainability. 'Strong sustainability' exists where such trade-offs are not allowed or are restricted, whilst 'weak sustainability' exists where they are possible and allowed. In practice this means that development decisions by governments, businesses and others put greatest emphasis on the economy and its performance, over and above environmental sustainability in particular. It also needs to be recognised that participants within the food chain do not regard the different broad dimensions of sustainability as equal priorities. The balance that individual players place upon each area will be influenced by company ethos and values, but it is not surprising however that businesses and indeed Government policy place greatest emphasis on the economic dimension (Barling and Lang, 2003). Second, connectivity implies that there may be win-win situations within which the advancement of one dimension of sustainability may simultaneously serve another (Adams, 2006).

Within the context of a sustainable food system there are issues of sustainable production and consumption. Whilst there are many definitions Yakoleva and Flynn (2004, p241) suggest '... sustainable production means ensuring that all sectors involved minimize material use and prevent pollution and waste to levels within both local and global carrying capacity', whilst '... sustainable consumption means ensuring that goods and services respond to basic needs for food ... and improve quality of life while minimizing environmental damage ..'.

Several authors / bodies have described the dimensions of a sustainable food system in relation to the three main dimensions of sustainability. A combination of those offered by the Food and Health Alliance (2008) and FSA / COI (2008) is listed below.

Economy

- Economic productivity and prosperity
- Employment within the food chain
- Skills development for food industry workforce
- Science based developments such as innovation
- Consumer choice

Society

- Ensuring a strong, healthy and just society
- Food and health including food safety
- Promoting healthy food choices, including food education
- Sustainable communities e.g. FareShare, shared distribution, growing projects
- Ethical trading e.g. Fair Trade
- Corporate social responsibility
- Social inclusion/ equal opportunities / equitable treatment

Environment

- Reducing the impact on the environment such as reducing carbon emissions, understanding the carbon footprint, reducing energy consumption, reducing waste, minimising packaging, reducing food transportation – collaborative supply chain, etc
- Prudent use of natural resources e.g. water, fish stocks, landscape, air quality, maintenance of bio-diversity, use of fuel alternatives, etc

The point to note is that the concept of food sustainability involves many different dimensions and issues, as well as many different interpretations by stakeholders (Aiking and de Boer, 2004). Moreover, within a food supply chain and its management, the issue of sustainability needs to be considered from food producer to consumer involving all parties and processes (Fresco, 2008). It is only through the optimisation of each stage that full sustainability of the system can be achieved (Yakoleva and Flynn, 2004; Heller and Keoleian, 2003)

(ii) Drivers of sustainability

Highly concentrated food processing, retailing and food service are key players in buyer driven food chains, and are able to consolidate their supply base and increasingly demand stringent levels of quality, compliance with codes of conduct and safety standards, and proof of sustainable agricultural production techniques (Vorley 2001). Thus, within modern day food supply chains it is recognised that multiple retailers in particular can have a major influence on sustainability practices at all chain stages. Seuring and Muller (2008) see these as focal companies in the triggering of sustainable supply chain management. Retailers are also seen as pushing cost reduction in areas such as logistics, in-store energy use, packaging and waste reduction (Opinion Leader, 2007).

However, another view is that the biggest driver is always consumer demand, primarily where it can be linked to shareholder value (Opinion Leader, 2007), but in the context of UK consumers it should be recognised that ... ‘It’s difficult to expect change to be driven by consumers because they are split into two camps – those who go to farmers’ markets, connect more locally and have disposable income, and those who wouldn’t know what to do with fresh food if you gave it to them!’ (ibid., p.20).

Research on sustainability in the New Zealand wine industry (Gabzdylova et al., 2009) has concluded that the most important drivers for sustainable practices are the personal values of those involved, followed by product quality and related customer demand, as well as size of firm. Also identified are institutional and legislative drivers (compliance and pre-emption of legislation, along with community groups). In examining the sustainability of the supply chain for fresh potatoes in Britain, Vasileiou and Morris (2006) identified the importance of regulatory compliance requirements and perceived market drivers, often transmitted down relatively shorter, consolidated supply chains.

(iii) Sustainability issues and indicators

There are a several levels at which assessment of food system sustainability can be applied – at a national level, industry level, supply chain level or firm level. Producing actors, public organisations, NGOs and the scientific community have attempted to respond to the societal demand for assessing and improving sustainability, by developing several frameworks and an enormous amount of indicators for the food sector (Singh et al., 2009). However, there is no agreement on accepted reporting standards and a systematic application of them, specifying what, when, how and where to monitor and report (Gerbens-Leenes et al., 2003). Consequently, sustainability indicators are rather poorly understood and utilised, justified by the fact that they rarely allow assessment of overall supply chain performance, capturing the trade-offs and trends along the chain and/or over time (e.g. benchmarking against targets or other

companies within the same supply chain). This happens because they centre on impacts generated by individual companies within the chain or individual moments and a local scale. They also ignore interactions between different assessed aspects of sustainability and the responsibility for most sustainability aspects is shared (Gerbens-Leenes et al., 2003). So, accountability and transparency along the supply chain with respect to sustainability actions are problematic. Furthermore, direct comparisons of sustainability between competing food systems (e.g. organic versus conventional, or local versus global supply chains) are extremely difficult.

Therefore, the notion of assessing sustainability in the food sector requires a system-based approach that employs a balanced and integrated mix of indicators, focusing on all essential aspects of sustainability: economic, environmental, social and institutional (governance) (UNCSD, 2001; HM Government, 2005). Furthermore, literature recommends a mix of sustainability indicators as a measuring (and benchmarking) tool to assess: (i) all relevant physical flows of raw materials and interim products involved in producing the end product (Moll, 1993; Gerbens-Leenes et al., 2003); (ii) the full product life cycle (Heijungs et al. 1992; Gerbens-Leenes et al., 2003), corresponding to all relevant stages (activities) of the supply chain from resource input to consumption (Yakoleva and Flynn, 2004), (iii) several key themes within each stage, with significant implications for sustainability (e.g. waste, transport, energy consumption, animal and human welfare - Yakoleva and Flynn, 2004), (iv) conditions and trends on the state of environment and natural resources (OECD, 1998) and (v) all stakeholders (e.g. economic and environmental agents – OECD, 1998). The ultimate scope is to produce composite indices, that “condense the enormous complexity of our dynamic environment to a manageable amount of meaningful information” (Godfrey and Todd, 2001 in Singh et al., 2009, p. 191), and enable comparisons between competing strategies or against targets (Yakoleva and Flynn, 2004). In this respect, investigating inter-linkages between individual indicators (Warhurst, 2002) and assigning a reference value (i.e. thresholds - Lancker and Nijkamp, 2000) are considered necessary.

(iv) Supply chain governance

Within the context of a food supply chain sustainability an increasingly important issue is that of how different governance structures and relationships (spot market, repeat transactions, contracted transactions, vertical integration) influence sustainability. Vasileiou and Morris (2006) have noted that the nature of relationships amongst supply chain participants is a critical component of its sustainability, embracing issues such as trust and mutual independence (Gereffi et al., 2005), whilst Vorley (2001) has noted that food retailer and processor policies affect livelihoods and environmental health right across supply chains. Moreover, corporate retail driven greening of the supply chain is becoming increasingly evident in the EU (Smith et al, 2010). Supply chain management practiced by large retailers and processors, by integrating supply side activities, can potentially give rise to improved economic sustainability of the chain, as well as serving certain aspects of social sustainability such as food safety and animal welfare, and environmental sustainability through wastage and transport reduction. Simultaneously, by communicating and integrating demand side requirements it can potentially serve the needs of customers who seek products with environmental and social sustainability attributes. Aiking and de Boer (2004) identified transparency as one of the main issues underlying good governance and extensive interest is now being focused on the role that transparency can play in

assisting decision makers to explicitly support sustainable supply chains through improved information (Potts et al., 2010).

(v) Challenges and conflicts

Sustainable food production faces a number of challenges at a time when it is being influenced by a confluence of pressures. On the demand side there is a forecast global population increase from 7 billion today to 9 billion by 2050, and increasing affluence which will require more varied and higher quality diets necessitating additional production resources. There is, and will be, increased competition for land, water and energy, as well as climate change to contend with, whilst globalisation will present greater economic and political pressures (Foresight 2011). Within this context, greater sustainability in the food supply system will have to respond to a number of challenges (Foresight, 2011; and Fresco, 2009).

- The food system will have to respond to changing demand, and for food to be affordable it must be resource efficient. A balance will have to be achieved between economic considerations and sound ecological practices throughout the entire food system, involving existing and new technologies.
- It will need to permit greater mechanisation and investment in new physical capital, both to replace some labour and raise eco-efficiency (creating more goods and services with fewer resources and creating less waste and pollution).
- It will need to address the threat of volatility and vulnerability, which embraces issues of high food prices, affordability and accessibility, as well as supply disruption (supply chain resilience) and risk management.
- It will need to meet the challenges of low emissions which may involve limits on GHG emissions, strict energy efficiency limits and waste reduction.
- It will have to maintain biodiversity, whilst maintaining production.

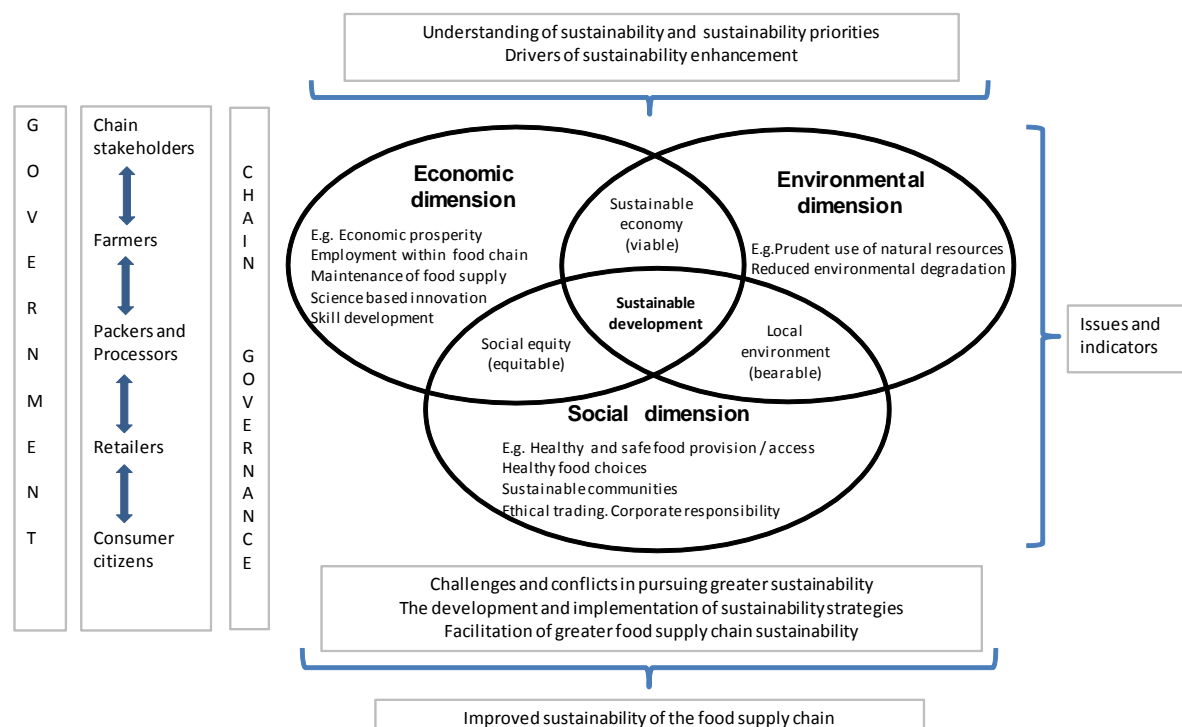
(vi) Government facilitation of greater food supply chain sustainability

Whilst increasing input costs and possibilities for increased competitiveness may encourage greater food chain sustainability from a supply side perspective (Rao and Holt, 2005; Gabzdylova et al, 2009; Flint and Golicic 2009), as well as the ethical stances of businesses, Government operating in many guises can assist the process. The British Government has identified a model of behavioural change (HM Government 2005) which goes beyond regulation and control and seeks to assist in the development of favourable attitudes and behaviour with respect to sustainability. This embraces the notion that Government needs to enable, encourage and engage as well as exemplify through its own actions (see Figure 1). Defra's Pro-Environmental Behaviours Framework (Defra, 2008) has used the model successfully in practice.

Research for the Sustainable Development Commission (Opinion Leader, 2007) has considered using this approach in conjunction with supermarkets as a way of improving the sustainability of food supply. This framework is a useful basis for developing a range of levers encouraging greater sustainability throughout the food supply chain. For example, by regulation and incentives, information and facility provision, food industry collective action, exemplary leadership and policy consistency. However, this needs to be undertaken within the structure and context of the community or industry concerned. It is this context that we endeavour to explore for key parts of the Scottish agri-food industry in this paper.

Finally, Figure 1 sets out the relationship of the key topics that are explored within the following cases.

Figure 1. Key topics for exploring sustainability issues within food supply chains



III The case studies and methodologies

The eight cases studies reported in this paper were undertaken in 2010. After initial desk research each case involved a set of recorded interviews with key people involved in the chain and its management, with each interview lasting 60-90 minutes. The interviewees for each case were a selection of farmers (3 or 4 in each case), possibly a cooperative manager – where the chain involved such a group, a key representative of the processor or packer, and 1 or 2 representatives of the retailer. The structured interviews were conducted with the aid of a discussion guide. The main issues tackled were: the meaning of sustainability and priorities; sustainability issues and indicators; drivers of sustainability concern and action; challenges and conflicts faced in achieving greater sustainability; the influence of chain governance (inc. collaboration); the facilitation of greater sustainability (responsibilities and support); and the extent of sustainability strategies and their implementation within the businesses and chains.

The cases were selected because they either: represented a significant element of the Scottish agri-food economy, and/or; exhibited clear enduring supply chain relationships; and/or exhibited particular agri-food chain sustainability issues. The eight cases can be briefly described as follows.

Case 1 - ASDA PorkLink Chain

This chain involves 85 pig farmers in the North East of Scotland and their marketing cooperative Scottish Pig Producers (SPP). SPP supplies a number of slaughterer-processors of which the largest is Vion-Halls (Vion Food Scotland Ltd) at Broxburn, near Edinburgh. Of the pigs consigned to Vion-Halls by SPP, 3,000 per week are supplied to ASDA under a 12 month rolling contract as part of a unique arrangement known as ASDA PorkLink. The PorkLink chain, which started in June

2009, aims to strengthen links with farmers by creating a number of benefits. These include prices which are linked to the Deadweight Average Pig Price (DAPP), bonus payments for Q-grade pigs and prompt payment within seven days. The scheme, which also encourages regular producer group meetings, is aiming to encourage consistency of supply, greater financial stability in the pig sector and improved quality. The Scottish Society for the Prevention of Cruelty to Animals (SSPCA) inspects supplying farms, hauliers and Vion-Halls to independently verify high animal welfare standards throughout the supply chain. The case was selected for study because: it represents the single largest pigmeat supply chain involving Scottish producers; its 3-party contractual agreement which is trying to ensure economic sustainability for pig producers; its considerable collaboration between producers; and its strong animal welfare feature which is on the retail pack label.

Case 2 - Tesco McIntosh Donald Scotch Beef Chain

The McIntosh Donald (Vion Food UK) beef and lamb slaughtering and processing plant near Aberdeen is one of Scotland's largest. It procures livestock from some 1500 producers from across Scotland all operating to the standards of Quality Meat Scotland's Farm Assured Scheme. The 75,000 or so beef cattle procured annually are provided through members of its Beef Producers Club. The plant is a dedicated Tesco supplier site with the multiple-retailer accounting for approximately two-thirds of throughput volume. An extensive range of packaged beef is supplied to Tesco, all carrying the Scotch Beef PGI (Protected Geographical Indication) and Tesco's own label. The plant operates to the high standards of its largest customers and the British Retail Consortium.

The 1000 beef producers who supply McIntosh Donald all belong to its Beef Producers Club. This organisation provides a means of communication - via meetings, farm and plant visits, and newsletters - between Tesco, the processor and the farmers. Information is given on market requirements and developments and routes to enterprise performance improvement. McIntosh Donald operates an online information system for producers called Qboxanalysis. This provides farmers with comparative information on the performance of their animals through to slaughter. It enables McIntosh Donald to take a proactive approach towards farmer suppliers in helping them achieve better efficiency and reduced farm costs, as well as producing carcasses that better match market needs. The system can help farmers achieve better carcass values and higher net margins. It also provides an accurate analysis of producer performance and can improve supply chain management by providing evidence of beef production trends. Longer term, a greater proportion of beef carcasses may hit the processor's ideal carcass specification. The case was selected for study as beef is Scotland's foremost agricultural product and this chain is one of Scotland's major beef supply chains. There is a clear chain leader with elements of strong collaboration and information sharing between producers, processor and retailer.

Case 3 - Cackleberry Eggs and Waitrose Chain

Cackleberry Ltd was formed in 2006 by 3 farmers in the Scottish Borders, with the aim of supplying free range organic eggs to the multiple-retailer Waitrose. Two of the farmers were looking to diversify their existing farming activities, whilst the third was already an established organic egg producer. The three producers have flocks of Columbian Blacktail hens (a cross between Rhode Island Red and Light Sussex) which

produce approximately 43,000 free range organic eggs per week for Waitrose. The eggs are supplied under contract to Stonegate - a national packer and distributor of eggs which operates with over 250 egg producers and supplies the UK's major food retailers - and put into the Waitrose distribution system for supply to Waitrose's Scottish stores. Stonegate provide extensive enterprise performance data which are discussed with producers through a producer liaison group. Consultation is also made with the egg producers over prices. Allied to this system of performance monitoring is a 'raising the standard' audit which is undertaken with producers on a 6 monthly basis by Stonegate's farm support team. The targets are set by Waitrose and the audit covers 10 areas of welfare and environmental performance. Where an audit indicates a need for improvement, 28 days is allowed with assistance provided through Stonegate's farm support team. The Cackleberry case represents strong collaboration between a major food retailer, their egg packer and distributor, and the Cackleberry producers. The case has been selected for study because of: strong sustainability features with the free range organic hens living in flocks of 4,000 in solar and wind powered, purpose built sheds; and close collaboration between all 3 parties with a sharing of information on market conditions and how to raise production performance and standards.

Case 4- The Highland Grain Chain

Highland Grain is an agricultural cooperative based in Easter Ross which specialises in the storage and marketing of malting barley. The cooperative, which is based on the Black Isle, has 85 members and a current throughput of 45,000 t. It has 3 major malting customers which account for approximately two-thirds of its tonnage, with the balance going for brewing/export.

One of Highland Grain's major customers is a maltster in Northern England which is a major provider of malted barley to the distilling, brewing and food industries in the UK and to exports markets. In turn, one of the maltster's customers is the Edrington Group Ltd which produces, bottles and markets several distinguished whisky brands including The Famous Grouse, The Macallan and Highland Park. The Highland Grain chain has been selected for study because: all three parties are successful players within the Scottish malting barley-malt-malt whisky sector; the businesses have considerable experience of working with each other; and Highland Grain is relatively progressive in developing greater environmental sustainability within its operations.

Case 5- Marks and Spencer (M&S) Oakham Chicken Chain

The chain involves Scottish contract farmers who supply chickens to a joint company, Hook2Sisters, and then on to M&S. Hook2Sisters was formed between P.D.Hook Ltd, the biggest broiler producer in the UK, and its largest customer (3.3 millions chickens per week) the 2 Sisters Food Group. In Scotland, the 2 Sisters Food Group has a manufacturing operation at Letham processing 210,000 chickens per week, which is supplied by Hook2Sisters who account for over 24 percent of Scotland's weekly chicken production. The processed chickens are put into both the Tesco and M&S distribution systems for supply to their Scottish stores. All fresh chickens produced under the M&S standards, are branded as Oakham Chicken. This brand represents an exclusive to M&S and differentiated product, guaranteeing a slower growth and high animal welfare. The case was selected for study because of its contractual agreement between P.D.Hook and 2 Sisters which protects broiler farmers against increases in costs for feed and chick stock. There is also considerable

collaboration between: P.D.Hook and contract farmers who share the latest advances in genetics and use information tracking systems to closely monitor performance and costs; and also between 2 Sisters and M&S who assist the funding of R&D activities for its own M&S teams and suppliers to address sustainability challenges, and jointly with 2 Sisters (through workshops) to identify effective sustainability indicators.

Case 6- Tio-Tesco Organic Carrots Chain

This is Organics Ltd (Tio) was formed in 1998 with the aim of marketing and distributing of organic crops to the multiple retailer Tesco, initially through an existing Tesco packer but later direct, through its own packing facilities. Tio is based in Moray, and specialises in organic root vegetables, potatoes and barley and constitutes the only dedicated supplier of organic carrots to Tesco under the retailer's brand. Mid Coul farms, together with an independent farm called A&A Carrots in Aberdeenshire, are the two largest suppliers, accounting for more than 30 per cent of Tio's intake. Tio supplies 8,500 tonnes of organic produce per year and Tesco sales account for 75 per cent of Tio's turnover. The targets are set by Tesco, requiring all supplying farmers to achieve Tesco Nature's Choice standards, which also cover environmental performance. The organic production and supply system has been selected for study because: it represents the single largest organic supply chain involving Scottish producers; its strong environmental and economic sustainability features; and, close collaboration between all 3 parties with a sharing of information on market conditions, production costs and how to raise organic production performance and standards.

Case 7- Angus Soft Fruit-Tesco Chain

Angus Soft Fruit Ltd (ASF) together with its dedicated network of 24 Scottish growers, called Angus Growers, constitute a production and marketing group which is one of the leading suppliers of strawberries, raspberries, blueberries and blackberries to UK multiple retailers, including Tesco. ASF has a market share in excess of 15 per cent of the soft fruit sold in the UK, which gives it first position amongst Scottish soft fruit suppliers. In addition to packing under the retailers' label, ASF has developed its own premium brand, Good Nature Fruit (GNF), which is pesticide residue-free and is supplied to Tesco, Asda, The Co-op and Sainsbury. In order to guarantee all year round supply, ASF is supplied by 35 like-minded growers in Holland, Spain, Morocco, the Middle East and South America. ASF in collaboration with Angus Growers have heavily invested in innovation and sustainability, aiming to differentiate its products and improve efficiency. As a result, it has successfully developed both a premium strawberry variety called AVA, which is exclusive to ASF, and a patented production system, called SEATON System. The case was selected for study as it represents the single largest soft fruit supply chain involving Scottish producers, and it includes considerable collaboration between ASF and Angus Growers. There is extensive sharing of knowledge and information on benchmarking, and its strong innovation and sustainability drive is communicated through its GNF premium brand.

Case 8- Taypack-ASDA Potato Chain

The chain under investigation includes 15 Scottish potato growers who were previously members of the grower cooperative, Taygrow Produce Ltd, which consisted of 26 growers sharing information and machinery. This cooperative dedicated their

total potato crop to the Inchtute-based packhouse of Taypack Ltd, supplying over 130,000 tonnes of fresh potatoes to ASDA one of the four biggest multiple retailers in the UK. After a ten-year mutual commitment between 3 parties, in 2008 the agreement between Taypack, Taygrow Produce and Asda came to an end. This forced Taypack to operate more as a trade broker rather than a packer in order to ensure alternative outlets for the output of its grower base. Most of the fresh produce was transported down to England where potatoes were graded, packaged and labelled. Soon after the completion of interviews, in June 2010, the Inchtute-based packhouse of Taypack was acquired by QV Foods Ltd, a Lincolnshire-based potato and vegetable growing business that supplies chefs, foodservice outlets, and multiple retailers including Tesco, Sainsbury, Asda, Aldi and M&S. The case was selected for study as it represented one of the largest potato supply chains involving Scottish producers, operating under a close mutual commitment between growers, processor and retailer, and characterised by collaboration and sharing of information and equipment between producers and processor.

VI Analysis

(i) Understanding of sustainability and sustainability priorities

There is not a widespread or common understanding of sustainability amongst farmers. Many (organic producers excepted) see it in terms of maintaining their business for future generations and protecting the environmental and biological features of their farm. However, the appreciation of food system sustainability issues seems to be increasing for those involved in supply chains where the focal or lead businesses have a clear and broad sustainability agenda.

Across the cases there is a very strong emphasis on economic sustainability at all levels of the chain. Amongst farmers this is focussed on good technical performance and the parallel theme of costs, as well as prices that are being achieved. Where the enterprise is a major part of the farming business there is a concern that it should yield a living for the farming family. Whilst all of the farmers have a clear economic orientation – they do to differing degrees have a concern for their immediate farm environment and beyond. Those engaged in organic production tend to have a naturally stronger orientation (Cases 3 and 6), although in some cases they see it as a route to better prices and returns (Case 3 and 7).

Processors also have a very strong economic sustainability orientation (ultimately the profit and loss account of the business) and in a supply chain context this translates into the maintenance of agricultural product supplies. There is a very strong concern that their supply chain is resilient to issues such as supply disruption (possibly caused by disease or poor weather). This is based on the need to drive their own businesses and to simultaneously meet the ongoing needs of their retail customers with whom they have a contract or supply agreement. Where this customer is a major part of the supplier's business, the need for supply resilience is very strong (Cases 1, 2, 4 and 5).

Retailers are also driven by profitability and the needs of shareholders. However, the major retailers (Cases 1, 2, 3 and 5), as well as some of the major processors (Cases 1, 2, 3, 4, 5 and 6), have corporate social responsibility or sustainability strategies, the implementation of which is a work in progress. Environmental and social sustainability actions which simultaneously serve economic performance are pursued vigorously (e.g. reduced transport mileage, decreased energy consumption, reduced product packaging).

Whilst economic viability represents a foremost concern for all the businesses involved, there were some amongst farmers, processors and retailers (Cases 4, 5 and 6), who had a more balanced view and placed greater emphasis on the environmental and social aspects of sustainability. For them, first all three facets of sustainability are an integral part of their business, representing a long-term commitment and embracing all stakeholders. Second, adequate profitability within a short time frame is recognised as a necessity for securing long-term sustainability in all three dimensions, because it generates confidence to move forward and enables investment. Third, not only is economic sustainability in many instances viewed as complementary to the other aspects of sustainability, but also the opposite relationship is evident, because in many cases caring for the environment and communities builds a premium brand and drives efficiency further in innovative ways (Cases 1, 4, 5, 6 and 7).

(ii) Issues and indicators

As far as farmers are concerned, their primary focus is on economic sustainability and as a consequence their main involvement with indicators is with those relating to technical performance in terms of both inputs (feed usage, feed conversion, mortality rates, days to slaughter, etc) and outputs (eggs per bird, yield per hectare, grain or carcase quality, etc) and financial performance (costs of production, prices and returns, and margins). In the cases where farmers are engaged in some form of horizontal collaboration (co-operative, producer company, producer club) there is the provision of standard or comparative information to enable benchmark comparison activities to take place (Cases 5 and 7), and in a number of cases this is aided by downstream chain participants and sectoral bodies (Cases 1,2 and 3).

In the case of the organic egg producers (Case 3), there is also clear monitoring of environmental and animal welfare issues (in the form of a regular audit), which is undertaken in conjunction with the egg packer and retailer. A similar situation exists in the pork chain with welfare verification by SSPCA (Case 1). The producers in the other chains all belong to the appropriate farm assurance scheme with the prescribed practices and required record keeping, as well as having to comply with the retailers' own standards (e.g. Tesco's "Nature's Choice" scheme; M&S' "Field to Fork" scheme).

In order to receive the Single Farm Payment (plus payments under several other schemes) eligible farmers must meet keep their land in Good Agricultural and Environmental Condition (GAEC – covering soil erosion, soil organic matter, soil structure and minimum level of maintenance). They must also comply with a number of specified legal requirements, known as Statutory Management Requirements, relating to the environment, public and animal and plant health and animal welfare. In all relevant cases this 'cross compliance' was being observed, however, in areas related to eco-efficiency (the creation of more value with less environmental impact) farmers were generally adopting good practice but made little use of indicators, with the main exceptions being monitoring of energy consumption (power usage in intensive livestock buildings and fuel usage in fieldwork), fertiliser application being based upon soil nutrient status, water usage where private supplies are not available, and the transport of products. Larger operators in intensive livestock production are covered by IPPC requirements.¹

¹ Integrated Pollution Prevention and Control (IPPC) is a regulatory system that employs an integrated approach to control the environmental impact to air, land and water of emissions arising from industrial activities. It involves determining the appropriate controls for industry to protect the environment through

Beyond these sustainability issues, farmers had a general interest in bio-diversity and consumer matters (food access, affordability, consumer education on farming and food, food and health). However, they had greatest concern for animal health and welfare, bio-security and food traceability (participation in assurance schemes), all of which have the potential for a direct and instant financial impact on their business if things go wrong.

Supply chain resilience is a major issue for farmers and in the cases where there are contractual agreements at stake (Cases 1, 3, 4 and 5), the concern is to keep supplying their customer. It is also a primary concern for downstream businesses. In other cases, where no contract exists, the concern is a more general one about losing market access.

The downstream businesses are generally involved in a wide range of environmental and social sustainability issues and indicators. Some are driven by legal requirements and some are driven by cost concerns (water usage, power usage, transport, waste levels, etc), which may be self-imposed or may arise from pressure from the focal company in the chain (multiple retailers are very keen to drive any wastage out of their supply systems) (Cases 1, 2 and 5). They are also driven by company or industry strategy (Cases 1, 2, 3, 4, 5 and 6) through corporate responsibility or sustainability policies.

(iii) Drivers of sustainability advancement

A series of drivers for greater sustainability are apparent across the cases.

Chain internal drivers – the ethos and values of individuals, companies and industry bodies or groups. At the farm level the values of the farmer and his family can have a major influence on farm practices and activities (e.g. intensity and type of production (organic or otherwise), animal welfare standards adopted, investment in environmental features on the farm, investment in renewable energy sources or energy conservation, investment in improved worker welfare, etc.). Further down the supply chain, larger processors and retailers in particular are adopting corporate social responsibility strategies, environmental and sustainability strategies which are impacting directly on suppliers. In some cases these strategies are developed at an industry level (e.g. whisky industry - Case 4), and industry organisations can well play a role in encouraging and enabling greater sustainability (Case 1), by for example illustrating good practice, encouraging leading companies into collaboration and providing information.

Input markets – are a major driver for greater sustainability. At the farm level this is seen with the escalating prices of individual key inputs - such as fuel, inorganic fertiliser or non-GM soya for animal feed, and the need to increase the efficiency with which they are used (e.g. the use of GIS in undertaking field cultivations, more specific applications of fertiliser in terms of placement and timing of application, better use of animal waste, and better feed conversion and shorter production periods). Improved technical performance can thus be allied to improved environmental sustainability.

Customers and consumers – there is a widespread interest within food and drink markets for products and processes which are more sustainable than conventional offerings. Thus consumers and retail buyers are asking about or taking an interest in

a single permitting process. Operators of sites must show that they have systematically developed proposals to apply the Best Available Techniques (BAT) to pollution prevention and control and that they address other requirements, relevant to local factors.

products which have verifiable eco-friendly or welfare friendly attributes, or offer a social benefit. In some cases this interest is being passed down the supply chain by a retailer or processor who is seeking products with improved sustainability performance, or there is an enquiry about how sustainability standards might be raised. In other cases the initiative is at the farm / cooperative level and positive action on environmental or social sustainability is raising their competitiveness. In some cases they have even developed their own eco-friendly brand, such as Good Nature Fruit, the pesticide residue-free product from Angus Soft Fruit (Case 7), and Cackleberry Eggs (Case 3).

Legislation (encouragement / enforcement) – is universally recognised as a major driver of sustainability. It may involve the need to comply with current or new regulations, or pre-emptive action to comply with future regulations. A common concern is that Scottish or UK legislation should not run too far in advance of international legislation so as to impede competitiveness.

(iv) Challenges and conflicts in pursuing greater sustainability

It is recognised in a number of cases that there is a degree of conflict between high economic sustainability and raised environmental sustainability, and that there needs to be an acceptable balance between the two (Cases 1 and 4). Farmers in particular are concerned that any such balance could be impaired by strong (low price) competition from foreign imports (Cases 1 and 3), whether this be triggered by currency movements (e.g. a weakening of the Euro), differences in legislative requirements, or international market surpluses. Some retailers acknowledge that this is a threat in some product markets (the non premium, non niche categories) (Case 1) as many food items are becoming more price elastic as consumers look for lower priced alternatives.

Related to this issue of a balanced approach is a concern amongst farmers, and some retailers, that the pace of change is not too great and that it needs to be carefully managed so that competitiveness is not impaired, whether it be driven by legislation or the demands of the most powerful player in the chain (Cases 1, 2 and 4). This is because they need the necessary science based information and advice on how to adapt production systems, and that in many areas it will be necessary to make substantial capital investments in buildings and machinery. However, quick returns on these investments are difficult (Cases 1 and 3), and many farms are already in need of capital to keep existing facilities operational, before progressing into any further improvement.

A cautionary note should also be sounded, in that there is great disparity within the farming population in terms of abilities, motives, attitudes and resources, which in itself presents a challenge for the spread of more environmentally friendly farming practices. Simultaneously it is suggested that a similar divergence of views is evident within government, food industry bodies, and the scientific community in terms of what is needed to improve sustainability. Consequently, conflicting messages cause confusion and mistrust amongst supply chain actors, whilst the agricultural and food sector is left to a voluntary basis of response. So, the shortage in producing applied research, and transforming it into practitioners' knowledge on how to raise the environmental sustainability of farming, food production and distribution, whilst maintaining economic performance, is acknowledged as a problem of the structure of knowledge generation and diffusion, linked also with the commercialisation and privatisation of knowledge.

In some cases, initiatives at a farmer group level started by the processor, a farm cooperative or a retailer being in close collaboration with its supplying group, aim to

fill this gap in the knowledge structure. In practice, they set up and fund their own research agenda tailored to common sustainability challenges faced by farmers within the group. They also closely monitor, regularly benchmark performance (e.g. costs, waste, output) and share innovation information and experience.

Nevertheless, there is a view that the whole process of generating information and forcing change towards sustainably sound food supply would be assisted by an international market for GHGs.

At the consumer level, there is clear concern amongst many of the respondents that there is a lack of knowledge and understanding amongst consumers about farming and food production, the costs of production, and the preparation and health aspects of food. In this area, farmers and processors regard retailers and government as having a key responsibility to educate consumers about food and sustainability. The ultimate challenge is to secure a change in consumers' focus to a more balanced assessment of both price and the embedded sustainability features of products, rather than on the lowest price.

Amongst processors and retailers there is a clear view that one of the biggest challenges is to keep producers producing, so that they have the supplies to run their business. In this area there are concerns that the evolution of agricultural policy, the legislative and bureaucratic demands placed on farmers, and volatile market returns should not conspire to deter agricultural production.

Finally, with respect to social sustainability, it is recognised that any expansion of both meat and whisky production may be at odds with health policy. However, no clear understanding of social sustainability is apparent amongst most farmers and processors.

(v) Development and implementation of sustainability strategies

There is no comprehensive and shared understanding of sustainability and the issues involved amongst the businesses covered by the cases, although some cases appear to have a higher level of action and understanding than others (Cases 3, 4, 6, 7 and 8). For farmers, economic sustainability comes first but with a concern for their immediate farming environment. With regard to the latter, many of the farmers involved have taken their own actions to protect or add environmental features on their farm (e.g. allow woodland regeneration, engage in tree planting, protect wildlife habitats), most commonly with the assistance of grant aid (e.g. Rural Stewardship Scheme). There is also recognition that their concern with social sustainability tends to focus on their local community, their employees' welfare, obligatory food safety and in some instances providing opportunities for children to visit farms and learn about farming. In the cases of formal farmers' cooperatives some actions are clearly being taken to address important environmental sustainability issues (e.g. Waste Plans in Case 1).

There is a feeling amongst the majority of farmers and their organisations that others in the chain are more advanced in relation to their sustainability activities, so that in a number of cases farmers have a relatively high regard for the sustainability strategies and actions of the chains they serve and derive some comfort from this situation (e.g. Case 1 and Case 7).

Amongst the processor and retailers, there is a far wider perspective of social and environmental sustainability due to the scale and complexities of their businesses. Some of this is born out of IPPC or other legislative requirements, some comes from internal drives to cut costs and reduce waste, some comes from internal company

policies or industry policies, some comes from customer requirements and sometimes it comes from the focal company in the chain or chain leader. However, there is a widespread view that the full impact of developing a highly sustainable food system is not as yet understood. Moreover, in contrast to the perspective of farmers, in several cases they do not regard the sustainability strategies and activities of the chain they are involved with to be as highly developed as those of their own companies (Cases 1, 2, and 3). Whilst some of the retailers and processors have made major and very public commitments to increased sustainability, there is a recognition that whilst they have strategies, targets and some metrics in place, as well as people with clear sustainability related responsibilities, they have yet to get their activities fully integrated with respect to sustainability or to have a full set of metrics to monitor progress in a comprehensive manner. Thus the full integration of food system sustainability is still being developed within the businesses concerned and their supply chain activities

(vi) Chain Governance

The cases investigated are mainly collaborative in some form or other. In most cases this involves horizontal collaboration (with varying degrees of formalisation – two of the cases involve a farmer co-operative, four cases involve informal groups of farmers largely dedicated to a processor or marketing/producing company, one case involves a farmer owned company, and the other a producer club) at the farmer level. Beyond the farmer level there are also strong features of vertical collaboration between the various parties. Whilst this may be underpinned by contractual terms or repeat transactions, it takes the form of information sharing between participants on market developments and performance, and ways by which to enhance economic performance and environmental performance (Cases 1, 2, and 3). Particularly strong collaborative arrangements are associated with a degree of chain transparency, good personal relationships between key personnel and an element of trust. Strong managerial capabilities are also apparent amongst the parties.

Even in the case of clearly directed chains with a strong multiple retailer, environmental sustainability can be seen as being served by closely monitored moves to reduce costs through waste reduction (Cases 1 and 2).

It is clear that in all cases where a feature of collaboration is apparent, the various parties view the supply chain arrangements as beneficial to economic sustainability, with varying degrees of environmental and social sustainability being apparent.

In all of the cases, except one, the participants regard themselves as being part of a collaborative chain, and this is regarded by all concerned as having some marked positive effect on economic sustainability. This is not surprising as commercial benefit is often a key determinant of sustainable supply chain relationships (Revoredo-Giha and Leat, 2010). However, chain collaboration is also regarded as benefitting environmental sustainability in all of the cases, with examples being improved animal welfare, encouragement with eco-friendly investment, environmentally friendly adjustments to production systems, etc. However, in three of the cases it is recognised that further environmental benefits can be achieved as the economic merits of the relationship develop (Cases 1, 3 and 8). Thus a relational or collaborative chain can be seen as offering a pathway to greater sustainability.

Social sustainability is also seen as benefitting from collaborative arrangements with a collective sense amongst farmers that they are doing something to help secure their farming future and that of their family, and acting to maintain rural jobs.

Processors and farmers (Cases 2, 5, 6 and 8) highlighted the need of a constructive dialogue with retailers over their ability to secure cost savings without this becoming detrimental for performance or indeed social and environmental sustainability (e.g. over exploitation of natural resources). Some processors and marketing companies supplying multiple retailers such as in Cases 5 to 8, see themselves as playing a balancing role in the supply chain, by communicating this message to retailers.

We now move to consider the conclusions and policy implications of these findings.

V Conclusions and policy implications

(i) Understanding of sustainability

The research has identified differing interpretations, levels of understanding and activities / strategies related to sustainability within and across the food chains concerned. Nevertheless, economic sustainability is the foremost concern for the businesses involved, with progress on other dimensions of sustainability being developed from positions of economic viability. As a consequence, a sectoral business environment which assists the economic viability of constituent businesses may enable investments which also serve environmental and social sustainability. Environmental and social sustainability actions which simultaneously serve economic performance are pursued vigorously.

In addition to profit levels, cash flow and investment levels, a major feature of economic sustainability within supply chains is supply resilience; the ability to keep sourcing appropriate raw materials and supplying customers with product. This forces businesses to recognise their mutual inter-dependence and there is widespread acknowledgement that sustainability involves the development of chains within which all parties can achieve acceptable profits which enable investment.

(ii) Sustainability indicators

Sustainability indicators are most commonly monitored in relation to technical and economic performance, especially at the farm level, with environmental and social indicators largely being pursued by chain participants because of economic (e.g., efforts to reduce energy consumption and waste), legislative, customer-related and company policy reasons. Comparative technical and financial performance information is most frequently available to farmers within collaborative supply chains (involving both horizontal and vertical collaboration). Environmental concerns at the farm level relate mainly to the immediate farm environment and legislative (such as those relating to cross-compliance) or farm assurance requirements, and those which also serve economic ends (i.e. cost saving, performance increasing). The development and implementation of holistic environmental strategies is most evident in individual companies as opposed to whole supply chains. However, focal companies within chains (multiple retailers or major processors) who have clear sustainability agendas and strategies can have a significant influence on the development of greater sustainability within their supply chains.

(iii) Sustainability Drivers

The main chain internal drivers for greater sustainability appear to be the ethos, values and strategies of individuals, companies and industry bodies or groups. In the case of lead companies within a chain, their agenda will be passed to others, which

may or may not be beneficial to broadly based food supply sustainability. Simultaneously, the main external drivers of increased sustainability are: (a) input markets and the cost of key inputs such as energy, fertiliser, water, etc; (b) product markets where customers increasingly seek products with good sustainability attributes (e.g., low food miles, reduced carbon footprint, high animal welfare) (c) legislation (e.g. on emissions, pollution, waste treatment and animal welfare) and the strategies of industry bodies and other influential institutions.

Whilst all stakeholders within the food system are regarded as responsible for ensuring sustainable food production and responsible food consumption, a particular importance is placed upon Government to provide an equitable and practical regulatory environment (enforcement) and to support and promote good practice (encouragement). Moreover, Scottish legislation on sustainability issues should not be radically out of line with UK, EU or international policy so as to damage the competitiveness of the Scottish agri-food sector.

(iv) Challenges is securing greater sustainability

There is a degree of conflict between high economic sustainability and raised environmental sustainability, and there needs to be an acceptable balance between the two. Farmers in particular are concerned that any such balance could be impaired by strong (low price) competition from foreign imports. Related to this issue of a balanced approach is a concern amongst farmers, and some retailers, that the pace of change is not too great and that it needs to be carefully managed so that competitiveness is not impaired. There also needs to be a clearer consensus and consistency in the development of policy and action relating to greater food system sustainability, with the provision of science-based actionable information being a priority.

At the farm level, many farmers have clearly sought more sustainable production systems, particularly in economic and environmental terms (e.g. better use of energy and fertilisers, greater use of waste products, shorter production cycles, investment in renewable energy sources, development of bio-diverse areas, etc.) but there is a need for greater guidance and assistance with developing more sustainable systems. This should cover certain forms of investment, training and knowledge transfer on new processes and good practices, and collaboration with downstream players.

(v) Chain Governance

Collaborative supply chains with enhanced transparency which initially seek to secure improved economic performance, frequently assist advances in environmental and social sustainability. The development of greater social and environmental sustainability may initially come through raised production efficiency and a better alignment of supply with market demands. It may, however, arise from the subsequent collective pursuit of distinct environmental and social sustainability goals in order to strengthen market competitiveness through product and process differentiation.

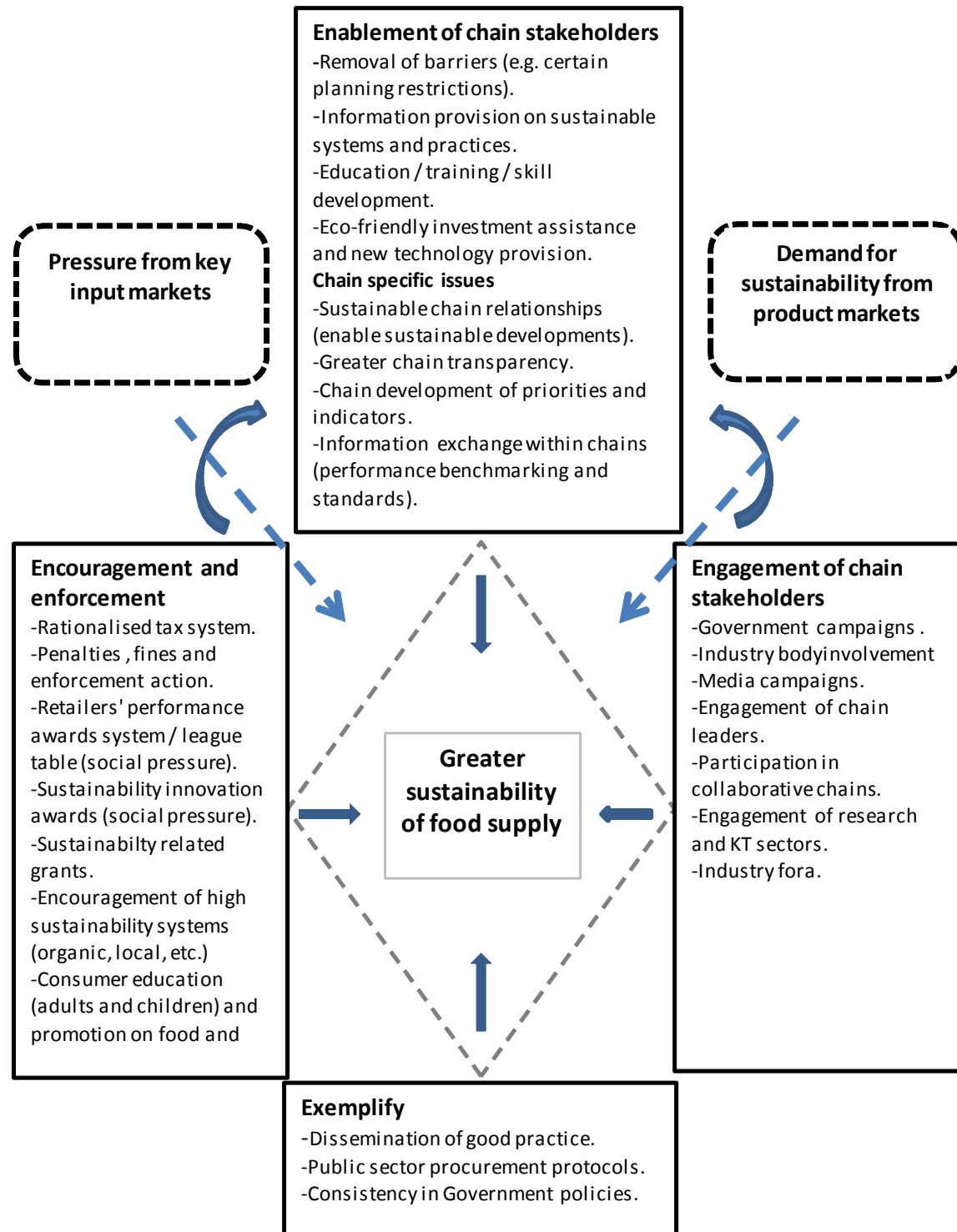
(vi) Policy development

Whilst all stakeholders within the food system are regarded as responsible for ensuring sustainable food production and responsible food consumption, a particular importance is placed upon Government and institutions to provide an equitable and practical regulatory environment (enforcement) and to promote and support good practice with respect to sustainability (engage, encourage and enable). A key message

from the research is that such policy must not impair competitiveness and that recognition should be given to those areas of environmental and social sustainability which are likely to be served by the pursuit of economic sustainability.

Drawing on these ideas Figure 2 sets out a model of attitude and behavioural change which Government (UK and Scottish) has been employing to facilitate such change with respect to sustainability, but it has been developed specifically for the development of sustainability in food supply to take account of the findings of this current research.

Figure 2 Changing attitudes and behaviour towards greater sustainability in food supply



Source: Developed from HM Government: *Securing the Future, UK Sustainable Development Strategy 2005*

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