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Policies and actions to shift eating patterns: What works?

A review of the evidence of the effectiveness of interventions aimed at shifting diets in more sustainable and healthy directions.

Photo: the Argument by Design

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1. Introduction

The food system is linked to some of the most pressing challenges of the day. It generates some 30% of global climate changing greenhouse gas (GHG) emissions, is the dominant driver of deforestation and biodiversity loss and a major user and polluter of our increasingly scarce water resources. Overfishing has led to the collapse of important fish stocks and threatens the stability of marine ecosystems.[1,2]

There are also striking inequalities in how the economic benefits of food provisioning are distributed: while the top ten food companies collectively generate daily revenues of more than $1.1bn,[3] over a billion people who rely upon agriculture for their livelihoods live below the poverty line of US$1.25 a day.[4,5] And although there is sufficient food in the world to feed our population of seven billion, some 800 million worldwide are still hungry and undernourished and two billion suffer from micronutrient deficiencies. Paradoxically, a further two billion people suffer the consequences of obesity and overconsumption, leading to a growing burden of non-communicable diseases (NCDs) such as heart conditions, strokes, diabetes and some cancers. Economies in rapid transition are particularly affected since they are experiencing the double burdens both of under nutrition and overconsumption, combined with acute environmental challenges.[6] Tragically some 30% of all food produced – at such great environmental cost – is wasted.[7]

As our global population grows, urbanises, becomes on average wealthier and starts to demand increasingly resource intensive and energy rich foods, the signs are that without action this nexus of socio-economic, health and environmental problems will only get worse.[8,9]

1 Vermeulen, S. J., Campbell, B. M. and Ingram, J. S. I. (2012) Climate Change and Food Systems. *Annual Review of Environment and Resources.* 37. p.195-222.

2 Garnett, T. (2013) Food sustainability: problems, perspectives and solutions. *Proceedings of the Nutrition Society,* 72, p.29–39.

3 OXFAM (2013) *Behind the Brands: food justice and the 'Big 10' food and beverage companies.* [Online] Available from:http://www.behindthebrands.org/en/campaign-news/a-race-to-the-top,-c-,-new-update-on-food-and-beverage-companies-progress.

4 IFAD (2013) *Smallholders, food security, and the environment*, International Fund for Agricultural Development and United Nations Environment Programme.

5 FAO (2013) *FAO Statistical Yearbook 2013: World Food and Agriculture,* Food and Agriculture Organisation, Rome.

6 Hawkes, C., Chopra, M. and Friel, S. (2009) Globalization, trade, and the nutrition transition. In Labonté, R., Schrecker, T., Packer, C. and Runnels, V. (eds.). *Globalization and Health: Pathways, Evidence and Policy.* New York: Routledge; p.235-262.

7 IMECHE (2013) *Global food: Waste not, want not*, Institute of Mechanical Engineers, London, UK.

8 Tilman, D. and Clark, M., (2014) *Global diets link environmental sustainability and human health. Nature*. 515, p.518–522.

9 Foresight (2011) T*he Future of Food and Farming. Final Project Report.* The Government Office for Science, London.

This much is recognised. Action is being taken by major governments and donors to promote 'climate smart agriculture' and 'sustainable intensification' approaches centring on producing more food with less environmental impact[10] and in ways that adapt to climatic and environmental change.[11,12,13]

Such approaches have potential to deliver important environmental benefits and increase food availability in regions where yields are low (Box 1).

Box 1: Sustainable intensification – an evolving concept

As highlighted above, the main policy and business approach to approving food system sustainability has been on improving the environmental performance of production.

Sustainable intensification has been defined as a set of techniques that enable food (sometimes more food) to be produced with less environmental impact and without incurring further land use change – the latter is critical since major biodiversity and carbon losses result from deforestation. The concept of sustainable intensification is, however, still evolving and can be ideologically loaded – with some critics arguing that it is little more than a 'greenwash' for business as usual, industrialised intensive agriculture.[14] There is also recognition of the need to go beyond a simple emphasis on producing more food to take into account factors such as the nutritional quality and diversity of foods produced as well as non-food environmental and social goods and services that contribute to the livelihoods of producers and local consumers.[15,16] Finally, it is recognised that measures are also needed to address the distributional aspects of food security and its social and economic determinants – to improve the ability of poor people to produce their own food and, since many are net food consumers, to access and afford food.[17] In other words, sustainable intensification may be necessary but it cannot be seen as a sufficient 'solution' to the complex problems we face.

10 Foley, J.A., Ramankutty, N., Brauman, K.A., Cassidy, E.S., Gerber, J.S., Johnston, M., Mueller, N. D., O'Connell, C., Ray, D.K., West, P. C., Balzer, C., Bennett, E. M., Carpenter, S. R., Hill, J., Monfreda, C., Polasky, S., Rockstrom, J., Sheehan, J., Siebert, S., Tilman, D. and Zaks, D. P. M. (2011) *Solutions for a cultivated planet. Nature.* 478 (7369) p.337-42.

11 DEFRA (2014) *Sustainable Intensification Platform (1) Integrated Farm Management* – LM0201, Defra Project 2014. [Online] Available from: http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=18802

12 Africa CSA Alliance (2015). *Proposed Locations.* [Online] Available from: http://africacsa.org/#proposed-locations

13 DFID (2010) Bill and Melinda Gates Foundation (BMGF) S*trategic Collaboration Portfolio for Sustainable Intensification of Agriculture*. [Online] Available from: http://r4d.dfid.gov.uk/Project/60792/Default.aspx.

14 *FOEI (2012) A Wolf in Sheep's Clothing?* An analysis of the 'sustainable intensification' of agriculture. Friends of the Earth International.

15 Garnett, T., Appleby, M. C., Balmford, A., Bateman, I. J., Benton, T. G., Bloomer, P., Burlingame, B., Dawkins, M., Dolan, L., Fraser, D., Herrero, M., Hoffman, I., Smith, P., Thornton, P. K., Toulmin, C., Vermeulen, S. J. and Godfray, H. C. J. (2013) *Sustainable Intensification in Agriculture: Premises and Policies, Science,* 34(6141) p.33-34.

16 Godfray, C. and Garnett, T. (2014) *Food security and sustainable intensification.* Philosophical Transactions of the Royal Society B., 369(1639)

17 Loos, J., Abson, D. J., Chappell, M. J., Hanspach, .J, Mikulcak, F., Tichit, M. and Fischer, J. (2014) *Putting meaning back into "sustainable intensification"*. Frontiers in Ecology and the Environment. 12:6, p.356-361.

However it is increasingly recognised that production-side measures alone cannot address the severity of the environmental problems we face nor the interlinkages between key issues. These include the need to address systemic inequities that are important determinants of food security -increases in supply do not automatically lead to increases in access nor to improvements in food quality – and to tackle the growth in obesity and diet-related non communicable diseases while continuing to reduce hunger and malnutrition. They include also the need to reduce waste, to address marine ecosystem destruction, and to achieve *absolute* reductions in food related GHG emissions and in land and water use, rather than simply relative improvements in unit efficiency.

If we are to tackle all these challenges together we need to change how we produce food, improve governance of the food system and – critically – consume differently.[18,19,20]

Specifically, we need to adopt dietary patterns that are less resource-intensive, generate fewer environmental impacts, and have a more favourable nutritional profile, thereby helping curb the increase in non-communicable diseases. Critically, a large and rapidly growing body of work finds a strong potential compatibility between diets that have lower environmental impacts and those better for health both at the national and at the global aggregate level. The concept of 'sustainable healthy diets (SHDs)' is thus gaining increasing attention.

18 Bajželj, B., Richards, K. S., Allwood, J. M., Smith, P., Dennis, J. S., Curmi and E., Gilligan, C. A. (2014) *Importance of food-demand management for climate mitigation*, Nature Climate Change.

19 Ray, D. K., Mueller, N. D., West, P. C. and Foley, J. A. (2013) *Yield Trends Are Insufficient to Double Global Crop Production by 2050*. PLoS ONE 8(6).

20 Garnett, T. (2011) Where are the best opportunities for reducing greenhouse gas emissions in the food system (including the food chain)? *Food Policy* 36 p.S23–S32.

2. Characteristics of sustainable healthy diets (SHDs).

There is now a substantial body of research into the role of dietary change in addressing food's environmental impacts and the implications of such shifts for human nutrition – and vice versa.[21] Generally, studies find that a low environmental impact diet is one centred on a diverse range of tubers, whole grains, legumes and fruits and vegetables, with animal products eaten sparingly. While general principles may not be applicable to all individuals, such a diet is also broadly consistent with health. [22,23,24,25,26,27,28,29,30,31,32,33]

21 Garnett, T. (2014) *What is a sustainable healthy diet?* A discussion paper. Food Climate Research Network – Oxford Martin School – CCAFs.

22 Vanham, D., Hoekstra, A. Y. and Bidoglio, G. (2013) *Potential water saving through changes in European diets.* Environment International p.6145–56.

23 Stehfest, E., Bouwman, L., van Vuuren, D. P., den Elzen, M. G. J., Eickhout, B. and Kabat, P. (2009) *Climate benefits of changing diet*. Climatic Change, 95, 1–2.

24 Pairotti, M. B., Cerutti, A. K., Martini, F., Vesce, E., Padovan, D. and Beltramo, R. (2014) *Energy consumption and GHG emission of the Mediterranean diet*: a systemic assessment using a hybrid LCA-IO method. Journal of Cleaner Production

25 Van Kernebeek, H. R. J., Oosting, S. J., Feskens, E. J. M., Gerber, P. J. and De Boer, I. J. M. (2014). T*he effect of nutritional quality on comparing environmental impacts of human diets*, Journal of Cleaner Production.

26 Van Dooren, C. and Kramer, G. (2012) F*ood patterns and dietary recommendations in Spain, France and Sweden.* WWF-UK [Online] Available from: http://www.livewellforlife.eu/wp-content/uploads/2012/05/LiveWell_A4-Food-Patterns-Report_web.pdf.

27 Brunner, E., Jones, P., Friel, S. and Bartley, M. (2009) *Fish, human health and marine ecosystem health: policies in collision*. International Journal of Epidemiology. 38. p93-100.

28 Hallström, E., Carlsson-Kanyama, A. and Borjessön, P. (2014) *Environmental impact of dietary change*: a systematic review. Journal of Cleaner Production.

29 Auestad, N. and Fulgoni III, V. L. (2015) *What Current Literature Tells Us about Sustainable Diets*: Emerging Research Linking Dietary Patterns, Environmental Sustainability, and Economics. Adv. Nutr. 6. P.19–36.

30 Röös, E., Karlsson, K., Witthöft, C. and Sundberg, C. (2015) *Evaluating the sustainability of diets–combining environmental and nutritional aspects*. Environmental Science & Policy. 47. P.157-166.

31 Tilman, D. and Clark, M. (2014) *Global diets link environmental sustainability and human health*. Nature. 515. p.518–522.

32 Green, R., Milner, J., Dangour, A. D., Haines, A., Chalabi, Z., Markandya, A., Spadaro, J. and Wilkinson, P. (2015) *The potential to reduce greenhouse gas emissions in the UK through healthy and realistic dietary change*. Climatic Change.

33 Van Dooren, C. and Kramer, G. (2012) *Food patterns and dietary recommendations in Spain, France and Sweden.* WWF-UK [Online] Available from: http://www.livewellforlife.eu/wp-content/uploads/2012/05/LiveWell_A4-Food-Patterns-Report_web.pdf.

These conclusions hold not just at the individual country but also at the global level.[34] Estimates range but they suggest that dietary changes in high income countries can achieve per capita GHG emission reductions of 25-50% without too radical a departure from current accepted norms.[35,36,37]

The lower the meat, fish and dairy content, the lower the environmental impact – and the more important it is that reduced meat intakes are compensated for, nutritionally speaking, with increases in the quantity and diversity of whole grains, fruits and vegetables, and legumes.[38,39]

This said, dietary and environmental challenges will always be contextual, shaped by particular population requirements, cultures or geographies. While there is scope for achieving major synergies, a healthy diet is not automatically environmentally sustainable nor vice versa.[40] There can, moreover, be trade-offs between health and environmental goals and also between different environmental objectives. For example fish is good for health but stocks of many species are depleted, and overfishing harms not only the viability of target species but also the marine ecosystem more generally. From a global perspective there is simply not enough fish for everyone on the planet to consume as much as government health guidelines recommend, even taking the huge expansion of global aquaculture into account, since there are many sustainability concerns associated with this growth.[41] And while fruit and vegetables are good for health and generally carry a lower GHG footprint than animal products, some forms of horticultural production rely heavily on irrigation water. Much production takes place in regions that are already water stressed and so there is a potential conflict between GHG mitigation and water use objectives.[42] As it stands, research suggests that fruit and vegetable supply is currently insufficient to meet current population needs, falling approximately 22% short of quantities needed to meet nutritional recommendations.[43] Increases in supply to meet requirements could potentially exacerbate water pressures, depending on the types of produce grown.

34 Tilman, D. and Clark, M. (2014) *Global diets link environmental sustainability and human health.* Nature. 515. p.518–522.

35 WWF UK (2011) Livewell: *a balance of healthy and sustainable food choices.* WWF UK. Godalming, UK.

36 Green, R., Milner, J., Dangour, A. D., Haines, A., Chalabi, Z., Markandya, A., Spadaro, J. and Wilkinson, P. (2015) T*he potential to reduce greenhouse gas emissions in the UK through healthy and realistic dietary change.* Climatic Change.

37 Hallström, E., Carlsson-Kanyama, A. and Borjessön, P. (2014) *Environmental impact of dietary change*: a systematic review. Journal of Cleaner Production.

38 WWF UK (2011) Livewell: *a balance of healthy and sustainable food choices*, WWF UK, Godalming, UK.

39 Van Dooren, C. and Kramer, G. (2012) F*ood patterns and dietary recommendations in Spain, France and Sweden.* WWF-UK [Online] Available from: http://www.livewellforlife.eu/wp-content/uploads/2012/05/LiveWell_A4-Food-Patterns-Report_web.pdf.

40 Vieux, F., Soler, L. G., Touazi, D. and Darmon, N. (2013) *High nutritional quality is not associated with low greenhouse gas emissions in self-selected diets of French adults*. Am J Clin Nutr. 97. p569–83.

41 Thurstan, R. H. and Roberts, C. M. (2014) *The past and future of fish consumption: Can supplies meet healthy eating recommendations?* Mar. Pollut. Bull. 89(1-2) p.5-11.

42 Hess, T., Andersson, U., Mena, C. and Williams, A. (2014) T*he impact of healthier dietary scenarios on the global blue water scarcity footprint of food consumption in the UK*. Food Policy. 50, p.1–10.

43 Siegel, K. R., Ali, M. K., Srinivasiah, A., Nugent, R. A. and Narayan, K. M. V. (2014) D*o We Produce Enough Fruits and Vegetables to Meet Global Health Need?* PLoS ONE 9(8).

Within food groups, different product types carry different distributions of environmental and nutritional benefits and costs: for example beef has a higher carbon footprint than poultry meat or pork, but ruminant animals can graze on land unsuited to other forms of food production. By contrast, the diets of intensively reared monogastric animals (increasingly the production norm) depend on grains and protein feeds, such as soy. Feed production places pressure on arable land that is also needed for direct human crop production. The merits of one meat type over another will thus substantially depend upon the choice of metric.

Box 2 sets out the current state of knowledge on the key characteristics of lower GHG impact, and healthier eating patterns. However, as is discussed in Box 3 below, more research is needed to understand the characteristics of sustainable diets measured using other metrics, such as the sustainability of water use, impact on biodiversity and so forth.

Box 2: Characteristics of healthier and less GHG-and land-intensive eating patterns

- Healthier dies with lower GHG and land use impacts have the following characteristics:
- Diversity – a wide variety of foods eaten
- Balance achieved between energy intake and energy needs
- Based around: minimally processed tubers and whole grains; legumes; fruits and vegetables – particularly those that are field grown, 'robust' (less prone to spoilage) and less requiring of rapid and more energy-intensive transport modes
- Meat eaten sparingly if at all – and all animal parts consumed
- Dairy products or alternatives eaten in moderation e.g. fortified milk substitutes and other foods rich in calcium and micronutrients
- Unsalted seeds and nuts
- Small quantities of fish and aquatic products sourced from certified fisheries and certified aquaculture systems
- Very limited consumption of processed foods high in fat, sugar or salt and low in micronutrients e.g. crisps, confectionery, sugary drinks

Source: Garnett, T. (2014). Changing what we eat: A call for research & action on widespread adoption of sustainable healthy eating. *Food Climate Research Network, University of Oxford.*

These findings are starting to be incorporated into the recommendations of a few forward-thinking official policy bodies. These include the Health Council of the Netherlands, Sweden's National Food Agency and the 2012 New Nordic Recommendations. [44,45,46] The new Brazilian recommendations also include some discussion of environmental issues and recommend moderating meat consumption to achieve both environmental and health benefits.[47] For the development of the 2015 United States Dietary Guidelines, an advisory committee has produced a report that makes recommendations for diets that are not only healthful, but also generate fewer environmental impacts. A consultation process is underway; however, as discussed by Lee-Gammage[48] there has been very substantial lobbying by the livestock industry against the incorporation of environmental principles into the new guidelines and the outcome for the US remains to be seen.

While the general direction of travel is becoming clearer, a number of critically important questions still need answering if we are to have a more complete and accurate understanding of the characteristics of sustainable healthy diets. These are summarised in Box 3.

Box 3: Towards a fuller understanding of sustainable healthy eating patterns – critical areas for further research

While we have a growing understanding of the characteristics of diets that are lower in greenhouse gases and land use, compared with the Western average, a fuller understanding of the relationship between health and sustainability requires more research in the following areas.

The production-consumption relationship

Analysis needs to take account of not only what we eat, but *how* these foods are produced. The production method will determine how much food can be produced for a given level of environmental cost and it also potentially influences a food's nutritional and other health properties. The issues here are not easy. Recent years have seen the spotlight falling variously on organic production and/or on locally sourced foods, with advocates arguing that such foods are not only more environmentally sustainable but deliver health benefits too although

44 Norden (2014). *Nordic Nutrition Recommendations* 2012, Nordic Council of Ministers, Copenhagen. https://www.norden.org/en/theme/tidligere-temaer/themes-2014/nordic-nutrition-recommendation/nordic-nutrition-recommendations-2012

45 *National Food Agency* (undated) [Online] Available from: http://www.livsmedelsverket.se/en/food-habits-health-and-environment/food-and-environment/

46 HCN (2011) *Guidelines for a healthy diet: the ecological perspective.* Health Council of the Netherlands, The Hague.

47 Ministry of Health of Brazil (2014) *Dietary Guidelines for the Brazilian population*. Ministry of Health of Brazil, Secretariat of Health Care, Primary Health Care Department.

48 Lee-Gammage, S. (2015) *Who will win in the battle over sustainability in the Dietary Guidelines for Americans, science or special interests?* [Online] Available from: http://www.fcrn.org.uk/fcrn-blogs/samuel-lee-gammage/who-will-win-battle-over-sustainability-dietary-guidelines-americans.

the evidence on these remains contested.[49,50,51,52] Taking organics first: overuse of pesticides and fertilisers generates serious environmental problems and in these circumstances, a switch to organic and lower input production will likely deliver gains from a health and environmental perspective. But in regions such as Sub Saharan Africa, where soils are degraded and both organic and inorganic inputs are minimal, judicious use of fertilisers can help replenish soils and deliver higher yields, while pesticides can help counter crop losses due to pests and disease. By maintaining or increasing production on existing land, there is less need to convert additional land – including forest – to compensate for low and dwindling yields. Thus there can be a role for these inputs, provided they are not excessively applied. As for local sourcing, the merits need to be assessed on a case by case basis. Since environmental impacts at the agricultural stage are often so significant, more efficient agricultural production in a more distant location can sometimes compensate for longer transport distances.[53]

Rebounds and leakages

If everyone in the UK were to consume along the lines suggested, this might lead to an overall reduction in environmental impacts – or, given the complexity of the food system, it might not. UK producers could continue farming livestock and simply ratchet up their exports – thereby increasing availability overseas, driving down prices and stimulating consumption. Or they might switch to producing other foods. Or they might exit the sector altogether. All of these possible scenarios would have varying environmental and societal consequences. These possibilities illustrate the point that production and consumption are linked, that food markets are now globalised and that food and dietary patterns need to be seen in the context of broader consumption practices – from buying shoes to holidaying overseas – and their environmental impacts. There are evidently crucial implications for the design of interventions intended to shift consumption patterns.

49 Curl, C. L., Beresford, S. A., Fenske, R. A., Fitzpatrick, A. L., Lu, C., Nettleton, J. A. and Kaufman, J. D. (2015) *Estimating Pesticide Exposure from Dietary Intake and Organic Food Choices*: The Multi-Ethnic Study of Atherosclerosis (MESA). Environ Health Perspect. 123(5) p.475-83.

50 Dangour, A. D., Dodhia, S. K., Hayter, A., Allen, E., Lock, K. and Uauy, R. (2009) N*utritional quality of organic foods*: a systematic review. Am J Clin Nutr. 90(3) p.680-5.

51 Smith-Spangler, C., Brandeau, M. L., Hunter, G. E., Bavinger, J. C., Pearson, M., Eschbach, P. J., Sundaram, V., Shirmer, P., Stave, C., Olkin, I. and Bravata, D. M. (2012) *Are Organic Foods Safer or Healthier Than Conventional Alternatives?*: A Systematic Review, Ann Intern Med. 157(5) p.348-366.

52 Brandt, K., Leifert, C., Sanderson, R. and Seal, C. J. (2011) *Agroecosystem Management and Nutritional Quality of Plant Foods:* The Case of Organic Fruits and Vegetables. Critical Reviews in Plant Sciences. 30(1-2).

53 Webb, J., Williams, A. G., Hope, E., Evans, D. and Moorhouse, E. (2013) *Do foods imported into the UK have a greater environmental impact than the same foods produced within the UK?* Int J Life Cycle Assess. 18. p.1325–1343.

Sustainability metrics that go beyond GHGs

While knowledge of the link between nutritional objectives and environmental sustainability is advancing, the metrics used to assess sustainability tend to focus on GHG emissions, land and sometimes water use. Less attention has been paid to the impacts of different diets on biodiversity both on- and off-farm. Critically, we also know far less about the complex relationship between environmental and other social and economic goals. A low environmental impact system of production and consumption that relies on exploitative labour practices or that consumers cannot afford will not be socially or economically sustainable. The predominantly environmental focus reflects not only the importance of the issue but also the fact that social and economic objectives and priorities are extremely hard to agree upon. For example: food should be affordable, but does that mean that cheap food is good? Is small scale or large scale production to be preferred? Is equality an end in itself or can its pursuit stifle innovation? There may well be synergies between nutritional adequacy, environmental sustainability and certain economic goals, but there will also be costs: how should these be balanced? How do we trade off present gains against future losses, and vice versa? How far can or should we actually alter the global economy – is radical change actually possible or desirable?

More focus on low and middle income countries

Most of the discourse on sustainable diets centres on rich-world, developed country contexts. Yet most of the growth in food-related environmental impacts from meat and dairy consumption, and most of the rise in obesity and chronic diseases, are taking place in developing countries, particularly in the rapidly industrialising economies of South and South East Asia, and parts of Central and South America. The implications are unarguable: if we are to address the social, health and environmental problems inherent in the food system, then diets in low and middle income countries need to be sustainable. This observation may be controversial given the historical responsibility of rich countries for the environmental problems we face today and for the inequities in the global food economy; and the fact that, while obesity and chronic diseases are on the rise, the problems of hunger, malnutrition and food insecurity continue. The challenge is to align sustainable diets with broader developmental and societal objectives so as to orient development interventions along lower impact, more nutritious pathways; a challenge which is, of course, easier articulated than overcome.

3. Aims and approach

3.a. Aims

Box 2 above highlighted the broad characteristics of sustainable healthy diets although the caveats discussed in Box 3 should be noted. The purpose of this literature review is, therefore – and given resource constraints – to focus on a *specific subset* of four key eating practices within that overall pattern. It considers what the evidence says about effective ways of shifting people's consumption practices to achieve these dietary patterns in order to improve health and environmental sustainability outcomes, and identifies knowledge gaps and research priorities.

The four identified key eating practices are as follows: 1. Increased consumption of plant based foods including fruit and vegetables; 2. Reduced meat consumption; 3. Shifts in palm oil consumption (i.e. not always or necessarily reductions); 4. Reductions in sugar intakes. Our review also considers a fifth area where health and environmental goals diverge – the case of fish. Table 1 below summarises the rationale for focusing on these practices and highlights important caveats and qualifiers.

Table 1: Target health and sustainability-relevant consumption practices

Eating practice: *Eat more plants especially fruit and vegetables*

Health rationale: Fruit and vegetables provide fibre, fewer calories and less fat than alternative foodstuffs. There is strong evidence that consuming fruit and vegetables has a protective effect against heart disease, stroke and some cancers.[54,55]

Environmental rationale: Plant based foods of all types (including legumes and grains, fruits and vegetables) generate fewer GHGs and use less land than animal based foods.[56] Diverse diets can potentially enhance food system resilience through reduced dependence on a few species or varieties.

Qualifiers and caveats: Need to be cautious of water use for some horticultural crops particularly commercial production in water stressed regions,[57] as well as poor nutrient and pest management practices. Air freighted and processed vegetables have a high carbon footprint.[58] If substituted isocalorically for animal products or sugary foods then the GHG and land use impact of fruit and vegetables rises.[59]

Not all plant based foods are healthy (e.g. chocolate, processed starches).

54 Scarborough, P., Nnoaham, K. E., Clarke, D., Capewell, S. and Rayner, M. (2010) Modelling the impact of a healthy diet on cardiovascular disease and cancer mortality. *J Epidemiol Community Health.*

55 Lock, K., Pomerleau, J., Causer, L., Altmann, D. R. and McKee, M. (2005) *The global burden of disease attributable to low consumption of fruit and vegetables: implications for the global strategy on diet.* Bulletin of the World Health Organization. 83. p.100-108.

56 Garnett, T. (2014) *What is a sustainable healthy diet? A discussion paper*. Food Climate Research Network – Oxford Martin School – CCAFs.

57 Hess, T., Andersson, U., Mena, C. and Williams, A. (2014) T*he impact of healthier dietary scenarios on the global blue water scarcity footprint of food consumption in the UK.* Food Policy. 50.p.1–10.

58 Sim, S., Barry, M., Clift, R. and Cowell, S.J. (2007) *The Relative Importance of Transport in Determining an Appropriate Sustainability Strategy for Food Sourcing.* Int J LCA 12 (6) 422–431.

59 Vieux, F., Soler, L. G., Touazi, D. and Darmon, N. (2013) *High nutritional quality is not associated with low greenhouse gas emissions in self-selected diets of French adults.* Am J Clin Nutr. 97. p569–83.

Table 1 continued – Eating practice: *Eat less meat*

Health rationale: High intakes of meat, particularly of red and processed meat, are associated with increased risks of heart disease, ischaemic stroke, Type 2 diabetes and specific types of cancer.[60,61,62]

Environmental rationale: Animal products are land- and GHG – intensive foods. Cuts in consumption reduce GHGs and potentially both direct land requirements and indirect, through reduced demand for feed crops[63,64] On the whole, more plant based diets have lower GHG impacts than animal based diets.[65,66]

Qualifiers and caveats: Only reduces GHGs if consumption leads to decreased production; negative socio economic impacts on livestock farmers need to be addressed. Different meat types have different implications for GHGs, land use, reliance on arable grains and irrigation water. Poultry meat and eggs are associated with positive health outcomes and has a low carbon footprint but its production relies heavily on grains and irrigation water. There are also animal welfare issues to consider in all production systems which interface in complex ways with environmental and health objectives.[67] Dairy foods are also animal products and also carry high environmental costs but they are generally

60 Sinha, R., Cross, A. J., Graubard, B. I., Leitzmann, M. F. and Schatzkin, A. (2009) *Meat Intake and Mortality: A Prospective Study of Over Half a Million People.* Arch Intern Med. 169(6) p.562-571.

61 SACN (2010) *Iron and health*. Scientific Advisory Committee on Nutrition, London.

62 Micha, R., Wallace, S. K. and Mozaffarian, D. (2010) R*ed and processed meat consumption and risk of incident coronary heart disease, stroke, and diabetes mellitus: a systematic review and meta-analysis.* Circulation. 121(21) p.2271-83.

63 Garnett, T. (2011) *Where are the best opportunities for reducing greenhouse gas emissions in the food system (including the food chain)?* Food Policy. 36. p.23–32.

64 Ripple, W. J., Smith, P., Haberl, H., Montzka, S. A., McAlpine, C. and Boucher, D. H. (2014) R*uminants, climate change and climate policy.* Nature climate change. 4(1). p.2-5.

65 Scarborough, P., Appleby, P. N., Mizdrak, A., Briggs, A. D., Travis, R. C., Bradbury, K. E., Key, T. J., 2014, *Dietary greenhouse gas emissions of meat-eaters, fish-eaters, vegetarians and vegans in the UK,* Climatic Change.

66 Tilman, T. and Clark, M. (2014) *Global diets link environmental sustainability and human health.* Nature. 515. p.518–522.

67 Garnett, T. (2011) W*here are the best opportunities for reducing greenhouse gas emissions in the food system (including the food chain)?* Food Policy. 36. p.23–32.

Table 1 continued –

associated with beneficial health outcomes.[68,69,70,71,72,73,74]

Livestock keeping provides livelihoods and security for around 600 million poor people worldwide.[75]

Eating practice: *Shift consumption of palm oil; reduce among high consumers and consume sustainably sourced palm oil in all cases*

Health rationale: Palm oil is high in saturated fat and its consumption is strongly associated with higher rates of death from myocardial infarction, particularly in LMIC countries where it tends to be used most.[76]

Environmental rationale: Palm oil production can be a major driver of land use change, soil carbon release and ecosystem destruction in key biodiversity 'hotspots', particularly in South East Asia.[77]

Qualifiers and caveats: There is some evidence that the ban on transfats has led to increases in the use of palm oil as substitutes, leading to unintended health and environmental consequences.

From an environmental perspective a total shift away from palm oil may not be desirable; palm oil is very high yielding. Producing an equivalent volume of oil from alternative oil crops would use more land and give rise to associated environmental problems. [78]

68 Aune, D., Norat, T., Romundstad, P. and Vatten, L. J. (2013) *Dairy products and the risk of type 2 diabetes: a systematic review and dose-response meta-analysis of cohort studies*. Am J Clin Nutr.

69 Alvarez-León, E. E., Román-Viñas, B. and Serra-Majem, L. (2006) *Dairy products and health: A review of the epidemiological evidence.* Br J Nutr. 96(Suppl 1) p.S94-S99.

70 Elwood, P. C., Givens, D. I., Beswick, A. D., Fehily, A. M., Pickering, J. E. and Gallacher, J. (2008) *The survival advantage of milk and dairy consumption: An overview of evidence from cohort studies of vascular diseases, diabetes and cancer.* J Am Coll Nutr. 27 (6) p.723S-734S.

71 Aune, D., Lau, R., Chan, D. S. M., Vieiram, R., Greenwood, D. C., Kampman, E. and Norat, T. (2012) *Dairy products and colorectal cancer risk: a systematic review and meta-analysis of cohort studies.* Ann Oncol. 23 (1) p.37-45.

72 Soedamah-Muthu, S. S., Ding, E. L., Al-Lelaimy, W. K., Hu, F. B., Engbrerink, M. F., Willett, W. C. and Geleijnse, J. M. (2011) *Milk and dairy consumption and incidence of cardiovascular diseases and all-cause mortality: dose-response meta-analysis of prospective cohort studies1–3.* Am J Clin Nutr. 93. p.158–71.

73 Ralston, R. A., Lee, J. H., Truby, H., Palermo, C. E. and Walker, K. Z. (2012) *A systematic review and meta-analysis of elevated blood pressure and consumption of dairy foods. Journal of Human Hypertension*. 26. p.3–13.

74 Gibson, R. A., Makrides, M., Smithers, L. G., Voevodin, M. and Sinclair, A. J. (2009) *The effect of dairy foods on CHD: a systematic review of prospective cohort studies, British Journal of Nutrition.* 102(9) p.1267-75

75 Herrero, M., Thornton, P. K., Gerber, P. and Reid, R. S. (2009). L*ivestock, livelihoods and the environment: understanding the trade-offs.* Current Opinion in Environmental Sustainability. 1(2). p.111-120.

76 Chen, B. K., Seligman, B., Farquhar, J. W. and Goldhaber-Fiebert, J.D. (2011) *Multi-country analysis of palm oil consumption and cardiovascular disease mortality for countries at different stages of economic development: 1980-1997.* Global Health.7. p.1-10.

77 Campbell, A. and Doswald, N. (2009) *The impacts of biofuel production on biodiversity: A review of the current literature*. UNEP-WCMC, Cambridge, UK

78 EUFIC (undated) Frequently Asked Questions: Palm oil Q&A, EUFIC. European Food Information Council. [Online] Available from: http://www.eufic.org/page/en/page/FAQ/faqid/question-answer-palm-oil/

Table 1 continued –

Thus many environmental organisations recommend a shift towards more sustainable palm oil production rather than away from palm oil entirely.

Eating practice: *Eat less sugar and fewer sugary foods*

Health rationale: High sugar intakes are associated with poor quality diets, obesity and increased risk of NCDs. There is also a strong association between high sugar intakes and dental diseases.[79]

WHO recommended sugar intakes have been revised downwards to less than 10% and preferably to under 5% of total energy intakes.[80]

Environmental rationale: Pressure on wetland ecosystems, excessive water consumption, pre-harvest burning degrades soils and cause acidification, possibly an indirect driver of deforestation.[81]

There is some suggestion that large scale sugar production has been driving land acquisitions that have marginalised and displaced smallholders.[82]

Qualifiers and caveats: Intrinsic sugars are not associated with the same negative health effects. From an environmental perspective, sugar is actually a 'low carbon' food (hence its use as a biofuel) and isocaloric substitution with fruit and vegetables could lead to GHG increases.

Bioethanol from sugar cane is an important fuel in various countries particularly Brazil. This can offer reduced carbon intensity fuel with lower air pollution. However, land use change can negate the GHG benefits or require long payback times.[83,84]

Sugarcane production is a major source of livelihoods involving farmers in 123 countries. Only 30% of sugar produced is traded globally suggesting that cultivation makes an important contribution to local economies.[85]

79 Joint WHO/FAO Expert Consultation. (2003) *Diet, Nutrition and the Prevention of Chronic Diseases WHO Technical Report Series 916.*

80 WHO (2015) *Guideline: Sugars intake for adults and children.* World Health Organisation, Geneva. [Online] Available from: http://who.int/nutrition/publications/guidelines/sugars_intake/en/.

81 Cheesman, O. D. (2004) *Environmental impacts of sugar production: the cultivation and processing of sugarcane and sugar beet.* CABI/WWF.

82 Oxfam (2013) *Sugar rush: Land rights and the supply chains of the biggest food and beverage companies*, Oxfam Briefing Note.

83 Lapola, D. M., Schaldach, R., Alcamo, J., Bondeau, A., Koch, J., Koelking, C. and Riess, J. A. (2010) *Indirect land-use changes can overcome carbon savings from biofuels in Brazil.* Proceedings of the National Academy of Sciences. 107(8) p.3388–93.

84 Mello, F. F. C., Cerri, C. E. P., Davies, C. A., Holbrook, N. M., Paustian, K., Maiai, S. M. F., Galdos, M. V., Bernoux, M. and Cerri, C. C. (2014) *Payback time for soil carbon and sugar-cane ethanol.* Nature Climate Change. 4. p.605–609.

85 Fairtrade Foundation (2013) *Fairtrade & sugar: Commodity briefing,* Fairtrade Foundation, UK.

Table 1 continued – Eating practice: *Fish – a divergent issue*

Health rationale: Fish is a major source of protein and essential nutrients in many settings. Consumption of omega-3 fatty acids is associated with reduced risk of cardiovascular disease.[86] Evidence on its role in cognitive function requires more research. [87,88,89]

Environmental rationale: Biodiversity loss and ecosystem collapse; there is not enough fish available for us all globally to consume in accordance with nutritional recommendations.[90,91]

Qualifiers and caveats: Concerns that levels of methylmercury and dioxins in some species may have adverse effects on human health, particularly in some populations (e.g. women of childbearing age).[92,93,94]

Not all fish stocks are overexploited and aquaculture holds potential to address some environmental concerns depending on the system of production. Fish, fishing and aquaculture production can be a very important source of animal protein and livelihoods for food insecure populations in many parts of the world and for vulnerable coastal communities.[95]

86 Rizos, E. C., Ntzani, E. E., Bika, E., Kostapanos, M. S. and Elisaf, M. S. (2012) Association between omega-3 fatty acid supplementation and risk of major cardiovascular disease events: a systematic review and meta-analysis. *JAMA: the journal of the American Medical Association*. 308(10) p.1024-33.

87 Mayo Clinic (2013) *Drugs and Supplements: Omega-3 fatty acids, fish oil, alpha-linolenic acid.* [Online] Available from: http://www.mayoclinic.org/drugs-supplements/omega-3-fatty-acids-fish-oil-alpha-linolenic-acid/evidence/hrb-20059372.

88 Sydenham, E. D. A. and Lim, W. S. (2012) *Fish oils for the prevention of dementia in older people.* [Online] Available from: http://www.cochrane.org/CD005379/DEMENTIA_fish-oils-for-the-prevention-of-dementia-in-older-people.

89 FAO/WHO (2010) Report of the joint FAO / WHO e*xpert consultation on the risks and benefits of fish consumption. Rome: FAO Fisheries and Aquaculture Report* No. 978.

90 Thurstan, R. H. and Roberts, C. M. (2014) T*he past and future of fish consumption: Can supplies meet healthy eating recommendations?* Mar. Pollut. Bull. 89(1-2) p.5-11.

91 Brunner, E., Jones, P., Friel, S. and Bartley, M. (2009) Fish, human health and marine ecosystem health: policies in collision. *International Journal of Epidemiology*. 38. p93-100.

92 Mozaffarian, D. (2006) *Fish Intake, Contaminants, and Human Health. Evaluating the Risks and the Benefits. JAMA.* 296(15). p.1885-1899.

93 EFSA (2012) Scientific Opinion on the risk for public health related to the presence of mercury and methylmercury in food. *EFSA Journal*. 10(12):2985.

94 FAO/WHO (2011) R*eport of the Joint FAO/WHO Expert Consultation on the Risks and Benefits of Fish Consumption.* Rome, Food and Agriculture Organization of the United Nations. Geneva.

95 *Ibid.*

3.b. Approach

The approach we have adopted and the structure for the remainder of this review is as follows:

- Provide an overview of literature on consumption and intervention theories; set out a theoretical framework for our review (Section 4)
- Define methodology and conduct literature review (Section 5)
- Analyse findings; highlight what is known and not known; draw conclusions; (6, 7, and 8)

4. The theoretical framework: understanding consumption practices and theories of change

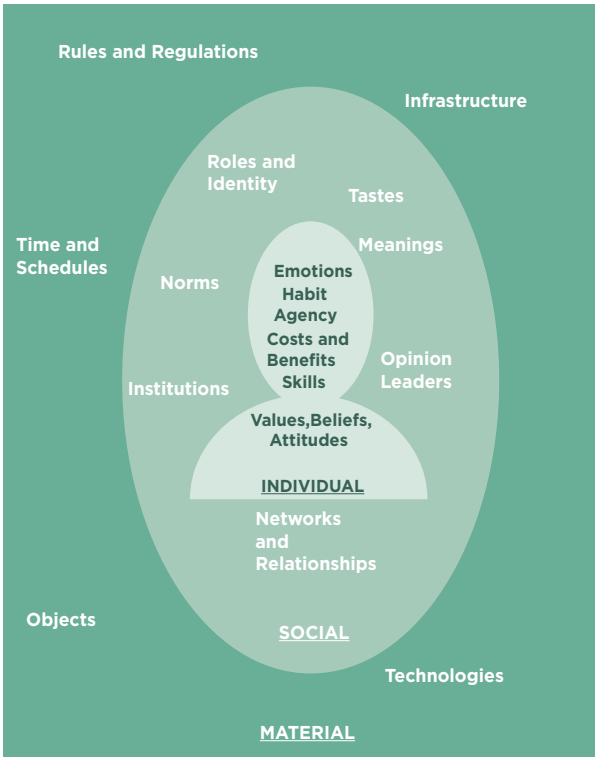
A huge body of research seeks to characterise consumption practices, understand what influences those practices and how they differ between populations, and investigate how consumption practices might be changed. Some is academic, and spans diverse disciplines including sociology, psychology, economics and marketing. There is also a vast literature driven by government and public interest organisations and priorities, focusing on behaviours with implications for health (smoking, drug addiction, obesity, alcohol); society (voting practices, organ donation); or the environment (transport, food, energy use).

These aim to understand the motivations and attitudes underpinning undesirable practices so as to shift them in positive directions. There is also commercially driven work: here insights into people's behaviours, motivations, habits and practices are central to the development of effective sales and marketing strategies. The approaches adopted and conclusions drawn often reflect not just particular disciplinary or sectoral lenses but also ideologies, as regards, say, the balance between personal and collective responsibility, the role of the state, or the importance of 'rational' influences on consumption relative to 'irrational', habitual or socio-politically determined influences. Garnett[96] provides a fuller discussion.

Attempts have been made to draw upon and integrate these multiple perspectives as found, for example in the ISM tool developed by Darnton and Evans in 2013.[97] This maps the *individual* (I) influences on consumption (e.g. values, skills, emotions); the *societal* (S) influences (e.g. institutions, norms, networks) and the *material* (M) influences such as rules and regulations, physical infrastructure, technologies and the timings and schedules of the day in any given society.On the basis of such analyses, a

96 Garnett, T. (2014) *Changing consumption: How can we change the way we eat? A discussion paper*. Food Climate Research Network, University of Oxford.

97 Darnton, A. and Evans, D. (2013) *Influencing behaviours: A technical guide to the ISM tool*, The Scottish Government.



number of theories of change have also been developed.[98,99,100,101] The proposed approaches vary depending on the intended audience – some are aimed at health promotion specialists and others at policy audiences.[102] Such theories can, in principle, be used to map out the design of a given intervention although in practice many policy interventions are tested without drawing upon any particular conceptual framework.

Since this review is intended to inform policy, it draws broadly upon three more policy oriented approaches – the Nuffield ladder,[103] the Defra sustainable development diamond[104] and the IIED's matrix[105] and synthesises them into a simple typology set out in Table 2. This typology of interventions structures the discussion in Section 7.

98 Darnton, A. (2008a) *Behaviour Change Knowledge Review. Practical Guide: An overview of behaviour change models and their uses.* Government Social Research Unit, UK.

99 Darnton, A. (2008b) *Behaviour Change Knowledge Review. Reference Report: An overview of behaviour change models and their uses.* Government Social Research Unit, UK.

100 Jackson, T. (2004) *Models of Mammon: A Cross-Disciplinary Survey in Pursuit of The "Sustainable Consumer".* Working Paper Series, Nr 2004/1, Centre for Environmental Strategy, University of Surrey, Guildford, UK.

101 Jackson T. (2005) M*otivating Sustainable Consumption: a review of evidence on consumer behaviour and behavioural change. A report to the Sustainable Development Research Network*. Centre for Environmental Strategy, University of Surrey, Guildford, UK.

102 Michie, S., van Stralen, M., West, R. (2011) T*he Behaviour Change Wheel: A new method for characterising and designing behaviour change interventions*. Implementation Science. 6(42).

103 Nuffield Council on Bioethics (2007). *Chapter 3: Policy process and practice. In: Public health ethical issues.* Nuffield Council on Bioethics, London.

104 HMG (2005) S*ecuring the Future: Delivering the UK's sustainable development strategy*. Her Majesty's Government, UK.

105 Blackmore, E. (2011) *Shaping Sustainable Markets: Research Prospectus.* International Institute for Environment and Development.

Table 2: Typology of interventions

	Approach	Examples
1	Disincentivise or incentivise choices through fiscal measures	Fiscal measures – taxes, subsidies, trading
2	Change the governance of production or consumption	Macroeconomic policies and agreements, national public procurement and planning policies, other regulations
3	Encourage collaboration and shared agreements	Voluntary industry agreements, certification schemes
4	Changing the context, defaults and norms of production or consumption	Changing the choice architecture, nudge, store layouts, catering provision etc.
5	Inform, educate, promote or empower through community initiatives, labelling and other means	Labelling, gardening or cooking projects, media or other campaigns, education programs

There is inevitable overlap between these categories. Measures to restrict choice through fiscal means (1) are also a consequence of changes in governance; (2) changes in governance may change the context of consumption; (4) industry collaboration; (3) through certification schemes may be communicated via a consumer facing label; (5) go hand in hand with changes in the context of consumption; (4) or be driven by fear of regulation. Such overlaps arise with all typologies.

5. Methodology

We conducted literature searches focusing on interventions relevant to the eating practices described above. Our search encompassed interventions aimed at shifting consumption practices either for health, or for environmental reasons or both. For clarification the term 'health' studies in the analysis below refers to dietary interventions and analyses that focus on the health implications of altered consumption. We use 'sustainable food consumption' as a short hand for environmentally-driven interventions analyses and interventions.

We felt it important to include interventions aimed at actors further up food supply chain (producers, manufacturers, retailers, caterers) where shifts in their practice holds potential to achieve shifts in diets although the available literature was thin on the ground. While the link with manufacturers, retailers and caterers may be apparent, the rationale for including producers may be less obvious and so is summarised in Box 4.

Box 4: Production side interventions: What is the link with consumption?

As Section 1 describes, so far the dominant approach to addressing food system sustainability has been to focus on improving the environmental sustainability of production, on the assumption that changing consumption is hard or politically unacceptable. But while production side approaches do not *necessarily* affect consumption practices they may do so, through at least four pathways:

1. Changes in production practice may *alter the costs of production* so influencing the end price to consumers which in turn affects demand. For example policies to increase livestock productivity can lower producer costs; if reflected in the product's end price this may trigger increases in consumption, and this will have both health and environmental consequences.

2. Changes in production practice (resulting from regulations, fiscal measures or voluntary agreements) may *alter the environmental profile of a food* such that identified trade-offs between health and sustainability may be overcome. Sustainable aquaculture, which potentially substitutes for capture fishing, is a possible example; health and environmental objectives may become more or less closely aligned. Another might be the development of more sustainable animal feeds that reduce the land or water footprint associated with animal production and so make meat eating less of a sustainability issue; in the case of poultry meat or dairy foods which are associated with positive health outcomes; this may reduce the trade-off between objectives.

3. Breeding techniques (as in the case of biofortification) or production methods may *alter the nutrient content of a food* so changing its nutritional role in the diet. Such foods can potentially substitute for others that may have a higher environmental impact; alternatively more or less of the food in question may need to be consumed to meet nutritional requirements, meaning that more or less may need to be produced, with subsequent environmental implications.

4. Change in the types of foods produced, such as increases in the supply or diversity of fruit and vegetables, may affect *availability and accessibility* and thus consumption patterns.

Finally, and less directly, where changes in production practice are combined with *communication* of those changes, such as through an ethical or environmental label, changes in purchase may result. This is relevant not just because a label may influence the level of consumption but also because insights can be gained into how consumers respond to labels and associated messaging.

We also considered a few interventions focused on non-target practices such as alcohol consumption or home energy use where these added insights to our analysis.

A set of search terms were agreed (see Appendix 2 for details) which covered the range of the review and the foods in question. These were applied to key search engines. Additional search terms were used on an ad hoc basis following new insights gained from our initial search, in order to deepen and extend our range. The Food Climate Research Network website (www.fcrn.org.uk) was an additional important source of key publications. We also reviewed literature from key global organisations such as the Food and Agriculture Organisation (FAO), World Cancer Research Fund (WCRF), World Health Organisation (WHO) and, at the national level, from UK and US bodies such as the Department for International Development, Public Health England and the Institute of Medicine. A list of the studies reviewed can be found in Appendix 1. The UK bias to our review reflect the short time frame and limited resources available for our work and the greater familiarity of the researchers with UK literature; a fuller discussion of potential sources of bias is found in the conclusions.

Note that our aim was to review the literature obtained through these searches against a set of broad criteria that included: strength and durability of scope (i.e. how large scale); scalability; equity; relevance to environment and/or health; overall credibility of approach and of course impact. 'Impact' can be measured in various ways: whether it leads to minor change at the population level or substantial changes for specific groups; whether it delivers short versus long term effects; whether the 'impact' is increased purchase, or intakes, or measurable changes in health status. Despite these intentions, because of time limitations and – of equal importance – because the range of studies we reviewed were so wide and their methodologies so diverse, a consistent and rigorous approach proved difficult to adopt.

Appendix 2 provides further details of the methodology.

6. Results

6.a. Overview

In total, this literature reviewed hundreds of articles (see Appendix 1 for a list). The majority related to health, reflecting the wealth of research in this area; the literature on interventions relating to food and the environment is still relatively limited. To partially address this imbalance, we also reviewed a few studies that were not food-related but offered insights regarding the design and outcomes of sustainability oriented interventions.

6.b. Types of interventions:

Assessments of the effectiveness of interventions to change consumption patterns drew on a range of evidence types. We also looked at literature that considered attitudes to certain foods or certain interventions (see Box 5).

Box 5

What kinds of studies did we look at?

This was a very rapid and thus limited review and we were not able to be as comprehensive as we would have wished. However we sought to achieve a spread of study types. We tried to include studies that explored:

Attitudes and the relationship between attitudes and action

- Attitudes to particular foods or shifts in consumption; impact of 'framings' on attitudes.
- Evidence on the attitude-behaviour relationship.

Model based studies

- Studies that model the impacts of hypothetical interventions (e.g. a tax or subsidy) on either production or consumption.

Experimental studies

- Interventions aimed at producers where this might lead to a change in what consumers eat.
- Interventions aimed at intermediaries (public sector caterers, retailers etc.).
- Interventions aimed at consumers either at the population or subpopulation/ individual level.

Natural experiments

- Historical changes in policy or the economy (e.g. change in agricultural production policies, price fluctuations, change in planning policy) intended to achieve economic or other objectives but which have also led to observed changes in consumption.
- Changes in the built environment that have influenced access to certain foods.

Good ideas

- Interesting ideas worth exploring, but for which there is currently no evidence.

6.c. Target population and location of intervention

The interventions included in this review variously targeted the general population (at individual, community and national level); groups within an institution (school, hospital, military, workplaces, supply chain stakeholders) or specific environment (grocery store, restaurant, cafeteria); and occasionally, sub populations defined by key characteristics (socio-economic status, ethnicity, race, gender, age).

The health and sustainable food consumption interventions included in this review aimed either to achieve small impacts at scale by focusing on entire populations, or were targeted at the particular needs of a specific population. Most of the population level health studies also discussed the possible unintended or adverse effects on particular groups that might result from population-level intervention. Many of the studies focusing on groups characterised by institutional affiliation will not have been representative of the general population, and a number of the interventions were conducted without the use of controls. Of those studies that focused on a specific social group the majority gave a reason for so doing – for example that the particular group experienced a high burden of disease. Although most of the studies focused on consumers as the population of interest, some explicitly or indirectly considered the effects of interventions on intermediaries (such as retailers) and consumers. The interventions included ranged from individual experiments to a period of up to a few years. There was also variation in follow-up periods following the intervention.

There is very limited consideration of the role of producers in the health literature. The focus on consumers rather than producers arguably reflects the disconnect between public health policy on the one hand and economic and agricultural policy on the other.

6.d. Focus on eating practice

Most of the sustainable food consumption papers focused on interventions to increase consumption of fruit and vegetables or to reduce meat consumption. However, some of the sustainable consumption literature considered general consumption trends such as the New Nordic or the Mediterranean diet. The latter is characterized by a high intake of vegetables, legumes, fruits and nuts, unrefined cereals, olive oil, fish, low-to-moderate moderate dairy intakes, low meat intakes and regular moderate wine consumption.[106] The New Nordic Diet is rich in fruits and vegetables (especially berries, cabbages, root vegetables and legumes), fresh herbs, potatoes, plants and mushrooms, whole grains, nuts, fish and shellfish, seaweed, free-range livestock (including pigs and poultry) and game.[107] Both these diets are shown to promote health and also generate fewer GHG emissions than average 'Western' diets.[108,109]

106 Trichopolou, A., Costacou, T., Bamia, C. and Trichopoulos, D. (2003) *Adherence to a Mediterranean Diet and Survival in a Greek Population.* N Engl J Med. 348. p.2599-2608.

107 Mithril, C., Dragsted, L. O., Meyer, C., Tetens, I., Biltoft-Jensen, A. and Astrup, A. (2013) *Dietary composition and nutrient content of the New Nordic Diet.* Public Health Nutr. 16(05) p.777-85.

108 Saxe, Henrik, Larsen, Thomas and Mogensen, Lisbeth, (2013), *The global warming potential of two healthy Nordic diets compared with the average Danish diet,* Climatic Change, 116, issue 2, p. 249-262.

109 Tilman, D. and Clark, M. (2014) *Global diets link environmental sustainability and human health.* Nature. 515. p.518–522.

In the health intervention literature the majority of studies sought to improve the overall nutritional quality of diets by increasing fruit and vegetable intake and reducing sugar, fat and sodium. Of these, few studies explicitly included the aim of reducing meat consumption. Some interventions explicitly focused on measures to increase fruit and vegetable intakes or to reduce consumption of sugar, particularly sugar-sweetened beverages or low-nutrient energy dense foods. Very few health oriented papers sought to reduce consumption of palm oil or to alter fish consumption.

6.e. Geography

In terms of geographic coverage, the vast majority of the articles covered in this study were biased towards North America and the EU. Given the obesity crisis in these regions this is understandable. It also reflects the long standing nature of environmental activism in these regions. Other countries that contributed handfuls of papers included South Africa, Australia and New Zealand, Thailand, Brazil, Mexico, South Korea, Japan and the Pacific Islands. However, it is also clear that there is a paucity of research in BRIC economics (Brazil, India and China), which is of concern as these emerging economies already have a high prevalence of overweight and obesity, while also contending with historical problems of hunger and malnutrition. These are also the regions where food related GHG emissions and other environmental pressures are set to grow rapidly in coming years, driven by growing populations and economic development. Note that the bias also partly reflects the location of the researchers (UK) and their greater familiarity with English language academic and grey literature from the UK, Europe and the US than with those published elsewhere and/or written in other languages.

7. Discussion: What did we find?

This section is structured as follows:

7.a. discusses what we know about influences on consumption, attitudes to certain foods or to changed practice and the relationship between attitudes and actions.

The remainder of Section 7 examines evidence about the effectiveness of interventions following the typology set out in Table 1:

7.b. Restrict, eliminate or incentivise choice;

7.c. Change the governance of production or consumption;

7.d. Change the context, defaults and norms of production or consumption;

7.e. Encourage collaboration and shared agreements and

7.f. Inform, educate, promote or empower.

Focusing on the key consumption practices (more fruit and vegetables, less meat and sugar and addressing palm oil and the 'difficult' fish issue), we consider what the evidence has to say about the effectiveness of interventions against the criteria set out in 5 above (where possible), and also highlight areas where evidence is weak or lacking, or where a more focused literature review is needed.

7.a. Attitudes and the attitudes-action relationship

There is a vast literature on attitudes drawn from different disciplines, and multiple approaches to categorising people according to their motivations and values. Given the limitations of this study it was impossible to be comprehensive. Most of the studies reviewed in this section are drawn from the UK or from Northern Europe. More detailed research into cross-cultural attitudes and how they vary across countries, and among populations within countries is needed.

General attitudes to healthy diets

Multiple surveys in developed countries show that the primary influences on people's consumption habits are price, affordability and taste, with

trustworthiness and convenience also high ranking concerns. [110,111,112,113,114,115] Health considerations are also increasingly stated to be important.[116] There are variations between men and women, and across the socio economic and educational spectrum. Research into attitudes to food by ethnic minority groups living in high income countries is less in evidence.[117] A global survey found that on the whole health ranks high as a concern for people and that less processed foods are seen as healthier; nevertheless there are cultural differences in the health attributes that people prioritise – some value added functionality (e.g. fortification) while others prioritise attributes such as low fat.[118]

A six country European survey (UK, Sweden, France, Germany, Poland and Hungary) of nearly 6000 food shoppers found that overall levels of knowledge on nutrition recommendations were relatively good with a majority of respondents knowing which foods should be favoured or eaten occasionally, according to recommendations. Knowledge on nutrient sources was also good for main macronutrients and food-related recommendations, but less so when it came to details such as fat quality (e.g. monounsaturated fat, trans-fat and even saturated fat) or the difference between sodium and salt. It also found that health literacy varies between countries, likely due to different cultures and foods as well as the number and type of nutrition-related public health campaigns. Higher socio economic status and being female were variables associated with greater knowledge and interest in healthy eating.[119]

110 Gilbert, L. (2013) *From Walmart to Whole Foods What Are Shoppers Looking For? Clean Label Conference 2013.* [Presentation]. [Online] Available from: http://www.globalfoodforums.com/wp-content/uploads/2013/11/2013_Clean_Label_Conference_Linda_Gilbert-FINAL.pdf.

111 Which? (2013) *Future of food: Giving people a say. Which? Consumer report, Which?* UK. [Online] Available from: http://press.which.co.uk/wp-content/uploads/2013/04/Future-of-Food-Report-2013_Final.pdf.

112 IGD (2013) *Sustainable diets: helping shoppers*. IGD. UK.

113 Konttinen, H., Sarlio-Lähteenkorva, S., Silventoinen, K., Männistö, S. and Haukkala, A. (2012) *Socio-economic disparities in the consumption of vegetables, fruit and energy-dense foods: the role of motive priorities.* Public Health Nutrition.

114 Bailey, R., Froggatt, A. and Wellesley, L. (2014) Livestock – *climate change's forgotten sector. Global public opinion on meat and dairy consumption.* The Royal Institute of International Affairs. Chatham House.

115 EC (2012) *Europeans' attitudes towards food Security, food quality and the Countryside, Special Eurobarometer 389 / Wave EB77.2 – TNS. European Commission*, Directorate-General for Agriculture and Rural Development.

116 IFICF (2014) Food & Health Survey: *Consumer Attitudes toward Food Safety, Nutrition & Health. Food Insight.* [Online] Available from: http://old.foodinsight.org/LinkClick.aspx?fileticket=fRGR4y%2bEI%2b0%3d&tabid=1492.

117 HM Government (2015) *Healthy Weight, Healthy lives: Consumer Insight Summary.* Produced by COI for the Department of Health and the Department for Children, Schools and Families; 2008. [Online] Available from: http://www.nhs.uk/change4life/supporter-resources/downloads/consumer_insight.pdf

118 Nielsen (2015) *We are what we eat: Healthy eating trends around the world*, Nielsen.

119 Grunert, K. G., Wills, J., Fernández, C. L., Lähteenmäki, L., Scholderer, J. and Bonsmann, S. S. (2012) *Socio-demographic and attitudinal determinants of nutrition knowledge of food shoppers in six European countries.* Food Quality and Preference. 26 (2) p.166-177.

Multiple surveys of UK consumers suggest a high level of awareness of dietary public health messages, such as the need to limit consumption of salty and fatty food, and to eat at least five portions of fruit and vegetables.[120] The same analysis also found that while most respondents considered their diet to be 'quite healthy' they would like to eat more healthily but that time and cost were barriers – cost especially for those on low income. Those surveyed also felt that 'eating lots of red meat' was not thought to be very, or at all important for a healthy diet in the case of adults (66%) or children (58%).[121]

Time limitations meant that detailed region-specific research into food attitudes was not possible. However we note a study focusing on China's changing food system which reviewed a range of literature on attitudes to food. It found that among Chinese consumers, concerns around food safety are a major public preoccupation, while anxieties around nutritional wellbeing, environment and animal welfare are on the increase, particularly among more affluent consumers. At the same time with rising affluence people are embracing more materialistic lifestyles, lifestyles that are associated with more resource intensive forms of consumption.[122] Finally, a review of nutrition labelling in 20 countries in the global South reported that consumers' preferences regarding labelling (such as front of pack labels, and information per portion size) were similar to those in higher income countries. However the study authors suggested that this may be because the populations included in the study were relatively better educated. It notes the need for more research into how labels are perceived among the urban and rural poor in order to assess the effectiveness of labelling policies.[123]

Attitudes to food and the environment

An 18-country Greendex survey found that people generally believed large changes were needed to improve the sustainability of the food system; however they personally felt alienated and that they had little power to help change things. As regards ideas about sustainability, consumers placed strong emphasis on the benefits of organic and local food, and expressed willingness to pay more for foods produced in this way. There was little understanding of the environmental impacts of meat production and consumption.[124]

A European on-line survey of around 4,000 consumers in six countries (UK, France, Germany, Spain, Sweden, and Poland) found medium high to high levels of concern about sustainability issues at the general level, but less concern in the context of concrete food product choices. People also had limited understanding as to what sustainability means. Understanding of four selected labels (Fair Trade, Rainforest

120 HSE (2007) *Health Survey for England* [Online] Available from: http://www.noo.org.uk/uploads/doc/vid_11171_Attitudes.pdf.

121 NOO (2011) *Knowledge and attitudes towards healthy eating and physical activity: what the data tell us.* National Obesity Observatory, National Health Service, UK.

122 Garnett, T. and Wilkes, A. (2014) *Appetite for Change: Social, economic and environmental transformations in China's food system. Examination of China 's changing food system, the emerging socio-economic, health, environmental, socio-cultural trends and their shaping drivers; challenges for coming years.* Food Climate Research Network – Oxford Martin School.

123 Mandle, J., Tugendhaft, A., Michalow, J. and Hofman, K. (2015) *Nutrition labelling: a review of research on consumer and industry response in the global South.* Global Health Action. [S.l.] v. 8.

124 Greendex (2014) *Summary of food results and analysis of behaviour change*. National Geographic.

Alliance, Carbon Footprint, and Animal Welfare) and what they signified was better. The study authors concluded sustainability labels do not play a major role in consumers' food choices.[125] The role of labelling is discussed further in Section 7.f. below.

UK focused work finds that with the exception of a few environmentally oriented segments of the population, consumers place low priority on sustainability related issues in food. When it comes to motivations and behaviours around practices many consider to be sustainable, such as buying local food, the motivation underpinning purchase of these foods may be more to do with perceptions of quality than environmental concern.[126,127]

A US survey finds that about 3 in 5 Americans have given some thought to whether their food and drink purchases are produced in an environmentally sustainable way although more than a quarter have not. Thirty seven percent say they purchase foods advertised as 'natural' while a third look for 'local' or 'organic' again suggesting that for the most part understanding of the multiple elements that constitute sustainability is somewhat hazy and that health and environmental qualities may sometimes be conflated.[128]

Attitudes to fruit and vegetables

The majority of European citizens associate a healthy diet with fruit and vegetable consumption.[129] UK based consumer surveys find a consistently high level of awareness of fruit and vegetables as a component of a healthy diet, including among low income individuals[130,131] although there may be confusion as to what constitutes a 'portion' of fruit or vegetables.[132]

There is limited information on attitudes to fruit and vegetable consumption in low and middle income countries.[133] However, a survey of 250 respondents in an urban-slum setting Nigeria reported that the majority of participants had fair knowledge of the nutritional value of fruit and vegetables.[134]

125 Grunert, K., Hieke, S. and Wills, J. 2014. *Sustainability labels on food products: consumer motivation, understanding and use*. Food Policy. 44.

126 Owen, L., Seaman, H., and Prince, S. (2007) *Public Understanding of Sustainable Consumption of Food: A report to the Department for Environment,* Food and Rural Affairs. Opinion Leader. Defra, London.

127 IGD (2013) Sustainable diets: helping shoppers. IGD, UK.

128 IFICF (2014) *Food & Health Survey: Consumer Attitudes toward Food Safety, Nutrition & Health. Food Insight.* [Online] Available from: http://old.foodinsight.org/LinkClick.aspx?fileticket=fRGR4y%2bEI%2b0%3d&tabid=1492.

129 EC (2006) *Health and food. Special Eurobarometer 246 / Wave 64.3 – TNS Opinion & Social.* European Commission: Brussels.

130 HSE (2007) *Health Survey for England* [Online] Available from: http://www.noo.org.uk/uploads/doc/vid_11171_Attitudes.pdf.

131 NOO (2005) *Low Income Diet and Nutrition Survey.* [Online] Available from: http://www.hscic.gov.uk/pubs/hse07healthylifestyles.

132 Herbert, G., Butler, L., Kennedy, O. and Lobb A. (2010) *Young UK adults and the 5 A DAY campaign: perceived benefits and barriers of eating more fruits and vegetables.* Int J Consum Stud. 34(6) p.657-64.

133 Ruel, M.T., Minot, N. and Smith, L. O. (2004) P*atterns and determinants of fruit and vegetable consumption in sub-Saharan Africa. Background paper for the Joint FAO/WHO Workshop on fruit and vegetables for health.* Kobe, Japan.

134 Lar, M. E., Daboer, J. L. A., Audu, S. and Banwat, S. L. (2012) Knowledge and Intake of Fruit and Vegetables Consumption among Adults in an Urban Community in North Central Nigeria. *The Nigerian Health Journal.* 12,1.

A US survey of >1200 students in the US finds some suggestion of a link between high fruit and vegetable consumption and high importance placed on sustainable food practices although the causality is hard to ascertain.[135]

Attitudes to meat

The Greendex survey mentioned above, found low understanding of the impact of meat on the environment, internationally.[136] However, it also found that, once informed, people said they intended to eat less meat. The survey also finds that internationally meat consumption has plateaued or reduced in the last five years with the exception of Chinese and South Korean consumers. The most commonly cited reason for this is cost (in view of the global recession), followed by health. Environmental considerations rank lowest. It suggests that consumers' self-reported motivation for eating less meat in the future is most likely to be health, followed by cost. Animal treatment, food safety, and the environment are least likely to be motivators with some country exceptions. Of those consumers who do not eat meat, ethical considerations were the most commonly cited, followed by health and the environment. An international survey by Chatham House spanning the US, various European countries as well as Brazil, China, India and South Africa[137] likewise found a huge gap in public understanding of the role of meat and livestock in climate change. While 83% of respondents agreed that human activity is contributing to climate change, only 30% identified meat and livestock as a significant contributor. The Chatham House survey also found a relationship between greater awareness of the impact of livestock on the environment and willingness to change patterns of consumption. The relationship between attitudes and actions is briefly discussed below.

A study by de Boer, Schösler and Aiking[138] looked in more detail at Dutch attitudes to various proposed strategies to reduce meat consumption: smaller portions, smaller portions of more sustainably produced meat, smaller portions of meat and more of vegetable derived protein, as well as meatless meals with or without meat substitutes. In essence the study finds that the more frequently people eat meat, the larger their portion sizes, the higher their BMI and the less likely they are to choose free range or organic meat and less likely to want to eat plant based or non-meat substitutes – and vice versa.[138] In other words, the more meat that people eat, the less likely it is that people will be open to the idea of reducing consumption.

Graça[139]analysed over 400 open ended responses to meat eating and found that respondents cluster broadly into three key groups – those who have morally internalised a strong disgust towards meat, those with no strong feelings and a willingness to change habits, and those with a strong attachment to meat and an unwillingness to change behaviour.

135 Pelletier, J. E., Laska, M. N., Neumark-Sztainer, D. and Story, M. (2013) *Positive Attitudes toward Organic, Local, and Sustainable Foods Are Associated with Higher Dietary Quality among Young Adults.* Journal of the Academy of Nutrition and Dietetics. 113(1). p.127-32.

136 Greendex (2014) *Summary of food results and analysis of behaviour change.* National Geographic.

137 Bailey, R., Froggatt, A. and Wellesley, L. (2014) *Livestock – climate change's forgotten sector. Global public opinion on meat and dairy consumption.* The Royal Institute of International Affairs. Chatham House.

138 De Boer, J., Schösler, H. & Aiking, H. (2014) *''Meatless days'' or ''less but better''? Exploring strategies to adapt Western meat consumption to health and sustainability challenges.* Appetite. 76: 120-128.

139 Graça, J., Oliveira, A. and Calheiros, M. M. (2015) *Meat, beyond the plate: data-driven hypotheses for understanding consumer willingness to adopt a more plant-based diet.* Appetite. 1(90). p.80-90.

An earlier study by the authors found that while people accept they have personal responsibilities regarding the planet, public health and animal welfare, they find ways of disengaging from the meat issue by 'explaining away' their consumption ("it's not up to me", "it's not that bad", "blame the system", "there's no alternative").[140] This suggests a strong social and cultural attachment to meat, a point underlined by Ruby and Heine[141] whose work in Canada showed the strong association between meat and masculinity, and a perception that 'healthy' or more 'vegetarian' diets are less masculine. In a rare example of a cross-cultural study in this area, Schösler *et al.*[142] examined how this link between meat consumption and framings of masculinity differs across cultures. They conducted face to face surveys of young second generation Chinese Dutch, Turkish Dutch and native Dutch adults. They found that the Turkish group was the most traditional and showed the largest gender differences and the strongest meat–masculinity link. In contrast, the native Dutch group showed the smallest gender differences and the weakest meat–masculinity link. They conclude that a combination of traditional framings of masculinity and a Western food environment where meat is abundant and cheap together impedes a transition to a less meat-based diet.

Rothgerber[143] surveyed 'semi-vegetarians' and vegetarians, and found differences in their attitudes: predictably, 'semi vegetarians' see humans as being less similar to animals and express a lower level of expressed 'disgust' towards meat than vegetarians.

The UK based 'Eating Better' alliance conducted a poll of UK citizens in 2013 and detected some small signs of change in sentiment: it found that 35% of those polled are willing to eat less meat while 20% report having reduced meat consumption over the previous year.[144] Interestingly, according to Defra's latest statistics published in 2014, there has indeed been a slight decrease in the purchase of all kinds of meat since 2010[145] although in view of the recession-induced pressures on spending it is difficult to know how much to attribute this to factors other than financial considerations.

The Eating Better alliance also commissioned a literature review into attitudes to meat.[146] This identified the main reasons for people considering eating less meat to be: animal welfare (39%), saving money (35%), food quality/safety (34%), health (33%) and provenance (33%). Environmental concerns were ranked lower: carbon footprint (31%), other environmental concerns (25%), and food security (17%). The review identified a number of drivers and barriers to eating 'better' meat or reducing its consumption while increasing fruit and vegetable intake.

140 Graça, J., Oliveira, A. and Calheiros, M. M. (2014) *Moral Disengagement in Harmful but Cherished Food Practices? An Exploration into the Case of Meat.* J. Agric. Environ. Ethics. 27. p.749-765.

141 Ruby, M. B., Heine, S. J. (2011) *Meat, morals, and masculinity*. Appetite. 56. p.447-450.

142 Schösler, H., de Boer, J., Boersema, J. J. and Aiking, H. (2015) *Meat and masculinity among young Chinese, Turkish and Dutch adults in the Netherlands*. Appetite. 89. p.152–159.

143 Rothgerber, H. (2014) *A comparison of attitudes toward meat and animals among strict and semi-vegetarians. Appetite.* 72 98-105.

144 Eating Better (2013) *New survey shows support for Eating Better messages.* Available from: http://www.eating-better.org/blog/23/new-survey-shows-support-for-eating-better-messages.html.

145 Defra (2013) *Family Food Report. Defra. London.* [Online] Available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/385694/familyfood-2013report-11dec14.pdf.

146 Dibb S and Fitzpatrick I (2014). *Let's talk about meat: changing dietary behaviour for the 21st century, Eating Better.* Available from: http://www.eating-better.org/uploads/Documents/Let'sTalkAboutMeat.pdf

Attitudes to palm oil

We found very little research into public attitudes to palm oil. Until recently palm oil was a 'hidden' ingredient in food, usually featuring on a label simply as 'vegetable oil'. However since EU legislation (EU Regulation 1169/2011)[147] came into force in 2014, foods containing palm oil must name it specifically as an ingredient.

Such research as was uncovered generally took the form of media reportage or industry presentations. This evidence suggests that awareness of palm oil as an issue varies across Europe. Some sources cite a TNS survey of 2013 which finds that public concern about palm oil and its environmental and health dimensions is high in France and French-speaking Belgium but less so in Flemish-speaking Belgium and the other countries surveyed – Italy, Australia, Germany, the Netherlands and Israel.[148] An article in a UK trade magazine, the Grocer, reports on a YouGov survey finding that only 3% of consumers are aware of the Roundtable on Sustainable Palm Oil (RSPO's) sustainable palm oil logo – a figure that has not changed since an earlier survey was undertaken in 2012.[149] On the other hand it appears that a public awareness campaign by the Rainforest Foundation in Norway has been highly successful in raising the issue's profile and has led to a massive reduction in use of unsustainable palm oil (see discussion in Attitudes to Palm Oil below).[150] The success of this campaign may reflect the importance of deforestation related issues in Norway in general – Norway is the world's single largest foreign donor to tropical forest conservation.[151] There is also some website-based commentary on low consumer interest in the sustainability dimensions of palm oil in India and China.[152]

Finally, there is some UK based discussion, largely in the media or in industry presentations, about palm oil labelling. As regards chocolate, manufacturers can be wary about putting the RSPO logo on a product because it draws attention to the presence of palm oil as an ingredient; a presence that is associated with poor quality and health concerns. Others note that there are already many labels on packages that compete for consumers' attention. Many manufacturers that do use 100% certified palm oil also choose not to put the RSPO certification trademark on product packaging, preferring instead to reference it only in CSR reports or corporate websites. One representative of the Association of Chocolate, Biscuit and Confectionery Industries of Europe points out that "What manufacturers are basically looking for is

147 EC (2014) *Food Information to Consumers – EU rules*. [Online] Available from: http://ec.europa.eu/food/food/labellingnutrition/foodlabelling/proposed_legislation_en.htm.

148 Cremona, L. (2014) E*uropean Market Challenges: creating a European consumer awareness campaign in anticipation of 2014 EU labeling regulations, MPOC Industry Seminar, Kuching.* [Online] Available from: http://www.mpoc.org.my/upload/Reach-and-Remind-2014-European-Market-Challenges-Mr-Laurent-Cremona.pdf.

149 Brown, R. (2014) *Consumers remain in dark over Sustainable Palm Oil on-pack logo*. The Grocer. [Online] Available at http://www.thegrocer.co.uk/home/topics/consumers-remain-in-dark-over-sustainable-palm-oil-logo/354339.article.

150 Rainforest Foundation Norway (undated) *Running a successful palm oil campaign*. [Online] Available from: http://www.regnskog.no/en/campaigns.

151 Mongabay (2014) *Norway puts $1.6B into rainforest conservation*. 19 August 2014. [Online] Available from: http://news.mongabay.com/2014/0819-norway-climate-forests-initiative-evaluation.html.

152 Norman, B. (2012) *GreenPalm: China and India. Sustainable Palm Oil Platform*. Available from: http://www.sustainablepalmoil.org/standards-certfication/certification-schemes/case-studies/greenpalm-kick-starting-sustainability-in-china-and-india/.

that [the consumer] trusts the brand." [153,154] Further discussion of certification and the effectiveness of labelling are provided in Section 7.f. on standards, below.

Attitudes to Sugar

Our review has identified very little research specifically investigating global consumer attitudes to sugar, and differences in these attitudes across countries. However it would be reasonable to conclude that where health awareness is high (see discussion above) there is also likely to be good understanding of the need to reduce sugar intakes. As regards the UK, The Food Standards Agency's (FSA's) biannual public attitudes *Tracker* found that concern about the amount of sugar in food ranked second in importance, after food prices, and just above concerns about salt.[155]

No research into public attitudes to sugar in relation to the environment was found.

Attitudes to fish

Relatively little research into attitudes to fish was identified. A 2014 international survey conducted on behalf of the Marine Stewardship Council[156,157] questioned nearly 10,000 seafood buyers across 15 developed countries in Europe, Asia, Australasia and North America. It found that 90% of those surveyed felt that ocean sustainability was important, 65% agreed that supermarkets should sell sustainably caught fish and 61% that restaurants should show sustainable seafood options on their menus. Thirty-three percent of respondents recognised the MSC logo, up from 25% in 2010. A higher percentage (41%) claimed actively to seek out sustainable seafood options, although the basis on which they made purchasing decisions is not clear. At present, price remains the one of the primary factors determining seafood purchasing decisions (79%), with product (66%) and sustainability (61%) also ranking highly. Respondents expressed an increased willingness to pay a little more for a product with an ecolabel (39% compared with 32% in 2010).

In the UK, a study by the supermarket Sainsbury's of adults who eat fish[158] showed that health considerations rank higher than environmental ones: 51% were encouraged to eat more fish on grounds of health while this made no difference to 48% of those surveyed. Eighteen percent were motivated to eat less fish due to concerns about

153 Dominic Bates (2015) *The chocolate companies on the hunt for a sustainable Easter egg. The Guardian. 27 March 2015.* [Online] Available from: http://www.theguardian.com/sustainable-business/2015/mar/27/chocolate-palm-oil-easter-egg-nestle-mars-lindt-cadbury-ferrero.

154 Smedley, T. (2014) *EU labelling changes force industry action on palm oil. The Guardian. 12 December 2014.* [Online] Available from: http://www.theguardian.com/sustainable-business/2014/dec/12/eu-labelling-changes-palm-oil-consumer-change.

155 FSA (2014) *Biannual Public Attitudes Tracker, Wave 8. Social Science Research Unit,* Food Standards Agency. UK. Available from: http://www.food.gov.uk/news-updates/news/2014/6124/tracker.

156 MSC (2014) *Vast majority of British consumers expect retailers and restaurants to provide sustainable seafood options: survey,* Marine Stewardship Council. 13 November 2014. Available from: http://www.msc.org/newsroom/news/vast-majority-of-british-consumers-expect-retailers-and-restaurants-to-provide-sustainable-seafood-options-survey.

157 MSC (2014) *The increasing appetite for sustainable seafood.* [Presentation] Marine Stewardship Council. 11 November 2014. [Online] Available from: http://www.slideshare.net/MSCecolabel/msc-2014?next_slideshow=1.

158 Sainsbury's (2014) *Our future with fish: Investigating customer attitudes, behaviours and motivations.*

sustainability or over-fishing and 78% reported indifference. Concerns about price rises made no difference to the amount of fish people eat in 64% cases, but had an impact on 33%. Without more detailed analysis and information it is not possible to draw conclusions about the socio economic circumstances of these survey participants and how these have a bearing on their attitudes. A 2013 survey of 145 UK consumers showed that 87% had bought fish in the last 6 months, 24% had heard of the Marine Stewardship Council (MSC), 55% always or sometimes checked if the fish was from a sustainable source, and 61% agree that there are environmental, animal welfare and human health issues with farmed seafood.[159] In a 2011 survey by Defra of 3123 UK consumers, 70% responded that it was very or quite important to them that their fish came from sustainable sources.[160] One of the main barriers this study found to buying sustainable fish was poor knowledge or recognition of the MSC label.

In a survey of 2400 French, Polish and Spanish participants and their attitudes to fish and health,[161] Pieniak *et al.* (2010) identified four consumer segments: those with a low interest in healthy eating (29.4%), 'positive health enthusiasts' (28.2%), 'health strivers' (35%) and the 'health uninvolved' (7.4%). The study results suggest that those interested in health, food and information about the food they buy have positive associations with these issues and fish consumption.

Non-food related attitudes to health and the environment

There is a vast literature on attitudes to the environment in general, on attitudes to various environmental issues (such as climate change or wilderness preservation) or on measures intended to address environmental problems (such as policy action on climate). This short review cannot consider these in depth; we simply note that studies find people and populations to vary in their attitudes towards health and sustainability by country;[162] by political or ideological persuasion;[163,164] depending how the issue or the intervention is framed; and by socio-demographic status.[165,166] Wealthier and more educated populations tend to be first to adopt pro-environmental views[167]

159 The Fish Site (2013) *Attitudes of UK Consumers to Farmed Seafood*. The Fish Site. 18 February 2013. Available from: http://www.thefishsite.com/articles/1560/attitudes-of-uk-consumers-to-farmed-seafood/.

160 Defra (2011) *Attitudes and Behaviours around sustainable food purchasing.* Department for Environment, Food and Rural Affairs, UK.

161 Pieniak, Z., Verbeke, W., Olsen, S.O., Hansen, K.B. and BrunsØ, K. (2010). *Health-related attitudes as a basis for segmenting European fish consumers.* Food Policy. 35.

162 National Geographic (2014) *Consumer Choice and the Environment – A Worldwide Tracking Survey.* The National Geographic. [Online] Available from: http://environment.nationalgeographic.com/environment/greendex/.

163 Kahan, D. M. (2015) *Climate-Science Communication and the Measurement Problem*. Political Psychology. 36(1).

164 Zia, A. and Todd, A. M. (2010) *Evaluating the effects of ideology on public understanding of climate change science: how to improve communication across ideological divides?* Public understanding of science. 19(6). p.743-61.

165 Hamedani, M.G., Markus, H.R. and Fu, A.S. (2013) I*n the Land of the Free, Interdependent Action Undermines Motivation*. Psychological Science.

166 Wardle, J. and Steptoes A. (2003) *Socioeconomic differences in attitudes and beliefs about healthy lifestyles*. J Epidemiol Commun H.

167 Nawrotzki, R. J. and Pampel, F. C. (2013) *Cohort change and the diffusion of environmental concern: A cross-national analysis.* Population and environment. 35(1).

although, ironically, their carbon footprints tend to be higher.[168,169] Regarding health, lower socio-economic status has been associated with less health consciousness, and stronger beliefs in the influence of chance upon health status, which in turn influences behaviour.[165]

Such variations are also likely to play out in relation to attitudes to health and sustainability in diet as well as to specific food types, and there may be merit in further food-specific research that draws upon these insights.

What do we know about the relationship between attitude and action?

The value-action gap is a well-recognised phenomenon and occurs across a range of issues, including stated intentions to eat more healthily, to live more sustainably, or to buy animal products that meet higher welfare standards.[170] Numerous studies highlight the complex relationship between what participants' state they prefer, base decisions on, or perceive as barriers to behaviour change – and their actual measurable consumption choices.[169,171,172] Essentially other factors, including habit, taste, cost or convenience tend to rank more highly at the moment of purchase than issues of health, welfare or sustainability, although as noted above in the case of fish, some purchases are health driven.[173,174] Moreover, people may intend well, but not always be able to make the connection between abstract values and concrete practices.[175]

7.b. Fiscal measures: Disincentivise or incentivise choices through fiscal measures

A significant body of health-oriented literature considers whether taxes or subsidies are effective mechanisms, either independently or in combination, to regulate consumption and thereby improving health outcomes.[176] Much of the tax oriented literature focuses on sugar (particularly sugar-sweetened beverages – SSBs), fats and highly processed foodstuffs while subsidy-oriented interventions centre on fruit and vegetables. A

168 Fahmy, E., Thumim, J. and White, V. (2011) *The distribution of UK household CO2 emissions: Interim report. JRF programme paper: Climate change and social justice.* Joseph Rowntree Foundation. [Online] Available from: http://www.jrf.org.uk/sites/files/jrf/carbon-reduction-policy-full.pdf.

169 Freeman, S. B., (2009) *The Correlation of Socio-Economic Status to Consumption Using Greenhouse Gas Emissions as a Measurement*. Capstone Collection. Paper 1287. Available from: http://digitalcollections.sit.edu/capstones/1287

170 Dixon, J. and Isaacs, B. (2013) *Why sustainable and nutritionally correct food is not on the agenda: Western Sydney, the moral arts of everyday life and public policy.* Food Policy. 43. p.67-76.

171 Dixon, J. and Isaacs, B. (2013) *Why sustainable and nutritionally correct food is not on the agenda: Western Sydney, the moral arts of everyday life and public policy.* Food Policy 43.0: 67-76.

172 RSPCA (2007) *Consumer attitudes to animal welfare.* RSPCA.

173 Mäkiniemi, J. P. and Vainio, A. (2014) *Barriers to climate-friendly food choices among young adults in Finland.* Appetite. 74. p.12-19.

174 Dixon, J. and Isaacs, B. (2013) *Why sustainable and nutritionally correct food is not on the agenda: Western Sydney, the moral arts of everyday life and public policy.* Food Policy. 43. p.67-76.

175 Maio, G. R. (2011) *Don't Mind the Gap Between Values and Action. Values and Frames*. [Online] Available from: www.valuesandframes.org.

176 ECORYS (2014) *Food taxes and their impact on competitiveness in the agri-food sector: Annexes to the Main report*. Ref. Ares(2014)2604304. Rotterdam. The Netherlands. [Online] Available from: http://ec.europa.eu/DocsRoom/documents/6150/attachments/1/translations/en/renditions/pdf.

combination of the two as a means of improving entire diets is also explored. The significant focus on sugar, particularly SSBs, reflects not only health concerns but also the sense that SSBs are 'unnecessary' and therefore a legitimate area for intervention;[177] in practice considerable efforts are made by industry to contest them.

Our review covers both experimental and model-based analyses. A number of systematic reviews drew upon both approaches to investigate the impacts of fiscal measures on a range of outcomes including weight, diet quality and nutritional status. The interventions we analysed centred on a range of European countries, the UK, Brazil, North America and Mexico with some studies in India, Ghana and North Africa. A limited number of studies, all model-based and by European authors, examined the role of fiscal measures in shifting consumption practices to achieve GHG emission reductions.

Health oriented studies

Several systematic reviews of both simulated and experimental food-pricing studies in developed countries (covering taxes on SSBs and saturated fat, and/or subsidies on fruits and vegetables) concluded that these measures would improve diets and potentially improve health outcomes although the range in magnitude of impact was not reported.[178,179,180] Another systematic review, by Thow *et al.* comes to similar conclusions.[181] However, the authors draw attention to the high proportion of modelling studies among those reviewed, and their limitations. Models are based on assumptions, subject to data limitations and tend not to consider shifts in consumption within or across food categories. This, the 'substitution effect' is an important area for further research, and should explicitly be addressed in future evaluations of actual interventions. They also note wide variations in data sources and analytical methods, making comparisons across studies difficult, and the fact that most of the evidence came from high-income countries.

Thow *et al.* also highlight two studies[181,182] that respectively model a 50% and 20% tax on consumption and body weight and find no effects. However they note that Chouinard *et al.*[182] modelled a tax on fat from dairy products, which, as a core food group in the USA may be less price elastic than fats from other food groups. Kuchler *et al.*[183] note that varying the price elasticity estimates used in the model substantially changed consumption and body weight outcomes.

177 Brownell, K. D. and Frieden, T. R. (2009) *Ounces of Prevention — The Public Policy Case for Taxes on Sugared Beverages.* N Engl J Med. 360. p.1805-1808.

178 Eyles, H., Ni, M. C., Nghiem, N. and Blakely, T. (2012) *Food pricing strategies, population diets, and non-communicable disease: a systematic review of simulation studies.* PLoS medicine. 9(12).

179 Andreyeva, T., Long, M.W. and Brownell, K.D. (2008) T*he impact of food prices on consumption: a systematic review of research on the price elasticity of demand for food.* Government, Politics and Law. 100(2).

180 Niebylski, M. L., Redburn, K. A., Duhaney, T. and Campbell, N. R. C. (2015) *Healthy Food Subsidies and Unhealthy Food Taxation: A Systematic Review of the Evidence.* Nutrition.

181 Thow, A. M., Jan, S., Leeder, S. and Swinburn, B. (2010) *The effect of fiscal policy on diet, obesity and chronic disease: a systematic review.* Bulletin of the World Health Organization. 88(8). p.609-14.

182 Chouinard, H. H., Davis, D. E., LaFrance, J. T. and Perloff, J. M. (2007) *Fat taxes: big money for small change.* Forum Health Econ Policy. 10(2).

183 Kuchler, F., Tegene, A. and Harris, J. M. (2004*) Taxing snack foods: what to expect for diet and tax revenues.* Agric Info Bul. 8. p.1-11.

Powell *et al.*'s systematic review of health taxes and subsidies in the US also looked at weight outcomes, and found evidence of impacts to be small or inconsistent.[184] In a study of the effectiveness of a volume-based soft drink excise tax in 19 European countries, Jou and Techakehakij suggest that a specific fiscal measure may have different effects in different countries depending on factors such as the baseline tax rate, population obesity rate and consumption behaviours. Where possible, models should be designed that are able to take these factors into account.[185]

A systematic review of empirical evidence for combinations of subsidies and taxes (which also included some of the same studies highlighted in the other systematic review literature) concludes that the net effects were small and does not recommend the use of fiscal instruments. It also speculates that a single nutrient tax might have unhelpful consequences – for example a fat tax may lead manufacturers to substitute sugar for fat – and identified this as an under researched area, requiring further study.[186] Finally they recommend that other approaches may hold more potential such as public awareness programmes, youth education programmes, whose effectiveness is discussed further in 7.f. below.

Regarding individual studies, a study from Norway analysed households that purchased low, median and high levels of healthy and unhealthy foods. It modelled the effects of VAT increases for unhealthy food and VAT removals for healthy food. The model found that VAT increases would be more effective in reducing unhealthy food purchases among high-purchasing households than a VAT removal would be in increasing healthy food purchases among low-purchasing households; in other words the strength of 'negative' measures was greater than that of the positive ones.[187] A US study on SSBs found that a penny per ounce[188] tax could improve public health and generate revenues. None of these studies model the impact on health outcomes, such as the prevalence of obesity.

As regards evidence that is drawn from actual interventions, evidence suggests that in the four months following introduction of a tax of 0.07 EUR per litre in France on all drinks with added sugar or artificial sweeteners, supermarket sales declined by 3.3%.[189] Preliminary analysis of the 10% Mexican soda tax suggest that sales of sweetened beverages have dropped by 10% (between the last quarter of 2013 and the first quarter of 2014) while sales of untaxed beverages (such as diet sodas, bottled or zero calorie flavoured water, 100% juices, and plain milk) have increased by 7%. The costs of the

184 Powell, L. M., Chriqui, J. F., Khan, T., Wada, R. and Chaloupka, F. J. (2013) *Assessing the potential effectiveness of food and beverage taxes and subsidies for improving public health: a systematic review of prices, demand and body weight outcomes.* Obesity reviews. 14(2) p.110-28.

185 Jou, J. and Techakehakij, W. (2012) *International application of sugar-sweetened beverage (SSB) taxation in obesity reduction: factors that may influence policy effectiveness in country-specific contexts.* Health Policy. 107(1) p.83-90.

186 Clark, J. S., Dittrich, L.O. and Xu, Q. (2014) *Empirical evidence of the efficiency and efficacy of fat taxes and thin subsidies.* Central European journal of public health. 22(3) p.201-6.

187 Gustavsen, G. W. and Rickertsen, K. (2013) A*djusting VAT rates to promote healthier diets in Norway: A censored quantile regression approach.* Food Policy. 42. p.88-95.

188 Andreyeva, T., Chaloupka, F. J. and Brownell, K. D. (2011) *Estimating the potential of taxes on sugar-sweetened beverages to reduce consumption and generate revenue.* Prev Med. 52(6) p.413-6.

189 Lavin, R. T. H. (2013) *Exploring the Acceptability of a Tax on Sugar-Sweetened Beverages Brief Evidence Review.* Applied Health and Wellbeing Partnership, Centre for Public Health, Liverpool John Moores University. [Online] Available from: http://www.cph.org.uk/wp-content/uploads/2013/11/SSB-Evidence-Review_Apr-2013-2.pdf.

taxes have mainly been passed on to consumers – that is, not absorbed by producers. A more rigorous evaluation of the Mexican soda tax is underway.[190,191,192,193]

Other research suggests that taxes need to increase product prices by at least 20% to be effective in reducing obesity.[188] A UK study that modelled the effect of a 20% tax on SSBs suggested that it would reduce obesity levels by 1.3%, with the impacts greatest among young people.[194] Tiffin *et al.*[195] also look at the effects of a soft drink tax in the UK, exploring four taxation scenarios – including those that have already been introduced in France and Hungary. They find that high consuming households respond more than moderate consuming ones, but that substitution effects, including among non-taxed foods and drinks, also need to be considered; the impacts can either be complementary or contradictory depending upon the tax's design. Overall, it finds the impacts of a tax to be modest.

Modelling studies can be helpful in identifying the ways in which the effects of taxes and subsidies may fall differently across different income groups. This is particularly important in countries with significant socio-economic inequality; indeed some question the logic of designing interventions affecting entire populations to address the needs of particular groups and suggest that targeted efforts and policies might be more effective.[196,197] The systematic review by Thow *et al.* discussed above reported on a range of studies which found differing impacts on low-income consumers. Some find that taxes disproportionately affect low income groups who do not reduce their consumption habits, and for whom the impacts on overall household budgets are disproportionately large, while others find these taxes to be only slightly regressive. Thow *et al.* argue that a combination of taxes and subsidies could reduce regressive effects.[198]

A microsimulation by Kristensen *et al.*[199] examined the potential impact on child and adolescent obesity of three government policies – a tax on SSBs, a ban on television food advertising to children, and an after-school physical activity programme.

190 UNC (undated) *Evaluation of 2014 SSB & Non-Essential Foods Taxes in Mexico*. [Online] Available from: http://uncfoodresearchprogram.web.unc.edu/projects/mexico-tax-eval/.

191 INSP (undated) Resultados preliminares sobre los efectos del impuesto a bebidas azucaradas y alimentos básicos de alta densidad energética sobre sus precios. National Institute of Public Health of Mexico. [Online] Available from: http://www.insp.mx/epppo/blog/preliminares-refresco-alimentos.html.

192 INSP (undated). *Resultados preliminares sobre los efectos del impuesto de un peso a bebidas azucaradas en México.* National Institute of Public Health of Mexico. [Online] Available from: http://www.insp.mx/epppo/blog/preliminares-bebidas-azucaradas.html.

193 WSJ (2014) Survey Shows Mexicans Drinking Less Soda After Tax. *The Wall Street Journal.* Oct. 13, 2014. [Online] Available from: http://www.wsj.com/articles/survey-shows-mexicans-drinking-less-soda-after-tax-1413226009.

194 Briggs, A. D. M., Mytton, O. T., Kehlbacher, A., Tiffin, R., Rayner, M. and Scarborough, P. (2013). *Overall and income specific effect on prevalence of overweight and obesity of 20% sugar sweetened drink tax in UK: econometric and comparative risk assessment modelling study.* BMJ.347(6189).

195 Tiffin, R., Kehlbacher, A. and Salois, M. (2014) *The effects of a soft drink tax in the UK*. Health Economics.

196 Tiffin, R. and Arnoult, M. (2011) The public health impacts of a fat tax. *European journal of clinical nutrition*. 65(4) p.427-33.

197 Tiffin, R. and Salois, M. (2012) *Inequalities in diet and nutrition*. The Proceedings of the Nutrition Society. 71(1) p.105-11.

198 Thow, A. M., Jan, S., Leeder, S. and Swinburn, B. (201) *The effect of fiscal policy on diet, obesity and chronic disease: a systematic review*. Bulletin of the World Health Organization. 88(8) p.609-14.

199 Kristensen, A. H., Flottemesch, T. J., Maciosek, M. V., Jenson, J., Barclay, G., Ashe, M., Sanchez, E., Story, M., Teutsch, S. M. and Brownson, R. C. (2014) *Reducing Childhood Obesity through U.S. Federal Policy A Microsimulation Analysis*. Am J Prev Med. 47(5) p.604–612.

While it found that all three approaches led to improvements, the tax was to be preferred since it generated revenue for additional obesity prevention activities and could also impact upon adult consumption of SSBs.

Some studies have used economic and/or economic-epidemiological modelling approaches to investigate the optimal threshold at which a tax or subsidy is most likely to achieve the greatest health impacts for the largest population. Basu and colleagues developed a model investigating the possible effects on the burden of cardiovascular mortality of a 20% tax on palm oil in India between 2014 and 2023. The study models the effects of a reduction in fat consumption, and substitution with alternatives including a polyunsaturated cooking fat (e.g. soybean oil). They conclude that this would avert around 363 000 (95% confidence interval 247 000 to 479 000) deaths during the same period (which represents 1.3% of cardiovascular mortality in India). The study suggests that subsidies might be one mechanism to address concerns that the tax might increase food insecurity among rural women.[200] Tiffin and Salois[201] focusing on the UK, specifically consider the welfare implications of taxes on unhealthy foods in combination with subsidies on fruit and vegetables. They conclude that since lower income households tend to consume more unhealthy foods and higher income households more healthy foods, a combination of taxes and subsidies increases regressive effects. They note, though, that while income impacts may be regressive and the health benefits may be progressive; the real effects will depend on the responsiveness of different population groups to the taxes and subsidies.

An empirical review of health subsidy programmes in high income countries that largely focused on perinatal women and children reported a 10-20% increase in consumption of targeted nutrients, and a small but significant increase in mean birth weight. However, there is limited evidence on the sustained effect of these interventions.[202]

Some studies also point out that government revenues gained from taxes could be used for public health measures or other services, which could increase their public acceptability.[203] During the 1980s Ireland levied a tax on SSBs in order to raise additional revenue (rather than to improve health).[204] Although the tax was subsequently abandoned there is some evidence of public support for a new tax on SSBs in Ireland. Similarly, a study examining the introduction of a Danish tax on saturated fat in 2011 and the circumstances of its repeal in 2012 suggest that opposition to the tax was largely because it had been introduced to generate revenue.[205] In a study on the context and implementation of taxation of soft drinks in

200 Basu, S., Babiarz, K. S., Ebrahim, S., Vellakkal, S., Stuckler, D., Goldhaber-Fiebert, J. D. (2013) *Palm oil taxes and cardiovascular disease mortality in India: economic-epidemiologic model*. BMJ. 347.

201 Tiffin, R. and Salois, M. (2014) *The distributional consequences of a fiscal food policy: evidence from the UK.* European Review of Agricultural Economics.

202 Black, A. P., Brimblecombe, J., Eyles, H., Morris, P., Vally, H. and Dea, O. (2012) *Food subsidy programs and the health and nutritional status of disadvantaged families in high income countries: A systematic review.* BMC Public Health. 12(1099).

203 Brownell, K. D. and Frieden, T. R. (2009) Ounces of prevention--the public policy case for taxes on sugared beverages. *The New England Journal of Medicine.* 360(18) p.1805-8.

204 Bahl, R., Bird, R. and Walker, M. B. (2003) *The Uneasy Case Against Discriminatory Excise Taxation: Soft Drink Taxes in Ireland.* Public Finance Review. 31 p.510-533.

205 Vallgarda, S., Holm, L. and Jensen, J. D. (2015) *The Danish tax on saturated fat: why it did not survive.* Eur J Clin Nutr. 69(2) p.223-6.

four Pacific Islands the authors suggested that success depended on it being clearly linked to the government's fiscal priorities, and able to be administered through existing tax systems.[206] In Algeria, France, Hungary and Mexico where these taxes have been implemented, it has been suggested that the ring-fencing of revenues to fund public health or health prevention programmes has increased public acceptability.[207]

Taxes may also reinforce efforts to educate consumers; being aware that a product has been taxed because it is unhealthy may discourage purchases. In an experiment of over 350 US shoppers, individuals were asked to choose – hypothetically – between high-fat and healthier snacks; the high fat foods were taxed. Some of the taxed items also came with a warning label stating that they were being taxed because of their high fat content. The responses were analysed, and showed three groups of consumers. While two of the groups were already sensitive to either price or to less healthy snacks and tended to avoid them, the group with the highest body weight seemed deterred only by the warning label. The authors conclude "it appears that it is more important to tell people that the product is taxed because it is less healthy than to actually tax it."[208]

A systematic review focusing on pricing interventions in schools – including the provision of free or cheap fruit and vegetables, and increases in the price of unhealthy foods – found that these can be effective. The study also finds that other financial incentives may be effective, including those geared at facilitating schools' participation and teachers' involvement in health-promoting educational activities as well as incentives that remove or reduce barriers for such participation. However the study also noted that price changes could exacerbate social inequalities[209] and warned that financial incentives potentially undermine intrinsic motivations to adopt healthier eating patterns, risking a return to unhealthier behaviours once incentives are withdrawn.

A study by Asfaw (2007) provides an example of a subsidy programme intended to promote food security in a middle income country, Egypt, but which has also had negative consequences. The subsidy programme provides bread (called baladi bread), wheat flour, sugar, and cooking oil at a subsidized price. The bread subsidy (at 57%) is available to all; the other foods are available only to lower income ration card holders and are also heavily subsidised at varying rates depending on income levels. Assessing the impact of the program on mothers' weight, the study found an inverse relationship between the mothers' BMI and both the price of baladi bread and of fully and partially subsidized sugar. It also finds a direct relationship between high priced healthier foods such as fruits, milk, and eggs and BMI; the implication, he suggests is that reducing the relative price of healthy diets is likely to reduce the BMI of mothers.[210] Note that the

206 Thow, A. M., Quested, C., Juventin, L., Kun, R., Khan, A. N. and Swinburn, B. (2011) *Taxing soft drinks in the Pacific: implementation lessons for improving health.* Health Promot. Int. 26(1) p.55-64.

207 Lavin, R. T. H. (2013) *Exploring the Acceptability of a Tax on Sugar-Sweetened Beverages Brief Evidence Review*. Applied Health and Wellbeing Partnership, Centre for Public Health, Liverpool John Moores University. [Online] Available from: http://www.cph.org.uk/wp-content/uploads/2013/11/SSB-Evidence-Review_Apr-2013-2.pdf.

208 Lacanilao, R. D., Cash, S. B. and Adamowicz, W. L. (2011) Heterogeneous Consumer Responses to Snack Food Taxes and Warning Labels. *Journal of Consumer Affairs.* 45(1) p.108-122.

209 Jensen, J. D., Hartmann, H., de Mul, A., Schuit, A., Brug, J. and Consortium, E. (2011) *Economic incentives and nutritional behaviour of children in the school setting: A systematic review.* Nutr Rev. 69(11) p.660-74.

210 Asfaw, A. (2007) *Do government food price policies affect the prevalence of obesity? Empirical evidence from Egypt*. World Dev. 35. p.687-701.

subsidy programme is extremely expensive. It has been reported that it is currently being overhauled in order to reduce costs and trading on the black market, to target more specifically on poor people and to extend the range of subsidised foods to include healthier items.[211]

An EU commissioned study was one of the few that examined not just the effect of food taxes on consumption but also on profitability, competitiveness and employment in the supply chain and trade flows within Europe.[212] These non agri-food considerations are important in order to understand where and why objections to taxation might arise from within the food industry and the wider implications of a tax on socio-economic determinants of health, including incomes and employment.

The study, based on literature reviews, interviews with agri-food stakeholders and case studies, concluded that in general food taxes lead to reduced consumption of the taxed products and, in some cases, product reformulation aimed at reducing the sugar, salt and fat levels. It is also found that product substitution takes place; cheaper brands of taxed products may be consumed in place of more expensive versions, or non-, or-less, taxed products may be consumed instead. The report notes that the actual impacts on public health are still unclear. As to competitiveness, taxes increased administrative burdens and potentially but not necessarily profitability since other factors, including the impact of the tax on demand for substitute products and other factors not influenced by taxation were also important. Employment may be negatively impacted but the impacts on labour productivity were unclear. Cross border shopping effects (a major argument against the Danish fat tax and a concern which was subsequently shown to be unfounded) were limited and other factors, in particular other taxes on food/drinks, are found to be more important drivers for the cross-border shopping effect. The competitiveness of individual firms within a member state can be affected. The report notes that more research is needed as empirical health data becomes available over time. Additional availability of empirical data over time will also improve understanding of the effects of the taxes on agri-food sector competitiveness.

Finally Cornelsen *et al.*[213] warn against overemphasising the potential role of fiscal instruments in health policy. They argue that the substitution effects of taxes are not fully understood; foods consumed in the place of taxed foods may be healthy or unhealthy, while subsidies may also affect the overall spending decisions that people make. They note too, the insufficient understanding of how taxes affect costs and decision-making further up the supply chain – for example the increased cost to producers may or may not be passed onto consumers, or may be shared across foods, including those that are not the intended target for change. Their conclusion is not that fiscal measures should be avoided but that the empirical evidence base is poor and that these instruments constitute just one of a range of needed approaches to alter the context in which people consume.

211 Fick, M. (2014) *Egypt must target neediest in food subsidy reforms. WFP, Reuters. 27 October 2014.* [Online] Available from: http://uk.reuters.com/article/2014/10/27/us-egypt-foodsecurity-idUSKBN0IG20J20141027.

212 Ecorys (2014) *Food taxes and their impact on competitiveness in the agri-food sector. Final report For DG Enterprise and Industry*. ECSIP Consortium, Rotterdam.

213 Cornelsen, L., Green, R., Dangour, A. and Smith, R. (2014) Why fat taxes won't make us thin. *Journal of Public Health.* 37(1) p.18–23.

Environment oriented studies

Taxes seeking to alter agricultural practices have been introduced in certain countries, targeting inputs such as fertilisers. The effects on desired outcomes such as reduced nitrogen pollution have been limited due to variations in climate and soils (i.e. some soils require more nitrogen than others) and because non-targeted inputs, such as manures, can be used instead, which may still cause pollution. Input taxes have often been set too low and so do not alter practice. Taxes on emissions may have greater effects but can be hard and expensive to monitor and measure (Garnett, 2012).[214]

Studies that examine such production-centred mechanisms tend not to make the link with consumption or even consider consumption as a variable. For example one study modelled four scenarios for achieving a 20% reduction in agricultural GHG emissions in Europe by 2020.[215] Four main policy options were considered – two emissions caps, an emission trading scheme, and a livestock tax. It found that all four scenarios could achieve reductions approaching 20% through differing combinations of increased efficiencies and reduced production, particularly in the beef sector. However, when emission leakage is factored in, the reductions in EU emissions are partially offset by emissions increases in the rest of the world, mainly as a result of higher net imports of feed and animal products. Thus in this study demand is assumed to be relatively inelastic and so the higher production costs are absorbed by the consumer.

However Wirsenius *et al.*[216] do factor in demand elasticities. They model the GHG effects of an animal product consumption tax in the EU equivalent to €60/tonne CO_2 eq. This translates into varying increases in the end price paid by consumers – a 16% increase in the cost of ruminant meat and a 4% increase for poultry. On average, price changes of this magnitude would mean that consumption of ruminant meat would fall by 15% while that of pork and poultry increases by 1% and 7% respectively due to substitution between meat categories. Overall food consumption is reduced by 1% in energy terms. The study concludes that a tax of this order would reduce EU agricultural emissions by 7%, and potentially up to six times more if the land spared from animal production were used for bioenergy production. It notes, however, that the tax would be regressive and that the impacts on imports and exports need to be considered. Health impacts are not quantified.

Briggs *et al.*[217] model two tax scenarios in the UK for all foods: (A) a carbon tax applied to all food and drink groups with above average GHG emissions, and (B) as with scenario (A) but food groups with emissions below average are subsidised to create a tax neutral scenario. The study finds that emission reductions are achieved under both scenarios. However, scenario A also delivers a reduction in premature deaths due to improved health outcomes (1.4% reduction in all UK deaths) as well as well as taxation

214 Garnett, T. (2012) *Climate change and agriculture: Can market governance mechanisms reduce emissions from the food system fairly and effectively?* International Institute for Environment and Development.

215 Leip, A., Weiss, F., Wassenaar, T., Perez, I., Fellmann, T., Loudjani, P., Tubiello, F., Grandgirard, D., Monni, S. and Biala, K. (2010) *Evaluation of the livestock sector's contribution to the EU greenhouse gas emissions (GGELS) -final report,* European Commission, Joint Research Centre.

216 Wirsenius, S., Hedenus, F. and Mohlin, K. (2010) *Greenhouse gas taxes on animal food products: rationale, tax scheme and climate mitigation effects.* Climatic Change.

217 Briggs, A. D. M., Kehlbacher, A., Tiffin, R., Rayner, M. and Scarborough, P. (2013) *Assessing the impact on chronic disease of incorporating the societal cost of greenhouse gases into the price of food: an econometric and comparative risk assessment modelling study.* BMJ Open. 3(10).

revenue; Scenario B is revenue neutral and leads to a slight increase in premature mortality. This is because a subsidy on low GHG foods lowers the cost of sugar based products (which have a low carbon intensity), and in turn undermines health.

Edjabou and Smed[188] consider four climate-related tax scenarios in Denmark. In two, a climate tax of differing levels is placed on all food items with VAT remaining the same (uncompensated). In two other scenarios, a climate change tax of differing levels is introduced but VAT is lowered to achieve revenue neutrality. In all scenarios GHG emissions fall – by up to 19% in the uncompensated higher tax scenario. In the uncompensated scenarios, sugar, saturated fat and calorie intakes also fall, suggesting a win-win for climate and public health. Beef intakes fall in all scenarios. However in the compensated scenarios calories and sugar intakes rise due to lowered VAT and sugar's relatively low carbon footprint.[218] Effects on health outcomes such as obesity or CVD are not quantified.

7.c. Change the governance of production or consumption

The political, economic, social and physical influences on the production, trade, distribution and ultimately consumption of food, and the health, societal and environmental consequences of these, are profound. Macro-economic policies relating to production and trade; national level policies around urban planning and public procurement; and the governance of advertising are all 'interventions' in that they determine what food is available, affordable, accessible and 'normal' in a given society. Establishing the link between such interventions and health outcomes is not easy given the scale of these forces and the complex interactions among them, and as a result much of the available literature tends to be polemic or advocacy-oriented in nature. However more academically-oriented attempts at analysing and, where possible, measuring the impacts of these 'natural' experiments have been attempted and are included here.

Macro-economic agri-food policies

There is considerable analysis of the driving influences on the nutrition transition – a global phenomenon defined as a shift towards Westernised diets rich in processed foods, sugars, oils and meat, and low in fruit and vegetables. These analyses argue that the nutrition transition is an outcome of interacting political, economic and social developments including government support for agriculture via subsidies and research and development (R&D) in high income and rapidly industrialising economies such as China; technological investment along the whole value chain; a trade liberalisation agenda advanced by the World Trade Organisation (WTO) and associated international agreements that enable foreign investment into emerging markets, the rise of industrialised export agriculture and of transnational manufacturing and retailing food

218 Edjabou, L. D. and Smed, S. (2013) *The effect of using consumption taxes on foods to promote climate friendly diets – The case of Denmark.* Food Policy. 39. p.84–96

companies; and the growth of powerful media corporations, which have contributed to cultural homogenisation worldwide.[219,220,221,222,223]

The impacts of such changes on consumption patterns and public health can be explored using cross-sectional survey data from before and after an 'intervention' – defined here as a policy change implemented for reasons that may have little or nothing to do with health. While conclusions may be muddied by various confounding factors they can offer insights into the changes associated with an intervention.

The role of agricultural subsidies in contributing to obesity is one obvious area for investigation. Support for agricultural production through, for example the Common Agricultural Policy (CAP) or US agricultural subsidies, combined with investment in agricultural research have dramatically changed the supply and availability of food since the Second World War. It has often been argued that such subsidies, by distorting markets and prices, have contributed to the public health crisis experienced in many EU countries and in particular to overconsumption of meat, dairy and sugar.[224,225]

While this may have been the case up until the 1980s, developments since then suggest that this analysis is overly simple. Agricultural subsidies in OECD countries have halved since the 1980s; they account on average for 19% of gross farm receipts, although there is considerable variation between countries (compare less than 3% for Australia, New Zealand and Chile with half-to-two thirds for Switzerland, Norway, Iceland and North Korea).[226] They have also become increasingly decoupled from production, shifting instead to supporting environmental or social objectives.

219 Hawkes, C. (2005) *The role of foreign direct investment in the nutrition transition.* Public Health Nutr. 8(4) p.357-65.

220 Hawkes, C. (2006) *Uneven dietary development: linking the policies and processes of globalization with the nutrition transition, obesity and diet-related chronic diseases.* Globalization and Health. 2(4).

221 Baker, P., Kay, A. and Walls, H. (2014) *Trade and investment liberalization and Asia's noncommunicable disease epidemic: a synthesis of data and existing literature.* Globalization Health. 10(1).

222 Popkin, B. M. (2006) *Technology, Transport, Globalization and the Nutrition Transition Food Policy*. Food Policy. 31(6).

223 Popkin, B. M., Adair, L. S. and Ng, S. W. (2012) *Global nutrition transition and the pandemic of obesity in developing countries.* Nutr Rev. 70(1) p.3-21.

224 Birt, C. (2007) *A CAP on health? The impact of the EU common agricultural policy on public health*. A report by the Faculty of Public Health, London, UK.

225 Schäfer, E. L. (2005) *Obesity, hunger, and agriculture: the damaging role of subsidies.* BMJ. 331.

226 OECD (2014) *Agricultural Policy Monitoring and Evaluation.* OECD.

Equally importantly, as supply chains have become longer and more complex the link between the price of the commodity inputs relative to the end price of the product – and the impact of the subsidy on that price – has weakened.[227,228] Thus Beghin and Jensen find no correlation between corn prices, and the consumption of sweetened beverages in the USA since 1993, or between fluctuations in sugar price and sugar consumption. Other factors such as investment in and support for yield increases, together with advances in processing technologies are, they find, much more significant; these have lowered the cost of production and made them attractive as a cheap ingredient for the manufacturing industry. Thus a much stronger link can be found between obesity and support for research and development, including for the production of cheaper sweeteners such as high fructose corn syrup. [226,229] To summarise, as value chains become more complex, the link between farm practices and retail price weakens and the relative importance of 'value adding' processes further downstream grows.

International examples support the limited link between agricultural subsidies per se and non-communicable diseases. Australia and New Zealand, where obesity rates in men show similar trends to those in the US, phased out their farm subsidy programmes in the 1980s and 1990s.[230] If 'Producer Support Estimate' is used as a measure of farm subsidy,[231] international comparisons reveal examples where subsidy regimes are higher than in the USA and EU countries, and obesity rates are much lower – South Korea, Japan, and Switzerland. Within the EU, where subsidy rates are the same, we also see little correlation between farm subsidy and obesity. France has comparatively low obesity rates, while the UK has rates similar to the USA.

Overall these analyses indicate that protectionist agricultural policies in developed countries do not necessarily lead to diets that cause obesity and associated illnesses. The role of actors beyond the farm gate (processers, retailers etc.) in influencing the product's end price, together with non-price influences, also need to be understood.

However the situation in low and middle income countries where there is a stronger relationship between commodity prices and the end cost of a product may be different. Friel *et al.* cite research showing that in the Pacific Island countries, increased support for export crop production has resulted in a shift in agricultural land use away from traditional crops (particularly staple grains) towards 'cash crops' typically grown for export (such as refined cereals and vegetable oils). This in turn can affect people's ability to access and afford staple or traditional foods.[232,233]

227 Alston, J.A., Sumner, D.A. and Vosti, S.A. (2008) *Farm subsidies and obesity in the United State: National evidence and international comparisons*. Food Policy. 33.

228 Miller, J.C. and Coble, K.H. (2007) *Cheap food policy: facto or rhetoric?* Food policy. 32.

229 Beghin, J. C. and Jensen, H. H. (2008) *Farm Policies and Added Sugars in US Diets, Working Paper 08-WP 462*. Center for Agricultural and Rural Development, Iowa State University.

230 Alston, J.A., Sumner, D.A. and Vosti, S.A. (2008) *Farm subsidies and obesity in the United State: National evidence and international comparisons.* Food Policy. 33.

231 OECD (2014) *Agricultural Policy Monitoring and Evaluation.* OECD.

232 Friel, S., Hattersley, L., Snowdon, W., Sacks, G., Swinburn, B., Thow, A. M., Lobstein, T., Sanders, D., Barquera, S., Mohan, S., Hawkes, C., Kelly, B., Kumanyika, S., L'Abbe, M., Lee, A., Ma, J., Macmullan, J., Monteiro, C., Neal, B., Rayner, M., Vandevijvere, S., and Walker, C. (2013) M*onitoring the impacts of trade agreements on food environments.* Obesity Reviews. 14. p.120-134.

233 Thow, A. M., Heywood, P., Schultz, J., Quested, C., Jan, S. and Colagiurie, S. (2011) T*rade and the nutrition transition: strengthening policy for health in the Pacific.* Ecol Food Nutr. 50. p.18–42.

Trade, foreign direct investment and globalisation

There is, however, evidence to suggest that the processes of globalisation including market liberalisation, investment in yield increases, trade policies, foreign direct investment and globalised marketing and advertising regimes are strongly connected to the nutrition transition in low income and developing economies. A review of the effects of trade agreements on food environments identified nine studies relevant to understanding links between trade and investment agreements and diets and health. From this review they find that trade agreements influence food environments through four pathways. First, trade liberalisation increases total food imports, and particularly imports of animal products and highly processed foods in LMICs. Second, liberalised trade and investment regimes opens countries to investments in the production, processing, retailing and advertising industries, and leading in particular to expanded highly processed food sectors.

Third, the selective granting of domestic support measures significantly influences investment decisions by domestic and foreign companies, and the production, price, availability, and consumption of specific foods. Finally trade liberalisation can affect domestic governance and policy space, in that the interests of investors and trading priorities may hold more sway than those of domestic stakeholders, or public health objectives. The authors also propose a set of guiding principles and data collection approaches to monitor the impact of trade and foreign direct investment and argue that formal risk assessment is needed to support healthy trade policy.[234]

More specifically, Hawkes (2006) demonstrates linkages between market integration through trade agreements and rising vegetable oil consumption in Brazil, China and India,[235] while Baker *et al.* emphasise the impact of trade regimes in increasing access to sugar-sweetened beverages and energy dense food products in Asia.[236] This said, Basu (2014) observes that economic and trade liberalisation affect supply and sales differently in different countries, even among those within the same region or which have similar levels of economic development. For example, he highlights differing trends in non-beef consumption in India and China as an example of how agriculture, food and trade policies may converge to have positive or negative effects on health in different contexts. Domestic policies also play a role and need further investigation.[237]

As noted, health-oriented domestic policies can be undermined by international trade agreements, so thwarting national level efforts to improve public health. For example, Snowdon *et al.* (2011) find that policy efforts in the Pacific Islands to reduce consumption of low-quality fatty cuts of meat largely supplied by New Zealand are undermined by their capacity to negotiate with powerful bodies such as the World

234 Friel, S., Hattersley, L., Snowdon, W., Sacks, G., Swinburn, B., Thow, A. M., Lobstein, T., Sanders, D., Barquera, S., Mohan, S., Hawkes, C., Kelly, B., Kumanyika, S., L'Abbe, M., Lee, A., Ma, J., Macmullan, J., Monteiro, C., Neal, B., Rayner, M., Vandevijvere, S., and Walker, C. (2013) M*onitoring the impacts of trade agreements on food environments.* Obesity Reviews. 14. p.120-134.

235 Hawkes, C. (2006) *Uneven dietary development: linking the policies and processes of globalization with the nutrition transition, obesity and diet-related chronic diseases.* Globalization and Health. 2(4).

236 Baker, P., Kay, A. and Wall, H. (2014) *Trade and investment liberalization and Asia's noncommunicable disease epidemic: a synthesis of data and existing literature.* Globalisation and Health. 10(66).

237 Basu, S. (2015) *The transitional dynamics of caloric ecosystems: changes in the food supply around the world.* Critical Public Health, 25(3).

Trade Organisation.[238] A Ghanaian study similarly shows that while it is possible to develop standards to restrict fatty meat supply in ways that comply with international trade legislation, enforcing these restrictions in low income contexts is difficult.[239] Note that from an environmental point of view, trade between countries in such commodities is arguably resource efficient; animal parts that do not have a market in the country of production can be exported to and consumed in countries where there is a market, potentially reducing the need for additional production of a higher quality substitute meat and associated environmental impacts – although the environmental costs of transport need also to be born in mind. The point here is that the synergies and trade-offs between health and environmental objectives need to be investigated not just in relation to food consumption, but along the whole value chain.

The modern supermarket is the iconic symbol of modern value chains. Hawkes (2008)[240] shows that the global growth of supermarkets has had both positive dietary impacts by making diverse foods available and accessible to more people, and negative, by encouraging consumption of unhealthy highly-processed foods. She observes that ultimately supermarkets encourage consumers to eat more, whatever the food. Other analysis comes to similarly equivocal conclusions.[241] A study of 170 supermarkets in high income countries found a link between large supermarket size and obesity. While the nature of the relationship is not analysed the authors speculate that large supermarkets may represent a food system that focuses on quantity over quality.[242]

Note that analyses of the drivers shaping the nutrition transition and its health implications tend to focus on broad dietary transitions towards more processed foods and meat and fewer fruits and vegetables. Research into the link between macroeconomic policies and the specific food consumption practices investigated in this review (including meat, fish, and palm oil) is less in evidence, although it can be found in the advocacy literature.[243,244,245,246,247] This said, one comprehensive analysis of

238 Snowdon, W., Moodie, M., Schultz, J. and Swinburn, B. (2011) M*odelling of potential food policy interventions in Fiji and Tonga and their impacts on noncommunicable disease mortality.* Food Policy. 36(5) p.597-605.

239 Thow , A. M., Annan, R., Mensah, L. and Chowdhury, S. N. (2014) D*evelopment, implementation and outcome of standards to restrict fatty meat in the food supply and prevent NCDs: learning from an innovative trade/food policy in Ghana.* BMC public health. 14(249).

240 Hawkes, C. (2008) *Dietary Implications of Supermarket Development: A Global Perspective. Development Policy Review.* 26(6) p.657–692.

241 Gómez, M. I. and Ricketts, K. D. (2013) *Food value chain transformations in developing countries Selected hypotheses on nutritional implications, ESA Working Paper* No. 13-05. Food and Agriculture Organization of the United Nations.

242 Cameron, A. J., Waterlander, W. E. and Svastisalee, C. M. (2014) *The correlation between supermarket size and national obesity prevalence.* BMC Obesity, 1(27).

243 Sharma, S. (2014) *Need for Feed: China's Demand for Industrialized Meat and Its Impacts*, Institute for Agriculture and Trade Policy, USA.

244 Lilliston, B. (2014) *Big Meat Swallows the Trans-Pacific Partnership,* Institute for Agriculture and Trade Policy, USA.

245 MacDonald, M. and Iyer, S. (2013) *Skillful Means: The Challenges of China's Encounter with Factory Farming,* Brighter Green, USA.

246 Macdonald, M. and Simon, M. (2013) C*attle, Soyanization, and Climate Change: Brazil's Agricultural Revolution,* Brighter Green, USA.

247 Brighter Green (2014) Beyond the Pail: *The Emergence of Industrialized Dairy Systems in Asia,* Brighter Green.

the historical and on-going changes in China's food system describes how the massive growth in livestock and aquatic production and consumption in China has been the outcome of integrated and deliberate agricultural and nutrition policies (Garnett and Wilkes 2014).[248]

One area of analysis which has received insufficient research attention is the possible link between growth in the oilseeds and in the livestock sectors. Garnett and Wilkes (2014) note that the rise in animal fat intakes in China is also connected to a rise in vegetable oil intakes. Increased meat availability is underpinned by the growing use of oilseeds as an animal feed; vegetable oils and oilseeds are both co-products of the oil crushing process; thus growth in livestock feed use has led to in the availability of vegetable fats and vice versa. The implications of this relationship (made more complex by growth in the biofuels sector) needs further investigation; a question to consider is how increases in soy production driven by livestock (for example) increase the availability of vegetable oils for food or for fuel, and vice versa, and with what health and environmental consequences.

Overall, the evidence shows that these powerful and interacting international and national economic forces have shaped and continue to shape diets in ways that contribute to obesity and associated non communicable diseases, although they have also helped tackle under consumption and hunger. The inference is that since these forces are so powerful and so effective they could also, if reoriented, have a major role to play in shifting consumption patterns in healthier and more sustainable directions. Comprehensive analysis of what a health- and sustainability-promoting agricultural, trading, investment and market development regime might look like has not yet been undertaken but is clearly an area that that merits further research.

National planning policies

The effect of the retail food environment on availability of healthy foods and consumption patterns, and therefore health, has been the subject of numerous studies across diverse settings.

For example, many studies have found strong associations between obesity and a high concentration of shops or restaurants selling very processed food. However, they also find that factors such as socio-economic status and educational attainment mediate this connection.[249,250] For example one systematic review of forty studies finds that fast food restaurants are more prevalent in low-income areas and in areas with higher concentrations of low-income ethnic minority groups in comparison with Caucasians.[251] Thus there is likely to be a complex and interactive relationship between the retail environment and other factors associated with poor health which needs

248 Garnett, T., and Wilkes, A. (2014) *Appetite for Change: Social, economic and environmental transformations in China's food system. Examination of China 's changing food system, the emerging socio-economic, health, environmental, socio-cultural trends and their shaping drivers; challenges for coming years*. Food Climate Research Network – Oxford Martin School.

249 Cummins, S., Macintyre, S. (2006) *Food environments and obesity--neighbourhood or nation?* Int J Epidemiol. 35(1) p.100-4.

250 Ford, P. B., Dzewaltowski, D. A. (2008) *Disparities in obesity prevalence due to variation in the retail food environment: three testable hypotheses.* Nutr Rev. 66(4). p.216-28.

251 Fleischhacker, S. E., Evenson, K. R., Rodriguez, D. A. and Ammerman, A. S. (2011) *A systematic review of fast food access studies*. Obes Rev. 12(5).

to be considered. Another study focusing on the relationship between pre-school childhood obesity prevalence, fast food accessibility, and two socio-economic factors (urbanization and poverty levels) finds that fast food accessibility may contribute to preschool childhood obesity in more urban, poor populations and, vice versa, that poverty and urbanization levels can amplify the potentially negative health effects associated with fast food availability.[252] The implications of these studies is that while planning policies offer opportunities for influencing the accessibility of different foods, other socio-economic determinants of poor health also need to be understood and addressed.

These studies show that there is some connection between access to unhealthy food and obesity. Another approach is to investigate the link between poor health and the absence of access to healthy food. The term 'food deserts' is used to describe communities with limited access to affordable or healthy food.[253] Their existence is in fact contested and recent evidence suggests that the issues in many countries are more complex than one of physical access in many high income countries, including the UK. However, a systematic review of food deserts between 1966 and 2007 found clear evidence for disparities in access to food by income or race in the US.[254,255]

While specific links between planning policies, eating patterns and environmental sustainability have not been explored, a number of studies show the role of planning policies in influencing generally more healthy and sustainable behaviours such as walking and cycling, opportunities for urban food growing and access to local fresh produce.[256,257,258] Wolch notes however that affluent communities are more likely to have access to nature and green spaces, or space to grow food.[259]

National health and food security policies

As a general observation, a review of policy measures across Europe considered both information oriented interventions, and those that sought to influence the context of consumption through fiscal measures, standard setting and so forth. It found the latter to be more effective than the former.[260]

One recent attempt in the UK to integrate health and environmental sustainability

252 Newman, C. L., Howlett, E. and Burton, S. (2014) Implications of fast food restaurant concentration for preschool-aged childhood obesity. *Journal of Business Research*. 67. p.1573–1580.

253 Wrigley, N. (2002) *'Food deserts' in British cities: policy context and research priorities.* Urban Studies. 39(11). p.2029-2040.

254 Beaulac, J., Kristjansson, E. and Cummins, S. (2009) *A Systematic Review of Food Deserts,* 1966-2007. Prev Chronic Dis. 6(3).

255 Macintyre, S. (2007) Deprivation amplification revisited; or, is it always true that poorer places have poorer access to resources for healthy diets and physical activity? *International Journal of Behavioral Nutrition and Physical Activity.* 4(32)

256 Durand, C. P., Andalib, M., Dunton, G. F., Wolch, J. and Pentz, M. A. (2011) *A systematic review of built environment factors related to physical activity and obesity risk: implications for smart growth urban planning.* Obesity Reviews. 12(5).

257 Goodwin, D.M., Mapp, F.M., Sautkina, E., Jones, A., Ogilvie, D., White, M., Petticrew, M. and Cummins, S. (2014) *How can planning add value to obesity prevention programmes? A qualitiative study of planning and planners in the healthy towns programme in England.* Health and Place.

258 Rydin, Y., Bleahu, A., Davies, M., Davila, J.D., Friel, S., De Grandis, G., Groce, N., Hallal, P.C., Hamilton, I., Howden-Chapman, P., Lai, K. M., Lim, C.J., Martins, J., Osrin, D., Ridley, I., Scott, I., Taylor, M. and Wilkinson, P. (2012) *Shaping cities for health: complexity and the planning of urban environments in the 21st century.* Lancet.

259 Wolch, J.R., Byrne, J., Newell, J.P. (2014) *Urban green space, public health and environmental justice: the challenge of making cities 'just green enough'.* Landscape and urban planning. 125.

260 Brambila-Macias, J., Shankar, B., Capacci, S., Mazzocchi, M., Perez, C. E., Verbeke, F. J. A. and Traill, W. B. (2011) *Policy interventions to promote healthy eating: a review of what works, what does not, and what is promising.* Food and Nutrition Bulletin. 32(4) p.365-75.

and define standards for both has been the 2014 'Plan for Public Procurement'. This outlines various criteria by which to judge good procurement practice, including production method and location; the health and nutritional content of the food and resource efficiency. As regards criteria relevant to this review, all fish procured needs to be demonstrably sustainable; with all wild-caught fish meeting the FAO Code of Conduct for Responsible Fisheries and no 'red list' or endangered species served. All palm oil used for cooking and as food ingredient needs to be sustainably produced and compliant with the RSPO or equivalent standards. Fruit and vegetables are to be promoted, menus should reflect the growing or production period for the UK, and in-season produce highlighted on menus. These standards have only been recently introduced and no impact assessment is available.

The UK government has also introduced nutritional standards for school meals. A pre- and post-implementation evaluation found improvements in the nutritional profile of the meals and also found them to be more nutritious than packed lunches. However the study did not quantify children's uptake of schools meals in the two periods.[261] One shortfall of these studies is that they do not measure impacts on actual health outcomes, such as the incidence of obesity. Further discussion of school based interventions can be found in 7.e. below.

In the US a number of states have implemented policies to regulate or restrict the sale of 'competitive' foods in schools – snack foods sold often through school cafeterias, or in vending machines, that tend to be high in salt, sugar and fat. One study which looked at the implementation of such policies in California, found population-level improvements in the prevalence of childhood overweight/obesity that coincided with the period following implementation of these policies across the state. However, it also found that these improvements were greatest at schools in the most advantaged neighbourhoods. The authors conclude that while state policies may help prevent child obesity, the degree of their effectiveness is likely to depend on socioeconomic and other contextual factors and that to reduce disparities and prevent obesity, school policies and environmental interventions must address relevant contextual factors in school neighbourhoods.[262]

The Danish government has also announced plans to increase organic food production, supply and provision, earmarking 400 million Kroner (€53.7 million) in support of the plan. Targets include doubling the area of farmland devoted to organic production compared with a 2007 baseline, increasing retail sales of organic food, increasing the proportion of organic food served in public canteens and supporting research and training in organic farming.[263,264,265] While the health and environmental benefits of organic food may be contested, the Plan provides a useful example of a systematic whole-supply-chain policy approach. Evaluation of the Plan's effectiveness will need to

261 Spence, S., Delve, J., Stamp, E., Matthews, J. N., White, M. and Adamson, A. J. (2013) *The impact of food and nutrient-based standards on primary school children's lunch and total dietary intake: a natural experimental evaluation of government policy in England.* Plos One. 8(10).

262 Sanchez-Vaznaugh, E. V., Sánchez B. N., Crawford, P. B. and Egerter, S. (2015) *Association Between Competitive Food and Beverage Policies in Elementary Schools and Childhood Overweight/Obesity Trends.* JAMA Pediatrics. 169(5).

263 The Local (2015) *Denmark launches 'most ambitious' organic plan*, 30 January 2015. The Local. [Online] Available from: http://www.thelocal.dk/20150130/denmark-announces-most-ambitious-organic-plan?

264 Scott-Thomas, C. (2015) *Denmark launches 'most ambitious' organic plan*, 2 February 2015, Food Navigator. [Online] Available from: http://www.foodnavigator.com/Policy/Denmark-launches-most-ambitious-organic-plan.

265 Ministeriet for Fødevarer, Landbrug og Fiskeri (2015) *Økologiplan Danmark, Sammen om mere økologi.* Available from: http://fvm.dk/fileadmin/user_upload/FVM.dk/Dokumenter/Landbrug/Indsatser/Oekologi/OekologiplanDanmark_PIXI_PRINT.pdf.

be undertaken.

Finally, there is evidence from Mauritius; in 1987, the Mauritian government intervened to switch the formulation of its subsidised cooking oil ('ration oil') from palm to soybean oil, resulting in significant reductions in both saturated fat consumption and serum cholesterol.[266] It has been suggested that a similar approach could be adopted by India, whose government subsidises vegetable oils through the Public Distribution System.[267] Note that this is in a sense a 'hidden' intervention in that the taste of products is not affected.

7.d. Collaboration and shared agreements

This section reviews evidence on the effectiveness of collective, voluntary initiatives undertaken by the food industry or by multi-stakeholder partnerships.

Voluntary industry agreements

Collaborations and voluntary agreements focusing on areas of mutual benefit for private industry and consumer health represent a relatively new model of health interventions. A scoping review of 47 voluntary agreements mostly in Europe and North America looked at a broad range of issues, largely environment (and not specifically food) related. The review found, based on surveys and interviews with stakeholders, that agreements varied widely in their design, broadly falling into three categories: (a) agreements that are completely voluntary where businesses have a totally free choice on whether to join and there are no sanctions for non-compliance; (b) voluntary agreements that use the threat of future regulations or taxes as a motivation to participate, and (c) voluntary agreements implemented in conjunction with an existing tax policy or strict regulations. These agreements usually include well-specified targets, comprehensive monitoring systems and sanctions for non-compliance. The financial disincentives for non-participation in these agreements are often so costly for businesses that they may not be seen as truly 'voluntary.'[268,269] The scoping review found that Governments may promote a voluntary agreement for a number of reasons, believing it to be quicker and cheaper than introducing new legislation, and often in response to pressure from businesses who may wish to avoid mandatory actions. Voluntary agreements may help to improve relationships between government and business, and help both parties come to an agreement on target-setting and data sharing. Governments may also use the experience to inform development of subsequent legislation, or the agreement may be part of a wider policy package. As to business motivations, some may see joining an agreement as a way of improving their public image, as an accepted approach to a shared problem, to avoid mandatory actions or prepare for compliance if necessary, or in obtaining a 'first

266 Uusitalo, U., Feskens, E.J., Tuomilehto, J., Dowse, G., Haw, U., Fareed, D., Hemraj, F., Gareeboo, H., Alberti, K. G. M. M. and Zimmet, P. (1996) *Fall in total cholesterol concentration over five years in association with changes in fatty acid composition of cooking oil in Mauritius: cross sectional survey.* BMJ. 313. p.1044–1046.

267 Downs, S. M., Thow, A. M., Ghosh-Jerath, S. and Leeder, S. R. (2014) Developing Interventions to Reduce Consumption of Unhealthy Fat in the Food Retail Environment: A Case Study of India. *Journal of Hunger& Environmental Nutrition.* 9(2). p.210-229.

268 Bryden, A., Petticrew, M., Mays, N., Eastmure, E. and Knai, C. (2012) *Scoping review of evaluations of voluntary agreements between government and business*. Policy Research Unit in Policy Innovation Research, London School of Hygiene & Tropical Medicine, UK.

269 Bryden, A., Petticrew, M., Mays, N., Eastmure, E. and Knai, C. (2013) *Voluntary agreements between government and business – a scoping review of the literature with specific reference to the Public Health Responsibility Deal*. Health Policy. 110(2-3). p.186-97.

mover' market advantage over non-participants.

Overall the review finds that if properly implemented and monitored, voluntary agreements can be effective and businesses can help to achieve public policy aims, but it is not possible to ascertain how they compare with regulatory alternatives. It recommends that targets should be ambitious and clearly defined, and robust monitoring systems in place. The role of businesses' public image can be very important both to encourage participation and to ensure compliance. Finally, it is important to note that some of the most effective voluntary agreements are those with substantial disincentives for non-participation and costly sanctions for non-compliance.[267]

As regards public health, a recent mapping of public health initiatives in Europe found a number of voluntary industry approaches underway. Salt reduction is the most common focus (in 25 of the 30 countries reviewed) but a number of countries also have voluntary reformulation agreements for sugar and fat. Other than for sugar, there are no specific agreements regarding the foods that form the focus of this review – palm oil, meat, fish, fruit and vegetables. The study concludes that while voluntary measures may make some contribution, 'harder' measures such as taxation may be needed.[270]

In the UK the Public Health Responsibility Deal was established in 2011, and is based on three types of commitments: core commitments, collective pledges, and individual pledges. Pledges address a range of social policy areas, including alcohol labelling and domestic violence; examples of food pledges include commitments such as reducing salt or saturated fat content.[271] This voluntary approach has been the subject of fierce debate. While its critics draw parallels between the food and tobacco industries, particularly with reference to industry funding of scientific research,[272,273,274] its proponents argue that health is a matter of collective interest and that business has a role to play in enhancing public health.[275] A 2015 analysis of the responsibility deal examined the effectiveness of the specific actions undertaking to implement the pledges – on nutrition labelling, fruit and vegetable consumption, and reductions in salt, calories and saturated fat – as well as the 'additionality' factor: the likelihood that the pledges have brought about actions among organisations that would not otherwise have taken place.

It found that while some of the interventions, if fully implemented, could be effective, those that held potential to deliver the greatest impact, such as food pricing strategies, restrictions on marketing, and reducing sugar intake, are not reflected in the RD food pledges. It also found that the paucity and heterogeneity of the different organisations'

270 Lloyd-Williams, F., Bromley, H., Orton, L., Hawkes, C., Taylor-Robinson, D., O'Flaherty, M., McGill, R., Anwar, E., Hyseni, L., Moonan, M., Rayer, M. and Capewell, S. (2014) *Smorgasboard or symphony? Assessing Public Health Nutrition Policies across 30 European countries using a novel framework.* BMC Public Health. 14(1195). p.1-20.

271 Department of Health (undated) *Pledges*. [Online] Available from: https://responsibilitydeal.dh.gov.uk/pledges/.

272 Gilmore, A. B., Savell, E. and Collin, J. (2011) Public health, corporations and the New Responsibility Deal: promoting partnerships with vectors of disease? *Journal of Public Health*. 33(1). p.2–4.

273 Gornall, J. (2015) *Sugar's web of influence 3: Why the responsibility deal is a "dead duck" for sugar reduction.* BMJ 2015. 350.

274 Gornall, J. (2015) *Sugar's web of influence 2: Biasing the science.* BMJ. 350.

275 Lansley, A. (2011) *The role of business in public health*. Correspondence, The Lancet.

progress reports made it hard to establish how far and how well the interventions had been implemented – a point that has been made elsewhere in the context of certification schemes. The study also points out that most of the interventions underway were not 'additional.' It recommends that pledges or proposed actions need to be evidence-based, well-defined, and measurable, pushing actors to go beyond 'business as usual' and setting out clear penalties for not demonstrating progress.[276]

In the area of food and the environment, the UK's government funded waste and resources charity, WRAP (Waste Resources Action Programme) leads the Courtauld Commitment. This voluntary multi-stakeholder agreement aims to improve resource efficiency and reduce waste within the UK grocery sector. Launched in 2005, spanning three phases and now with 53 grocery business signatories, its focus has evolved beyond packaging to encompass food waste reduction. Actions by collaborating businesses include not just supply chain improvements but participation in WRAP's high profile 'Love food hate waste' consumer-facing campaign, which highlights the problem of food waste and shows consumers what they can do to reduce the amount of food they throw away.

WRAP claims that its actions in Phase two (running to 2012) have achieved a reduction in packaging equivalent to a 10% cut in GHG emissions, a 7.4% cut in supply chain waste and a 3.7% cut in food waste.[277] An econometric assessment commissioned by WRAP specifically into the impact of the LFHW campaign attributes 40% of the observed reduction in household food waste between 2007 and 2010 to greater public awareness of and activities around food waste issues, for which the LFHW, it argues, takes most of the credit, although higher food prices and recession-induced income decreases also substantially contributed.[278] Now in its third commitment stage, the aim is to reduce household food and drink waste by a further 5% in absolute terms by 2015. This represents a 9% reduction relative to anticipated changes in food and drink sales.[279]

A 'daughter' voluntary agreement, Courtauld 2025, is being developed. One of its four themes will focus on 'changing how we consume.'[280] Details are still being developed but a focus on healthy sustainable eating is likely, in recognition that resource issues are inherently linked to the driver of resource use – consumption patterns. This shift from a sole focus on food waste, arguably the easier, acceptable face of behaviour change, towards the more challenging area of dietary shift, is an important development, but it remains to be seen how fast industry is willing to move in this area.

Standards

276 Knai, C., Petticrew, M., Durand, M. A., Eastmure, E., James, L., Mehrotra, A., Scott, C. and Mays, N. (2015) *Has a public–private partnership resulted in action on healthier diets in England? An analysis of the Public Health Responsibility Deal food pledges.* Food Policy. 54. p.1–10.

277 WRAP (2015) *Courtauld Commitment 2. WRAP.* [Online] Available from: http://www.wrap.org.uk/content/courtauld-commitment-2-1.

278 Britton, E., Brigdon, A., Parry, A. and LeRoux, A. (2014) *Econometric modelling and household food waste.* WRAP. UK.

279 WRAP (2015) *Courtauld Commitment 3. WRAP.* [Online] Available from: http://www.wrap.org.uk/node/14621.

280 WRAP (2015) *Courtauld Commitment 2025.* WRAP. [Online] Available from: http://www.wrap.org.uk/content/courtauld-2025.

Sustainability standards have been developed for a range of food products and supply chains including sugar and palm oil, two of the five focal foods of this report. These standards can sometimes but not always be communicated via a label intended to help a consumer decide between similar products (see discussion on labelling in Section 7.f below). Examples of standards with consumer facing labels include the various organic labels (in the UK the Soil Association Organic standards), Fairtrade, the MSC certification logo for fisheries products and the RSPCA's Freedom Food animal welfare label. As regards the key foods focused on here, organic standards potentially apply to all of them; Fairtrade to many (certain fruit and vegetables, sugar) and animal welfare labels to livestock and aquaculture production; other standards also variously apply, as discussed below. It is worth noting that a sustainability standard is no indicator that the product is healthy, as for example certified sugar.

While certification schemes are voluntary, government policy can require the use of certified products in public procurement specifications, illustrating the overlap between the regulatory and voluntary domains. Private sector food service providers can of course also specify the use of certified products; for example the UK coffee chain *Costa* only uses Rainforest Alliance certified coffee, while the sandwich chain *Pret*, specifies the use of free-range eggs and organic coffee.

'Ownership' by stakeholders in the supply chain varies across sustainability standards; some have higher support from industry bodies, while others may be more NGO driven. Taking a non-food example, the Forest Stewardship Council (FSC) is supported by NGOs such as WWF, while PEFC (Programme for the Endorsement of Forest Certification), a separate sustainable forest certification scheme, is associated with industry.

This section focuses on certification schemes for two products that form the subject of this review: sugar and palm oil.

Sugar has been the focus of several standards including Fairtrade, Rainforest Alliance, organic and Bonsucro. The latter, which evolved out of the Better Sugarcane Initiative, founded by WWF in 2005, has by far the largest share of all certified production. It accounts for 4% of overall sugar production and has set a target of taking a 20% share of all sugar production by 2017. The scheme's members include Coca-Cola, the Ferrero Group, Cargill, Unilever and oil companies BP and Shell. Bonsucro focuses on five key areas of concern: legal compliance; biodiversity and ecosystem impacts; human rights; production and processing; and continuous improvement. Although the initiative is still young and evolving, preliminary evaluation of a small subsection of participating mills in Australia and Brazil find that the scheme has delivered reductions in GHGs, water and agrochemical use.[281]

While these results are encouraging, a major review by IISD[282] notes that the sustainable sugar market remains small relative to other sustainable commodity sectors largely because developed countries consume not just cane sugar but also domestically produced beet, which has benefitted from subsidies. Only 16% of all

281 Bonsucro (2014) *Preliminary Outcome Report 2013* – V1. Bonsucro Secretariat, London. [Online] Available from: http://bonsucro.com/site/wp-content/uploads/2013/11/Bonsucro-Preliminary-Outcome-Report-20131.pdf.

282 Potts, J., Lynch, M., Wilkings, A., Huppé, G. A., Cunningham, M. and Voora, V. (2014) *The State of Sustainability Initiatives Review 2014*: Standards and the Green Economy, IISD.

standards-compliant production was actually sold as such in 2012. This said the percentage is likely to have increased since then since the Bonsucro scheme is rapidly expanding -at an average 106% annually between 2008-2012. This growth is driven in part by the requirement under the EU renewable fuels obligation that sugar-derived ethanol be certified, and also by the commitments of major confectionary and chocolate manufacturers, who wish to avoid risks of negative publicity associated with poor labour practices. Given the significant mainstream momentum behind the initiative the prospects are good for the scheme's continued growth.

However the report notes that given the fungible nature of sugar (it can be replaced, for example by corn syrup or beet), its 'hidden' nature as an ingredient in processed foods and the relative absence of any major news media coverage on sugar sustainability issues in recent years, this growth cannot be taken for granted.

As to palm oil, RSPO certified oil has grown by 90% per annum between 2008-2008 according to IISD[283] and now accounts for 18% of palm oil production[284] (2012 figures). However, less than 50% of compliant palm oil is sold as such on the global market.[282] This may reflect the fact that India and China are among the top three importers and interest from companies and consumers in sustainable sourcing from these regions is currently low.[285,286]

The RSPO has been criticised by NGOs and academics for the weakness of its sustainability criteria, for violating the rights of indigenous peoples and local communities and for failing to halt deforestation and peatland destruction.[287,288,289] Ruysschaert and Salles find that the RSPO has not been successful in its conservation goals and that deforestation and social conflicts continue unabated in South-East Asia, notably Indonesia. It argues, based on in situ observation as conservation NGO representative and 49 semi-structured interviews across 33 institutions that this failure reflects five key shortcomings in the RSPO. Financial compensation for grower participation in the scheme is too small; there is too much room for interpretation in the guidance document, little agreement has been reached on contentious issues,

the RSPO is not integrated into the local socio-politico-legal context and, finally, an

283 Potts, J., Lynch, M., Wilkings, A., Huppé, G. A., Cunningham, M. and Voora, V. (2014) T*he State of Sustainability Initiatives Review 2014*: Standards and the Green Economy, IISD.

284 RSPO (2015) *Impacts. RSPO.* [Online] Available from: http://www.rspo.org/about/impacts.

285 Norman, B. (2012) GreenPalm: China and India. Sustainable Palm Oil Platform. Available from: http://www.sustainablepalmoil.org/standards-certfication/certification-schemes/case-studies/greenpalm-kick-starting-sustainability-in-china-and-india/.

286 Balch, O. (2013) *Sustainable palm oil: how successful is RSPO certification?* The Guardian. 4/7/2013. [Online] Available from: http://www.theguardian.com/sustainable-business/sustainable-palm-oil-successful-rspo-certification.

287 Laurence, W. F., Koh, L. P., Butler, R., Sodhi, N. S., Bradshaw, C. J. A., Neidel, J. D., Consunji, H. and Vega, J. M. (2010) I*mproving the performance of the Roundtable on Sustainable Palm Oil for Nature Conservation,* Conservation Practice and Policy. 24(2). p.377–81.

288 Colchester, M. and Chao, S. (2013) *Conflict or consent? The oil palm sector at a crossroads.* Forest Peoples Programme.

289 Greenpeace International (2013) C*ertifying Destruction: Why consumer companies need to go beyond the RSPO to stop forest destruction*, Greenpeace International. The Hague.

effective external control system is lacking.[290]

Frustration at these weaknesses has led to the formation of the Palm Oil Innovation Group (POIG) by a group of international NGOs (including WWF, Rainforest Action Network and Greenpeace) along with palm oil producing companies who are recognized as leaders in sustainability. A number of retailers and consumer goods manufacturers including Ferrero, Tesco, Edeka, Rewe Group and Stephenson have also recently pledged their support of POIG.

The group was initiated after the 2013 review of the RSPO Principals and Criteria (P&Cs), which POIG members believe should have been more innovative, especially on issues of deforestation, carbon stocks, biodiversity and social relations. The POIG is not intended to replace the RSPO or to establish a new standard. Instead it has set out a 'Charter' for palm oil producers, to drive higher standards.

More recently there have been signs that the RSPO is showing signs of teeth; for example in early 2015 over 100 companies had their membership suspended or terminated for failing to submit annual progress reports.[291]

While the focus here has been on sugar and palm oil, the Bonsucro and RSPO schemes exemplify some of the strengths and weaknesses of certification approaches in general. The IISD review highlighted above examined 16 of the most prevalent standards initiatives operating across ten different commodity sectors (including not just palm oil and sugar but also tea, coffee, cocoa, soy, timber and bananas) and found that as a whole, sustainability standards continue to grow vigorously. These standards have entered and been effective in shifting mainstream markets.[292]

However, production of compliant products is still concentrated in more industrialised, export-oriented economies and there is currently oversupply relative to demand (i.e. up to 50% of compliant products are not sold as such). This means that it is harder for poorer, less organised regions and farmers to participate and also places a downward pressure on prices, undermining poverty reduction objectives. More positively, the growth of sustainability standards is creating new opportunities for stakeholder participation in decision making and standards are increasingly independently monitored and reinforced. However, as the use of standards becomes more mainstream, there are signs that criteria of reduced depth and breadth are applied to allow for more rapid uptake, meaning that the benefits arising may be limited. In other words there is a tension between the goals of inclusivity and quality. Finally the review notes that while voluntary sustainability standards can contribute to the development of a green economy they cannot be assumed to deliver sustainable development outcomes. Certification schemes need to be seen as one component of a broader set of market and non-market policy options, with overarching governance mechanisms in place to provide a level and transparent playing field and to ensure that the purported benefits of certification actually obtain.

This has not always been the case so far. For example one major review of Fairtrade certification concluded that workers involved in the scheme were not better off

290 Ruysschaert, D., Salles, D. (2014) *Towards global voluntary standards: questioning the effectiveness in attaining conservation goals.* The case of the roundtable on sustainable palm oil (RSPO). Ecological Economics. 107.

291 RSPO (2014) *Terminated and Suspended Members. RSPO.* [Online] Available from: http://www.rspo.org/members/terminated-and-suspended-members

292 Potts, J., Lynch, M., Wilkings, A., Huppé, G. A., Cunningham, M. and Voora, V. (2014) *The State of Sustainability Initiatives Review 2014:* Standards and the Green Economy, IISD.

working on Fairtrade certified farms than in non-certified farms, while a review of various voluntary certification standards and their effects on poverty found the impacts to be mixed or small in scale.[293,294] Equally the environmental and health credentials of organically produced food remain a vigorous subject for debate.[295,296,297,298,299,300,301,302] There is a need for common metrics in order to measure the real environmental and developmental impacts of certification schemes.[303]

More fundamentally still, certification schemes do not address the question of what level of demand can be deemed sustainable. As von Geibler writes in relation to palm oil: "Can palm oil value chains be sustainable? The answer might be 'no', when looking at the increasing market demand exceeding the supply of what could be deemed sustainable. The answer might be 'yes', when looking at alternatives to palm oil being less efficient crops…even if all palm oil and its derivatives were produced and traded within the framework of a non-governmental (or also governmental) sustainability certificate, undesired impacts would still occur outside the value chains due to increasing demand without a global restriction of energy and resource use and without a social balance between industrial and developing countries."

Dauverge and Lister[304] likewise observe that while global companies are achieving environmental gains in product design and production, these advances are also fundamentally limited and will not on their own resolve our environmental problems.

293 Nelson, V. and Martin, A. (2013) *Final Technical Report: Assessing the poverty impact of sustainability standards,* Natural Resources Institute, University of Greenwich, UK.

294 Cramer, C., Johnston, D., Oya, C. and Sender, J. (2014) *Fairtrade, Employment and Poverty Reduction in Ethiopia and Uganda,* School of Oriental and African Studies, UK.

295 Ponisio, L. C., M'Gonigle, L.K., Mace, K.C., Palomino, J., de Valpine, P. and Kremen, C. (2014) *Diversification practices reduce organic to conventional yield gap,* Proceedings of the Royal Society of London Biological Sciences.

296 Smith-Spangler, C., Brandeau, M. L., Hunter, G. E., Bavinger, J. C., Pearson, M., Eschbach, P. J., Sundaram, V., Shirmer, P., Stave, C., Olkin, I. and Bravata, D. M. (2012) *Are Organic Foods Safer or Healthier Than Conventional Alternatives?: A Systematic Review,* Ann Intern Med. 157(5) p.348-366.

297 Brandt, K., Leifert, C., Sanderson, R. and Seal, C. J. (2011) A*groecosystem Management and Nutritional Quality of Plant Foods: The Case of Organic Fruits and Vegetables.* Critical Reviews in Plant Sciences. 30(1-2).

298 Curl, C. L., Beresford, S. A., Fenske, R. A., Fitzpatrick, A. L., Lu, C., Nettleton, J. A. and Kaufman, J. D. (2015) *Estimating Pesticide Exposure from Dietary Intake and Organic Food Choices: The Multi-Ethnic Study of Atherosclerosis (MESA).* Environ Health Perspect. 123(5) p.475-83.

299 Dangour, A., Dodhia, S., Hayter, A., Aikenhead, A., Allen, E., Lock, K. and Uauy, R. (2009) C*omparison of composition (nutrients and other substances) of organically and conventionally produced foodstuffs: a systematic review of the available literature.* Report for the Food Standards Agency, Contract number: PAU221, London, UK.

300 Schneider, M. K., Luscher, G., Jeanneret, P., Arndorfer, M., Ammari, Y., Bailey, D., Balazs, K., Baldi, A., Choisis, J. P. Dennis, P., Eiter, S., Fjellstad, W., Fraser, M. D., Frank, T., Friedel, J. K., Garchi, S., Geijzendorffer, I. L., Gomiero, T. Gozalez-Bornay, G., Hector, A., Jerkovich, G., Jongman, R. H. G., Kakudidi, E., Kainz, M., Kovacs-Hostyanszki, A., Moreno, G., Nkwiine, C., Opio, J., Oschatz, M-L., Paoletti, M. G., Pointereau, P., Pulido, F. J. and Sarthou, J.P. (2014) *Gains to species diversity in organically farmed fields are not propagated at the farm level.* Nat Commun. 5(4).

301 Venkat, K. (2012) Comparison of Twelve Organic and Conventional Farming Systems: A Life Cycle Greenhouse Gas Emissions Perspective. *Journal of Sustainable Agriculture.*

302 Seufert, V., Ramankutty, N. and Foley, J. A. (2012) L*etter: Comparing the yields of organic and conventional agriculture.* Nature.

303 Potts, J., Lynch, M., Wilkings, A., Huppé, G. A., Cunningham, M. and Voora, V. (2014) T*he State of Sustainability Initiatives Review 2014:* Standards and the Green Economy, IISD.

304 Dauvergne, P. and Lister, J. (2012) B*ig brand sustainability: Governance prospects and environmental limits.* Global Environmental Change. 22(1) p.36–45.

Ultimately, the total environmental impacts of consumption are increasing as brand companies use corporate sustainability credentials to achieve competitive advantage, business growth, and increased sales.

Overall, the IISD review, and the studies by von Geibler and by Dauvergne and Lister all emphasise that while non-state approaches make an important contribution to the activity mix, they are not sufficient. National and international regulatory frameworks are needed too so that standards are integrated into other policies around the environment, energy and development and more transformative change is achieved.[302 305]

Pro-environmental collective initiatives

A number of large scale, city-led initiatives to promote food, health and sustainability, are currently underway. For example the UK Sustainable Food Cities network involves 38 cities, including London, which has its own detailed plan;[306] and brings together stakeholders from public bodies, businesses and NGOs to prioritise work in six food related areas, covering among other things, sustainable healthy diets, sustainable food procurement and tackling food poverty.[307]

Further evaluation of the health and sustainability impacts is needed but note that a comparable initiative, C40 – a network of the world's megacities taking action to reduce greenhouse gas emissions – claims to have achieved results over its 10 years. Membership now stands at 70 and C40 states that member cities have collectively committed to reducing emissions by 1 gigatonne of CO^2 eq by 2020. It highlights the potential for such networks to cross-fertilise ideas, pointing to the 500% increase in C40 cities with cycle hire systems, following the example set by Paris.[308] While this and other such initiatives are welcome and may indeed help galvanise change it is hard to identify the specific role that such a network plays in generating city level action and separate it out from other political, economic, institutional or cultural influences.

7.e. Changing the context, defaults and norms of production or consumption

This section focuses on the immediate context which influences consumption. It considers two particular context related interventions: those seeking to influence or regulate advertising and marketing, and interventions that seek to change the 'choice architecture' within which people make their consumption choices. Note that the discussion on advertising and regulation could equally have been included in 7.d above, but is considered in this section since advertising is such an important, immediate and pervasive influence on consumption.

305 Von Geibler, J. (2013) Market-based governance for sustainability in value chains: conditions for successful standard setting in the palm oil sector. *Journal of Cleaner Production.* 56.

306 GLA (2015) *Strategy & Implementation Plans.* London.gov.uk. [Online] Available from: http://www.london.gov.uk/priorities/business-economy/working-in-partnership/london-food-board/london-food-board/strategy-implementation-plans.

307 Sustainable Food Cities (2015) *Sustainable food cities*. [Online] Available from: http://sustainablefoodcities.org/.

308 C40 Cities (2015) *10 Years of Results: C40 By the Numbers.C40 Cities.* [Online] Available from: http://www.c40.org/blog_posts/10-years-of-results-c40-by-the-numbers.

Advertising and marketing

The processes of urbanisation, globalisation and increasing market liberalisation have also facilitated the growth in global food advertising and marketing. Numerous individual studies and several systematic reviews show that children in developed and developing countries are heavily exposed to food advertising and marketing that promotes high-salt, -sugar and -fat products; that they recall and like this advertising; and that they use it to prompt their own and their parents' purchase decisions. These effects in turn influence their consumption patterns and their diet related health.[309] [310,311] Television advertising is particularly influential and is dominated by high-energy, low-nutrition foods.[312,313] There is evidence too that government policies have encouraged broadcasters to launch more children's channels in order to stimulate national competition, and enabled companies to form strategic partnerships with the advertising and media sectors, thereby exacerbating the problem.[314]

As regards the influence of food advertising to adults, one review noted the poor quality of available evidence and found that at present results do not show conclusively whether or not food advertising affects food-related behaviour, attitudes or beliefs in adults. It suggests, though, that the impact varies inconsistently within subgroups, including gender, weight and existing food psychology.[315]

Given the strength of evidence showing that advertising to children influences consumption in ways damaging to health, there have been many calls within the academic and NGO community for strong regulations to restrict the marketing of unhealthy food to this age group.[316,317,318]

309 Hastings, G., McDermott, L., Angus, K., Stead, M. and Thompson, S. (2006) *The Extent, Nature and Effects of Food promotion to children: a review of the evidence. WHO Technical Paper*. Geneva: World Health Organization.

310 Cairns, G., Angus, K., Hastings, G. and Caraher, M. (2013) *Systematic reviews of the evidence on the nature, extent and effects of food marketing to children.* A retrospective summary. Appetite. 62. p.209–215.

311 Robinson, T. N., Borzekowski, D. G., Matheson, D. M., Kraemer, H. C. (2007) *Effects of Fast Food Branding on Young Children's Taste Preferences.* Arch Pediatr Adolesc Med. 161(8). p.792-797.

312 Kelly, B., Halford, J. C., Boyland, E. J., Chapman, K., Bautista-Castano, I., Berg, C., Caroli, M., Cook, B., Coutinho J. G., Efferts, T., Grammatikaki E., Keller, K., Leung, R., Manios, Y., Pedley, R., Prell, H., Raine, K., Recine, E., Serra-Mejem, L, Singh, S. and Summerbell, C. (2010) *Television food advertising to children: a global perspective.* Am J Public Health. 100(9). p.1730-6.

313 Baillie, K. (2008) *Health implications of transition from a planned to a free-market economy – an overview.* Obesity Reviews. (9) suppl.1. p.146–150.

314 Hawkes, C. (2008) *Agro-food industry growth and obesity in China: what role for regulating food advertising and promotion and nutrition labelling?* Obesity Reviews, (9)suppl.1. p.151–161.

315 Mills, S. D. H., Tannerm L. M. and Adams, J. (2013) Systematic literature review of the effects of food and drink advertising on food and drink-related behaviour, attitudes and beliefs in adult populations. Obesity Reviews. 14. p.303–314.

316 Raine, K. D., Lobstein, T., Landon, J., Kent, M. P., Pellerin, S., Caulfield, T. abd Spence, J. C. (2013) Restricting marketing to children: consensus on policy interventions to address obesity. *Journal of Public Health Policy*. 34(2). p.239–53.

317 BHF/CFC (undated). *BHF Briefing: Junk food marketing to children campaign*, British Heart Foundation and Children's Food Campaign, UK.

318 Novak, N. L., Brownell, K. D. (2012) *Role of Policy and Government in the Obesity Epidemic,* Circulation.126:2345-2352.

The question for research, therefore, is whether restrictions do indeed lead to improved health outcomes. There is some evidence to suggest that it does. For example Dhar and Baylis (2011)[319] study the effect of a ban on advertising of unhealthy food to children in the Canadian province of Quebec. Using household expenditure survey data from 1984 to 1992, the authors examined whether spending on fast food is lower in groups affected by the ban than in those that are not. Given Quebec's media market and demographic composition, the ban disproportionately affected French- rather than English-speaking households and did not affect similar households in Ontario or childless households in either province. The authors found that French-speaking households with children in Quebec were significantly less likely to purchase fast food than equivalent French speaking households in Ontario or English speaking households in Quebec. They estimated that the ban significantly decreased the propensity to consume fast food by 13% for the affected households and that if anything this was an underestimate.

Restrictions do need to keep pace with technological and market change. Lee *et al.* (2013) examined the effect of TV food advertising restrictions on food companies' marketing approaches in South Korea, a year after their enforcement.[320] It found that the while the restrictions to an extent encouraged companies to reformulate their energy dense, nutrient poor products to make them more healthy, companies also employed strategies to bypass the regulations by changing marketing channels from TV to other channels (e.g. internet marketing) or by reducing product serving sizes so as to fit within nutritional content specifications. The need to consider the role of non 'traditional' marketing channels such as television is evident.

Finally Galbraith-Emami and Lobstein (2013)[321] conducted a systematic review of the effects of both regulation and self-regulation (including voluntary industry pledges) on children's exposure to marketing of less healthy foods. They found a sharp division in findings: surveys reported in peer-reviewed journals provide evidence of continuing high levels of promotion of less healthy food and of children's exposure to promotion, with small or no reductions over recent years in many locations – except in response to statutory regulation. Industry sponsored reports, however, showed strong reductions in the promotion of unhealthy products and children's exposure. The authors conclude that statutory – but not voluntary – regulation may have the potential to reduce children's exposure significantly, but regulations currently do not cover the full range of opportunities for marketing to children. They note various limitations to the current regulatory and self-regulatory framework, including not just the narrow range of media covered (e.g. television but not the Internet), but also the weak definitions of marketing, lack of involvement by many large food companies and the lack of enforceability or penalties for failure in the case of self-regulation (a point that reinforces those made in the section on voluntary agreements, above). They recommend comprehensive, preferably statutory measures, with adequate monitoring of compliance and sanctions for non-compliance, and based on government-led definitions of the media to be covered, the products to be controlled and the audience to be protected. Impacts on health outcomes were not assessed.

319 Dhar, T. and Baylis, K. (2011) Fast-Food Consumption and the Ban on advertising Targeting Children: The Quebec *Experience Journal of Marketing Research*. XLVIII. p.799 –813.

320 Lee, Y., Yoon, J., Chung, S-J., Lee, S-K., Kim, H. and Kim, S. (2013). *Effect of TV food advertising restriction on food environment for children in South Korea,* Health Promot. Int.

321 Galbraith-Emami, S. and Lobstein, T. (2013) *The impact of initiatives to limit the advertising of food and beverage products to children: a systematic review*. Obesity Reviews. 14. p.960–974.

A systematic review of 47 studies by Chambers *et al.*[322] came to a similar conclusion about the limitations and possibilities of self-regulatory and statutory approaches respectively. It also highlighted the lack of consistent outcome measures, nutrition criteria and time-scales. Importantly, it underlined the point that change may be long-term and cumulative and that while no single intervention can (at least in the short term) be expected to have a large impact, measures to reduce the volume of, and children's exposure to, advertising of these foods can be justified on precautionary grounds – and they can also help change social norms.

Choice architecture and social marketing approaches

There is growing interest on the potential for changing people's behaviours by altering the 'choice architecture' that frames their consumption. Since this term lacks clarity, Hollands *et al.* (2013), propose the following definition.[323] These are interventions that:

> *"... involve altering the properties or placement of objects or stimuli within micro-environments with the intention of changing health-related behaviour. Such interventions are implemented within the same micro-environment as that in which the target behaviour is performed, typically require minimal conscious engagement, can in principle influence the behaviour of many people simultaneously, and are not targeted or tailored to specific individuals."*

The micro-environment can include settings such as schools, canteens, workplaces, hospitals, or grocery stores. Interventions can be clustered into two broad types: those that involve altering the properties of objects or stimuli within this environment, and those that involve altering their placement, with some interventions involving both. Note that some of these interventions (particularly those in institutional settings such as schools) will have been implemented as a result of government policy (see above), or may also include price incentives, underlining the point that interventions do not fall neatly into separate categories.

It has been established in experiments that people alter their consumption in response to subtle environmental cues – for example changes in portion or package size, plate size, glass shape, the number of people eating, background ambience (music, lighting), the variety of foods available or the order in which they are presented to consumers (as in a buffet or in a refrigerator). Wansink and colleagues draw upon such studies to argue that changes in these cues – for example repackaging food into smaller portion sizes, using smaller plates, positioning healthier foods near the front of the refrigerator etc.) can potentially reduce consumption and promote healthier choices.[324,325]

In more recent work based on laboratory studies and behavioural psychology Wansink and Love[323] make recommendations to restaurants that they suggest would generate

322 Chambers, S. A., Freeman, R., Anderson, A. A and MacGillivray, S. (2015) *Reducing the volume, exposure and negative impacts of advertising for foods high in fat, sugar and salt to children: A systematic review of the evidence from statutory and self-regulatory actions and educational measures.* Preventive Medicine.

323 Hollands, G. J., Shemilt, I., Marteau, T. M., Jebb, S. A., Kelly, M.,P., Nakamura, R., Suhurcke, M. and Ogilvie, D. (2013) A*ltering micro-environments to change population health behaviour: towards an evidence base for choice architecture interventions.* BMC Public Health. 13.

324 Wansink, B. (2004) *Environmental factors that increase the food intake and consumption volume of unknowing consumers.* Annu Rev Nutr. 24. p.455-79.

325 Wansink, B. and Love, K. (2014) Slim by design: Menu strategies for promoting high-margin, healthy foods. *International Journal of Hospitality Management.* 42. p.137–143.

both profits for restaurants and healthier choices for customers. These essentially focus on designing the menu to flag up and enhance the appeal of high value, healthy options. Follow up work examining whether these recommendations have been implemented and with what impact have not, to our knowledge, been undertaken.

Overall, however, there is a lack of good evidence in this area, particularly as to the strength or duration of impact; more, and more sustained studies are needed.

Beyond the micro-specifics of modifying plate size and so forth, changes in the choice architecture can also be implemented at a larger scale. One systematic review of store based interventions assessed the impacts of a range of measures including increased stocking of healthy foods; monetary incentives such as food coupons or vouchers for consumers or monetary incentives to store-owners to promote and increase availability of healthy foods; and education and awareness raising programmes ranging from interactive activities (tasting sessions and cookery demonstrations) to less personalised approaches such as provision of flyers. The review found that short term monetary incentives can potentially be effective but that there was a lack of good quality studies addressing all other types of interventions or the influence of mediating factors.[326]

A systematic review of interventions in small US stores in deprived areas examined a range of approaches such as increasing access to fresh food (particularly fruit and vegetables), price reductions, distribution of educational materials and education programmes combined with incentives such as vouchers. These multi-pronged strategies were found to be effective but the contribution of individual components of programmes could not be analysed.[327]

Another systematic review, this time of interventions in self-service restaurants, examined measures such as labelling, price incentives, payment option manipulation (restricting debit payments to healthy foods), and changes in the variety of foods offered. The evidence reviewed included lab experiments as well as real settings. It found some evidence that health labelling at point of purchase, changes in the perceived assortment and variety of foods on offer, and payment option manipulation were all associated with healthier food choices although the impact on total calories consumed or overall nutrient impacts were not assessed. Changing the plate or cutlery size had an inconclusive effect on consumption volume. However the study conclusions emphasised the poor quality of many of the studies reviewed, noted that many were in laboratory rather than real life settings and that different methodological approaches also made comparison difficult. It was not clear whether the effects reported in individual studies could be sustained in the longer term. In general, it was felt that a more standardised methodology for reporting these types of studies would enable more effective comparisons.[328]

A systematic review focused on both multiple diet and physical activity oriented interventions in worksites. Dietary approaches included individual educational sessions, changes in company policy to increase provision of healthier food and reductions in the price of low fat vending machine snacks. Some studies examined impacts on

326 Liberato, S. C., Bailie, R. and Brimblecombe, J. (2014) *Nutrition interventions at point-of-sale to encourage healthier food purchasing: a systematic review.* BMC Public Health. 14(919).

327 Gittelsohn, J., Rowan, M. and Gadhoke, P. (2012) *Interventions in Small Food Stores to Change the Food Environment, Improve Diet, and Reduce Risk of Chronic Disease.* Prev Chronic Dis.

328 Skov, L. R., Lourenco, S., Hansen, G. L., Mikkelsen, B. E., Schofield, C. (2013) *Choice architecture as a means to change eating behaviour in self-service settings: a systematic review.* Obes Rev. 14(3) p.187-96.

health outcomes such as BMI. Generally, interventions that combine multiple strategies and that changed both the policy and eating environment and provided individual education and support were found to be moderately effective, at least in the short term. However the quality of studies was highly variable, outcomes were largely self-reported, and it is difficult to assess the comparative contribution of different measures.[329]

A systematic review of 'natural experiments', including those focusing on school meal standards, vending machine bans and so forth generally found more active interventions to be more effective than passive ones. For example school food policies or standards that changed the food environment generally led to improvements in purchasing or self-reported diet, while simply providing nutritional information for the most part had little effect. A study examining the impact of a new supermarket in a previously under-served area found no effect but interventions geared at increasing the ability of low-income people to use their benefits to buy fruits and vegetables saw improvements in the purchase and home availability of healthy food.[330] However the impacts on BMI or other health outcomes were not measured.

Schools can be an important site for interventions. The Food for life Partnership (FFLP)[331] is a UK voluntary award scheme for schools led by the UK's organic charity, the Soil Association. It stands out from other studies reviewed in this section in that it seeks to improve both the nutritional and environmental quality of school meals. Participating schools can work towards bronze, silver or gold catering mark awards; bronze targets are largely health oriented but silver and bronze standards incorporate ethical, animal welfare and environmental criteria. At present however there has only been limited research into the scheme's effectiveness. One qualitative impact evaluation of the FFLP focusing on 15 of the participating 3600 schools concluded that, for the schools reviewed the FFLP had helped schools transform their food culture (i.e. school meal times were made more attractive and children were more knowledgeable of and engaged in food issues); take up of school meals in participating schools increased as did fruit and vegetable consumption; educational attainment improved while parental engagement in the scheme was strong; and the schools' interaction with the local community increased (Orme *et al.* 2011).[332] However this was a small scale qualitative study and numerous confounding factors need to be taken into account.

A number of countries have sought to improve the health of children by providing free or subsidised school fruit and sometimes vegetables to children at primary level. A systematic review and meta-analysis of school programmes assessed the impacts of 27 programmes, involving over 26,000 children in the US, New Zealand and various European countries. Twenty one were eventually used in meta-analyses. It found

329 Kahn-Marshall, J. L. and Gallant, M. P. (2012) *Making Healthy Behaviors the Easy Choice for Employees: A Review of the Literature on Environmental and Policy Changes in Worksite Health Promotion*. Health Educ Behav. 39(6) p.752-76.

330 Mayne, S. L., Auchincloss, A. H. and Michael, Y. L. (2015) I*mpact of policy and built environment changes on obesity-related outcomes: a systematic review of naturally occurring experiments.* Obesity Reviews (Early View).

331 FLP (undated) *What We Do. Food for Life Partnership.* [Online] Available at: http://www.foodforlife.org.uk/what-is-food-for-life.

332 Orme, J., Jones, M., Kimberlee, R., Salmon, D., Weitkamp, E., Dailami, N., Morgan, K. and Morley, A. (2011) *Food for Life Partnership Evaluation*. Bristol:University of the West of England. Available from: http://eprints.uwe.ac.uk/14456/.

that the schemes on average led to an increase in fruit and vegetables– by 0.25 portions if fruit juice was excluded and by 0.32 portions including juice. These were mainly increases in fruit but not vegetable consumption. It also found that multiple interventions (i.e. provision of fruit and vegetables as well as efforts to motivate and engage children and families to change their eating behaviours) were more effective than single-component programs that simply provided the produce. However, teachers who rated programs for ease of use rated distribution-only programs easier to implement than multicomponent programs. The study's overall conclusion is that school-based interventions moderately improve fruit, but have minimal impact on vegetable intakes. Additional studies are needed to address the barriers to success in changing dietary patterns, particularly in relation to vegetables.[333]

It is worth noting however, that negative substitution or compensatory behaviours may sometimes arise following an intervention. While the evidence is limited, one Dutch study that looked at the effect of reducing portion sizes in a workplace cafeteria reported that 19.5% of people who bought a smaller meal portion compensated by buying more items than they normally did, including fried snacks.[334] In an experimental study in a Canadian elementary school, chocolate milk provided as part of the School Meal Programme was replaced with plain milk. This change was associated with a decrease in overall milk consumption and an increase in milk waste – effects that were sustained over the four weeks of the intervention. The authors note that many children from low socio-economic groups were in receipt of free milk, while those who paid for their milk were reluctant to spend their money on unflavoured milk. [335] The study highlights the need to consider the impact of choice editing on the overall dietary quality. Another study found that in schools where soda machines were banned, students actually drank more soda than schools where they were not banned, but only if their state allowed soda to be sold in other school venues, such as cafeterias or school stores.[336] This study does not conclude that bans are ineffective but rather underlines the point that 'single issue' actions may be unhelpful.

It is also important to note that trial interventions in school canteens and so forth may rely on goodwill by the vendor, caterer, or school authorities in accepting revenue losses during the trial period. They may not be willing to accept permanent losses at larger scale, raising questions about the feasibility of scaling up interventions without enforcement or compensatory mechanisms. Another US study highlights the tension between programmes aimed at improving pupils' diets and those that provided low nutrient foods in order to support US agriculture.[337]

333 Evans, C.E., Christian, M.S., Cleghorn, C.L., Greenwood, D.C., and Cade, J.E. (2012) Systematic review and meta-analysis of school-based interventions to improve daily fruit and vegetable intake in children aged 5 to 12 y. *American Journal of Clinical Nutrition.* 96(4) p.889-901.

334 Vermeer, W. M., Steenhuis, I. H., Leeuwis, F. H., Heymans, M. W. and Seidell, J. C. (2011) S*mall portion sizes in worksite cafeterias: do they help consumers to reduce their food intake?* Int J Obes (Lond). 35(9). p.1200-7.

335 Henry, C., Whiting, S. J., Phillips, T, Finch, S. L, Zello, G.A., and Vatanparast, H. (2015) *Impact of the removal of chocolate milk from school milk programs for children in Saskatoon, Canada*. Applied Physiology, Nutrition, and Metabolism.

336 Taber, D. R., Chriqui, J. F., Vuillaume, R. and Chaloupka, F. J. (2014) *How state taxes and policies targeting soda consumption modify the association between school vending machines and student dietary behaviors: a cross-sectional analysis*. Plos One. 9(8).

337 Group, H. S., Mobley, C. C., Stadler, D. D., Staten, M. A., El Ghormli, L., Gillis, B., Hartstein, J., Siega-Riz, A. M. and Virus, A. (2012) Effect of nutrition changes on foods selected by students in a middle school-based diabetes prevention intervention program: the HEALTHY experience. *The Journal of school health.* 82(2):82-90.

Few institutional initiatives address the issue of meat consumption. An exception is the US initiative Meatless Mondays.[338] Set up in 2003 and now active in 30 countries, this campaign encourages people to avoid eating meat on Mondays on grounds of health and the environment. This is another example of an intervention that straddles the typological divide presented in this report; it is an 'awareness raising' initiative discussed in Section 7.f below , but it also changes the 'context of consumption' – the subject here – here since hundreds of food service companies, health care providers, schools, businesses and university campuses, have signed up. These signatories promote vegetarian options on Mondays to their customers; meat is generally still on offer, but vegetarian dishes predominate.

In 2012 Meatless Monday commissioned an online survey[339] of US citizens' meat consumption trends and assessed the role of Meatless Mondays. Of those surveyed, 59% said they had cut back on meat in the past year, and 41% were trying to do so. About 30% said they had not cut back and did not intend to. Forty three percent of respondents were aware of Meatless Mondays, and of those 36% said the initiative had influenced their decision to cut back or consider doing so.

Sodexo, a large US food service company involved in Meatless Mondays since 2011 surveyed its participating sites in 2012. Of the 245 respondent who took part in the survey (a 15% response rate), 74% offered meatless Monday meal options, 64% said they would continue to offer this option, and 24% responded they might continue. 76% felt it was easy or very easy to promote this option. As to purchasing behaviour, 56% saw no change and 30% saw a decrease in meat purchases. Forty nine percent reported an increase in vegetable sales, with 46% seeing no change; 5% saw a decrease in vegetable sales (Leidig 2012).[340] These trends were more apparent in sites in health care than in corporate settings.

Overall these results cautiously suggest the campaign is yielding results, but further research is needed to understand the impacts on consumers, and on whether the initiative has a spillover impact outside the food service setting. Other factors (e.g. changes in food prices due to the economic downturn) also need to be considered as possible contributory factors.

Outside of the food arena Momsen and Stoerk (2014)[341] sought, via an online survey of German and international students, to assess the effectiveness of different kinds of nudge-type approaches aimed at encouraging uptake of renewable over conventional energy. They presented the choice of renewable or conventional energy in a variety of different ways – by framing the issues differently (i.e. informing them about the carbon dioxide impacts of their choice), using priming techniques (i.e. getting them to think about renewable energy and climate change before presenting them with a choice) through social norms setting (i.e. telling them that most of their neighbours used renewable energy) and or by changing the purchase defaults (i.e. presenting the renewable option as the default option). In fact, only the default approach significantly altered choices from the baseline, increasing uptake of renewable energy by over 44%.

338 Meatless Monday (undated). Available from http://www.meatlessmonday.com/.

339 Righter, A. (2012) *New Survey Shows Meatless Monday Makes Room for More Veggies, 4 October 2012.* Center for a Liveable Future. [Online] Available from: http://www.livablefutureblog.com/2012/10/new-survey-shows-meatless-monday-makes-room-for-more-veggies.

340 Leidig, R. (2012) *Sodexo meatless Monday survey results.* The Johns Hopkins Centre for a liveable future, US.

341 Momsen, K. and Stoerk, T. (2014) F*rom intention to action: can nudges help consumers to choose renewable energy?* Energy Policy. 74. p.376–382.

A meta-analysis study by Abrahamse and Steg (2013)[342] considered evidence on the effectiveness of social influence approaches to promoting resource conservation and other pro-environmental behaviours. Forty two studies were examined, although some were excluded from final analysis, undertaken between 1976 -2013. The social influence approaches considered included the use of block leaders (volunteers who help inform other people); interventions encouraging people to make public commitments; the use of social norms ("the majority of our customers re-use their towels"), socially comparative feedback (e.g. providing information on a household's energy consumption relative to others in the area). The study found that while these approaches do seem to encourage resource conservation, the effect is small. Certain approaches, such as the use of block leaders and public commitments can be more effective; the use of social norms had less impact.

However another systematic review of experimental studies focusing on diets found that social norms did have an effect. It found that providing people with information about other people are eating habits influenced food choices; information indicating that others make low-energy or high-energy food choices significantly increased the likelihood that participants made similar choices.[343]

Finally, Southerton, McMeekin and Evans (2011)[344] in their review of initiatives aiming to shift behaviour in more climate friendly directions make a general point in observing that interventions focus disproportionately on the individual rather than the social and material influences on consumption.

7.f. Education, information and awareness raising

This subsection considers interventions that seek to achieve change by informing, raising awareness and creating a sense of empowerment. Interventions can be aimed at individuals, sometimes in institutional settings, and/or small communities.

Labelling

Food products can carry a number of ethical, environmental or nutritional labels. While ethical and environmental labels communicate that a product is accredited in some way, the purpose of nutritional labels (as distinct from health claims) is not to signal that a particular quality standard has been met. Rather their purpose is to provide clear, readily understandable information on a product's nutritional content and dietary quality. Consumers can, if they choose, use this information to make healthier choices. Some form of nutrition labelling on retailed products is now mandatory in the EU, the US, and in many other countries across the world, including in some South American countries, and in China, Japan, and South Korea.[345]

342 Abrahamse, W. and Steg, L. (2013) *Social influence approaches to encourage resource conservation:* A *meta-analysis*. Global Environmental Change. 23.

343 Robinson, E., Thomas, J., Aveyard, P. and Higgs, S. (2014) What Everyone Else Is Eating: A Systematic Review and Meta-Analysis of the Effect of Informational Eating Norms on Eating Behavior. *Journal of the Academy of Nutrition and Dietetics*. 114(3) p.414 – 429.

344 Southerton, D., McMeekin, A. and Evans, D. (2011) *International Review of behavior Change Initiatives*, Scottish Government.

345 EUFIC (2014) *Global Update on Nutrition Labelling*, European Food Information Council.

However, although labels are associated with increased nutritional knowledge two reviews highlight the fact that the relationship between information and choice is not straightforward.

A systematic review of labelling on pre-packaged foods in seven countries found that nutrition labels are an important source of information for consumers and are associated with healthier diets. It notes that the causal nature of this association is likely bidirectional: nutrition labels may promote healthier eating, whereas individuals with healthier diets are more likely to seek out nutritional labels in the first place. It concludes that there is sufficient evidence from a range of study designs to indicate that providing nutritional information has a positive impact on diet. However it also finds that the use of nutrition labels varies considerably across population subgroups. Use is particularly high among individuals with health conditions and special dietary requirements and notably lower among children, adolescents and older adults, and people in lower socio-economic groups. This, therefore, suggests that there are a number of confounding factors at play.[346] A major EU funded study (FLABEL) found that nutrition labels are well understood, but lack of motivation and attention are significant barriers to people using and acting positively to the information.[347]

Individual studies reviewed ranged in their assessment of the evidence between use of labels and overall diet quality. One study examined the impact of a 'guiding star' shelf-based nutrition labelling scheme introduced in a supermarket chain two years. It found weak positive impacts immediately after the labels were brought in and the effects, while small, were sustained 1 and 2 years later. If maintained in a large population and over a large range of foodstuffs these shifts could be important for both health and the environment. However the authors note that the findings are weakened by the lack of adjustment for other trends over time.[348]

Another study, which used surveys to ask consumers about their knowledge of nutrition and use of nutritional labels, reported that label reading was associated with increased adherence to a Mediterranean-type diet, although the causality could run either way.[349] Other well-conducted studies did not find evidence that labelling had a direct impact on choice or consumption behaviour. An Australian study that explored the impact of introducing traffic light nutrition information on consumers' online food purchases over a 10-week period found that this had no impact on consumption patterns. The authors noted that other studies had reported similar results.[350]

As regards sustainability, several studies have investigated the role of sustainability labels on consumer behaviour (Grunert, Hieke and Wills 2014; Tallontire *et al.* 2012). Evidence suggests that consumer awareness of certain standards has increased in the

346 Campos, S., Doxey, J. and Hammond, D. (2011) *Nutrition labels on pre-packaged foods: a systematic review.* Public Health Nutrition. 14(8) p.1496–1506.

347 FLABEL (2015) *Introducing FLABEL*. [Online] Available from: http://www.flabel.org/en/.

348 Sutherland, L. A., Kaley, L. A., Fischer, L. (2010) Guiding stars: the effect of a nutrition navigation program on consumer purchases at the supermarket. *The American journal of clinical nutrition*. 91(4).

349 Bonanni, A. E., Bonaccio, M., di Castelnuovo, A., de Lucia, F., Costanzo, S., Persichillo, M., (2013) *Food labels use is associated with higher adherence to Mediterranean diet:* results from the Moli-sani study. Nutrients. 5(11) p.4364-79.

350 Sacks, G., Tikellis, K., Millar, L. and Swinburn, B. (2011) *Impact of 'traffic-light' nutrition information on online food purchases in Australia.* Aust N Z J Public Health. 35(2) p.122-6.

past two decades[351,352] although as highlighted in above, a European survey by Grunert *et al.* finds that sustainability labels currently do not play a major role in consumers' food choices.[353] A study of 3000 UK households reported that while 65% of households felt that ethical food production methods were an important issue, only 29% actively sought these products, and an even smaller 4-7% actually bought Fairtrade products[354] – another instance of the attitude-behaviour gap highlighted in **7.a**. above.

However, while consumer responses to labels may be inconsistent, NGOs can use standards to rank companies according to the level of their compliance and 'name and shame' bottom performers.[355,356,357] Evidence suggests that high profile campaigns by NGOs have indeed been effective in provoking action. For example Oxfam reports that 18 months after publishing its 'Behind the Brands' ranking of the top ten global food companies across a range of criteria (including women's rights, climate change, water use, labour standards), all the companies have published policies or assessments in these areas, and all but one have made progress in at least one area.[358,359]

Note that carbon labels have been trialled by the UK supermarket Tesco since 2008 and by a few other manufacturers and retailers, with mixed success. Initially Tesco's intention was to carbon footprint all 70,000 of its product lines, but the plan was dropped in 2012 (although its carbon footprinting activities continue).[360] Consumer understanding of the scheme was limited since people found it difficult to make sense of numerical values. The study concludes that there is more scope for using carbon reduction labels to indicate a programme of *on-going* emissions reductions, than in expecting consumers to incentivise emissions reductions by actively choosing the lower carbon variant of two or more products.[361,362] Another UK study[363] based on a

351 Grunert, K., Hieke, S. and Wills, J. (2014) *Sustainability labels on food products: consumer motivation, understanding and use.* Food Policy. 44.

352 Tallontire, A., Nelson, V., Dixon, J. and Benton, T. G. (2012) *A review of the literature and knowledge of standards and certification systems in agricultural production and farming systems,* NRI Working Paper Series on Sustainability Standards no. 2, Natural Resources Institute, University of Greenwich. Kent.

353 Grunert, K., Hieke, S., Wills, J. 2014. *Sustainability labels on food products: consumer motivation, understanding and use.* Food Policy. 44.

354 Defra (2011) *Attitudes and Behaviours around Sustainable Food Purchasing Report* (SERP 1011/10). Defra, UK.

355 Greenpeace (2014) *From win to bin: our 2014 tuna league table.* [Online] Available from: http://www.greenpeace.org.uk/blog/oceans/win-bin-our-2014-tuna-league-table-20140228.

356 WWF (2013) *2013 Palm Oil Buyers Scorecard.* [Online] Available from: http://wwf.panda.org/what_we_do/footprint/agriculture/palm_oil/solutions/responsible_purchasing/palm_oil_buyers_scorecard_2013/.

357 OXFAM (2013) *Behind the Brands: food justice and the 'Big 10' food and beverage companies.*

358 Behind the Brands (2015) *A race to the top: New update on food and beverage companies progress.* [Online] Available from: http://www.behindthebrands.org/en/campaign-news/a-race-to-the-top,-c-,-new-update-on-food-and-beverage-companies-progress.

359 Smith, D. (2014) *Food giants are listening to demands for sustainability. Oxfam.* [Online] Available from: http://policy-practice.oxfam.org.uk/blog/2014/10/food-giants-are-listening-to-demands-for-sustainability.

360 Vaughan, A. (2012) *Tesco drops carbon-label pledge.* The Guardian. 30/1/2012. [Online] Available from: http://www.theguardian.com/environment/2012/jan/30/tesco-drops-carbon-labelling

361 Upham, P. and Bleda, M. (2009) *Carbon Labelling: Public Perceptions of the Debate. Summary report.* The Sustainable Consumption Institute, The University of Manchester.

362 Upham, P., Dendler, L. and Bleda, M. (2011) Carbon labelling of grocery products: public perceptions and potential emissions reductions. *Journal of Cleaner Production*. 19(4), pp. 348-355.

363 Gadema, Z. and Oglethorpe, D. (2011) *The use and usefulness of carbon labelling food: A policy perspective from a survey of UK supermarket shoppers.* Food Policy, 36(6) p.815 -822.

survey of 428 UK supermarket shoppers reveals that while consumer demand is strong for carbon labels (72% in favour), most people (89%) find it difficult to understand and interpret the labels, mainly because of poor communication and the proliferation of different labels. It concludes that a strong policy steer leading to a targeted, coherent and possibly mandatory carbon labelling policy is needed.

A Finnish study[364] which explored, through focus groups and an online survey of 1010 respondents, how consumers perceive the communication of carbon footprints for food products also found substantial confusion. While the term 'product carbon footprint' is familiar to many, only 7% of respondents linked 'product carbon footprint' spontaneously to GHGs associated with the product; an additional 5% of the respondents linked it to climate change. Attitudes towards carbon labels are positive, with 90% stating that a carbon footprint would have at least a little impact on their buying decision, but the information became meaningful only when many other purchasing criteria (such as price and taste) were satisfied. Eighty six percent preferred carbon labels that allow comparisons of carbon footprints to be made among food products (either within or across food categories), but on the whole it was concluded that given current levels of awareness, carbon labels have a low appeal.

As regards the impacts on purchasing decisions, in an Australian study,[365] 37 food products were labelled with high, medium or low carbon footprints, the labels displayed over 8 weeks, and sales recorded over a three month period including pre- and post-intervention. The study found sales of green (low carbon) labelled products increased by about 4% and black (high carbon) reduced by 6%. However sales of green items rose by 20% when these items were also the cheapest, suggesting that while people may be well disposed towards the issue, prices signals need to be right.

In a willingness-to-pay study of carbon footprints in China participants were given a small amount of money to buy food products, such as milk, bananas, eggs and instant noodles, labelled as high, medium or low carbon. The study found significant differences exist among consumers, with higher levels of education and income positively correlated with willingness to pay. [366]

In all then, while carbon labelling appears to be received positively by consumers, understanding is low and other considerations – including price and ability to pay – are critical influences on the purchasing decision that people ultimately make.

364 Hartikainen, H., Katajajuuri, J-M., Pulkkinen, H. (2014) Finnish consumer perceptions of carbon footprints and carbon labelling of food products. *Journal of Cleaner Production.* 73.

365 Vanclay, J. K., Shortiss, J., Aulsebrook, S., Gillespie, A. M., Johanni, R., Maher, M. J., Mitchell, K. M., Stewart, M. D. and Yates, J. (2011) Customer Response to Carbon Labelling of Groceries. *Journal of Consumer Policy.* 34(1) p.153-160.

366 Shuai, C-M., Ding, L-P., Zhang, Z-K., Guo, Q. and Shua, J. (2014) How consumers are willing to pay for low-carbon products? Results from a carbon-labelling scenario experiment in China. *Journal of Cleaner Production,* 83(15) p.366–373.

Other forms of information provision and awareness raising

A handful of studies included in this review engaged directly with consumers through communications such as text messages or TV shows; these reported some evidence of shifts in consumption.[367,368] A web-based intervention that sought to increase fruit and vegetable consumption in five US cities reported that increased consumption was significant and sustained at 12 months.[369] And, although the impact of the intervention was not reported, a study found that users of a text-messaging approach to diabetes education had positive perceptions.[365] However the evaluation of the UK's Change 4 Life programme which uses metrics such as 'awareness' and 'reach,' highlights the fact that many outcome measures are based on definitions of impact in the realm of communications and marketing rather than health.[370] It is therefore difficult to assess how far these actually change behaviour or shift consumption patterns.

Some of the interventions draw upon ideas from health psychology to encourage behaviour change, particularly in institutional environments such as workplace canteens. These include the concept of 'self-efficacy', the idea that an individual must feel capable of achieving their goals – such as eating more fruit and vegetables – if change is to be achieved. Two studies reviewed here saw sustained shifts in consumption patterns, although some methodological weaknesses relating to the recruitment of participants and duration of follow-up were noted.[371,372]

High profile celebrity-driven or endorsed campaigns may also have a play a role in altering consumption at least in the short term. For example in the UK, celebrity chef and environmental campaigner Hugh Fearnley-Whittingstall made a series of widely viewed programmes, first in 2010 and then in 2013, highlighting the environmental problems caused by overfishing and the practice of discards (throwing non-target species, dead, back into the sea) and urging the public to switch to more abundant and certified fish species and the EU to reform the Common Fishing Policy. The Fish Fight campaign spread to other European countries where it was taken up by other celebrities; an EU wide petition attracted 870,000 signatories. Public awareness raising was complemented by the lobbying of politicians across Europe.

Formal academic analysis of the impacts of this campaign is lacking and it is hard to distinguish between the impact of this campaign and the long standing efforts of NGOs such as WWF to reform the Common Fisheries Policy. However the Fish Fight

367 Buis, L. R., Hirzel, L., Turske, S. A., Des Jardins, T. R., Yarandi, H., Bondurant, P. (2013) Use of a text message program to raise type 2 diabetes risk awareness and promote health behaviour change (part II): assessment of participants' perceptions on efficacy. *Journal of medical Internet research.* 15(12).

368 Al-Haifi, A. R., Al-Fayez, M. A., Al-Nashi, B., Al-Athari, B. I., Bawadi, H. and Musaiger, A. O. (2012) *Right Diet: a television series to combat obesity among adolescents in Kuwait. Diabetes, metabolic syndrome and obesity:* targets and therapy.5. p.205-12.

369 Alexander, G. L., McClure, J. B., Calvi, J. H., Divine, G. W., Stopponi, M. A., Rolnick, S. J., (2010) *A randomized clinical trial evaluating online interventions to improve fruit and vegetable consumption*. Am J Public Health. 100(2) p.319-26.

370 NHS (2009) *Change4Life Marketing Strategy 2009* [cited 2015]. Available from: http://www.nhs.uk/change4life/supporter-resources/downloads/change4life_marketing%20strategy_april09.pdf.

371 Kreausukon, P., Gellert, P., Lippke, S. and Schwarzer, R. (2012) *Planning and self-efficacy can increase fruit and vegetable consumption: a randomized controlled trial.* J Behav Med. 35(4) p.443-51.

372 Kushida, O. and Murayama, N. (2014) *Effects of Environmental Intervention in Workplace Cafeterias on Vegetable Consumption by Male Workers*. J Nutr Educ Behav. 46(5) p.350-8.

campaign claims credit for the EU's decision to reform the Common Fisheries Policy and ban the practice of discards and for changing people's fish consumption habits.[373] One newspaper article reports that all the main supermarkets have seen an increase in sales of alternative and less exploited fish species, suggesting that the programme did have an impact, at least in the short term. However, all but one of the supermarkets also said that sales of popular, and often depleted species such as cod had held steady as well, suggesting that an unintended consequence of the programme was an increase in fish consumption overall, rather than simply a switch from less to more sustainable species.[374] This said, since the article simply covered the period immediately following the airing of the programme, any long term and sustained consequences of programmes such as these are unclear.

In Australia, a partnership between industry and Curtin University similarly sought to alter people's fish consumption habits through awareness raising efforts. This time however, the campaign was more localised in scale – focusing simply on the Australian City of Mandurah – and the aim was to increase fish consumption for the benefit of health and to support the Australian fishing industry. Sustainability issues were not a focus of the campaign. A range of targeted materials explaining the benefits of fish eating were developed and these were then sent to businesses, medical practices, GPs, schools (primary and secondary) and vocational educational organisations. Point of sale materials were also distributed to major seafood retail outlets while the local council promoted the health benefits of seafood in their weekly advertisements in the community newspaper.[375] The intervention was preceded by a community survey, conducted to explore awareness, attitudes and consumption habits. After distribution of the materials and associated publicity, sales of seafood rose by 24% during the month of the intervention and remained 15% above the mean in the month after. There was also strong positive feedback from those using the resources, especially GPs. These findings indicate that concerted awareness raising efforts spanning a range of audiences can have an impact in the short term although the longer term effects are unknown; the impacts on sustainability are also unclear and may be negative, depending on what was consumed.

In all it appears that measures to raise awareness through media campaigns and information provision can play a part in influencing consumption. However the long term sustained effects are unclear. Note too that a systematic EU wide review of both 'hard' and 'soft' approaches to promoting healthy eating found the former to be more effective than the latter,[376] and noted that while information campaigns raise awareness the message does not necessarily translate into action.

373 *Fish Fight* (undated) Available from http://www.fishfight.net/story.html.

374 Vaughan, A. (2011) *Hugh Fearnley-Whittingstall's TV Fish Fight boosts consumption,* The Guardian. 8 August 2011. [Online] Available from: http://www.theguardian.com/environment/2011/aug/08/fish-consumption-rises-despite-campaign.

375 McManus, A., White, J., Hunt, W., Storey, J., McManus, J., Cuesta-Briand, B., Golightly, A. (2011) *Community intervention to increase seafood consumption* (CIISC). Centre of Excellence for Science Seafood & Health (CESSH), Curtin Health Innovation Research Institute, Curtin University Report # 16092011.

376 Brambila-Macias, J., Shankar, B., Capacci, S., Mazzocchi, M., Perez Cueto Eulert, F. J. A., Verbeke, W. and Traill, W. B. (2011) *Policy interventions to promote healthy eating: a review of what works, what does not, and what is promising*. Food and Nutrition Bulletin. 32(4), p.365-75.

Community empowerment initiatives

In developing countries, a great many interventions have sought to improve nutritional outcomes through small scale agricultural interventions, ranging from school, home or community gardening schemes to support for small scale livestock keeping or aquaculture. On the whole, evidence for the effectiveness of these interventions is poor (i.e. there is a paucity of good evidence, rather than evidence of no impact).[377,378] However, since this a huge area of study, already being investigated by others, [379] it is not discussed further here except to observe that the evidence base focusing on interventions that seek to improve both nutrition and environmental sustainability is conspicuous by its absence. This is an area that deserves a programme of research in its own right.

As to the developed world the situation is different in that the vast majority of people live in urban areas and produce little, if any of their own food. However recent years have seen an increased focus on engaging communities in gardening and community food growing schemes as a means of re-connecting them with food improving people's health and sense of empowerment, and contributing to greener and more sustainable urban environments. Examples include community and school based food growing schemes, community supported agriculture, community cookery programmes, farmers markets and so forth.

As regards urban food growing, a great deal has been written about the potential benefits. However, much of this is in the form of 'grey literature' and the line between advocacy as to the *potential* benefits of urban food growing and analysis of actual impacts is not always clear-cut. That said, it does seem to be the case that community food growing projects are valued by participants and can engender a general sense of wellbeing, improve social cohesion and of stimulate interest in food.[380,381,382] A limited number of academic research has been undertaken and there are some studies which review the academic literature. These find evidence of positive impacts across a spectrum of health areas; as regards nutrition, benefits include increased knowledge of

377 Masset, E., Haddad, L., Cornelius, A. and Isaza-Castro, J. (2011) A systematic review of agricultural interventions that aim to improve nutritional status of children. London: EPPI-Centre, Social Science Research Unit, Institute of Education, University of London.

378 World Bank (2007) From Agriculture to Nutrition: Pathways, Synergies and Outcomes, World Bank, Washington DC.

379 LCIRAH (undated) Leverhulme Centre for Integrated Research on Agriculture and Health, Available from: http://www.lcirah.ac.uk/.

380 Garnett, T. (1996) Growing food in cities, A report to highlight and promote the benefits of urban agriculture in the UK, National Food Alliance, UK.

381 Garnett, T. (1999) CityHarvest: The feasibility of growing more food in London, Sustain, London.

382 DCLG (2012) Food Growing Case Studies. Department for Communities and Local Government, UK.

fruits and vegetables, greater willingness to try unfamiliar produce, and consumption increases.[383,384,385,386,387,388]

An academic review of the literature on both farmers' markets and community gardens in the US[389] concluded, on the basis of the studies examined, that both have potential to increase access to fruits and vegetables, especially in low-income areas that have poor access to affordable, healthful foods. However, despite the fact that some evidence exists for the positive effects of farmers' markets and community gardens on community-building and other social outcomes, there is limited research assessing the specific health benefits of farmers' markets and community gardens. It underlined the point that additional well-designed studies are needed. Note that a recent paper focusing on farmers' markets in Bronx County, New York strikes a note of warning.[390] Its analysis finds that in this area, farmers' markets may offer and promote many items that are less-than-ideal for good nutrition and health and they may carry less-varied, less-common, more-expensive produce in neighbourhoods that already have stores with overwhelmingly more hours of operation. They point out that although farmers' markets may increase access to organic and fresher produce, their lower accessibility, restricted variety, and higher cost, might provide little net benefit to food environments in urban communities, especially when so much of their inventory is refined and processed non-produce fare. Of course it is also worth noting that farmers' markets are still at an embryonic stage of development and if scaled up, these issues are potentially resolvable.

It is important to note too, in the context of urban food growing and farmers markets that this review found a real paucity of studies that sought to evaluate the environmental impacts of these initiatives. This is an area where considerably more work is needed.

Turning to community cooking schemes, a systematic review of the effects of home cooking courses for adults in the UK is inconclusive because high-quality evaluations of these schemes are generally lacking (i.e. no evidence of impact, rather than evidence of no impact). This said, one well-conducted evaluation of peer-led cooking clubs for elderly people in sheltered housing in socially deprived areas suggests that cooking courses in this population might have beneficial impacts and participants enjoyed

383 Gibbs, L., Staiger, P., Johnson, B., Block, K., Macfarlane, S., Gold, L., Kulas, J., Townsend, M., Long, C., Ukoumunne, O. (2013) Expanding children's food experiences: the impact of a school-based kitchen garden program. *Journal of Nutrition education and behaviour.*

384 Langellotto, G., Gupta, A. (2012) Gardening increases vegetable consumption in School-aged children: a meta-analytical synthesis. Hortechnology. 22.

385 Morgan, P., Warren, J.M., Lubans, D.R., Saunders, K.L., Quick, G.I., Collins, C.E. (2010) *The impact of nutrition education with and without a school garden on knowledge, vegetable intake and preferences and quality of school life among primary-school students.* Public health nutrition. 13.

386 Nelson J, Martin K, Nicholas J, Easton C and Featherstone G (2011) *Food Growing Activities in Schools,* National Foundation for Educational Research.

387 Kazmierczak A, Connelly A and Sherriff G (2013) *Growing Manchester Programme: Final Evaluation Report,* Centre for Urban and Regional Ecology/Manchester Architecture Research Centre, The University of Manchester, Manchester, UK.

388 Davies G, Devereaux M, Lennartsson M, Schmutz U and Williams S (2014) T*he benefits of gardening and food growing for health and wellbeing.* Garden Organic and Sustain, UK.

389 McCormack LA, Laska MN, Larson NI, Story M (2010) *Review of the nutritional implications of farmers' markets and community gardens:* a call for evaluation and research efforts. J Am Diet Assoc.

390 Lucan, S. C., Maroko, A. R., Sanon, O., Frias, R., Schechter C. B., (2015) U*rban farmers' markets: Accessibility, offerings, and produce variety, quality, and price compared to nearby stores,* Appetite.

the social aspects of their cooking sessions.[391] One US analysis of a six week cookery course focusing on plant based cooking found that the 63 participants who completed the programme increased their intakes of fruit the variety of vegetables consumed and decreased their purchase of meat, carbonated beverages, desserts, snacks and total groceries.[392] A systematic review of the impact of cookery classes on knowledge, preferences and behaviours of school-aged children found that these classes may have a positive impact but the quality of the studies was variable and the long term effects hard to ascertain.[393]

Overall, the main point that emerges from this overview is that community initiatives of the kind described here tend to be small in scale, underfunded, and often operated by volunteers. There has been little robust analysis of their impacts and in the precarious contexts in which they operate applying robust research methods including controls is difficult.

391 Rees, R., Hinds, K., Dickson, K., O'Mara-Eves, A., Thomas, J. (2012) *Communities that cook: a systematic review of the effectiveness and appropriateness of interventions to introduce adults to home cooking.* London: EPPI-Centre, Social Science Research Unit, Institute of Education, University of London.

392 Flynn, M. M., Reinert S, and Schiff, A. R. (2013) A Six-Week Cooking Program of Plant-Based Recipes Improves Food Security, Body Weight, and Food Purchases for Food Pantry Clients. *Journal of Hunger & Environmental Nutrition*. 8(1) p.73-84.

393 Hersch, D., Perdue, L., Ambroz, T., Boucher, J. L. (2014) *The Impact of Cooking Classes on Food-Related Preferences, Attitudes, and Behaviors of School-Aged Children: A Systematic Review of the Evidence,* 2003–2014. Prev Chronic Dis.

8. Conclusions

In this final section we offer conclusions about: **a.** the quality and extent of the evidence base; **b.** public knowledge of and attitudes to health and the environment, particularly as regards the focal consumption practice of this report and **c.** which interventions work, based on the evidence reviewed. Finally **d.**, we draw some cross cutting conclusions and recommend areas for research.

8.a. The quality and extent of the evidence base: general conclusions

This rapid overview of the available literature on interventions relevant to healthy and sustainable diets has been limited by time and resource constraints. These have been compounded by the breadth of the research question – "what do we know about the evidence on the effectiveness of interventions aimed at shifting diets in more healthy and sustainable directions?" This means that a very wide range of interventions have fallen within our scope and that have differed widely in their design, methodologies, quality, and outcomes investigated. Our review suffers too from a number of weaknesses, the most obvious being its dominant focus on high income countries, and particularly on the UK where these authors are based.

However, the developed country bias is not just a weakness; it also stands as our first general observation in this concluding section. Our focus has necessarily been on high income countries since this is where the bulk of research is to be found. Evidence of interventions and of the effectiveness of interventions within the scope of this analysis in low and middle income countries is scanty. This is clearly problematic since the greatest growth in environmental impacts and in non-communicable diseases is set to occur in low and middle income countries in coming years.

A second general observation is that there is a huge imbalance between the quantity and quality of studies that focus on health and those that are environment oriented. This in turn reflects the fact that to date considerably more attention has been paid to intervening in diets in order to improve public health than to achieve sustainability objectives. There are even fewer designed with the aim of achieving integrated outcomes.

Our third general observation is that most of the experimental evidence is of voluntary interventions aimed at individuals or in group settings, such as schools or workplaces. This is inevitable since interventions of this kind are obviously much easier to implement and evaluate than those that require cooperation from policy makers in order to change governance or prices. The effects of small scale studies are also much easier to assess. However the potential for a catch-22 situation then arises: policy makers are unwilling to implement more 'robust' measures since the evidence base is

lacking, which makes it impossible to evaluate the potential of such measures. While action should be informed by evidence, building the evidence base requires action. It is notable that many of the insights gained about the role of international and national regulations come from observations of 'natural experiments' and the lessons learned are of policy actions to be avoided rather than to be emulated, a point discussed further below. As to fiscal interventions, while a growing number of studies focus on real life interventions, much of the work undertaken here is model based.

What also emerges is that most of the interventions we did find that focused on fiscal, regulatory and contextual changes – whether experimental or model based – came from the health literature. For the most part, environmentally-oriented interventions tended to focus on information and awareness raising or on production-centred certification schemes rather than on systemic changes. This difference likely reflects the fact that the public health discourse is long standing and well established, where the 'public' is treated as a unit and where the limitations of individually-oriented approaches are increasingly recognised. The field of sustainable consumption is relatively new, far less supported by policy attention and the emphasis is still very much on individual voluntary actions or on shifting production practices.

Our fourth general point considers the richness of the evidence base in relation to the key consumption practices for this review:

Fruit and vegetables: We have found a vast number of interventions aimed at encouraging increases in fruit and vegetables, mostly on grounds of health although occasionally on grounds of sustainability, particularly where produce is organic or local. Many of these interventions have been of the awareness raising or settings-based variety. However some interventions have been policy driven, have led to changes in public procurement provision and to associated increases in consumption.

Sugar: As with fruit and vegetables, there is evidence of diverse interventions seeking to reduce sugar consumption, usually of specific products such as SSBs or, in the case of interventions aimed at marketing, of foods generally high in sugar. Sugar-oriented interventions tend to be of the following variety: general awareness raising campaigns to promote overall 'healthy eating messages' (i.e. more fruit and vegetables, fewer sugary or fatty 'treat foods'); settings- based interventions (i.e. bans on SSB-providing vending machines in schools); limits on advertising of sugary and unhealthy foods to children; and taxes on sugary foods such as SSBs. Some tax based studies investigated real life interventions but many were model based. Strikingly, we have come across no interventions aimed at reducing sugar consumption on environmental grounds or based on a joined up health-environmental rationale. Certification and labelling schemes promote more ethical, rather than less overall sugar consumption.

Meat: the evidence based here is extremely limited. We have found no real life policy driven interventions aimed at reducing meat consumption (although some governments are now incorporating a less-meat message into their healthy sustainable eating guidelines). A few model based studies have assessed the impact of climate-oriented taxes on meat and the Meatless Monday campaign is an example of a real life public awareness/context changing intervention underway which combines a health and environmental message. Overall however, interventions focusing on meat are extremely thin on the ground.

Palm oil: Our research found almost no health-oriented interventions aimed at moderating palm oil consumption. The environment has been the main focus of public awareness campaigns and of collective voluntary initiatives seeking (e.g. certification) to improve the sustainability of supply. As with meat, this is an area where interventions are strongly lacking.

Fish: We found only one intervention that specifically sought to increase fish consumption for health and this was partly industry funded. Environment-oriented interventions mainly took the form (as with palm oil) of media campaigns and certification schemes.

8.b. Attitudes and awareness: what do we know?

On the whole our review supported the observation often made: for most consumers, price and taste are the main influences on their decisions to buy and eat food. Other factors, including its perceived quality and safety are also important as is health – increasingly so. Knowledge of what constitutes healthy eating is generally good in developed countries and among educated people in developing countries; awareness of the need to eat more fruit and vegetables and cut back on sugary or processed food is high. However, people are less knowledgeable about the specifics of healthy eating – that is, about different types of fat, for instance.

As regards the environment, the public are well disposed but on the whole it is not a priority. While they may have warm feelings towards production methods such as local and organic food, their real knowledge of food and its environmental impacts is weak; for example knowledge of the livestock sector's contribution to the problem of climate change is poor. As regards meat, attitudes do in fact appear to be contradictory. On the one hand there are signs within certain high consuming countries (the US and the UK) that meat consumption is stabilising or even declining, and some people say they are trying to, or willing to eat less meat. However, surveys also show that people resist the idea of eating less meat and that meat has strong cultural resonance for many people, particularly men. On the whole this is an issue in flux and while it remains contested, it is potentially malleable to interventions at least among some population groups. It will be interesting to see how and if NGO campaigning in this area in coming years alters current mainstream opinion.

Knowledge about palm oil and its environmental impacts is also weak, although stronger in some countries where there have been substantial public awareness raising efforts. As to fish, people say that the sustainability of fish stocks is important but knowledge of the issues is poor.

Predictably, the attitude-action gap is much in evidence; while people say they want to eat healthily they often do not, and this is even more so when it comes to pro-environmental food practices.

8.c. What works? The effectiveness of interventions

The typology adopted in this review clustered interventions into five categories, acknowledging overlaps between them: i. Restrict, eliminate or incentivise choices; ii. Change the governance of production or consumption; iii. Encourage collaboration and shared agreements; iv. Change the context, defaults and norms of production or consumption; v. Inform, educate, promote or empower through community initiatives, labelling and other means.

Our conclusions as to the effectiveness of these approaches is as follows:

Disincentivise or incentivise choices through fiscal measures

One key observation of fiscal interventions was the dominance of model based studies, a practical research necessity given the paucity of governments currently willing to intervene in the market. Models are inherently simplistic and by their very nature cannot capture or describe the multiple influences on consumption. In particular the substitution effects of an imposed tax are hard to model and so quantifying the actual link with measurable outcomes, such as GHG reductions or the incidence of obesity, is subject to major assumptions and uncertainties. As such, model based analyses of fiscal measures can only be considered as pointers, rather than predictions.

These provisos aside, models certainly have their merits, provided there is transparency as to the assumptions that go into their construction. For a start, models are essential where experimental evidence is lacking: they help analysts explore what might happen in cases where a hypothetical intervention may be politically sensitive, costly, or unpopular with the public or industry, and allow researchers to modify and adjust in order to improve outcomes. Moreover the reality is that many economic policy decisions are based on models anyway so models speak 'policy language.' Policy makers who are not motivated by health or the environment but by economic arguments may be swayed by models that show a relationship between health/ environmental and economic gains.

While as noted, many of the studies we reviewed were based on models, some real life interventions are also underway – mainly taxes on sugary drinks. Since these have only recently been imposed, the long term effects are still unclear but preliminary analysis suggests that they may be altering consumption in intended directions. The value to policy makers of investing in robust evaluations processes so as to understand impacts and modify policies in light of new evidence is unarguable.

The potentially regressive nature of taxes emerges as a common theme, particularly in the modelling literature. However, what 'regressive' actually means requires further thought. Potentially taxes that hit poor low income consumers hardest may also deliver the greatest health benefits for those groups and as such be progressive in health terms. However, all depends on how and if people compensate by consuming substitute foods, or in other areas of expenditure. For example poor people may 'ring-fence' their consumption of less healthy foods and cut back on purchases of more healthy foods, or they may buy poorer quality versions of taxed foods. Understanding the substitution effect is therefore critical. Specifically, more work is needed to investigate what substitute foods may be eaten in place of taxed foods, how these differ between population groups; and the health and environmental implications, to ensure that policies do not lead to unintended consequences.

Subsidies for healthy foods potentially have an important role to play too, although they may disproportionately benefit higher income consumers who already consume more healthily. Targeted incentives aimed at particularly vulnerable groups (for example vouchers for healthy foods for people on income support) may be one way of ensuring that the benefits obtain for those who need them most.

It is worth noting too that while there are health-oriented studies modelling the effects of fiscal measures on sugar, fruit and vegetable consumption, we found no evidence of health -oriented fiscal interventions geared at moderating fish or meat consumption except, in the latter case, through taxes on saturated fats.

This last point – relating to saturated fats – leads on to an important observation: since pro-environment and pro-health interventions differ in their goals, they can differ in their effects in ways that may be contradictory. For example a consumption tax on saturated fat may encourage a manufacturer to reformulate a product or remove fat from meats sold; this may affect saturated fat intakes and potentially health outcomes, but may not affect livestock production and associated GHG emissions. The animal will still be reared and an alternative industrial use found for the fat – alternatively fatty cuts can be exported, and in an example of the risks of 'leakage' effects, potentially undermine people's health in other countries. A climate tax on the other hand may not distinguish between the nutritional qualities of meat cuts; indeed by increasing the cost of meat, consumers might even switch to fattier but cheaper cuts of meat or processed foods to compensate, thereby undermining health goals. On the whole taxes that send a clear signal to producers are likely to have a stronger impact on the environment than those that simply target a consumption practice, particularly where the production-consumption link is weakened by the complexity of the supply chain, and the globalised nature of food systems. Following from this, more research is needed not just to understand how a tax (or subsidy) impacts upon consumers but also what the effects are on actors along the whole supply chain, and to ascertain the optimal stage for intervening so as to achieve both health and environmental benefits.

Additionally as some of the studies reviewed showed, while sugary foods are a target for health taxes, in the environment literature climate taxes and/or subsidies for lower climate impact foods can actually lead to increases in sugar intakes, since sugar is a relatively low carbon food. Thus measures to align environmental and nutritional objectives require careful thought. There has been no environment-oriented analysis of how fiscal changes might support other environmental objectives, such as water use in food systems, or biodiversity.

While much of the literature on the role of taxes and subsidies is model based and somewhat simplistic, mounting evidence does however suggest that combinations of taxes and subsidies can be effective in shifting consumption. Experiments with such combinations are needed; the level of taxation needs to be set sufficiently high; and care is needed when designing measures to avoid unintended consequences – these include both unhealthy food substitutions across or within food categories, and disproportionate burdens on low income populations. Ring-fencing funds for spending on public health or sustainability measures can improve public acceptability. The fear of unintended effects should not be used as an excuse for inaction.

Finally, while fiscal instruments have an important role to play, they are not the be-all and end-all of policy interventions; consumption and purchasing practices are shaped by multiple influences.

Change the governance of production or consumption

The dramatic transformation of the global economy over the last fifty years has been extremely successful in altering people's diets. While the impacts of the so called 'nutrition transition' may have been bad for health and for the environment, there is no doubt that the macro-political and economic measures that were implemented had effects on what and how people consume. The inference from this 'negative lesson' is that if substantive and positive changes in dietary patterns are to be achieved then fire needs to be fought with fire – macro-economic and political interventions will be called for that are designed to reverse the negative effects of the powerful measures that have been put in place to date. Efforts to influence diets at individual or community level through awareness raising approaches – the kind of interventions that tend to be more acceptable to policy makers loathe to intervene more forcefully – are likely to have only a limited effect given the greater influence of these more robust political forces.

In other words, systemic changes to the political economy of food provisioning and supply are needed if the rise in diet related diseases and environmental damage is to be checked. There is a need for more analysis of what sort of systemic changes – changes in agricultural policy, in trade, in food provisioning infrastructure and in public and private sector investment – are needed to achieve health and environment-enhancing shifts in food provisioning.

Moving from the international to the national level, governments have a strong role to play in shaping the regulatory and physical environment via the introduction of standards, and planning policies. Government also exert strong influence on the socio-economic determinants of health – levels of poverty, inequality and lack of educational attainment in society that are so strongly correlated with poor dietary health.

Collaborations and shared agreements

The evidence reviewed indicates that certification schemes and standards have help shift the market – although evidence of their measurable benefits for the environment (for example) is more mixed. However, as the certification sector grows, the risk is that standards are diluted or 'dumbed down' in order to expand their reach and involve more stakeholders.

Certification schemes rely for their success on a market and at present, the market for certified products is fairly weak. This suggests that their purpose and values needs to be better communicated both to consumers and to policy makers. Indeed, certification schemes can be synergistic with regulatory approaches, as for example when public procurement standards specify the provision of certified food. As such public procurement policies have a role to play in expanding the market for certified foods even in the absence of consumer awareness.

However certification should not be seen as a substitute for regulation. A strong policy framework is needed for several reasons. First policies are needed to improve transparency and enable comparisons across schemes; in order to ensure that schemes actually deliver on their claimed benefits; robust monitoring schemes need also to be in place that likewise works across schemes. A policy framework is also

important in ensuring that all – including less powerful – stakeholders, can access and participate in certification schemes. Third, policy has a role in setting the framework of consumption; while certified products may be more sustainable than their non-certified counterparts, consumption above a certain level (be it of fish, or palm oil, or sugar) will not be sustainable, or healthy or either.

Regarding voluntary industry agreements, the evidence is mixed and limited. There is some evidence that the somewhat less 'voluntary' of the voluntary initiatives can be effective – that is, in schemes with penalties attached to non-compliance or non-involvement – but even here, in the absence of a counterfactual, their effectiveness as compared with more regulatory approaches is unknown . The UK's Courtauld Commitment is a striking example of an initiative that has achieved results and is also is evolving in forward-thinking ways that are potentially quite challenging for its business members.

It is also worth noting that voluntary initiatives tend to be successful largely where there is a business case for them. At present, the business case for companies to engage in fostering sustainable healthy diets can certainly be made at least when thinking about mid-to-long term risks and opportunities but may not be immediately obvious or credible in the immediate term. Once again this suggests the need for a clearer and more robust policy steer, a steer which anecdotal evidence suggests, industry would welcome provided it created a level playing field.

Finally, the growth in recent years of national and international networks such as Sustainable Food Cities is interesting and positive. So far however, there has been no robust analysis of their impacts.

Changing the context, defaults and norms of production or consumption

The interventions included in this category included both the role of advertising and marketing – as examples of large scale influences on the context of consumption – and more context specific interventions in work or school based settings.

As to the former, evidence that advertising and marketing foster unhealthy consumption preferences and consumption patterns, and contribute to negative health outcomes among children is robust. In the limited number of cases where regulations to limit unhealthy marketing to children had been imposed, there was evidence of some positive impact, although actual effects on health outcomes have not been quantified. Government regulation, as opposed to self-regulation was more effective and recommended by researchers. The effects of advertising and marketing were less clear in the case of adults, but this reflects a lack of evidence as much as evidence of no impact.

As regards other context based interventions, most of these were undertaken in schools, workplaces and other settings. The research finds that multiple-component interventions tend to be effective especially when some price incentive (in the form of coupons, differential pricing and so forth) is included in the mix and combined with some educational and awareness raising approaches. Interventions in schools, such as the setting of school meal standards or the provision of free or subsidised fruit, generally yield positive effects (note that these are examples of interventions that could equally have been discussed in the context of governance, above).

'Nudge' type approaches, drawing upon techniques such as priming, framing, changing the defaults, and the presentation of desirable social norms, are the subject of acute interest but the evidence here is still limited and less robust. More research is needed particularly to investigate whether effects are sustained. Note that nudge approaches may raise some ethical questions by 'duping' people into behaving in certain ways by presenting them with a set of artificially constructed pro-health or pro-environmental norms. On the whole, while an interesting area for further research and a promising tool in the interventions tool-kit, nudge approaches cannot be seen as a substitute for regulatory or fiscal interventions.

Inform, educate, promote or empower through community initiatives, labelling and other means

Non-intrusive approaches to fostering behaviour change, such as public awareness raising and labelling have formed the backbone of health promotion policy in recent years. These approaches are seen as more politically acceptable than regulatory or fiscal approaches. However the evidence reviewed here suggests an almost inverse correlation between policy enthusiasm for such approaches, and their effectiveness.

This is not to say that they are having no effect and no role to play. On the contrary, nutrition and other consumer facing labels certainly help build consumer awareness, people find them acceptable, and some people also make use of them; but the evidence suggests that they are not always fully understood and their impact is only weakly positive. There is indeed an association between use of labels and healthier eating patterns, but the causality is not straightforward; more health conscious people are more likely to make use of labels. More positively however, by creating consumer awareness and concern, they may 'soften up' the public, making them more likely to accept more robust forms of intervention, such as regulation.

Also on a positive note, labels may have a role in driving a 'race to the top' by manufacturers who do not want their labels to appear nutritionally unfavourable, particularly when they appear on the front of food packages. This is also the case when it comes to hard hitting benchmarking or ranking exercise that are sometimes undertaken by NGOs (as for example Oxfam's Behind the Brands campaign), and that do have a role in altering business practice.

Nutrition labels have a relatively long pedigree; sustainability-oriented labels less so. The environment is currently low on people's list of priorities and knowledge of environmental issues is poor – hence the limited success of efforts to carbon-label products. While consumer recognition of certification scheme logos (e.g. MSC fish) levels is growing, it is still low and up to fifty percent of commodities that meet certification criteria are not sold as such – significantly less in the case of some, such as Bonsucro certified sugar. Measures to raise public awareness will be important to enabling continued growth of this sector, together with, as noted, commitment by the public and private catering sector to procure certified products.

As to other community empowerment and educational activities such as community gardening or cooking schemes, and farmers markets, the evidence here is weak, testifying to the underfunded nature of these sorts of schemes. However, such evidence as there is suggests these initiatives are liked by people and can help build community cohesion, stimulate interest in food and shift mind-sets, whether or not they have a measurable effect on health or environmental outcomes.

Finally, and following on from this point, awareness raising, educational activities of the kind reviewed here may have a constructive role to play in in creating greater consumer engagement in health and sustainability issues. This greater engagement may instil in policy makers and the food industry the confidence to take more radical action as needed.

8.d. Overall conclusions and recommendations for further research

Our cross cutting conclusions are as follows:

Consumption matters: sustainable healthy diets should be a policy priority

A global shift towards more healthy and sustainable eating patterns is urgently needed. Policy makers and industry need to recognise the importance of this goal and prioritise efforts to advance it. Production side measures, while important and necessary, cannot by themselves address the interconnected health and environmental challenges we face – our consumption patterns also need to change. This observation holds true not just in high income countries but also in emerging economies where diets are rapidly transitioning; and it applies too to low income countries. While in these settings problems of hunger and malnutrition still dominate, food systems are nevertheless changing. If the nutrition and environmental problems experienced by the West are to be avoided then thinking needs to start now as to how best to 'future proof' the evolution of their agri-food systems, in order to ensure that diets evolve along health- and environment-enhancing pathways.

Don't leave it to the individual

For too long the focus of interventions around health, and now sustainability, has been on the individual. This needs to change; the evidence reviewed here overwhelmingly shows that approaches aimed at getting individuals to change voluntarily have limited impacts. The context of consumption also needs reshaping. The attitude-action gap is profound even when it comes to health – where there is self-interest might be expected to play a part. As to the environment, the gulf is even greater given relatively limited public interest and knowledge, and the much less immediate link to individual wellbeing.

Don't leave it to industry goodwill or enlightened self interest

While the food industry is taking positive steps to address some of the health and environmental problems it causes through its involvement in certification schemes and shared voluntary agreements, these measures alone are not enough. Such initiatives help to shift the market and have in some cases led to improvements in the health or sustainability of foods consumed. But they are not enough. Government should provide a framework within which these voluntary initiatives operate in order to ensure that they are transparent, that they deliver results on the ground, and that there are penalties for those who undermine the efforts of the best and –critically – to define limits to consumption. For some foods and some consumers, environmental limits

require us not just to consume 'better' but also 'less' – this is true, for meat, sugar and to an extent for palm oil. The 'less' message is hard for industry to accept and act upon; this is where government needs to step in and lead.

Governments need to govern

Following directly on from this point, there is a need for policy makers to set a strong regulatory and fiscal framework. The evidence reviewed in this report shows that the macro-economic influences on consumption are profound and their impacts have been damaging both to public health and to the environment. There is a need to change the rules that govern international trade and investment, while at the national level, standards and regulations influencing planning and public procurement policies are required.

Measures to inform and educate the public may engender, among policy and industry, a sense that there is a mandate for change, while industry agreements and voluntary certification approaches can help shift the market. But while they may complement, they cannot substitute for more robust action. As noted above, a supportive policy environment additionally enables more voluntary approaches and agreements to actually deliver on their intended results.

Schools are a promising context for intervention

School based interventions, such as the introduction of school meal standards, the banning or restriction of certain foods and drinks, provision of fruit in schools and gardening schemes, show promising and positive results. The evidence suggests that they not only help improve children's diets but can also increase awareness of and interest in food. At the moment most school based interventions are health oriented. There is now a need to move the agenda on by incorporating environmental considerations into the design and implementation of interventions.

Composite approaches are needed

Given the scale and urgency of food sustainability problem, no one approach will achieve the changes we need in the time we have. A mix of approaches – regulatory, fiscal, voluntary, and contextual and information oriented – is required. Changes may also not be immediate, or if immediate may not be sustained; and they may impact differently on different population groups. Thus changes need to be monitored over time and across sections of the population, and robust evaluation methods incorporated into the initial design of interventions.

Time, commitment and money needs to be invested in developing clear and consistent metrics and reporting processes

Throughout this study two themes emerge time and again; the paucity of the evidence available and the problem of comparing 'apples and pears.' Interventions need to be underpinned by effective mechanisms for tracking and understanding their impacts. Equally there needs to be more consistency in establishing what outcomes are to be reported and measured and how, particularly for voluntary approaches such as certification schemes and industry agreements. This will make it possible to compare across interventions.

Lack of evidence is not an excuse for inaction: action engenders evidence

Notwithstanding the point made above, lack of evidence should not be used as an excuse for policy inaction. Indeed policy inaction leads to a paucity of empirical evidence. Trials and experimentation particularly based on the some of the more politically challenging fiscal and regulatory approaches discussed are essential. As noted, robust monitoring and evaluation processes need to be in place so that impacts in the short, medium and longer term can be understood. In this way the evidence base is built and policies progressively refined and improved.

A whole supply chain approach is needed to understand the environmental and health relationship, including trade- offs

While there are many overlaps between health and environmental goals there can be trade-offs too, particularly when a whole supply chain approach is considered. Interventions geared at changing consumption may positively affect health but lead to no or damaging effects on the environment if production does not change and commodities are simply exported, potentially causing health problems in overseas populations. Equally production-side penalties designed to reduce environmental impacts may simply trigger an increase in imports, leading to no improvements in public health in this country and increased environmental impacts overseas. Thus production and consumption side measures, and the relationship between them, need to be understood and considered together and interventions designed with these in mind.

More research is (inevitably) needed

While underlining the importance of action *now*, clearly there are areas where further research is needed. Once again, we underline the point that research need not precede action, since action itself helps build the evidence base.

Of course there are any number of important research questions that need to be addressed if we are to improve our understanding of what sustainable healthy diets look like – for example when defined across a range social, environmental and ethical indicators; or in the specific context of middle and low income countries. These have been articulated elsewhere (Garnett 2014).[394] Rather the research questions set out here are not intended not to pursue this question but rather to support understanding of how best to design effective interventions – in other words, of how to achieve *change*.

More integrated studies are needed:most of the studies reviewed came from the health literature or (to a lesser extent) from the sustainability literature. There were very few studies that sought to investigate the effects of interventions on both health and sustainability outcomes. More cross- disciplinary collaboration and research here is required.

394 Garnett, T. (2014) *Changing what we eat: A call for research & action on widespread adoption of sustainable healthy eating.* Food Climate Research Network, University of Oxford.

Substitution effects need to be explored: how do different interventions (particularly but not only those that influence price) affect our consumption of non-targeted foods, and how do the effects of interventions vary by population group?

Understanding the production-consumption, health-environment relationship: studies need to look at the effect of consumption-targeted interventions on producers and vice versa. They also need to consider the impacts on both health and the environment both in the country where the intervention is undertaken and any risks of 'leakage' of impacts in other regions.

Designing macro-economic policies for health and sustainability: Analysis of what a health- and sustainability-promoting agricultural, trading, investment and market development regime might look like has not yet been undertaken. This is clearly an area – albeit vast – that merits further research and could lend it to model based exploration.

Understanding the influences on consumption in middle and low income countries and the potential levers for change: As highlighted, most of the work on the sustainable healthy eating agenda, on the drivers of consumption and on the intervention options is undertaken in and for high income countries. Understanding of how and why people consume in low and middle income countries, how this is changing and why, and what the intervention levers are for change, is conspicuous by its action. This needs to change.

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