

## Conference on 'Future food and health' Symposium I: Sustainability and food security

### Nutrition and sustainability: an emerging food policy discourse

Tim Lang\* and David Barling

Centre for Food Policy, City University London, Northampton Square, London EC1V 0HB, UK

It is well known that food has a considerable environmental impact. Less attention has been given to mapping and analysing the emergence of policy responses. This paper contributes to that process. It summarises emerging policy development on nutrition and sustainability, and explores difficulties in their integration. The paper describes some policy thinking at national, European and international levels of governance. It points to the existence of particular policy hotspots such as meat and dairy, sustainable diets and waste. Understanding the environmental impact of food systems challenges nutrition science to draw upon traditions of thinking which have recently been fragmented. These perspectives (life sciences, social and environmental) are all required if policy engagement and clarification is to occur. Sustainability issues offer opportunities for nutrition science and scientists to play a more central role in the policy analysis of future food systems. The task of revising current nutrition policy advice to become sustainable diet advice needs to begin at national and international levels.

**Sustainable diet: Sustainability: Sustainable food: Food policy: Environmental impact: Food systems**

#### The problem of sustainability and food

In this paper, we outline some developments in policy thinking on nutrition and sustainability. We suggest that difficulties in the integration of public health nutrition and sustainability which are the central challenge for twenty-first century food policy: how to feed huge populations equitably, healthily and in ways which maintain ecosystems on which humanity depends. While the modern food security debate stresses the case for raising food production to feed populations, the issue of sustainability re-injects the question of 'how' into public health nutrition: how to eat, modes of production and consumption, how much<sup>(1,2)</sup>. This paper, firstly, summarises some of the strong evidence of food's impact on current unsustainable consumption patterns; secondly, it outlines existing and emerging policy thinking at national and international levels; thirdly, it explores some future tensions and challenges for nutrition science when engaging with sustainability.

Over recent decades, a broad scientific agreement has emerged that the food system both illustrates and is a key

element in the world's environmental and wider sustainability challenge. There is less agreement, however, on how to address the issue through policy. Although processes have now begun, they are not yet receiving due political attention or support. This is partly because the environmental perspective on food systems raises some serious questions about notions of progress generally and for food in particular. Can we really eat what we like, have ever more, and more cheaply? Footprint analyses suggest that North America and Europe consume resources (energy, land, materials etc.) as though they inhabit multiple planets; USA consumes as though it inhabits five planets, Europe three<sup>(3)</sup>. Food is a key factor in this picture. The implications for nutrition science of addressing environmental impacts when formulating population dietary advice are considerable. Should populations eat more fish? Almost all nutrition guidelines advise it<sup>(4)</sup>; stock analysts are increasingly concerned<sup>(5,6)</sup>. Indeed, the challenge of sustainability might well restructure not just societal definitions of progress, and consumer expectations and rights

**Abbreviations:** FAO, Food and Agriculture Organisation; GHG, greenhouse gas; SDC, Sustainable Development Commission.

\*Corresponding author: Professor Tim Lang, fax +44 20 7040 8580, email t.lang@city.ac.uk

to food, but also the tasks demanded of nutrition science itself. This statement is not made lightly. Elsewhere we have proposed that, from a policy perspective, nutrition poses particular difficulties for policy-makers, whether in government, commerce or civil society<sup>(7,8)</sup>.

Nutrition science, like many sciences, has different intellectual traditions, each of which proffers different emphases for public policy. We have identified three main traditions<sup>(7)</sup>. The first is what we termed Life Sciences Nutrition, where nutrition seeks to explain phenomena by ever more refined biochemical understanding, ‘mining’ down into molecular and genetic detail. This perspective is currently dominant. The second is Social Nutrition which conceives nutrition science as explaining how nutrition is embedded within culture and ways of living, a function of socio-economic processes, ranging from culture to class and income. The third is Eco-Nutrition or Environmental Nutrition, which conceives nutrition as a function of the biophysical environment. This tradition has roots back to the Malthusian question of population and food supply, on the one hand, and to recognition of nutritional dependency on biophysical factors such as soil, biodiversity, water and climate. Each of these traditions had its own champions and founding thinkers yet today they show signs of being sealed off from each other. Although in theory, each offers policy-makers useful insights, currently one dominates, Life Sciences. Each poses questions in relation to sustainability and, vice versa, sustainability issues demand responses from each if a holistic picture is to be generated of value for policy-makers.

The word ‘sustainability’ itself needs clarification and some caution. Sometimes it is used as shorthand for environment issues but it contains a broader intellectual meaning too. In the 1987 report of the Commission on Environment and Development, chaired by Gro-Harlan Brundtland, former Norwegian Prime Minister and later WHO Director General, sustainability was defined within a multigenerational perspective and as giving equal emphasis to environment, society and economy<sup>(9)</sup>. For Brundtland and the UN system which created her Commission, sustainable development was championed to chart a route apart from that espoused by the Bretton Woods financial institutions. Whereas the latter stressed progress as stemming from the pursuit of efficiencies in free markets and liberal trade, Brundtland stressed development as injecting environmental and social justice perspectives into economics, a return to political economy sought by the 1980 Brandt Commission<sup>(10)</sup>. As this ideological schism widened between the UN and Bretton Woods global institutions, there were, of course, attempts to bridge the gap. Green consumerism and a new wave of super-efficient technology were both proposed, for instance<sup>(11,12)</sup>. In food, these arguments were more submerged but have now moved to the fore due to recent events summarised later. Policy-makers in state, commerce and civil society now are debating whether coming changes meant consumer culture altering and people eating differently. Key is how: can changes be implemented out of sight, before ‘western’ consumers see the food? If so, who has the power to do this?

Food’s impact on sustainability, whether defined in ‘hard’ or ‘soft’, ‘dark’ or ‘light’ green terms, is not

disputed. In the last decade a sobering picture of the food system’s unsustainability in environmental, social and economic terms has emerged. The Stern report calculated that modern agriculture currently contributes about 14% of greenhouse gas (GHG) emissions<sup>(13)</sup>. This is probably an underestimate. Of those agriculture-related GHG, animals are responsible for 31% and fertilizers (N<sub>2</sub>O) for 38%<sup>(14)</sup>. Much progress in raising crop yields and food availability is due to plentiful energy, particularly oil. A total of 75% of fossil energy use is by developed countries, with 17% of that unequal share expended on the production, processing and packaging of food products<sup>(15)</sup>.

Social inequalities of consumption, meanwhile, are marked. Differences in quantity and quality determine foods’ environmental impact. A European Commission assessment of Europeans’ consumption patterns, a rich developed consumer profile, concluded that food accounts for one third of GHG emissions<sup>(16)</sup>. Using life cycle analysis, it found that meat and dairy products contributed an average of 24% of consumers’ environmental while representing only 6% of consumers’ financial spending. The overall picture is of a complex web of interactions with deeper environmental footprints, as rising consumer affluence creates unforeseen consequences<sup>(3)</sup>.

Meat and dairy are the most significant source of food-related GHG and other environmental impacts<sup>(17)</sup>. There are direct and indirect reasons. One is land use; approximately half all cereals grown globally are fed to animals<sup>(17)</sup>. One calculation suggests that, to feed the USA a healthy diet as officially defined, would require US farmers to increase fruit acreage by 117% and vegetable acreage by 137%<sup>(18)</sup>. Food’s impact on biodiversity is also immense. The UN’s Millennium Ecosystem Assessment concluded fifteen out of twenty-four of the world’s ecosystem services are being degraded or used unsustainably, and that food is a major source of this degradation<sup>(19)</sup>. In the twentieth century, about 75% of the genetic diversity of domestic agricultural crops was lost<sup>(20)</sup>. With climate change access to water, already a key indicator of social progress, is set to become critical. Global agriculture accounts for 70% of all freshwater extracted for human use<sup>(21)</sup>. Irrigation can raise crop yields but drain water sources, and create new competition for reserves. Rising demand for meat and/or dairy has immediate impacts on land and water use. Dutch studies for the UN show that in the Netherlands, 200 litres water are needed to produce a 200 ml glass of milk, and 2400 litres water to produce a 150 g hamburger<sup>(22)</sup>. The UN’s World Economic & Social Survey 2011 concluded: ‘intensive livestock production is probably the largest sector-specific source of water pollution’<sup>(13)</sup>.

The nature of waste in the food system also changes; it is not declining as mid twentieth century food science anticipated. Whereas developing countries tend to have high wastage on or near the farm, once food gets to consumers, they waste little. Rich consumers, however, waste on a prodigious scale. According to the UN Environment Programme, Indian losses for cereals and oil seeds are 10–12%. In some African countries, 25% of cereals are lost post-harvest, and for more perishable crops such as fruits, vegetables and roots, post-harvest losses can be

50%. Dairy sector losses due to spoilage and waste in East Africa are also considerable; in Tanzania over 16% of dry season production and 25% of the wet season's, while in Uganda milk losses are an estimated 27% of all milk produced<sup>(23)</sup>. In the USA, 30% of all food, worth US\$48.3 billion is thrown away each year<sup>(23)</sup>. US food waste represents 4% of all US energy use and approximately one quarter of all water use<sup>(24)</sup>. In 2007, UK consumers threw away 6.7 million tonnes of food, one third of the food they purchased, worth £10.2 billion. A fifth of this waste was judged unavoidable (peelings, cores, bones) but nearly one quarter of the 4.1 million tonnes was jettisoned whole, untouched or unopened<sup>(25)</sup>. Of this, at least 340 000 tonnes was still in date when thrown away. UK consumers left 1.2 million tonnes uneaten on their plates, unimaginable to developing world households.

### Policy engagement emerges across the food system

As data such as these emerged, it became clear to some policy-makers that consumer behaviour change would be central to any policy process, but this is politically delicate. Demanding or even subtly reframing consumer behaviour change is anathema to the neo-liberal ethos of consumer choice and sovereignty. Economists of diverse persuasions agree that consumers drive late twentieth century affluence<sup>(26–28)</sup>. The right of consumers to choose has been dear to Western notions of democracy. It is one of eight rights espoused by the worldwide consumer movement<sup>(29)</sup>. In the 2000s, some international advisory bodies and civil society organisations began overtly to champion the case for consumer change<sup>(30–33)</sup>. The UK's National Consumer Council, for instance, joined with the Government's Sustainable Development Commission (SDC; since abolished) to produce an analysis of how to help consumers break out of the consumerist 'lock-in'; the title was clear, *I Will If You Will*<sup>(34)</sup>. Since 2009 the WWF, the conservation non-governmental organisation, has promoted and developed a 'one planet diet' strategy<sup>(35)</sup>. Such moves signal awareness that dietary change at the population level may be required, and require more than just individual product differentiation or ethical appeal or 'green' options. It reflects a shift from 'single-issue' thinking by civil society campaigners and a resuscitation of more systemic thinking about food as cultural politics. In the late 1960s and 1970s, for example, early environmental arguments shaped the appeal to eat differently from researcher-activists (e.g. Moore Lappe and Collins' best-selling *Diet for a Small Planet*), and by academics such as Gussow and Clancy's proposal for 1986 guidelines for sustainable diets<sup>(36–38)</sup>.

By the early 2000s, governments remained reluctant to enter this sensitive policy terrain, but food companies realised otherwise. Climate change alters business capacities and questions the view that 'green' issues are merely a niche market and opportunity for product differentiation. New corporate analysis stressed how business survival will depend on food supply, water, energy, transport and waste management, raising questions about choice and resurrecting the dreaded word 'rationing'<sup>(39,40)</sup>. New transnational manufacturer alliances were created, pooling

analyses and generating new practices and standards-setting processes independent of governments<sup>(41,42)</sup>. EuropeGAP, where GAP stands for good agricultural practice, began in the late 1990s but went global in the 2000s. The Sustainable Agriculture Initiative was created in 2002. These initiatives were by the world's largest food transnational corporations. While critics were initially wary of 'greenwash' and 'thin' corporate responsibility, these initiatives made some remarkable commitments to reduce, for instance, water use and to lower C emissions<sup>(43)</sup>. The world's largest retailer, US-based Wal-Mart, had a sudden culture change following hurricane Katrina in 2005<sup>(44)</sup>. In the UK, some retailers overtly adopted 'choice-editing' within overall strategy, in effect making choices for consumers before they could select between products<sup>(45,46)</sup>.

### National policy engagement: four hotspots

In this discourse, a number of key themes have emerged with sensitive policy implications for markets and societal aspirations: how to manage supply chains sustainably, how to internalise uncosted environmental damage, how to prevent market failures and distortions, how to address the coexistence of over- and under-consumption<sup>(47,48)</sup>. These issues became high political priorities when world food commodity prices rocketed in 2007–08. Western complacency was shaken; its own food security was at stake, even as events destabilised food import dependent developing countries<sup>(49)</sup>. A number of issues emerged as particular policy hotspots.

The first was waste. Reducing waste has been a persistent goal of food policy since the 1930s. Part of both the appeal of modern food production systems and its moral leverage in political debate was the folly of waste. Even before the 1845–50 Irish famine, but decidedly so afterwards, the juxtaposition of plenty and hunger was known and politicised. The extent of waste in modern developed societies, however, has re-energised debate. Waste is itself a plastic notion. Waste of what? Where? Why? A supermarket chain might espouse 'zero waste', but in practice that means them holding little waste while others up or downstream still do. Indeed, while food putrefies, waste might be intrinsic to food systems not just a regrettable aberration. Some waste might be inevitable. The issues are: what to do with it, who takes responsibility and how to complete the biological cycle. Since much food technology has intervened in that, can new mass composting or even feeding waste again to animals be considered, thus overturning or revising regulations brought in following food hygiene crises? Certainly, the 1940s and 1950s promise to reduce waste by agricultural efficiency and storage, and through supermarket-led supply chain management needs to be revisited<sup>(50,51)</sup>. Should nutrition science ally with anti-waste advice?

The second policy hotspot is meat and dairy<sup>(52)</sup>. Nutrition advice tends to support their consumption, but environmental concerns suggest more consideration be given to upper limits. As incomes rise and in line with the nutrition transition, even vegetarian food cultures such as India have experienced rapid rise in production and

consumption<sup>(53–55)</sup>. Dairy animals have a high impact on land use, water and cereal use. The Food and Agriculture Organisation (FAO) estimates that feed production for animals accounts for about 33% of all cropland use; about 50% of cereals produced worldwide are consumed by animals<sup>(17)</sup>. Older, more cautious arguments are being resurrected. Even as recently as 1992, the FAO had reminded member states that animals are ‘poor converters of energy into foods for human consumption’, with an average of 29.288 kJ (7 kcal) input, if cereals are used, for every kcal generated<sup>(56)</sup>. Conversion ratios vary from 16:1 for beef production to 12.552 kJ (3 kcal) for broiler chickens. Where does nutrition science fit in the policy discussion about what policy mechanisms and instruments might reshape seemingly insatiable consumer demand. Can this be left to market signals? Will behaviour change if food prices more realistically reflect full costs? Could better consumer information work? Can change be left to more responsible marketing? Might rationing be needed, bearing in mind that markets already ration? Arguing that lowering average worldwide consumption is essential for climate change targets, McMichael and colleagues suggested an international contraction and convergence strategy for meat. With current global average meat consumption at 100 g per person per d (with a ten-fold variation between high-consuming and low-consuming populations), they proposed a 90 g per d working global target, with not more than 50 g per d coming from red meat from ruminants (i.e., cattle, sheep, goats, and other digastric grazers)<sup>(52)</sup>.

Not dissimilar considerations have emerged, too, about fish, the third policy hotspot for nutrition<sup>(5,6)</sup>. Most public health nutrition advice includes positive recommendations for regular fish consumption; the UK for example recommends two portions of fish of which one should be oily. Even concern about contamination in some stocks has not altered that advice<sup>(57)</sup>. Wild stock harvesting has globally plateaued, with aquaculture now the sole source of growth in supply<sup>(58)</sup>. By 2007, 52% of global wild fish stocks were ‘fully exploited’ according to the FAO classification<sup>(59)</sup>. Should consumers eat fish: yes or no?

The fourth eco-nutrition hotspot is sustainable diets, on which some formal thinking emerged and grew in the 2000s, particularly in Europe, although the academic case had been made much earlier<sup>(37,38)</sup>. In 2009, two Swedish agencies combined to produce sixteen pages of advice for the ‘environmentally conscious consumer’, delivered for approval to the European Food Safety Authority<sup>(60)</sup>. By 2011, it was withdrawn after some doubts about whether it had, *inter alia*, infringed core EU commitment to the single market by recommending local food. The UK, meanwhile, had entered the same policy terrain following studies from its SDC; these recommended that the policy conflict over issues such as fish and health v. environment must be resolved. In 2008–9, the SDC reviewed forty-four published academic research studies and expert reports and concluded that there was some coherence between the different literatures: nutrition, environment and social justice. There was more evidence of positive synergies (‘win-win’) between these sustainability impacts than of tensions (‘win-lose’). For example, reducing consumption of food

and drinks with low nutritional value (i.e. fatty/sugary foods and drinks) was found to have mainly positive impacts on health, the environment and reducing social inequalities. However, the research also found gaps in the evidence, most notably with respect to economic impacts of dietary changes<sup>(61)</sup>. The SDC and its University of Oxford reviewers argued there is sufficient coherence to guide reformulated consumer advice, with benefits for UK consumers from eating a more plant-based diet and less overall. This work encouraged the UK Government to develop two ancillary strands of work. The first was to work with some other northern EU member states to begin to pool experience and policy thinking; now halted. The second was to approve the UK’s Food Standards Agency to create an Integrated Advice to Consumers project, which was planned to be a web-based portal to advise and influence consumer behaviour<sup>(62)</sup>. This project was terminated, however, by the newly elected coalition Government in 2010.

Germany’s Council for Sustainable Development had first produced advice for sustainable eating in the 1990s, the first EU member state to do so. Although pioneering, this was and remains at a relatively unspecific level<sup>(63)</sup>. France has more recently provided more detailed consumer advice, echoing the now withdrawn Swedish advice, to eat seasonally and locally, to be aware of the impact of meat and dairy, to choose sustainable fish and so on. This included an overt social dimension, favouring fair trade, shopping without using a car<sup>(64)</sup>. In the late 2000s, too, the Netherlands adopted a systemic approach. In 2008, the Netherlands lead Minister made a powerful sixteen-page statement linking health, industry and environment and set out why a new policy framework was needed to drive innovation, food supply chain reform and consumer change for health, and to set a national goal for the Netherlands to ‘lead the world in sustainable food production within fifteen years’<sup>(65)</sup>. This was a systemic analysis, linking consumption and production, ecosystems and human health, industry and the domestic. However, this too has received less emphasis following governmental change and the ongoing Euro fiscal crisis. Yet in 2011, the Health Council of the Netherlands issued a formal ‘ecological perspective’ for new *Guidelines for a healthy diet*, whose main thrust was that eating differently, for health, has environmental advantages<sup>(66)</sup>. More significantly, while governments seemingly downgraded their interest, company level concern grew. In 2010 Unilever, the Anglo-Dutch giant food company, for example, launched major Sustainable Living Plan commitments<sup>(67)</sup>. It remains to be seen whether this heralds a widening gulf between elected government and corporate action. Table 1 summarises some of the state level developments within the EU<sup>(68)</sup>.

Australia is another developed country which had begun to debate whether food and nutrition policies needed to address sustainability. In the late 2000s, when its national nutrition guidance was being revised<sup>(69)</sup>, arguments were made within the process by stakeholders and ‘insiders’ that environmental considerations should be factored into public health nutrition advice. This became highly contested, not least since this nutrition policy process coincided with a parallel national food policy review. Some sections of the food industry were alarmed at this prospect. Strong

**Table 1.** Sustainable food consumption and production; emerging policy advice in European Countries (source: Barling<sup>(68)</sup>)

Country and date	Government agency or department	Policy document and scope
UK 2006	Sustainable Development Commission (SDC) and National Consumer Council set up the Sustainable Consumption Roundtable	Sustainable Consumption Roundtable report <i>I will if you will</i> – generic identification of challenges in moving to more sustainable consumption and identified the concept of ‘choice editing’
Germany 2008	German Council for Sustainable Development	<i>Sustainable Shopping Basket: A Guide to Better Shopping</i> produced since 2008 and updated regularly. Includes food and lists labels and certification schemes including organic, fair trade, sustainable fisheries etc.
Netherlands 2009	Ministry of Agriculture, Nature and Food Quality	<i>Sustainable Food: Public Summary of Policy Document</i> Policy outline for achieving Sustainable Food; emphasised the role of sustainable food production and consumer education campaigns
Sweden 2009	National Food Administration (and Swedish EPA) – notification to EU Council for adoption as official standards	<i>The National Food Administration's Environmentally Effective Food Choices: Proposal Notified to the EU</i> . Science-based assessment by range of product groups e.g. meat, fish and shellfish, fruits and berries etc.
UK 2009	SDC report to Department Environment Food Rural Affairs (Defra)	<i>Setting the Table: Advice to Government on Priority Elements of Sustainable Diets</i> Recommendations based on literature review, stakeholder and expert opinion on a low impact (sustainable) healthy diet
Netherlands 2011	Health Council for Ministry Economic Affairs, Agriculture and Innovation	<i>Guidelines Healthy Diet: Ecological Perspective</i> : Review based on expert advice

lobbying associated with farming and traded outputs succeeded in curtailing the ecological public health revision sought by some on the revising committee. When environmental criteria were dropped from the nutrition revision process, the head of the national farming organisation welcomed it. Although he accepted that farmers need to take environmental issues seriously, he rejected that the environment should affect dietary advice. ‘We don’t believe it is the right criteria on which to base decisions about what we eat,’ he stated<sup>(70)</sup>.

### The transnational dimension and the role of Europe

As European member states began to engage with sustainable food and sustainable diet questions, the European Commission’s international role also came to the fore. In fact, the EC interest had deep roots. Following the 1992 UN (‘Rio’) Conference on Environment and Development, the EC offered moral and policy leadership to pursue the question of sustainable consumption and production. The present paper is not the place to explore these important and complex negotiations. Suffice it to say that by the 2002 World Summit on Sustainable Development in Johannesburg, there was embryonic agreement to create a 10-year process towards a sustainable consumption and production plan. Formally, the process was overseen by the UN Environment Programme and UN Department of

Economic and Social Affairs. Within that the Swedish government took the lead<sup>(71,72)</sup>. In 2003, a Marrakech Process was launched to build the international consensus for serious engagement. This had four goals: (a) to assist countries in their efforts towards sustainability; (b) to green their economies; (c) to help corporations develop sustainable business models; (d) to encourage consumers to adopt more sustainable lifestyles<sup>(73)</sup>. This was ambitious but sets the context for more specific policy proposals and options.

To summarise the status now, while there is some acceptance of the need for change, the food issue has become mired in some difficulties. One argument is that developing countries cannot lead on or afford to shift food and nutrition policy towards sustainability. Their prime concern is poverty reduction. Economic growth is the priority. The counter argument is that developing countries already display the consequences of past models of development: rising obesity, the ‘westernisation’ of diet, environmental pressures from climate change, water stress, land degradation, the poverty from unplanned urbanisation and de-ruralisation. These were clear at the UN Conference on Sustainable Development, ‘Rio+20’, exactly as they were for its predecessor, the 1972 Stockholm Conference. The evidence exists; the challenge is for policy-makers to respond to that evidence. Thus far they have done so only inadequately.

**Table 2.** EU policy developments on sustainable food, 2008–12 (source: Barling<sup>(68)</sup>)

Policy initiative	Details
<i>Sustainable Consumption–Production and Sustainable Industrial Policy Action Plan</i> (2008)	Voluntary initiatives on environmental policy and industry – but little food focus
Suitability of the potential extension of the <i>Ecolabel to food products</i>	Background report recommended against this on the basis of lack of clear and agreed methodologies etc. making extension unlikely
<i>European Food Sustainable Consumption Production (SCP) Roundtable</i> (2009) co-chairs DG Environment and European Food and Feed Trade Associations. Based in FoodDrinkEurope (FDE) and supported by the EU's Joint Research Centre (JRC)	Facilitate agreement on environmental assessment methodologies for food products and environmental information on products via agreed voluntary communication to consumers
DG Environment and JRC (2011–2012): <i>Harmonised framework methodology for the calculation of the environmental footprint of products</i>	Framework methodology for most main industrial sectors including agriculture and food to be finalised by late 2012
<i>Roadmap to a Resource Efficient Europe</i> (2011) part of the actions form <i>Europe 2020: a strategy for smart, sustainable and inclusive growth</i> (2010)	Long-term policy goals with milestones, e.g. 20% reduction in the food chain's resource inputs (2020) Develop a methodology for sustainability criteria for food commodities by 2014

There are reasons for this. While the food policy paradigm was statist and interventionist in the 1940s and 1950s, this changed from the 1970s with the rise of neo-liberal policy thinking. This tends to reject government involvement, to rely on market relations, and to restrict policy action to consumerist and 'soft' policy measures such as labelling or consumer advice. Attempts to introduce coherent, detailed sustainable dietary advice have partly been thwarted by such macro-economic thinking and lobbies. While some food companies would welcome a new 'level playing field', others want such framework thinking kept to the minimum.

Such tensions are neither new nor unexpected. Indeed a feature of the European project on food, from the 1957 founding of the Common Agricultural Policy to today's battles over sustainable food systems, has been the EU dogged commitment and capacity to negotiate through such delicate and tortuous issues. The EU has balanced a seeming contradiction between formal support for liberal economics with strategic commitment to its own infrastructure and interests. On the one hand, the EU was a major player in farm trade liberalisation in the GATT Uruguay Round culminating at Marrakesh (1987–94) which brought agriculture and food into the world trade system,<sup>(74)</sup> and in the creation of its own Single Market, which liberalised internal trade and which celebrated the advantages of rationalising food systems (see the 1988 Cecchini Report<sup>(75)</sup>). Yet on the other hand, the EU has been quick to rein back neo-liberal tendencies when consumers have been alarmed by threats to public health and safety, as in the 1990s BSE and food safety crises. Only 8 years after the Single Market came into operation in 1992, the EU imposed strict requirements on food safety and international traceability<sup>(76)</sup>. The net effect is that Europe now displays a complex policy position on food and health. Broadly, any foods can be sold as long as they are traceable, safe at source and labelled; health is an individual responsibility in the marketplace; healthcare is a member state responsibility; the role of the EU is to help provide some health education and consumer support<sup>(77,78)</sup>.

Meanwhile consumer advice on sustainability has not fitted this pattern. There are EU-approved eco-labelling schemes for some processes such as organic food systems and energy efficiency labelling for white goods such as refrigerators and cookers, but until recently there has been reluctance to create an EU food sustainability labelling scheme.

This might, however, now change. The international process sketched earlier has already homed in on food as a key issue for sustainability. The data demand it. Formal policy thinking has emerged around resource efficiency in production and consumption as a sustainability driver for food systems. Table 2 summarises these developments, highlighting particular documents, and the commitment to sustainable consumption and production<sup>(79)</sup>. A Commission Communication is in preparation for 2014. Already, the European Commission and researchers are being asked to grapple with how to measure environmental impact in and of food.

### The policy terrain ahead

Where does this leave public health nutrition on sustainability? We think it inevitable that nutrition science will be drawn into the sustainability debate. A combination of pressures is coming together with significant implications for nutrition. We highlight five.

#### *Multi-level nature of food system requires multi-level policy*

The first is that a significant feature of the challenge for better integration of nutrition and sustainability is the sheer complexity of modern policy making processes. If the growth of policy in the nineteenth century, in reaction to the effects of industrialisation, became an argument about which level to act on, local or national, by the twenty-first century, food governance had become not just five levels: local, sub-national, national, regional/continental global; but also multi-sectoral. Few can subscribe to the view

**Table 3.** Sustainability as a set of 'omni-standards' or 'poly-values' (source: SDC 2011<sup>(82)</sup>)

Quality	Social values
Taste	Pleasure
Seasonality	Identity
Cosmetic	Animal welfare
Fresh (where appropriate)	Equality and justice
Authenticity	Trust
	Choice
	Skills (citizenship)
Environment	Health
Climate change	Safety
Energy use	Nutrition
Water	Equal access
Land use	Availability
Soil	Social status/affordability
Biodiversity	Information and education
Waste reduction	
Economy	Governance
Food security and resilience	Science and technology evidence base
Affordability (price)	Transparency
Efficiency	Democratic accountability
True competition and fair returns	Ethical values (fairness)
Jobs and decent working conditions	International aid and development
Fully internalised costs	

today that sustainable food and nutrition can be left to government, any more than they can be left to commerce or consumers. Modern food policy has to be multi-level, multi-sectoral and multi-disciplinary<sup>(7,8)</sup>. Nutrition science must engage with environmental science. And, if consumer behaviour (let alone policy maker involvement) is to follow, social scientific insights will be essential. We see this as nutrition science's contribution towards an appropriate food policy for the twenty-first century.

#### *Define sustainability in food terms*

Although this paper has pointed to difficulties in the policy translation of nutrition and sustainability, the pursuit of policy clarity is not helped by some looseness in the notion of sustainability itself. Therein lies another opportunity for nutrition science. It can help define food in sustainable terms and, vice versa, help clarify sustainability by operationalising what it means for food and diet. The tripartite Brundtland policy approach of environment, society and economy is too broad today. It may have been appropriate and imaginative in the 1980s but food companies may be correct in wanting more precision in the 2010s. The Brundtland tradition is too general, and lacks the detail required for policy translation, let alone data for contracts and specifications. A policy framework and perspective are required which provide, on the one hand, common goals and principles and, on the other hand, room to drill down sufficiently to provide depth, scale and range of action.

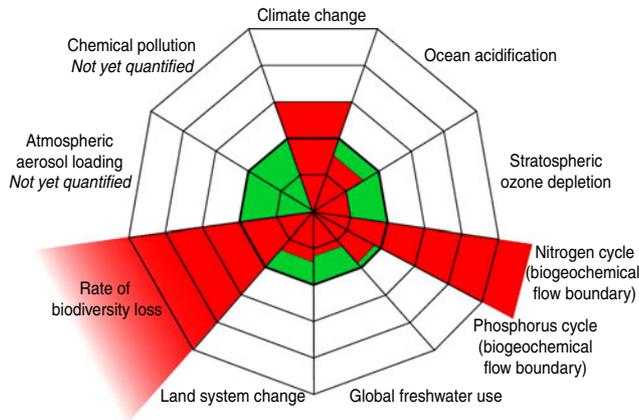
Currently, the definition and measurement of (un)sustainability of food are dominated by climate change thinking and data, exemplified in CO<sub>2</sub> and CO<sub>2</sub> equivalent (CO<sub>2</sub>e) measures. Initial footprint analyses of food and diet have concentrated on these measures<sup>(14)</sup>. But more recently, powerful cases to audit food in relation to embedded water, biodiversity and land use have been made<sup>(3,22,80–82)</sup>. These issues are not discrete but overlap and interact.

The UK SDC in its final report to government proposed a multi-dimensional or 'omni-standards' approach to sustainable food (see Table 3)<sup>(83)</sup>. This proposed six main issues for food sustainability: quality, health, social values, environment, economy and governance, and grouped factors under those main headings. Others are adapting footprint methodology to include factors beyond GHG, notably virtual or embedded water<sup>(35,84)</sup>. Useful though 'hard' measures such as these are, we are cautious about whether footprinting can be stretched to address the social and ethical values now needed. Here lies the potential reinvigorated contribution of the Social Nutrition tradition sketched at the start of this paper. One hopeful sign is the growing international interest in defining sustainable diets. UN Environment Programme, FAO and Bioversity (part of the Consultative Group on International Agricultural Research) all now recommend tighter operationalisation<sup>(82,85)</sup>. The latter two organisation have already proposed a working definition of sustainable diets as '...those diets with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations. Sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy; while optimizing natural and human resources'<sup>(86)</sup>. This now needs to be translated into population nutrition advice.

#### *Single problems or a paradigm under stress?*

There is also the issue of food politics itself. Can sustainability be disaggregated into single issues or are the data such as cited at the start of this paper signs of emerging systems failure? Part of the resistance of some sections of commerce and certainly of governments is undoubtedly the sheer scale of change implied to be coming to the world of food. A number of major international-focused policy reports from chief scientific advisory bodies and major foundations are clear about impending difficulty. They have been tabled in the USA, UK, Australia, France, to name a few<sup>(2,87–89)</sup>. Collectively, they have perhaps added a neo-Malthusian tone of impending crisis from rising population, shortage of land and resources, environmental stress (climate, water, soil) and consumer expectations. In 2009, the UK's Chief Scientific Adviser talked of a coming 'perfect storm'<sup>(90)</sup>. Rockström *et al.*<sup>(91)</sup> have proposed that human activity is now approaching its environmental limits on a number of indicators (see Fig. 1). Food production and consumption are implicated in half of these.

If such studies and figures are accurate and the food system is unsustainable, major adjustments to food policy are required. This is daunting but not the first time. In the



**Fig. 1.** (colour online) Are planetary boundaries already exceeded? Source: Rockström, Steffen et al. 2009<sup>(79)</sup>.

1930s, food-related scientists from nutrition, agriculture, biochemistry, began to coalesce around a vision, perhaps most famously articulated by John Boyd Orr and others<sup>(92,93)</sup>. Although they debated how best to address the problems<sup>(94)</sup>, they agreed on what the main problem was: unmet need and hunger. They generated a policy equation which reshaped twentieth century food systems. Application of investment capital (C), science and technology (S&T) and improved distribution (D) would generate increased output (O), which would in turn lower prices, which would make food more affordable and raise consumption (AC), which would result in improved public health (H) and amount to societal progress (P). This policy formula:  $C + S\&T + D \rightarrow O \rightarrow Pr \rightarrow AC \rightarrow H = Progress$  was rational, evidence-based in its time, and socially progressive.

This twentieth century paradigm now needs to be rethought and recalibrated in the twenty-first century. In its own terms, the paradigm has perhaps been subject to two major moments of doubt, both associated with oil price rise and speculation, in 1971–74 and today 2007–12. We have argued elsewhere that mainstream analyses have tended to focus on production capacity rather than consumption<sup>(95)</sup>, and we have proposed different models by which they can be grouped: productionism, life sciences integration and ecologically integrated paradigms<sup>(7,96)</sup>. Certainly, the dominant productionist paradigm is under stress, but why? If FAO data are correct, there is currently adequate energy output and availability to feed the world. So is the policy problem today really mal-distribution rather than under-production? Today yes but ahead probably not. Even if future food policy does need to raise production to meet environmental stresses, it would be sensible to recognise that productionism can be woven from many policy strands. We detect at least five analyses vying for attention.

The first is to focus on land itself, as was done from the eighteenth century via investment in new machinery, plants, land management, enclosures and drainage; this is the engineering tradition from Jethro Tull to George Stapledon. The second centres on the application of chemistry to manufacturing processes; this is the tradition from von Liebig and Benet Lawes in the mid nineteenth century to the Haber-Bosch process' application after 1909. The third

is the emergence of biological science from Mendel's at first ignored observations to the 1960s Green Revolution which won Norman Borlaug his Nobel Peace Prize. The fourth has received less acknowledgment but in fact has driven the supermarket and trade revolution that has unleashed mass consumer food choice since the 1960s/1970s. This is the application of logistics-led management via the technical development of computers, satellites and informatics. The fifth is ecological thinking centred on the primacy of maintaining ecosystems as the infrastructure on which human food systems ultimately depend. This is the ecological perspective from René Dubos and Rachel Carson to Tony McMichael and Miguel Altieri today. Nutrition science is interpreted and called upon in different ways by each strand.

Currently there is uncertainty as to policy direction, not least since these analyses suggest different emphasis and investment requirements. We are therefore reserved about the current scientific championing of 'sustainable intensification'<sup>(2)</sup>. We note an important divergence in the contract and convergence perspective, under which the West consumes less to allow the under-consuming to consume more and better<sup>(97)</sup>. From a policy perspective, the challenge is not intensification *per se* but how, defined by whom, at what scale, to produce what, for which kind of diet, for whom? Answers to these 'macro' policy questions will shape what is required of nutrition science.

Happily, there is growing agreement that there is a gap between policy, people, science and technology development, but there is divergence as to futures and analysis. There appears to be some agreement too that the mismatch of policy and evidence is worsening and widening, hence the increasingly worried, almost alarmist statements from scientists. Cool policy analysis is required.

#### *Active nutrition engagement in policy development*

We see a significant opportunity in the sustainable food and diet debates for nutrition scientific engagement at all levels of policy development. This has not yet happened. The developments charted in this paper are just that, some emerging signs, not fully fledged paradigm shift to new frameworks. The number of nutrition science academics engaged is small. Surely, this is a major opportunity for research and educational activity. Here is a chance to capture mainstream public interest. If corporations and global commercial analysts now see food sustainability as a key challenge, as was illustrated when a new Agriculture Sustainability Roadmap was launched at the 2011 Davos meeting of the World Economic Forum, the annual convention of big business, surely nutrition science ought to be developing its own contributions<sup>(98)</sup>. Why else has the largest pasta company in the world invested in a Centre to champion nutrition and sustainability and both published and promulgated its twin pyramid approach to sustainable diets?<sup>(99)</sup> There are opportunities to engage, too, in the role and shape of nutrition-related institutions<sup>(100)</sup>. If the World Committee on Food Security can be reformed to address the sustainability crisis, surely so can the Standing Committee on Nutrition<sup>(101)</sup>.

### Re-integrating nutrition science's traditions

Sustainability poses exciting intellectual challenges for public health nutrition. It changes the intellectual framework for food and health general thinking from one which is abstracted from, and separate to, the biological environment to one which is linked to, interactive with and ultimately reliant on ecosystems. We have outlined some of the theoretical implications of this elsewhere<sup>(8)</sup>. Above all, sustainability requires a pause in the fragmentation of nutrition across the three discourses outlined at the start of this paper: life sciences, social and environmental<sup>(7)</sup>. These traditions have been disengaged and thus the voice of public health nutrition has been weakened. To see them as re-woven together as ecological public health helps bind the discourses together, and does not view one as triumphant over the others. Thus the moral compass for nutrition science is recalibrated, providing the reason to help resolve humanity's need to eat within ecological space (the Malthusian problem). It focuses on how human food relies on but also alters the biological and material worlds on which we depend. It proposes nutrition as a central intellectual reason for (re)shaping the food system for all people not for rampant consumerism and its consequences. It revises the 'farm to fork' rhetoric of market economics, and poses the real post-Malthusian question: what would a farming and food supply chain look like if it was based around human physiological/nutrition needs, and if policy-makers pursued a better match between global food systems, ecosystems and human pursuit of sustainable food security?

There are already some pioneering attempts to answer this question; sustainable intensification is one<sup>(2)</sup>, ecological food systems is another<sup>(102)</sup>, contraction and convergence is another<sup>(97)</sup>. We need more. The answers look likely to centre on: more horticulture, less meat and dairy, more equal distribution, better skilled consumers, less consumption overall in the rich world. In short, the task of revising current nutrition policy advice needs to begin at national and international levels. The twenty-first century needs to reformulate population Nutrition Dietary Guidelines into Ecological Public Health shaped Sustainable Dietary Guidelines.

### Acknowledgements

The authors thank commentators at the meeting and colleagues in many countries and disciplines who have contributed to their thinking. In particular, they thank Mike Rayner, Peter Scarborough and the former UK SDC; the UK Cabinet Office Food Matters process 2007–8; Tara Garnett and the Food Climate Research Network; Barbara Burlingame, Sandro Dernini, Emile Frison and colleagues at FAO and Bioversity and Duncan Williamson and colleagues at WWF. The authors declare no conflicts of interest. The present work represents accumulated analysis by the authors including unpaid work for FAO, Bioversity, UN Environment Programme and for T. L. for his period as a paid Commissioner on the UK SDC 2006–11. T. L. drafted and presented the paper, incorporating discussions with D. B. The work is derived from years of observing

and participating in policy debates and formulation on what to do about food sustainability.

### References

1. FAO (2008) Declaration of the High-Level Conference on World Food Security: The Challenges of Climate Change and Bioenergy, 3–5 June 2008. Rome: Food and Agriculture Organisation. [http://www.fao.org/fileadmin/user\\_upload/food\\_climate/HLCdocs/declaration-E.pdf](http://www.fao.org/fileadmin/user_upload/food_climate/HLCdocs/declaration-E.pdf).
2. Foresight (2011) The future of food and farming: challenges and choices for global sustainability. *Final Report, 24 January 2011*. London: Government Office for Science.
3. Global Footprint Network (2010) *Living Planet Report 2010: Biodiversity, Biocapacity and Development*. Gland, London and Oakland: WWF, Institute of Zoology, Global Footprint Network.
4. Eurodiet (2001) Nutrition and diet for healthy lifestyles in Europe: the EURODIET evidence. *Public Health Nutr* **4**, 2(A) and 2(B).
5. Royal Commission on Environmental Pollution (2004) *Turning the Tide: Addressing the Impact of Fishing on the Marine Environment, 25th Report*. London: Royal Commission on Environmental Pollution.
6. Pew Oceans Commission (2003) *America's Living Oceans: Charting a Course for Sea Change*. Washington, DC: Pew Charitable Trusts June.
7. Lang T, Barling D & Caraher M (2009) *Food Policy: Integrating Health, Environment and Society*. Oxford: Oxford University Press.
8. Rayner G & Lang T (2012) *Ecological Public Health: Reshaping the Conditions for Good Health*. Abingdon: Routledge/Earthscan.
9. Brundtland GH (1987) *Our Common Future: Report of the World Commission on Environment and Development (WCED) Chaired by Gro Harlem Brundtland*. Oxford: Oxford University Press.
10. Brandt W (1980) *North-South: A Programme for Survival*. London: Pan Books.
11. Elkington J & Hailes J (1988) *The Green Consumer Guide: from Shampoo to Champagne: High-Street Shopping for a Better Environment*. London: V. Gollancz.
12. von Weizsäcker EU, Lovins AB & Lovins LH (1996) *Factor Four: Doubling Wealth – Halving Resource use: the New Report to the Club of Rome*. London: Earthscan.
13. UN (2011) *World Economic and Social Survey 2011: The Great Green Technological Transformation*. New York: United Nations Department of Economic and Social Affairs. [http://www.un.org/en/development/desa/policy/wess/wess\\_current/2011wess.pdf](http://www.un.org/en/development/desa/policy/wess/wess_current/2011wess.pdf).
14. Stern N (2006) The Stern Review of the economics of climate change. *Final Report*, 30 October 2006. London: H M Treasury.
15. Pimentel D & Pimentel M (1996) *Food, Energy and Society*. Niwet, CO: Colorado Press.
16. Tukker A, Bausch-Goldbohm S, Verheijden M *et al.* (2009) *Environmental Impacts of Diet Changes in the EU*. Seville: European Commission Joint Research Centre Institute for Prospective Technological Studies.
17. Steinfeld H, Gerber P, Wassenaar T *et al.* (2006) *Live-stock's Long Shadow: Environmental Issues and Options*. Rome: Food and Agriculture Organisation December.
18. Union of Concerned Scientists (2012) *Food and Agriculture: Plant the Plate*. Cambridge, MA: Union of Concerned Scientists. [http://www.ucsusa.org/assets/documents/food\\_and\\_agriculture/plant-the-plate.pdf](http://www.ucsusa.org/assets/documents/food_and_agriculture/plant-the-plate.pdf).

19. Millennium Ecosystem Assessment (Program) (2005) *Ecosystems and Human Well-being: Synthesis*. Washington, DC: Island Press.
20. FAO (1995) *Dimensions of Need: an Atlas of Food and Agriculture*. Rome: Food and Agriculture Organisation.
21. WWF (2006) *Thirsty Crops: Our Food and Clothes: Eating up Nature and Wearing out the Environment?* Zeist (NL): WWF.
22. Chapagain AK & Hoekstra AY (2006) *Water Footprints of Nations*, Vols 1 and 2. Paris: UNESCO.
23. UNEP (2009) *The Environmental Food Crisis: The Environment's Role in Averting Future food Crises. A UNEP Rapid Response Assessment* [C Nellemann, M MacDevette, T Manders, B Eickhout, B Svihus, AG Prins, BP Kaltenborn, editors]. Arendal, Norway: United Nations Environment Programme/GRID-Arendal. <http://www.grida.no>.
24. Jones T (2005) *Using Contemporary Archaeology and Applied Anthropology to Understand Food Loss in the American Food System*. Tucson, AZ: Bureau of Applied Research in Anthropology, University of Arizona.
25. WRAP (2008) *The Food We Waste*. Banbury: Waste & Resources Action Programme (WRAP).
26. Friedman M & Friedman RD (1980) *Free to Choose: a Personal Statement*. 1st ed. New York: Harcourt Brace Jovanovich.
27. Galbraith JK (1992) *The Culture of Contentment*. New York: Houghton Mifflin and Company.
28. John R, editor (1994) *The Consumer Revolution: Redressing the Balance*. London: Hodder and Stoughton.
29. Consumers International (2006) *Consumer Rights*. London: Consumers International.
30. Which? (2010) *Making Sustainable Food Choices Easier: a Consumer Focussed Approach to Food Labels*. London: Which?.
31. van Dooren C & Kramer G (2012) *Food Patterns and Dietary Recommendations in Spain, France and Sweden: Healthy People, Healthy Planet*. Godalming: WWF-UK.
32. European Environment Agency (2007) Time for action — towards sustainable consumption and production in Europe. *Summary Report of the Conference Held on 27–29 September 2007*, Ljubljana, Slovenia. Copenhagen: European Environment Agency.
33. Huenecke K, Fritsche UR & Brohmann B (2011) Sustainability of consumption patterns: historic and future trends for Europe. *Report of EU FP7 Project*. Darmstadt: Oeko-Institut.
34. National Consumer Council and Sustainable Development Commission (2006) I will if you will. *Report of the Sustainable Consumption Roundtable*. May 2006, London: Sustainable Development Commission.
35. WWF-UK (2009) *One Planet Food Strategy 2009–2012*. Godalming Surrey: WWF UK.
36. Lappé FM (1971) *Diet for a Small Planet*. New York: Ballantine Books.
37. Gussow JD & Clancy KL (1986) Dietary guidelines for sustainability. *J Nutr Educ* **18**, 1–5.
38. Gussow JD (1999) Dietary guidelines for sustainability: twelve years later. *J Nutr Educ* **31**, 194–200.
39. Hawken P, Lovins A & Lovins LH (1999) *Natural Capitalism: Creating the Next Industrial Revolution*. London: Earthscan.
40. Carbon Trust, Coca-Cola (2012) *Personal Carbon Allowances White Paper: How to Help Consumers Make Informed Choices*. London: Carbon Trust Advisory & Coca-Cola plc.
41. GlobalGAP (2008) *What is GLOBALGAP?* Cologne, Germany: GLOBALGAP. <http://www.globalgap.org/> (accessed 15 June 2008).
42. SAI (2008) *Sustainable Agriculture Initiative Platform*. Brussels: Sustainable Agriculture Initiative. <http://www.sai-platform.org/>.
43. PepsiCo UK (2010) *50 in 5 commitment: We plan to reduce our water use and carbon emissions by 50% in 5 years*. Richmond Surrey: PepsiCo UK. <http://www.pepsico.co.uk/purpose/environment/reports-and-updates/2010-environment-report/passionate-about-growing/50-in-5>.
44. Scott L (2005) 'Twenty First Century Leadership', *Speech to Associates, Wal-Mart*. <http://www.walmartstores.com/Files/21st%20Century%20Leadership.pdf> (accessed 9 June 2006).
45. Co-operative Wholesale Society (1996) *Responsible Retailing*. Manchester: Co-operative Retail Group.
46. Marks & Spencer plc (2009) *About Plan A: Plan A is our Five Year, 100 Point Plan*. London: Marks & Spencer plc. <http://plana.marksandspencer.com/about> (accessed 6 May 2012).
47. Jackson T (2005) *Motivating Sustainable Consumption: Report to the SDRN*. London: Sustainable Development Research Network.
48. Porritt J (2005) *Capitalism as if the World Matters*. London: Earthscan.
49. FAO (2008) Crop Prospects and Food Situation: Policy Measures Taken by Governments to Reduce the Impact of Soaring Prices. Issue 3, July. Rome: Food and Agriculture Organisation. <http://www.fao.org/docrep/010/ai470e/ai470e05.htm>.
50. Boyd Orr JL & Lubbock D (1953) *The White Man's Dilemma*. London: George Allen and Unwin.
51. Pyke M. *Industrial Nutrition*. London: MacDonald and Evans; 1950.
52. McMichael AJ, Powles JW, Butler CD *et al.* (2007) Food, livestock production, energy, climate change, and health. *Lancet* **370**, 1253–1263.
53. Popkin BM (2003) The nutrition transition in the developing world. *Dev Policy Rev* **21**, 581–597.
54. Popkin BM & Gordon-Larsen P (2004) The nutrition transition: worldwide obesity dynamics and their determinants. *Int J Obes Relat Metab Disord* **28**, Suppl. 3, S2–S9.
55. Popkin BM & Nielsen SJ (2003) The sweetening of the world's diet. *Obes Res* **11**, 1–8.
56. Bender A (1992) *Meat and Meat Products in Human Nutrition in Developing Countries*. Rome: Food and Agriculture Organisation of the United Nations.
57. Scientific Advisory Committee on Nutrition, Committee on Toxicity (2004) *Advice on Fish Consumption: Benefits & Risks*. London: The Stationery Office.
58. FAO (2010) *State of World Fisheries and Aquaculture 2010*. Rome: Food and Agriculture Organisation.
59. FAO (2007) *State of Food and Agriculture 2007*. Rome: Food and Agriculture Organisation.
60. National Food Administration, Sweden's Environmental Protection Agency (2009) *Environmentally Effective Food Choices: Proposal Notified to the EU, 15 May 2009*. Stockholm: National Food Administration and Swedish Environmental Protection Agency.
61. Sustainable Development Commission (2009) *Setting the Table: Advice to Government on Priority Elements of Sustainable Diets*. London: Sustainable Development Commission.
62. Food Standards Agency IAC Project Team (2010) *Integrated Advice for Consumers: Discussion and Analysis of Options*. London: Food Standards Agency. <http://www>.

- food.gov.uk/multimedia/pdfs/iacreport.pdf (accessed 29 January 2010).
63. German Council for Sustainable Development (2008) *The Sustainable Shopping Basket: a Guide to Better Shopping*, 3rd ed. Berlin: German Council for Sustainable Development.
  64. Agence de l'Environnement et de la Maîtrise de l'Énergie (France) (2012) Espace Éco-citoyens: Alimentation; 2012. Available at: [www.ecocitoyens.ademe.fr/mes-achats/bien-acheter/alimentation](http://www.ecocitoyens.ademe.fr/mes-achats/bien-acheter/alimentation) (accessed 22 November 2012).
  65. Minister of Agriculture NaFQN. (2008) *The Policy Document on Sustainable Food: Towards Sustainable Production and Consumption of Food*. Den Haag: Ministry of Agriculture, Nature and Food Quality.
  66. Health Council of the Netherlands (2011) *Guidelines for a Healthy Diet: the Ecological Perspective*. The Hague: Health Council of the Netherlands.
  67. Unilever (2010) *Sustainable Living Plan 2010*. London: Unilever PLC. <http://www.sustainable-living.unilever.com/the-plan/> (accessed 12 December 2010).
  68. Barling D (2011) The challenges facing contemporary food systems: European policy and governance pathways to sustainable food consumption and production. *Agron Environ Soc* **1**, 15–25.
  69. NHMRC (2011) Dietary Guidelines for All Australians: Review of the Dietary Guidelines 2010–2012. Canberra: National Health and Medical Research Council. <http://www.nhmrc.gov.au/guidelines/publications/n29-n30-n31-n32-n33-n34>
  70. Anon (2011) Diet plan drops environmental jab at red meat. Canberra. <http://www.beefcentral.com/p/news/article/1014> (accessed 13 December 2011).
  71. Ministry of Sustainable Development (Sweden) (2005) *Memorandum: International Task Force on Sustainable Lifestyles*. 25 August. Stockholm: Ministry of Sustainable Development.
  72. Ministry of the Environment Sweden, UN Environment Programme (2011) *Task Force on Sustainable Lifestyles*. Stockholm and Nairobi: Ministry of the Environment Sweden & UNEP.
  73. UNEP, UNDESA (2011) Background document to the draft 10YFP on SCP in preparation for CSD 18–19. Nairobi: UN Environment Programme and UN Department of Economics and Social Affairs. <http://esa.un.org/marrakechprocess/>.
  74. Lang T (1992) *Food Fit for the World?: how the GATT Food Trade Talks Challenge Public Health, the Environment and the Citizen; a Discussion Paper*. London: Public Health Alliance & Sustainable Agriculture Food and Environment Alliance.
  75. Cecchini P, Catinat M & Jacquemin A (1988) *The European Challenge 1992: The Benefits of a Single Market*. Aldershot: Wildwood House.
  76. Commission of the European Communities (2000). White paper on Food Safety. Brussels: Commission of the European Communities; January. *Report No. COM(1999) 719*.
  77. Belcher P (1997) Amsterdam 1997: a new dawn for public health. *Eurohealth* **3**, 1–3.
  78. CEC (1996) *Amsterdam Treaty. Article 152*. Brussels: Commission of the European Communities.
  79. European Commission (2008) *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on the Sustainable Consumption and Production and Sustainable Industrial Policy Action Plan COM/2008/0397 final*. Brussels: Commission of the European Communities.
  80. Chapagain AK & Hoekstra AY (2004) Water Footprints of Nations, vols. 1 and 2. *UNESCO-IHE Value of Water Research Report Series No. 16*. Paris: UNESCO.
  81. Hoekstra AY & Mekonnen MM (2012) The water footprint of humanity. *Proc Natl Acad Sci USA* **109**, 3232–3237.
  82. Burlingame B & Dernini S, editors (2012) Sustainable diets and biodiversity: directions and solutions for policy, research and action. Proceedings of the International Scientific Symposium 'Biodiversity and Sustainable Diets United against Hunger', 3–5 November 2010, FAO Headquarters, Rome. Rome: FAO and Bioversity International.
  83. Sustainable Development Commission (2011) Looking Forward, Looking Back: Sustainability and UK food policy 2000–2011. London: Sustainable Development Commission. <http://www.sd-commission.org.uk/publications.php?id=1187> (accessed on March 2011).
  84. Allan JA (2003) Virtual water – the water, food and trade nexus: useful concept or misleading metaphor? *Water Int* **28**, 4–11.
  85. UNEP (2012) *Avoiding Future Famines: Strengthening the Ecological Basis of Food Security through Sustainable Food Systems*. Nairobi: United Nations Environment Programme.
  86. FAO, Bioversity International (2010) *Final Document: International Scientific Symposium: Biodiversity and Sustainable Diets – United against Hunger*, 3–5 November 2010, FAO Headquarters, Rome, Italy. Rome: Food and Agriculture Organisation. [http://www.eurofir.net/sites/default/files/9th%20IFDC/FAO\\_Symposium\\_final\\_121110.pdf](http://www.eurofir.net/sites/default/files/9th%20IFDC/FAO_Symposium_final_121110.pdf).
  87. Pew Commission on Industrial Farm Animal Production (2008) *Putting Meat on the Table: Industrial Farm Animal Production in America*. Washington, DC: Pew Charitable Trusts and Johns Hopkins Bloomberg School of Public Health.
  88. PMSEIC (Australia) (2010) *Australia and Food Security in a Changing World*. Canberra: Science, Engineering and Innovation Council of Australia.
  89. Paillard S, Treyer S & Dorin B, editors (2011) *Agrimonde: Scenarios and Challenges for Feeding the World in 2050*. Paris: Editions Quae.
  90. Beddington J (2009) Food, energy, water and the climate: a perfect storm of global events? *Paper to 'Sustainable Development UK 09' Conference, QEII Conference Centre*, London, 19 March 2009.
  91. Rockström J, Steffen W, Noone K *et al.* (2009) Planetary boundaries: exploring the safe operating space for humanity. *Ecology and Society* **14**, 32 [online] (<http://www.ecologyandsociety.org/vol14/iss2/art32/>).
  92. Boyd Orr J (1936) *Food, Health and Income: Report on Adequacy of Diet in Relation to Income*. London: Macmillan and Co.
  93. Boyd Orr SJ (1943) *Food and the People. Target for Tomorrow No. 3*. London: Pilot Press.
  94. Vernon J (2007) *Hunger: a Modern History*. Cambridge, MA: Harvard University Press.
  95. Lang T & Barling D (2012) Food security and food sustainability: reformulating the debate. *Geogr J* **178**, 313–326.
  96. Lang T & Heasman M (2004) *Food Wars: the Global Battle for Mouths, Minds and Markets*. London: Earthscan.
  97. Royal Society (2012) *People and the Planet*. London: Royal Society.
  98. World Economic Forum, McKinsey & Co (2010) *Realizing a New Vision for Agriculture: A Roadmap for Stakeholders*. Davos: World Economic Forum.
  99. Barilla Centre for Food and Nutrition (2010) *Double Pyramid: Health food for People, Sustainable Food for the Planet*. Parma: Barilla Centre for Food and Nutrition.

100. Giessen Declaration (2005) The Giessen Declaration. *Public Health Nutr* **8**, 117–120.
101. Duncan J & Barling D (2012) Renewal through participation in global food security governance: implementing the international food security and nutrition civil society mechanism to the committee on world food security. *Int J Soc Agric Food* **19**, 143–161.
102. Anderson M (2009) *Charting Growth to Good Food: Developing Indicators and Measures of Good Food*. Arlington, VA: Wallace Center Winrock International.