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Developing sustainable food supply chains

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This paper reviews the opportunities available for food businesses to encourage consumers to eat healthier and more nutritious diets, to invest in more sustainable manufacturing and distribution systems and to develop procurement systems based on more sustainable forms of agriculture. The important factors in developing more sustainable supply chains are identified as the type of supply chain involved and the individual business attitude to extending responsibility for product quality into social and environmental performance within their own supply chains. Interpersonal trust and working to standards are both important to build more sustainable local and many conserved food supply chains, but inadequate to transform mainstream agriculture and raw material supplies to the manufactured and commodity food markets. Cooperation among food manufacturers, retailers, NGOs, governmental and farmers' organizations is vital in order to raise standards for some supply chains and to enable farmers to adopt more sustainable agricultural practices.

Keywords: food supply chains; sustainable agriculture; food manufacture; food retail; Corporate Social Responsibility

1. FOOD SUPPLY CHAINS

This paper reviews the opportunities available to businesses within food supply chains to link more sustainable agricultural and business practices to consumer purchases and societal value.

(a) *Types of supply chain*

In most of the world, eating habits have long been dependent on a mixture of local production and imported conserved foods. More recently, manufactured foods have become an important part of many people's diets, and many of the world's staple foods are now traded internationally as commodities. Although goods, money and (less so) knowledge and influence flow along all supply chains, the number and complexity of transactions along an individual chain, and therefore the capacity for any actor to exert a strong influence on others, varies enormously with the *type* of chain or network involved (table 1).

Local food supply chains are often considered to be relatively sustainable (e.g. Nestle 2002; Sustain 2002) partly because they support 'mixed' and organic farming and reduce emissions and externalities created by long-distance transport and high 'food miles' (Jones 2001; Pretty *et al.* 2005). Local food supply chains are also valued for their capacity to generate rural enterprise and regenerate rural communities, break agribusiness monopolies and create spiritual links between man and nature (e.g. Pretty 2002, 2004; Halweil 2004).

Food conservation is important for reducing losses and degradation during transport from rural areas to urban populations (Hulse 2004), and allowing people to enjoy a nutritious and varied diet throughout the year. Stable food products created by drying, salting, smoking and fermenting have been stored and traded outside the local area in 'conserved' food supply chains for thousands of years. Canning, pasteurization and freezing increased the variety of foods that could be conserved, and more recent technologies such as chilling, aseptic and controlled atmosphere packaging (combined with rapid inexpensive transport) have enabled many 'fresh' fruit and vegetables (Wu Huang *et al.* 2004) and dairy produce to be traded as 'conserved food', with considerable impact on national and international patterns of agricultural production and trade.

Manufactured foods usually contain ingredients from different origins and production systems. Although some may be derived from simple supply chains and others may involve many transactions between farmers and manufacturers, it is probable that the total number of the transactions involved in any one product is high. Some ingredients (e.g. herbs, spices, dried fruit) may make up only a tiny proportion of the finished product or may be required only for short product life of a particular variety of product (e.g. bakery product, sauce, meal) and major ingredients may be derived from dynamic international supply networks that overlap with those of business competitors; vegetable oils, for example, are often mixed or substituted to compensate for seasonal unavailability or variation in quality and price. Mixing and substitution along complicated dynamic supply networks may limit not only traceability but also the flow of information and influence along the chain.

Traceability, knowledge and influence only trickle along many commodity supply chains, where foods, bought and sold to standard specifications worldwide, are often bulked for low costs and ease of transport and storage. Commodities are usually simple conserved foods that can be stored and traded internationally, often using long-distance sea transport. Prices are dependent on market mechanisms and may be subject to future trading.

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Table 1. Typical features of four types of food supply chains. (+, low; ++, medium; +++, high.)

	type of food supply chain			
	local	conserved	manufactured	commodity
overall complexity of supply chain	+	++	+++	+/++
transportation distance ('food miles')	+	++	++/+++	+++
number of processing steps	+	++	+++	+
storability of finished product	+/++	+++	++/+++	+++
size of market for finished product	+	++	++	+++
seasonality of finished product on market	+++	+	+	++
volatility of market price	+/++	+	+	+++
demand for further processing by end user	++	+/++	+	++/+++

Since production often exceeds demand for traditional food commodities, prices tend to be low, unstable and declining (FAO 2004), making commodity-based foodstuffs (e.g. bread, sugar, rice and beverages) available to consumers from all sectors of society, but having catastrophic impact on the lives of farmers when prices fall dramatically (Fairtrade 2005, http://www.fairtrade.org.uk/about_what_is_fairtrade.htm).

Several, often contradictory, trends have emerged in the last 20–40 years. The removal of trade barriers, relatively inexpensive transport and technical advances in food conservation have encouraged international standardization and commoditization of conserved food, as producers of, for example, frozen chicken, wine, orange juice, fruits and vegetables, often in developing countries, compete internationally in 'buyer-driven' markets (Gereffi 1994). Meanwhile, manufacturers and retailers have been demanding differentiated specific attribute products, rather than traditional commodities, from farmers (Martin 2001*b*) in order to enhance their own product quality, brand reputation or range of specialty products, and political and social movements towards more local food supplies have emerged in some parts of the world.

(b) *What is a sustainable food supply chain?*

The UK Sustainable Development Commission (SDC; DEFRA 2002) has combined many different stakeholder views to produce an internationally applicable description of 'sustainable food supply chains' as those that:

(i) Produce safe, healthy products in response to market demands and ensure that all consumers have access to nutritious food and to accurate information about food products.
(ii) Support the viability and diversity of rural and urban economies and communities.
(iii) Enable viable livelihoods to be made from sustainable land management, both through the market and through payments for public benefits.
(iv) Respect and operate within the biological limits of natural resources (especially soil, water and biodiversity).
(v) Achieve consistently high standards of environmental performance by reducing energy consumption, minimizing resource inputs and using renewable energy wherever possible.
(vi) Ensure a safe and hygienic working environment and high social welfare and training for all employees involved in the food chain.
(vii) Achieve consistently high standards of animal health and welfare.
(viii) Sustain the resource available for growing food and supplying other public benefits over time, except where alternative land uses are essential to meet other needs of society.

A range of actors, working within and outside food supply chains, need to make changes to the ways in which they work to make supply chains more sustainable (table 2). Although the prime responsibilities for food businesses clearly lie within their own operations (employee training and welfare, eco-efficiency, innovative 'cleaner' production and waste management (part of SDC points 5 and 6)) and for their own products (food quality, safety, labelling (SDC point 1)), they are increasingly expected to use their influence with consumers 'up the chain' and suppliers 'down the chain' further to other parts of the SDC agenda.

Food businesses influence consumers by choosing which foods to make available and promote, by advertising, packaging, product placement and pricing. Here retailers and manufacturers can act independently of each other and in competition, for example by claiming to have different, better, more nutritious or more sustainable products.

Retailers and manufacturers are increasingly expected to take responsibility not only for their own operations and products, but also for everything they buy (Baldock *et al.* 1996; NZBCSD 2003; Nordic Partnership 2004; table 2). In the UK, Fox & Vorley (2004) identify supermarkets as holding the 'gatekeeper role' to the food chain; a role which offers 'shortcuts and access for positive change' as well as opportunities for retailers and manufacturers to pass down responsibility and costs to less powerful actors such as farmers. In countries where the retail sector is more fragmented, such as Indonesia, manufacturers are seen to exert greater influence (Clay 2005).

2. THE BUSINESS CASE FOR SUPPORTING SUSTAINABLE SUPPLY CHAINS

Food businesses must justify any investment to their shareholders and internal management. The 'business case' for investment in more sustainable supply chains

Table 2. Typical responsibilities assigned to actors within food supply chains. (+, low; ++, medium; +++, high.)

	actors within supply chain					outside chain	
UK Sustainable Development Commission priorities	farmers and growers	transport and distribution[a]	processing and manufacturing	retailing	consumers and citizens	governments	research and development
safe, healthy products, nutrition and information	++	++	+++	+++	+	++	++
rural and urban economies and communities	+		+	+		+++	
viable livelihoods from sustainable land management	+		++	++		+++	+
operate within biological limits of natural resources	++				+	+++	+++
reduce energy consumption, minimize inputs, renewable energy	++	+++	+++	++	+	+++	+
worker welfare, training, safety and hygiene	+	+	+++	+++		+++	+
high standards of animal health and welfare	+++	++	++	++		+++	+
sustaining the resource	+					+++	++

[a] Includes transport and distribution both before and after primary processing and manufacturing.

is strongest if investment costs can be used to improve profitability by generating products with higher consumer value. Investment may also be justified in terms of risk management, corporate reputation, corporate culture or Corporate Social Responsibility (CSR).

(a) *Creating consumer value for more nutritious, healthier products*

In surveys, 80% (of Europeans) believed that having a healthy diet is too difficult (HealthFocus International 2005) and 90% (UK) wanted retailers to make it easier (Co-op 2004). Manufacturers have a vested interest in making 'the healthy choice the easy choice more often' by producing and marketing nutritious products that are convenient, attractive and may even *feel* indulgent, for example high-quality traditional foods, pre-biotic, pro-biotic or fruit-and-vegetable drinks, foods with specific health benefits such as 'healthy heart' phyto-sterol-fortified margarines, high phyto-oestrogen bread and vitamin- or micronutrient-enhanced staple foods. A key technical target is the development of manufactured foods with the full taste and 'mouth-feel' of more conventional foods high in fat, salt and sugar. Producing 'safe, healthy products in response to market demands' (SDC point 1) can clearly make good business sense while supporting the development of more sustainable food supply chains.

Consumers deserve accurate and informative labelling and nutritional information to be made available to them, for example on carelines, websites and in leaflets available in-store, in order to make informed dietary choices.

(b) *Creating consumer value from sustainable procurement*

Some commentators consider that there is 'no business case' for investment in more sustainable sourcing (Drabæk & Brinch-Pederson 2004) other than to defend against activist attacks, shareholder demands for immediate action (Assadourian 2005) or product boycotts. Many mainstream businesses, particularly manufacturers or retailers dependent on multiple supply chains or commodities, argue that while consumer value is created by the safety, quality and performance of their products, consumer interest in 'process quality attributes' (Hooker & Caswell 1999) or 'extended product quality' (Knight 2002*b*) derived from more sustainable production is insufficient to justify the higher supply chain costs and reduced flexibility inherent in a smaller, more-sustainable supply base.

Conventional 'baseline' and 'higher-level' quality—and by analogy the extended product quality derived from sustainability—are valued very differently by businesses. Baseline standardization and quality assurance mean that firms no longer need to keep all supply chain functions in-house (Coase 1937) as in the days when Unilever ran its own oil palm and coconut plantations and a shipping line to transport the vegetable oil to its own factories. Baseline standards, and associated management systems (such as ISO 9000 and HACCP; WHO 2005) exemplified by those of commodities, are 'pre-competitive' and reduce processing, transportation and transaction costs for the entire food chain by conferring safety, legal compliance and reliability to the whole supply base.

By contrast, higher-level standards are 'competitive' and used to create consumer value by supporting claims for superior products and brands, often in niche markets. High-quality brands may be created by farmer groups or cooperatives (e.g. the Parma Ham Consortium (O'Reilly *et al.* 2002)), producers able to establish a reputation in a wider market (e.g. Northumberland lamb or Lincolnshire potatoes) or manufacturers and retailers. Where specific farming practices are required to ensure superior quality—such as using particular crop varieties or harvesting technologies—or where the geographical

source of raw material is critical to the 'high-quality' image, identity preserved (IP) supply chains must be created and maintained between the farm and consumer.

Although the concept of a baseline sustainability standard is non-sense, as sustainability is an aspirational open-ended agenda involving trade-offs and a range of potentially conflicting priorities (table 2), compliance with local laws and international norms for social and environmental performance has become the de facto baseline for many product assurance schemes and common codes of practice. Such schemes often combine minimum standards for quality, safety, social and environmental performance. Eurepgap requirements, for example, are for 'safe food that is produced respecting worker health, safety and welfare, environmental and animal welfare issues' (Eurepgap 2005).

Since social and environmental performance in the supply chain can be appreciated by consumers as a quality attribute, it is to be expected that many of the successful 'niche' products derived from more sustainable agriculture combine higher-level intrinsic quality with higher-level sustainability endorsements by trusted agencies. Trust can be based on personal contact for local supply chains: 'no supermarket will ever be able to compete with a farmers' market in terms of freshness, aesthetics and community ties' (Halweil 2004), or around a credible human 'face' (such as a local dairy farmer or a coffee farmer who can send her children to school owing to Fairtrade prices) presented on packaging, or linked to the product or brand in the media or via the Internet; for example, consumers can now trace fruit back to pictures of a grower's farm and family by entering a three-digit code from the fruit label on a website (Nature & More 2005, http://www.natureandmore.com/index.cfm?home=1). Credibility may also be derived from trusted Non-Governmental Organization (NGO) endorsements, such as bird-friendly coffee sporting the Royal Society for the Protection of Birds logo in the UK and the Audubon Society/Rainforest Alliance in the USA. Many consumers recognize a small number of on-pack logos and certification systems, for example 'Swan' within Scandinavia and the 'Blue Angel' in Germany as indicators of sound environmental credentials, and some brands and retailers, for example 'Fairtrade' (International), 'Max Havelaar' (The Netherlands) and the Co-operative Retail Organization (UK), as ethically based.

However, marketing professionals argue that the sheer complexity of the 'sustainability' concept, involving an enormous range of social and environmental issues, trade-offs, time scales and priorities (table 2), makes marketing 'produced using (more) sustainable agriculture' and 'delivered to you through a (more) sustainable supply chain' an impossible proposition. People need to feel involved and effective in order to make a change (Dawnay & Shah 2005), and since many important issues are either too big (e.g. climate change), too far away (e.g. the rainforest) or too complex for individual consumers to feel that their purchases can have any impact (Clarke 2001), there is a tendency for the successful higher-level systems to concentrate (or at least communicate, even if their scope is wider in practice) on only a small number of related issues where consumers can feel involved and empowered. Few higher-level certification programmes address *both* environmental and social issues within agriculture (Clay 2004), and supply chain sustainability performance outside the farm, during transport, processing, manufacturing or retailing usually remains invisible to consumers.

The value of simple communications linked to higher-level performance can be high for local produce and some conserved foods. However, manufactured foods are created in 'invisible' factories rather than on farms, and a simple, believable, added-value sustainability marketing proposition is difficult to generate for products containing many ingredients. The benefits of more sustainable supply chains are therefore harder to realize in the marketplace for manufactured foods and, because many supply chains are involved, the costs may be very high. If a manufactured food contains commodities or near-commodities, it may be necessary to create parallel, smaller, expensive IP supply chains in-house before making any higher-level sustainability claims, thereby negating most of the transaction and bulk handling cost savings introduced by the use of baseline standards and management systems. If certification and the application of higher-level standards create no consumer value, simple global economics and competition will kill the businesses that pay premiums to suppliers to support change or carry high extra costs for certification and IP.

The market value of more sustainable supply chains, either to grow niche markets or to support more mainstream brands, is therefore a matter for debate, and different businesses are working to quite different strategies, often confused by different understandings as to whether the standards used imply baseline or higher-level performance. 'Organic' certification, for example, is highly valued in many local food supply chains and niche markets and now represents 1–3% of total foods and beverage sales in US, Japan and Europe (IFST 2005), yet there is still considerable debate on the meanings and consumer value of the various Organic certifications. Some of the larger food businesses and big brands working in fresh or conserved food use external 'high-level' certification and IP for their whole supply chains (e.g. Chiquita bananas and the Rainforest Alliance; Rainforest Alliance 2000), whereas others have created niche product lines, such as Nestlé Fairtrade 'Partners' (Nescafé 2005) and Kraft Rainforest Alliance (Kraft Foods, Inc. 2005) coffee, to the consternation of some stakeholders (Ransom 2005).

People are motivated to 'do the right thing' and consumers who feel they can afford to do so make purchasing decisions based on a variety of considerations: habits; quality; value for money; personal values; and the approval of people around them (Holdsworth & Steadman 2005). The 80% of UK shoppers who say that they are prepared to pay a little more for 'ethical' products (Co-op 2004) have two main options; they can buy products where they trust that the specific higher-level attributes that appeal most to their personal values are catered for, or they can seek reassurances that their favoured brands,

retailers or manufacturers are engaged in developing more sustainable food supply chains on their behalf. Since people's behavioural changes such as starting to recycle (or developing brand loyalty) often precede their attitudinal changes (Jackson 2005), it should be possible for even manufacturing businesses to empower consumers to 'get to grips with sustainable food' (Jonathan Poritt quote from Unilever 2004) by offering sustainability enhancements to existing high-quality product reputations. Such messages must, of course, be underpinned by genuine actions within supply chains, which probably involve extending the scope of baselines or adopting higher-value standards and may also include a wide range of other activities linked to improved environmental, social and ethical performance.

(c) ***Supply chain action as part of CSR***

Casimir & Dutilh (2003) argue that mainstream food businesses should not mix ideas of 'markets' and 'corporate responsibility' by trying to communicate sustainability messages to consumers, because consumers make purchasing decisions in the 'masculine' (outgoing) mode rather than demonstrating 'feminine' concern for continuity and future generations when they behave as citizens. Brand-based communication and advertisements that cross the consumer/citizen divide may even create public outcry, as, for example, in The Netherlands when Heineken replaced 'Biertje?' ('want a small beer?'—a message to hedonistic consumers) with 'Bob je?' ('take a friend; do not drink and drive'—a message to responsible citizens) in the brand logo style on advertising hoardings. Fox & Vorley (2004) also consider that sustainability is part of what it means to be a 'responsible retailer…responding to Civil Society stakeholders acting on behalf of citizens', and that businesses should not conflate the notions of 'customer' and 'stakeholder' accountability or 'customer value' and 'public good'. The emphasis of many governmental and civil society organizations is now to demand that manufacturers and retailers act as responsible corporate citizens and use a mixture of science, business rationale, politics and emotion to assess the right course of action (Knight 2002*a*) rather than just making appropriate products available and encouraging consumers to 'buy green'. For those food businesses dependent on hedonistic products such as alcohol (e.g. Scottish & Newcastle 2004) or sweets (e.g. Cadbury-Schweppes 2004) and other products where dietary advice is to 'eat less' (such as manufactured foods high in fat, salt and sugar; Nestle 2002; Department of Health 2005), finding the marketing and lobbying strategies that maintain corporate credibility and reputation, while also improving profitability and market share, is a key challenge.

The benefits of being seen as a role model for corporate citizenship or as a leader on social and environmental issues can be significant for businesses. A reputation for integrity and responsibility is important for recruiting and motivating staff, since people care about the values and principles of their employers (WBCSD 2004) and may be critical for a 'licence to operate' or to expand into certain international markets. Working voluntarily to high environmental and social standards may even result in competitive advantage (while competitors catch up with legislation) and the experience and insights gained can be used to develop mutually beneficial partnerships with suppliers. On occasion, sustainable and secure supply chains may even be imperative for long-term commercial survival; the relationship between a fish population and that of the businesses dependent on it is a clear case in point (Unilever 2004; Howes 2005). A range of other practical business and supply chain considerations become important in determining whether action is justified, and which actions businesses are able to take, as part of their risk management or CSR agendas. The type of supply chains involved, and the visibility of the business to customers, consumers and citizens are key determinants (table 3).

Eventually, in many parts of the world, manufacturers, processors and farmers who do not develop an internal business case will find themselves forced to commit to parts of the sustainability agenda by their customers, external campaigns or new governmental regulations. Governments are not only a source of regulatory, tax and educational incentives, but are also important customers in some countries, accounting for 7% of the catering sector in the UK (Sustain 2002) and 10% of food consumption in Sweden (Jedvall 1999), with the power to make demands on suppliers (e.g. UK; DEFRA 2003) in the same way as do larger restaurants and pre-prepared food outlets (more than half of American and around one-third of European food expenditure; Euromonitor 2005, http://www.euromonitor.com/), supermarkets and food manufacturers. Where the public sector and major retailers and manufacturers lead, the lesson learnt from general adoption of ISO 9000 in manufacturing is that other businesses will eventually follow.

3. TAKING ACTION

Customer demands, or a link between 'issues' and raw materials or supply chain activities often makes priorities for action clear—human rights and labour for cocoa-based businesses (e.g. Cadbury-Schweppes 2004) or CO_2 emissions for foods with a high dependence on cold storage, transport or distribution (e.g. Ben & Jerry's 2005). However, even where external threats 'exert highly uneven pressures on supply chains' (Robins & Roberts 2000), and a business must focus on a single issue in the short term, a deeper understanding of the supply chain itself is usually necessary to ensure that improvements are made and maintained. Some local and conserved food chains can be relatively easy for food businesses to understand and influence, but foods derived from longer, complex supply chains may be difficult to trace beyond their immediate suppliers without specific studies. The methodology chosen for such studies can have a strong influence on the outcomes (table 4), and may only provide a 'snapshot' of the more dynamic chains. 'Life cycle thinking', more linked to risk management than formal recognized methodologies, often shows that important issues with high consumer and stakeholder visibility lie firmly within the agricultural parts of the food chain rather than in the transport

Table 3. Factors affecting food business investment in more sustainable supply chains. (Based in part on Paths to Sustainability in Supply Chain Management. Nordic Partnership SSCM Self Diagnostic Tool v. 1.0, August 2004.)

	supporting investment	counteracting investment
resources	resources available for strategic work	works to tight margins or in highly competitive environment. No time or energy for strategy
vision	long-term business vision	no long-term vision
culture	culture of involvement in (local) communities and support for local and national priorities high standards of social and environmental care within the business and with employees knowledge of issues (e.g. eco-efficiency, waste management, agronomy, biodiversity) and their management, based on in-house expertise or strong relationships with external experts	considers that responsibility to communities and national priorities is confined to paying taxes and obeying the law
products	high-quality products, trusted brands, high brand reputation value of differentiated products	short-lived product lines or products, perhaps subject to rapid changes in fashion
pressure	high-quality products, brands, brand reputation customer requirements for supply chain management to deliver environmental and social performance assurances risk of negative media exposure owing to social or environmental performance of suppliers	no pressure for change from customers media exposure has negligible effect on customers or employees
supply chain	local or conserved food supply chain where consumers purchase a recognizable farm product (e.g. fruit or vegetable) long-term relationships and interdependency with suppliers good understanding of own supply chains	commodity-based supply chains complicated, dynamic supply chains or multiple ingredients for manufactured foods buy entirely on cost rather than value does not value stable supplies or long-term relationships with suppliers

Table 4. Methods for gaining insight into supply chain sustainability.

	examples of insights gained	advantages and disadvantages
life cycle analysis (LCA)	energy use, gaseous pollution, CO_2 emissions, eutrophication potential, water use, solid waste	particularly useful for supply chain analyses of processing, manufacturing and distribution with direct insights into eco-efficiency and waste management (Hamprecht *et al.* 2005; Martin 2001*a*). Difficult to apply to an agricultural supply base
carbon accounting	carbon fixed and emitted as CO_2	
material flow analyses	waste reduction, reuse, recycling potential	
ecological footprinting	insights into the relative impact of many activities by converting them all into the same units	useful for geographically based policy discussions
converting impacts into financial costs	useful for financial incentives and taxation discussions	
food miles	distance travelled between producer and retailer	supports local food supply chains. Not directly proportional to transport externalities
HACCP studies	internationally agreed risk analysis system designed to produce safe food	useful in 'mapping' chains as starting point for other assessments
'life cycle thinking'	suitable for evaluating local priorities and those not covered by other methodologies	no generally accepted methodology available. highly dependent on expertise available
stakeholder dialogue and surveys	dependent on stakeholders consulted and survey design	useful for highlighting problem areas and/or risks

and processing stages. Hamprecht *et al.* (2005) consider that an in-house 'process management' approach (NZBCSD 2003) to supply chains, often developed by the more established international food businesses before other standards became available, is a prerequisite for incorporating sustainability into supply chain management for manufactured foods.

(a) *Working with standards and suppliers*

Food manufacturers and retailers are increasingly asking their immediate suppliers to meet minimum standards of 'CSR' as part of due diligence, or to help maintain their own corporate and brand reputation. Outsourcing arrangements and interdependencies between manufacturers and preferred and trusted

suppliers are now commonplace, and the 'balance of power' within these relationships is now seen as a source of competitive advantage (Christopherson & Coath 2002; Duffy & Fearne 2004; Klapwijk 2004) as companies develop mutual commitments to long-term linkage based on trust, shared risks and rewards (Allinson 2004) along supply chains. Once built up, mutually beneficial supply relationships are not abandoned lightly (Robins & Roberts 2000) and if problems do emerge within interdependent supply chains, buyers often support suppliers through the change process for several years before delisting (Harris-Pascal *et al.* 1998; Knight 2002*b*). Priorities for action with suppliers tend to be social rather than environmental, since eco-efficiency improvements, or the use of renewable energy (part of SDC point 5) within manufacturing and distribution has negligible consumer value or external visibility. Part of the problem is that a change in management culture is required, even to carry out the studies that eventually result in financial savings based on improved eco-efficiency (e.g. DEFRA 2005; UK Case Studies), since traditional business management systems, developed in an era when water, power, fuel and waste disposal were cheaper, often place a higher priority on areas of cost savings such as increased productivity or financial restraint.

If farmers are the immediate suppliers for food businesses, there is the opportunity to incorporate higher-level sustainable agriculture criteria into supply contracts; Nestlé ask Swiss dairy farmers to calculate the nutritional demand of the their soils annually (Hamprecht *et al.* 2005); Danone farmers work to a 'Good Practice Guide for Milk Producers', involving quality, safety, traceability, animal and environmental welfare standards (Groupe Danone 2005); and Unilever 'Birds Eye' pea growers work to a 'Quality with Sustainability' Field Manual. Higher-value in-house requirements for crop or farm, Integrated Pest Management (IPM), Environmental Action Plans, etc., may be combined with or replaced by higher-value externally verified standards such as (in the UK) 'Linking Environment and Farming' (LEAF 2005) or 'Freedom Foods' (2005, www.rspca.org.uk/servlet/Satellite?pagename=RSPCA/FreedomFood/FreedomFoodHomepage—108k) accreditation, especially where endorsement confers consumer credibility or where food businesses lack in-house understanding, for example in forestry/packaging, fisheries, wild harvesting, animal welfare or agronomy.

Trading relationships between farmers and the food businesses they supply directly have often been in place for many years. Farmers benefit from a reliable market and the ability to negotiate practical 'rules and regulations' for the partnership. The food businesses benefit from a reliable supply of high-quality raw materials, often close to processing facilities, and from insights into the farming systems, farmers' concerns and specific social or environmental risks. As an example, Bulmers have 30-year contracts with cider apple growers in Herefordshire that are of particular value to family farms because they ensure that *all* the production will be bought from an orchard (i.e. not a limited tonnage), a minimum price is guaranteed and contracts are transferable to the next generation or to new owners should the farm be sold; the mutual trust developed over many generations has been of considerable value to Bulmers during recent changes in business plans (C. Fairs 2005, personal communication).

Stable relationships generate the confidence for both farmers and food companies to invest in improved knowledge (for example, by sponsoring research), eco-efficiency improvements or mutually beneficial waste management. And where there is mutual trust, there is less need for external certification, expensive pesticide residue and contaminants analysis and frequent auditing. When quality and sustainability aspects of production both feature in contracts and specifications, the question 'how much extra do *you* pay the farmers to do it *your* way?' becomes impossible to answer because the commitment to sustainable development has become an intrinsic part of the supply chain relationship.

The costs, benefits and opportunities for business influence to reach down into agricultural production obviously depend on the type of food chain and the level of interdependence along the chain. If a supply chain can be 'mapped', improvement will lie in either eliminating unnecessary transactions along the chain or must show some potential net benefit to each member of the chain (Lillford & Howker 2000). If supply chains are too complicated or dynamic to map reliably, food businesses must accept the risks to their brands and reputation from unknown environmental impacts and security risks that lie outside the scope of the HACCP and assurance systems in place.

In the long term, some commentators argue that tracing technologies such as barcodes, GPS-based tracking, chips and RFID technologies will result in 'top-down' requirements being replaced by systems governed by 'bottom-up' intelligent goods flows (Klapwijk 2004). For complicated, or recently developed supply chains, farmers already bear the costs of becoming 'more sustainable' or changing practices to conform to certain standards or certification schemes (e.g. Organic, Eurepgap, Assured Produce Scheme) as a prerequisite for access to certain markets.

The cost of developing, applying and policing assurance schemes and the associated IP varies from less than 3% for UK Lion egg quality assurance scheme (which also incorporates higher standards of animal welfare than required by law (Lion Quality Mark 2005, http://www.britegg.co.uk/lionquality05/startlionquality.html; accessed in 2005) at a penny for every dozen eggs at the packing stage (Kirk-Wilson 2002)) up to that for 'Hard' IP for soya, operating to threshold levels for adventitious presence of GM-derived material of 0.1%, which is likely to rise from 10 to 25% in the 12 months from September 2005 (Brookes *et al.* 2005). Meanwhile, although some costs may be recouped by simplifying long or complicated supply chains, for example Fairtrade coffee (CBC, Marketplace 2000, http://www.cbc.ca/consumers/market/files/food/coffee/whogets.html), and the costs of assurance and sustainability initiatives within processing, manufacturing and retailing remain relatively low, the burden of cost increases in the supply chain will probably continue to 'fall disproportionally heavily on small suppliers such as farmers (UK Competition Commission 1999; quoted in Fox & Vorley 2004).

The proliferation of top-down food business and other standards can be a serious problem for farmers and others within supply chains, as the individual supermarket or food manufacturer's requirements differ based on their life cycle thinking, vulnerabilities, priorities, customer base and stakeholder feedback; Hamprecht *et al.* (2005) provide an example of a grain mill that has had to invest in three separate storage facilities for three different 'eco-labels'. A farmer may be unable to satisfy the apparently idiosyncratic requirements of a wide customer base owing to the investment in time or money required—or even because some demands are genuinely incompatible.

Expensive hard-currency audits or paper trails are, of course, completely unaffordable by poor farmers in developing countries, yet these are the people most in need of support for sustainable development; even the problem of Organic *and* Fairtrade co-certification is only now beginning to be addressed (Courville 2004). Such farmers need secure markets, education, healthcare, training, extension services and farmer field schools rather than demands from retailers or manufacturers for validated performance to higher-level standards in order to be selected as suppliers. Those food businesses who see the value of supply chain sustainability in terms of CSR rather than enhanced consumer value argue that imposing standards on their suppliers at every stage along the supply chain is not necessarily the only—or the best—way to achieve their objectives.

(b) *Beyond standards*

Adopting more sustainable agricultural practices may not be possible for many farmers because they lack the knowledge, commitment or finance to make improvements. Food business supply chain activities can help overcome such barriers.

Although developing knowledge-intensive 'regenerative technologies' such as land-management methods that minimize pest and disease outbreaks (Pretty 1995; Pretty & Hine 2001) is outside the scope for most food businesses, making such technologies applicable, available and financially attractive for farmers is likely to become increasingly attractive to food businesses wishing to strengthen their own supply chain sustainability.

International businesses that source from different parts of the world are particularly well placed to develop insights into production systems and 'better practices' in one part of the world that can guide research, development or extension projects elsewhere. Many of the larger food businesses fund applied agricultural research (e.g. The Douwe Egberts Foundation 2005, http://www.saralee-de.com/responsibilities/coffeeSourcing/DE+Foundation.htm) and some fund more basic work; Unilever, for example, paid for the research that overturned the dogma that oil palm was wind pollinated, enabling Malaysian growers to fund further work that resulted in higher yields in Southeast Asia (Corley & Tinker 2003).

There are many cases where food businesses provide credit or long-term loans at preferential rates to farmers or invest directly in agronomic advice, farmer training, better growing materials, inputs or capital equipment. As examples, UK potato packers offer their growers services such as seed supply and agronomy advice (Willcockson 2004); Tico Fruit in Costa Rica provides technical assistance to orange farmers to improve production and buys inputs in bulk and extends them in the form of credit to producers (Clay 2004); Danone Group are training farmers and providing financial assistance for the purchase of milk refrigeration equipment in Turkey (Danone 2004); Unilever tomato growers in Brazil are supported when converting to drip irrigation in order to conserve water or to mechanical harvesting where agricultural labour becomes unavailable, and oil palm estate and cooperative schemes often provide support to local smallholder outgrowers during the 3-year period before the crop starts to yield (Corley & Tinker 2003). Purchasing schemes such as that used by Marks & Spencer, 'milk pricing pledge to British farmers' developed with suppliers, co-ops, farmers, and the National Farmers Union (Marks & Spencer 2005), can dampen price oscillations, and thereby improve farm budgeting.

4. JOINT INITIATIVES

Individual food businesses, in competition, may be able to create or support supply chains that generate consumer value from (more) sustainable production, especially in niche markets. However, individual businesses will never have the power to transform agricultural systems or improve the sustainability of mainstream near-commodity and commodity supply chains.

However, the very lack of consumer discrimination that makes it difficult for mainstream businesses to compete to gain commercial advantage from extended product quality, coupled with a general desire on the part of many of the larger food businesses to at least manage supply chain risks (even if not fully committed to supply chain activities as part of CSR), encourages businesses to cooperate on common supply chain issues.

Business consortia fund pre-competitive research, especially on raw materials that are too minor for governmental sponsorship or too small a market for agribusiness companies. For example, the United Kingdom Association of Cider Manufacturers developed an IPM System for orchards and the UK sugar industry has funded research into beet quality and disease resistance, breeding, reducing soil erosion, fertilizer applications and sustainable crop management (CIAA 2002).

Businesses may also cooperate to develop sustainability assurance by 'raising the quality baseline' to include social and environmental performance. Klapwijk (2004) argues that business 'leaders' can agree on Value Chain Governance if three to six players in any market have a combined market share of 50–70% and where supply chains involve many components or ingredients. Given the number and diversity of food businesses, the difficulties competitors in the marketplace often have in working together and different understandings of the need for, definition of, and value created by 'sustainability' and related concepts, it is encouraging that there are already good examples of joint business initiatives leading to

Table 5. Benefits and costs of involvement in a multi-stakeholder supply chain approach. (Using RSPO as an example. Based in part on Tennyson & Wilde (2000).)

stakeholder	benefits of involvement	costs and risks of involvement
manufacturers and retailers in importing countries	credible 'more sustainable' sourcing without the expense of creating new IP supply chains benefits derived from a more stable and sustainable supply chain	no value to manufacturers and retailers where sustainability is not an issue difficulties buying into standards partly developed by competitors product claims based on distinctive sourcing criteria no longer an option
social NGOs	organization develops a wider reach and greater impact, e.g. on pricing schemes for smallholders and employment practices	being seen to 'fraternize with the enemy' and having to compromise in order to reach agreement
environmental NGOs	improved chance of conserving high conservation value forest and wildlife corridors providing continuous habitat linkage across landscapes. Good environmental practices such as terracing, cover crops, eco-efficiency become business 'norms'	difficulties buying into standards partly developed by organizations that do not have the same core interests or priorities
Responsible Plantations and Growers Organizations	more growers invest in the Good Practices already adopted by the more responsible businesses creating a 'level playing field'	costs of implementation and documentation
smallholder farmers	potential for improved participation, sustainability and business performance	difficulties in having a direct voice in the process. Costs of implementation and documentation
governments/public sector	standards adopted will support local laws and regulations in the producing countries. Involvement in the process provides evidence of responsiveness and accessibility	Potentially reduces the power of local officials

sustainability assurance schemes and either baseline or higher-level standards. These include the Eurepgap retailer-led initiative (Eurepgap 2005), the CCCC (Common Code for the Coffee Community; CCCC 2005) and several other coffee initiatives, and those being developed by the Sustainable Agriculture Initiative Platform (SAI Platform 2005; a joint initiative of Unilever, Nestlé and Danone, now involving many more companies in the food industry).

Shifting the de facto baseline upwards to bring sustainability issues into mainstream standards can have positive benefits for other supply chain actors (table 2), such as governments, since compliance inevitably requires producers to obey the law (Clay 2004), and farmers who no longer have to cope with a multiplicity of different customer requirements.

Multi-stakeholder initiatives involving governments, farmers, academics and NGOs as well as food businesses have even more potential for driving improvements by engaging in 'dialogue and action to achieve changes more ambitious than they could achieve separately' (Sustainable Food Laboratory 2005). Each of the actors is able to provide complementary skills, approaches and networks; businesses focus on 'making a real difference' and often provide management and technical skills, dissemination and distribution capacity; civil society organizations offer on-the-ground know-how, development expertise, people skills and imaginative low-cost solutions while the public sector offers information, skilled staff, authority to mobilize resources (Tennyson & Wilde 2000) and the power to create the institutional structures and incentives that break the 'Tragedy of the commons' (Hardin 1968) vicious cycle.

For specific projects, local NGOs often understand local social and environmental issues and may be the custodians of farmland biodiversity knowledge or be able to offer skills in participatory approaches to change; local universities are a source of applicable research expertise and local social networks (especially farmer groups) are critical for ensuring practicality of any project and generating commitment.

At the national, international and corporate level, NGO skills and insights are also important to businesses not only to share in the creation of more sustainable supply chains but also to develop trust in any associated product claims. Marks & Spencer (retailer), for example, is involved in various supply chain partnerships such as between WWF-UK and the National Federation of Fishermen's Organisations in the 'Invest in Fish' programme, aiming to produce a strategy for fishing 'embraced by and not imposed upon those it ultimately affects' (Marks & Spencer 2005).

Food business expertise in nutrition, safety, conservation techniques, manufacturing and distribution 'up' to consumers is of considerable value to partnerships geared to the United Nations Millennium Development Goal (United Nations 2000) to make a 'measurable difference to childhood mortality by improving nutrition and hygiene in a sustainable and affordable way'. Proctor & Gamble, Unilever and Nestlé are developing food products that combat nutritional deficiencies and are affordable to low-income families (Nelson & Prescott 2003) in parts of the world where micronutrient malnutrition is common owing to seasonal unavailability of fresh foods (Welch & Graham 1999) or micronutrient-deficient soils. Ideally, such partnerships deliver profits for the business concerned, such as the

Table 6. Summary of routes to more sustainable food supply chains

	type of food chain			
	local	conserved	manufactured	commodity
farmers and growers	develop local markets	develop relationships with important buyers and encourage them to develop a business case for creating value from more sustainably produced raw materials		joint initiatives with 'buy-in' from all key stakeholders in order to address ethical, social environmental and livelihood issues all along the chain
	take advantage of baseline or higher-level assurance schemes that will add value to produce or provide access to more lucrative markets. Access government-sponsored schemes designed to encourage farmers to provide environmental services			
	group together more in order to access better technologies and practices, negotiate with buyers and maintain a strong voice in the 'sustainable agriculture' debate			
transport and distribution	improved logistics	improved logistics. Adopt 'smart' technology to minimize fuel use and food miles		
processing and manufacturing	eco-efficiency, reduced pollution, improved worker welfare on own sites			buyers 'up the chain' purchase preferentially from more sustainable sources where practical
	work with farmer suppliers to support more sustainable agriculture		work with immediate suppliers (co-packers, processors) to improve supply chain sustainability, as joint 'pre-competitive' programmes to mutual benefit	
			understand the sustainability issues associated with agricultural raw materials and develop programmes and partnerships to address these	
retailing	source locally where practical	work with immediate suppliers (growers, processors and manufacturers) to improve supply chain sustainability, in joint programmes to mutual benefit		
	eco-efficiency, reduced pollution, improved worker welfare on own sites			
	provide information to consumers on nutrition and other sustainability aspects of foods on sale			
consumers	adopt food-buying habits that ensure a healthy diet			
	value local food supply chains	value assurance and higher-level sustainability standards	value support for sustainability as part of brand, manufacturer or retailer quality and reputation	
civil society and NGOs	highlight issues and problem areas. Share expertise and insights in order to support improvements			
governments	local sourcing for public sector catering	public sector food purchase criteria to combine price, quality and sustainability aspects. Regulatory, support, tax and advice to encourage the development of more socially, environmentally and financially sustainable food supply systems		national and international support for more sustainable production systems and trade
research and development	provide deeper understandings of sustainability issues linked to farming and food. Develop technologies to improve, for example tracking, tracing, waste management, eco-efficiency, participative working			

UNICEF/Unilever programme to make iodized salt available in iodine-deficient areas of West Africa (Veldte te *et al*. 2004).

Public/Private/NGO partnerships are vital to 'raise the baseline' for commodity supply chains. The 'Ethical Tea Partnership' (ETP 2005), for example, audits baseline ethical standards for thousands of tea growers throughout the world, is jointly financed by 17 tea packing companies (including large multinationals and small privately owned businesses) and is a full partner of the Ethical Trading Initiative (ETI, 2000 http://www.ethicaltrade.org/index.shtml): the International Cocoa Initiative (ICI) involves the chocolate industry and governments, NGOs and the ILO on child and forced labour abuses in West Africa (CIAA 2002; ICI 2005), and other public/private/NGO partnerships have been

set up to improve agronomy, farmer income and environmental protection or to institute equitable pricing systems within cocoa supply chains.

The 'Round Table for Sustainable Palm Oil' (RSPO) is a multi-stakeholder initiative founded by Unilever (food manufacturer), Migros, Sainsbury's (retailers), the WWF (NGO) and the Malaysian Palm Oil Association (growers' organization), and now (May 2006) has an ordinary membership of 103 growers, processors, traders, consumer goods manufacturers, retailers, banks, investors, environment/nature conservation NGOs and social/developmental NGOs. The RSPO has developed a credible globally acceptable definition of 'sustainable palm oil', encompassing wide-ranging societal and environmental issues—something that is beyond the scope of legislation in importing countries (FDF 2005) or business-only initiatives—and is now tasked with transforming a large mainstream commodity supply chain to become more sustainable (RSPO 2005). The business benefits of 'raising the baseline' rather than developing separate IP supply chains for 'sustainable' palm oil and 'the rest' include maintaining relatively low financial and environmental costs of bulk sea transport to both exporters and importers (Shonfield & Dumelin 2005) as well as creating the potential for industry-wide social and landscape-scale environmental improvements in the growing regions that would be otherwise unachievable.

Members of multi-stakeholder partnerships must find ways of ensuring that the benefits of involvement outweigh the risks of involvement (table 5) and overcoming traditional hostilities, and differences in expectations and approaches to problem solving. Common understandings of how to manage common pool resources (Adams *et al*. 2003) or determine what is a 'fair price' (Geilissen 2005) can be difficult to develop.

Since individual farmers usually have neither the time, nor the resource nor the mandate to negotiate on behalf of their peers, a common difficulty for multi-stakeholder programmes involving agriculture lies in ensuring that farmers have sufficient voice in the process and in the definition of good/better practices or standards. In most of the world, farmers need to work together more effectively to negotiate professionally with food buyers, to market their own produce and to engage in multi-stakeholder programmes in order to share more fully not only in the social and environmental benefits of more sustainable agriculture, but also in the commercial benefits. Farmers' incomes are under pressure from many directions; the (western) 'productionist' model for foods, where farmers could sell most of their produce for a good price either on the free or on the government-supported market, has been superseded by out-of-area and international competition (Lang & Heasman 2004). The percentage of the selling price for food that is returned to farmers has also fallen in recent years as manufacturers and retailers focus on 'added-value' products and their own profitability. As the sustainability agenda progresses, farmers need to be valued for the work they do not only as producers of food but also as custodians of the landscape, biodiversity and rural social networks.

5. CONCLUSION

Many of the options for food businesses and potential routes to more sustainable food supply chains discussed can create benefits both for the businesses involved and for others in the supply chain—from farmers to consumers (table 6).

Although creating niche markets for more sustainable locally produced produce, conserved foods and some manufactured foods can result in significant social, environmental and economic benefits for those involved, greater overall gains could undoubtedly be made by improving the sustainability of mainstream agriculture and international supply chains. Multi-stakeholder initiatives, where food businesses work together with farmers, academics, innovators, governments and NGOs, are important for raising the baseline for near-commodity and commodity food supply chains, including those important for manufactured foods.

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