General Advisory Committee on Science

Horizon Scanning Workshop: 'Future food production for healthier eating – opportunities and challenges'

Held at Prospero House, Borough,
London 24 June 2009

Workshop report

31 July 2009

Draft report for GACS comment

Contents

Executive summary

The horizon scanning workshop *'Future food production for healthier eating: opportunities and challenges'* has considered aspects of some of the more likely developments in areas of primary food production, over the next 10- to 20-years, which could lead to ingredients/foods that either could significantly support, or hinder, Agency objectives to promote healthier diets.

As its main focus, the workshop addressed the scientific and technological developments in primary products that were considered feasible, but the importance of wider issues such as consumer acceptance of likely developments and the role of producers in a global market were also recognised.

In particular, the relevance of the global context for food security in the UK – currently 60% self-sufficient in all foods – was acknowledged, participants recognising that in future the global food system is likely to come under pressure from climate change, resource-related issues and population growth. Within the context of addressing these issues and managing any accompanying changes in agricultural practices, however there may be an opportunity to devise sustainable strategies for future primary production of foodstuffs that will make a real impact on the Agency's aims in relation to dietary public health.

Importantly in this workshop, participants highlighted a number of more fundamental, underpinning issues which they considered of importance to the overall aims. There is evidence that improved dietary quality can mitigate or attenuate health-related problems, however the challenge will be to supply appropriate foodstuffs that are affordable and that the public will wish to consume. This may present difficulties for farmers and growers, and the industry may therefore need to be supported, for example by enabling research and through fiscal policy.

Equally, there is a need to develop a better understanding of consumers' behaviours, what they want from their food and what they will find acceptable. In particular, there was a need to understand better consumers' perception of technological innovation, especially if, in this context, it would result in healthier foods. While some consumers claim, for example, to prefer locally grown food, and may be willing to pay a premium for it, there is a need to make real choice also available to those on diminishing incomes, such as the aging population.

As consumers are reported to express a desire to eat healthily, there should be a better co-ordinated delivery of public nutrition advice and one coherent set of evidence-based guidance on diet and health; with special attention given to the eating habits of the young. A range of different messaging options should be used to inform the public and help them to make the right choices. In terms of promoting healthier diets in the next decades, it was recognised that there is scope for consumers, either through their own self-interest or through policy/economic intervention, to improve their dietary balance within the range of foodstuffs that is available now and likely to continue to be available in the future.

Some participants felt it would be easier to make minor modifications to the foodstuffs people do eat than to achieve big changes in their food choices. In terms of the scientific and technological developments that were the main focus of the workshop, participants suggested that in cases where innovation is required and anticipated, such changes need not necessarily involve high-technology solutions. They did however note the potential usefulness of biotechnology. Suggested ways for future modification of the food supply included improving the nutritional quality of food through the growing medium by enhancing the quality and nutrient capacity of the soil, as well as improved breeding strategies. Additionally, it was suggested using feed modification or feeding regimes in primary production to improve the nutritional quality of the foodstuff, for example making alterations to them to reduce the saturated fat content of milk and meat. The direct manipulation of crops or foodstuffs to either introduce, increase or decrease particular individual components was also anticipated, such as developing foods with increased omega-3 levels and optimising omega 3: omega 6 ratios in plants. Alternative sources of fish oils and omega 3 fatty acids were also proposed, as was the possible in vitro production of meat and the possible use of nano-nutrients in livestock feed These innovations could also be supported through policy/economic interventions.

The government needs to consider if any of these approaches is a suitable means of improving public health and if so take action. It would be necessary to demonstrate that any changes made to food production methods using new technologies are safe and beneficial, both to the consumer and the environment.

Finally, to address future managed changes in the food supply, it will be necessary to maintain or increase investment in research in this area, while engaging with research internationally and making full use of existing data.

Introduction

1. This workshop, organised by the Agency, was the first event of this type held under the auspices of the General Advisory Committee on Science (GACS). Professor Colin Blakemore, the Chair of GACS, explained the origin and purpose of the event in his welcoming address to the registered invited participants, that included several members of GACS (annex 1).

2. The idea to host a horizon scanning workshop on impacts of trends in food production in relation to healthy diets had originated in horizon scanning activities of two of the other independent scientific advisory committees that advise the Agency – the Advisory Committee on Animal Feedingstuffs (ACAF) and the Scientific Advisory Committee on Nutrition (SACN). It had been envisaged that a meeting held jointly by ACAF/SACN might perhaps look at trying to scope out the public health relevance for trends in manipulation of animal feeds to improve nutritional quality of foods.

3. Soon after GACS was established in December 2007, with the important role of providing independent challenge and advice to the Agency on how it uses science in all its business, the Committee had recognised in its work plan the importance of considering the science element of current science horizon scanning in the Agency, and how the GACS can add value through co-ordinating and developing work.

4. At GACS 2nd meeting on 29 October 2008[1], the Committee had recognised that the idea for a workshop of the type proposed fitted well with the work it had taken on related to horizon scanning, particularly on cross-cutting issues - where Professor Blakemore said GACS recognised the importance of exploring ways the different scientific advisory committees might work better across the boundaries of their remits to work together on horizon scanning. The Committee considered that the workshop might, for example, discuss a slightly broader remit, to give consideration to the more likely developments in primary production, over a medium-term horizon, leading to foods that support Agency objectives to promote healthier diets.

5. GACS also had noted that such a workshop topic fitted with its own discussions on the need for better intelligence on developments and trends in

[1] Minutes of GACS committee meeting on 29 October 2008:
http://www.food.gov.uk/science/ouradvisors/gacs/gacsmeetings/gacsmeets2008/gacsmeet0810/gacsmins081029

food production and the food industry, and on enhancing engagement with other funders, Committees, and experts (including from industry). Following this, GACS therefore agreed to set up a Working Group (WG) to do preparatory work to structure the planned workshop and define a clear remit for it. GACS also noted that the workshop should have a clear outcome with recommendations for actions that the Agency should take, as well as those it should not address.

6. Professor Blakemore noted that although horizon scanning was carried out by many organisations, it was implemented in different ways. There was not, he suggested, a recognised best practice in how to do it. 'Horizon scanning was not just a matter of trying to predict the future, but involved looking more widely, at implications from projections and considering other variables that might play into projections of outcome'.

7. Therefore he invited participants at the workshop to think of horizon scanning as a very positive process that can provide opportunities (as well as barriers to those opportunities) – and not just focus on prognostications about risk. In the workshop their consideration should be along the lines of opportunities that might emerge for producing food in new ways that might bring with it potential improvements in human health.

Aims and objectives

8. GACS agreement was to host a horizon scanning workshop on impacts of trends in food production on food safety, diet and health. The aims of this workshop were to identify the more likely developments in primary production[2], over a 10- to 20-year horizon, which would lead to ingredients/foods that would significantly support Agency objectives to promote healthier diets. This discussion it was suggested could also take account of practices which are current or imminent. These developments might be 'man-made' (e.g. manipulation of animal feed to alter food composition) or consequences of wider environmental changes (e.g. opportunities in crop production arising from climate change).

9. The discussions would focus on the primary production aspects but would need to take into account the utility of those products in later food processing manufacture. The workshop would not look in depth at wider food processing developments in terms of delivery of healthier products. This could be the basis of a future GACS workshop.

10. The specific aim of the workshop, therefore, was to identify developments in the various areas of primary production that have the most realistic chance of leading to products which will come to market and that could have a significant role in supporting Agency healthy eating messages. The discussions 'should not focus only on what is scientifically/technologically feasible, but also draw in issues around consumer acceptance of likely developments, the likelihood of uptake by the food manufacturing/retail industry (taking account of e.g processing characteristics) the potential for unforeseen impacts on food safety, and other wider issues such as sustainability, economics, food security etc'.

11. The main objectives of the workshop were listed in information sent to registered participants, before the meeting, as:

- To develop a picture of the future landscape within which the production of healthier primary products will take place, the various drivers and impactors which will influence this and how they interrelate

[2] Primary production covers all agricultural and aquacultural food production including crop cultivation, dairy and egg production, livestock rearing and fish/shellfish production.

- With this in mind, to identify the key developments in primary production which are the most realistic in terms of delivering healthier products to the market place in the next 10 to 20 years (or sooner), which will make a real impact on the Agency aims in relation to dietary public health. These should be products likely to make a significant impact in dietary health terms, which are also affordable and sustainable and, where appropriate, utilisable for food processing/manufacture.
- To determine the barriers to achieving the desirable changes, including any research, analysis or other evidence gaps that need to be addressed to overcome these
- To recommend prioritised next steps for consideration by GACS/others in advising the Agency on its future science/evidence needs in relation to the topics discussed and in developing a road map to addressing these (with appropriate partners)

12. Participants in general, were asked to note that their assessment should wherever possible take into account the range of issues which could affect that success – be they scientific, consumer/market acceptance, wider environmental changes (climate, economics etc) – as well as the underlying evidence relating the developments proposed to significantly improved dietary health.

13. Those participants who had particular experience/expertise of possible developments in the various food areas under discussion (broadly categorised as meat and dairy (including poultry), crops and fish and shellfish (including aquaculture) were specifically asked to come along with a suggestion for at least 1, and up to 3, developments which they felt were likely to make a significant impact in terms of leading to products which will support Agency healthy eating objectives in the coming years. It was suggested that syndicate groups would then chose to work with some of these ideas to examine their likelihood in more detail, drawing in the wider views in the groups.

14. In relation to factors possibly impacting on the likelihood of developments, a couple of recent publications (‘albeit in a food security context, but nevertheless seemingly pertinent’) were circulated to participants about a week prior to the meeting as reading to stimulate their thoughts:

Chatham House report - The Feeding of the 9 Billion

http://www.chathamhouse.org.uk/files/13179_r0109food.pdf

BBSRC consultation on food security research

http://www.bbsrc.ac.uk/organisation/policies/reviews/consultations/0905_food_security_consultation.pdf

Format and Outcomes

15. The workshop was led by an external facilitator (Delta Partnership- Louise Shaxson and Laurence Cranmer) with assistance from the workshop convenors (Alisdair Wotherspoon and Julie Norman from the Agency) and was divided into three sessions. In the first session, two keynote speakers with an international perspective (Professors Christine Williams and Richard Tiffin of Reading University) gave a strategic view on the broad environmental landscape within which food production for healthier eating might take place. Following these keynote presentations, participants formed into syndicate groups to consider, in two breakout sessions, what they had heard and try to identify their view of the most realistic developments (or the ones which would be most desirable from a potential healthier diet impact point of view), key reasons for these, and research gaps that the Agency needs to encourage to be tackled (including via other funders) to facilitate their introduction. The workshop agenda is shown in annex 2.

16. For the ten syndicate groups, participants were arranged as far as possible, to include a range of interested parties and particularly a diversity of views (science, consumer, industry etc) so that there was a more holistic view of the issues impacting on likely success of the proposed developments.

17. Each of the syndicate groups was aided by a representative from the Agency, who recorded and collated the points made by participants in the respective group discussion, as follows:

Elli Amanatidou (table 2)	Ranulf Barman (table 7)
Chrissie Tsampazi (table 3)	Paul Willetts (table 8)
Ruth Davies (table 4)	PK Khaira (table 9)
Aattifah Teladia (table 5)	Irene Hill (table 10)
Tim Marshall (table 6)	Patrick Miller (table 11)
(note: table 1 was not used)	

18. The participants in the pre-assigned syndicate groups were asked to address the objectives of the workshop by (i) firstly identifying a ‘long list’ of key issues, in respect of the likely key developments in foodstuffs, and then (ii) developing ‘a line of argument’ for one or more chosen topics. For the latter, they were asked to complete a pre-printed proforma, and in doing so identify relevant surrounding issues and evidence needs.

19. The 'line of argument' technique has previously been usefully deployed in an exercise by Defra to help it develop its evidence strategy for sustainable consumption[3]. The technique recognises the variety, and fluidity, of different stakeholder views, 'allows alternative views (and a full range of innovations) to emerge and encourages participants to think freely. Different stakeholders, for example, are thought to present different lines of argument, often because they favour different approaches to the delivery of the same goals (for example, technological solutions, green taxes or cultural change), and they may be selective in their use of analysis and data to support their case'.

20. 'By engaging with stakeholders in a structured way, which brings rigour to the data and to analysis, the approach can establish a 'line of argument' between the particular goal definition of a stakeholder group, the values inherent in that definition, and the evidence that stakeholders believe will validate their conviction that this is the path that policy should take. By encouraging this diversity and presenting stakeholder opinions in a structured fashion, it is possible to begin to map out the existing framings of the potential paths policy could take. The process of constructing those frames – as lines of argument – allows a mix of policymakers and external stakeholders to jointly explore the diversity of values, goals and innovation needs that permeate complex issues, while ensuring that discussions are based on the best available knowledge'.[4]

21. As a consequence of the group discussions, GACS and the other relevant SACs should be better informed of, and in a better position to advise the Agency on, possible future developments in this area and their implications and to identify issues which require further work or exploration. Research needs to facilitate the suggested most likely developments should also be identified. Where it is more appropriate for other funders to tackle these, the Agency would aim to encourage this in its future interactions with them.

[3] Cost-effective tools for managing the SCP evidence base: final report January 2009

[4] From Science Communication to Knowledge Brokering: the Shift from 'Science Push' to 'Policy Pull' (Chapter 12) by Alex T. Bielak, Andrew Campbell, Shealagh Pope, Karl Schaefer,and Louise Shaxson in D. Cheng et al. (eds.) *Communicating Science in Social Contexts*, 201 2008

Keynote presentation 1: Transfer of knowledge on diet and heath into primary production?

22. Professor Christine Williams, in helping to 'set the scene' and provide context for the later workshop discussions, invited participants to consider issues related to diet and health when thinking about future primary production, for the UK and wider.

23. She suggested that the issues of obesity and overweight were timely to consider in relation to the possible benefits of diet quality – in line with the Agency objective of 'healthy eating for all'. Acknowledging that these issues were complex ones, impacted on by many variables including location and lifestyle choices such as exercise as well as diet, she emphasised that her talk was not about obesity itself, or about preventing obesity necessarily. Nevertheless, she said there was increasing evidence that improvements in the quality of diet could have a mitigating and beneficial effect on the health problems that come with being overweight and obese. Many of these problems, linked to a complex array of metabolic and vascular disorders, are associated with resistance to the action of insulin – a pre-condition to chronic diseases, including type 2 diabetes, hypertension, cardiovascular disease and hormone-dependent cancers.

24. Observing that in the years 1991 to 2007 there had been an increase in the prevalence of obesity in England (for example, in women from 15% to nearly 25% of the population), with a similar increase in the number of people who are overweight, she outlined linear modelling results which projected that by 2020 as many as 35% of the population will be obese (body mass index > 30) and the majority of the population overweight.[5] There were already indicators of the probable consequences of the observed changes, with a 74% increase in the number of prescriptions issued over the last six years for diabetes (with an almost doubling of cost).[6] Moreover, although overall rates of cardiovascular disease are currently in decline, this decrease is levelling off and it is anticipated there will be an upturn in rates over the next five to ten years.

25. Therefore, she said the question she wished to address and provide evidence on – not just in relation to the example of obesity, but right across the board –

[5] Health survey for England, 1991-2007
[6] Prescribing for diabetes in England: an update, June 2009

was whether improving the quality of our diet can attenuate some of the health-related problems experienced by people.

26. She presented evidence, in turn, in three areas of diet and nutrition where there were existing nutritional guidelines for diet in the UK population:

- increase fruit and vegetable consumption to five servings per day
- increase fish to two portions per week (one to be oily)
- reduce saturated fat to 10% dietary energy intake

27. Firstly, in respect of fruit and vegetable consumption, she said there was strong and consistent evidence from a wide range of types of experimental study. Epidemiology, for example, that follows populations on which there is reliable dietary data had shown the incidence of cardiovascular disease is, on average, reduced by around 45% in people who eat four or five portions of fruit or vegetables a day.[7] Additional to epidemiological evidence, there was also evidence from intervention studies to show the impact of particular dietary changes on health parameters, as well as evidence from mechanistic studies with cells, animal models and in humans. For example, the 'dietary-action to stop hypertension' (DASH) trial had looked at the effect of consumption of fruit and vegetables – in a controlled study – and shown a measurable decline in systolic blood pressure over 45 days.[8] More recent studies appeared to show the DASH-diet also reduces incidence of type-2 diabetes. However, she suggested it is in the mechanistic area where some of the most interesting data has arisen; for example some components of fruit and vegetables have been shown to be cardio-protective, while some appear to have anti-cancer activities. In one particular study, where subjects were fed 85g of watercress per day for eight weeks, DNA damage in lymphocytes assessed by the Comet assay was reduced.[9] In another study which investigated attention and memory in subjects after acute flavonoid feeding with blueberries, she said that marked improvements in human performance to correctly detect target stimuli had been recorded.[10]

[7] Hu F.B., American Journal of Clinical Nutrition 78 (suppl) 544S-551S
[8] Sacks et al, New England Journal of Medicine 2001 Jan 4, 344(1) 3-10
[9] Gill et al, American Journal of Clinical Nutrition 2007; funding Watercress Alliance
[10] Spencer et al 2008

28. Despite the accumulating evidence in support of the beneficial effects of consuming five portions of fruit and vegetables each day however, she noted that – as with the other nutritional guideline targets – in practice consumption levels in the UK population fall below the '5-a-day' target; currently on average only 2.8 servings of fruit and vegetables per day are eaten. She particularly noted the relatively lower consumption levels of these foods by both men and women on low incomes. Perhaps the most concerning data though, she suggested, arose from patterns of different food types consumed more than once a day by young boys aged two to fifteen years. In a survey, reporting their patterns of food consumption across England in 1997, it was shown that a fifth or less of boys in this age range ate fruit or vegetables more than once each day.[11]

29. Given these observed experimental findings and dietary statistics, she queried whether nutritional quality, and possibly nutritional/bioactive trait enhancement, as well as appearance to stimulate uptake by consumers, should be more important considerations when fruit and vegetables are grown? Indeed, she invited participants to consider if consistent messages were being 'given out' in respect of public health and the way our food is grown – given that, for example, numbers of orchards are declining in the UK? Should we look, she asked, more critically at the way land is used; should land use better reflect nutritional policy; what should we grow; how should we grow it; and where should we grow it?

30. For the nutritional guideline 'eat two portions of fish (one to be oily) per week', she said there was strong evidence of the cardio-protective effect of omega-3 fatty acids in the diet. Indeed it appeared that, for people who previously presented with myocardial infarction, consumption of omega-3 fatty acids in the diet reduces risk of subsequent incidence.[12] Because of the benefits of dietary omega-3 fatty acids, national/international organisations had set recommended/advisory intake levels for long chain omega-3 polyunsaturated fats. What was noticeable, however, was the inability of western populations to achieve intakes anything like these levels. Again, she pointed out that consumption levels of omega-3 fatty acids in fish were much poorer in lower age ranges, with less than 5% of UK males aged 19 to 24 reported to eat

[11] Health Survey for England (1998)
[12] Lancet 1999, 354: 447-55

fish.[13] Does this she questioned suggest there is an argument for enriching or supplementing other foods, that these individuals do eat (for example, poultry and eggs), with omega-3 fatty acids?[14] Turning to consideration of fish stocks and sustainability, she noted that fish farming might assist with supply problems, but that unless the farmed fish were fed other small fish the levels of omega-3 fats (and omega-3 fatty acids) in farmed fish would be depleted. There might in future be alternative ways to produce fish oil, for example by industrial micro-algae production – but this may itself have sustainability issues?

31. In respect of the recommendation to reduce saturated fat intake to 10% dietary energy as fat, she said only 12% of adults met this target. Again should this disappointing figure, in public health terms, lead to changes in primary production? It is already known she said that it is possible, in theory, to reduce the saturated fat content of milk and meat by making alterations to animal feed and feeding regimes – but would this gain public acceptability?

32. Professor Williams also invited participants to consider the wider issue of food security – the access to safe and nutritious food to meet dietary needs for an active healthy life. She summarised some important issues:

- population growth would put pressure on the food chain; in turn affecting supply of nutritious foods
- biofuels production is putting upward pressure on food prices
- as much as 30% of foodstuffs produced are wasted
- production, as well as consumption (and waste), of foodstuffs generates greenhouse gases which contribute to climate change problems
- problems relating to climate change are predicted to take approximately 30% of land out of agricultural production, so that climate change will have a negative effect in terms of our ability to secure food and nutrition for the population.

33. Closing her presentation, she said that we need to acknowledge that we do have issues in relation to diet and health (and they are global), but that on a wider basis we also have to think about how we produce food and the

[13] National diet and nutrition survey, 2003
[14] Givens, D I and Gibbs, R A (2006) Nutrition Bulletin 31, 104-110

consequences of food production. In conclusion, she asked, does the UK need an integrated food and agricultural policy?

Note: In responding to questions from participants following her presentation, Professor Williams agreed that food allergy and intolerance were part of considerations in respect of 'healthy eating for all'. She also confirmed that the benefits of dietary quality on health parameters, assessed via intervention studies, can be seen over relatively short time-spans.

Keynote presentation 2: Food security in the UK

34. Professor Richard Tiffin invited participants to consider some of the wider issues related to the currently topical issue of food security – when thinking how primary production might contribute to improvements in diet and health, as well as offering his personal perspectives on the impact and likelihood of success of developments in this area.

35. He explained that the reason he was going to try to do this was because he felt the debate on food security, in addition to being high up the policy agenda, gave an opportunity to bring together research that had been done across disciplines and address what has been called 'agricultural and food sustainability'.

36. Food security, he pointed out, was not a new topic. However, until recent times it had primarily concerned guarding against catastrophic supply failures in the food chain. The definition of food security is now wider and more subtle and is exemplified by conceptualisation offered at the World Food Summit.[15] It addresses the quality of the diet and extends to how we actually produce food in the first place. It was no longer just about issues of food supply - the security of meeting demand for food and hence avoiding chronic malnutrition.

37. In respect of what might be the causes of the current interest in this topic, he queried whether the projections of population growth in the next decades, were an important driver of present food security considerations. These growth projections suggested it was in the less developed world where much bigger increases in population growth would occur, in the period to 2050. Initial thinking, he acknowledged, was to question how the world would meet the increased demand for food arising as a result of population growth?

38. On the other hand, he said, that if aggregate population data was considered across just a ten-year horizon, from 2005 to 2015, it appeared that global population growth is around 13% over this period. This closely matched a forecast growth in agricultural productivity (based on wheat productivity and yields) over a similar period.[16] Therefore it appeared at first sight, based on aggregate data (and assuming continued investment in crop production during this period), as if supply could meet rising demand. Food shortages in

[15] World Food Summit (1996)
[16] FAO/OECD

aggregate might not be a big problem – at least in a ten-year horizon. Rather the issue is likely to be achieving a distribution of food which ensures that local shortages do not arise.

39. Therefore the stimulus for very recent interest in food security lay elsewhere. It had arisen because of a massive sudden increase in the price of wheat, other agricultural commodities and oil, towards the middle/end of 2008. Although, with hindsight, it is now known that these commodities experienced merely an unexpected - but short - 'price spike', there was concern that the increase might be sustained. Present forecasts to 2020, suggest future prices are going to be reasonably stable, giving credence to the argument that, at aggregate levels, there is not going to be any substantial imbalance between demand and supply.

40. However, these forecasts do not rule out the possibility of further sudden 'price spikes', or the possibility of future volatility in agricultural commodity prices, that in itself presents food security challenges. Whilst there may be enough food to supply people overall, it would be the world's poor that would struggle most to ensure the quality of their diet if, in future, there were unpredictable dramatic increases in food prices.

41. Nevertheless, even if it is possible to be confident that overall the supply of food will keep pace with a growth in population in the short-to-medium term, it is necessary to recognise that the distribution of productivity and growth in the world's food systems will not be uniform; and this particularly will be influenced by the way that climate change affects agriculture. Predictions of its effects suggest that it will be in the tropics, in the equatorial regions of the world, that there will be a loss in agricultural productivity, with a rise in productivity in temperate areas, such as Europe.

42. So there is, he said, a potential concern for food supply globally, since it is in the countries where agricultural productivity is anticipated to be damaged and to decline that there is predicted to be the larger growth-rates in population. This implies the importance of a world trading system that allows re-distribution of productivity from the areas where there is a growth in agricultural productivity to areas that suffer losses in agricultural productivity but where the population growth is higher.

43. Moving to focus on Europe and on the UK in particular, Professor Tiffin, noted that if the British agricultural and farming industry- for primary production - was going to be expected to make contributions to 'diet and health', then it would be pertinent to bear in mind that this sector had for sometime been considered to be a relatively depressed industry. One approach would be to seek an understanding of whether, and to what extent, changing consumer preferences towards a healthy diet, either through policy intervention or self-interest, provides an opportunity for farms to address their depressed incomes.

44. Talking about the patterns of obesity across Europe, he suggested that the incidence of coronary heart disease is not that well correlated with obesity, suggesting that lifestyle factors or some other reasons may be mitigating the risks of coronary disease. He said this pointed to, and underlined, the importance of understanding the choices individuals make in their lifestyles, as well as the relationships between these choices and causal factors for disease.

45. He also pointed out that, in respect of obesity there was data to show that there are important inequalities in the distribution of obesity by social class. This is particularly so for women. This raises the question whether low incomes or low social status are primarily responsible?[17]

46. To highlight some of the further issues he said he felt were important for participants as they discussed the contribution of primary agricultural products and food security, Professor Tiffin then invited them to consider some research carried out at his own university. He spoke firstly about a demand-model which looked at the influence of economic and socioeconomic factors on five food categories that broadly reflect the Agency's 'eatwell plate'.[18]

47. The work attempted to disentangle the influences of economic variables, prices and incomes, from the influence of socioeconomic descriptors of people or households in explaining what their dietary choices were. He said that in the 'milk and dairy' category, there was significantly increased consumption of these products in households 'with children; regional and ethnic impacts could also be seen. For the 'meat' category there was a negative impact on consumption 'with children', while for 'fats and sugars'

[17] ESRC
[18] http://www.eatwell.gov.uk/healthydiet/eatwellplate/?lang=en

category it appeared consumption levels increased as they got older. In the 'cereals and potatoes' category there was markedly lower consumption in adults-only households. In this category too there were regional differences and an effect of ethnicity. However, for the 'fruit and vegetables' category, households with children have much lower levels of intake; higher classes consume more, and there were also regional variations within the UK – as you travel north and west the quality of the diet decreases.

48. Following on from these findings, he outlined work to understand better what people want to eat and to assess their preferences for food quality. Based on 'choice' experiments, he said that research data showed that, with some regional variation, there was a strong consumer preference for locally grown food; and he suggested that people are willing to pay a premium for it. He added that people seemed to prefer naturally produced food. There appeared to be less desire for GM-free or organic produce.

49. So, he suggested, it was helpful to recognise that while, in general terms, people may not eat as healthily as they might, they did express a desire to be eating healthily. This observation, he noted, led in turn to consideration of approaches to persuading people to eat healthily – and how this might be achieved from a policy perspective?

50. Professor Tiffin pointed to fiscal measures as one such way, describing a demand-model to simulate the possible impacts of taxes and subsidies. He outlined a policy with a tax penalty roughly equivalent to the application of VAT on food allied to a subsidy on fruit and vegetables designed to make the policy fiscally neutral. Simulations showed that whilst such a policy might bring average consumption in line or close to recommended levels the likely impacts on health will be small because of the substantial part of the population that would retain an unhealthy diet.

51. There was also a need, he said, to consider what might happen in relation to primary producers in the UK if all consumers adopted a diet in line with recommendations. Any such change in the diet would, for example, see demand for bread, fruit, vegetables, flour and potatoes increase substantially, with significant decreases in consumption of cheese, confectionery, soft drinks, sugars and preserves. Taking these demands, and climate changes, into account he said it is possible that there would be only small changes in patterns of cereal production across the regions, however production of fruit

and vegetables would increase noticeably in the south-east and also into the east midlands. In contrast, if consumers met the dietary guidelines, there would be a loss of domestic market for meat and consequent to this there would be reductions in sheep and cattle numbers and probably little use of upland areas in the UK for grazing.

52. In summary he said that to address the complex issues surrounding food security, in both developed and developing countries, it was necessary to understand better the linkages between food production and the wider context. It was not just a question of considering the challenge - of ways to feed a larger population more healthily - simply as a technical one which might, for example, be addressed using plant breeding. He stressed that what he was attempting to argue for was a more 'holistic' approach to resolving the challenge, that was as much about people - their different preferences and choices – and included consideration of the distribution and sustainable trading of foodstuffs (for example from remote production areas to regions of high population and consumption), as well as sustaining the world's ecosystems and resources.

Note: Following his presentation, in response to a question about the strength of evidence to support the suggestion of the willingness of some people to pay a premium for locally grown food (cf para 47), Professor Tiffin said that the reported findings came from choice experiments designed to indirectly assess consumer preference to particular attributes.

Syndicate Group Discussions – part 1 (identifying issues)

53. In the first of the syndicate group sessions, the participants in each group discussed their views in order to identify 'a long list' of the issues they considered to be most relevant in respect of the likely key developments in foodstuffs over the next 10 to 20 years. The lists of 'key issues' are shown in annex 3.

54. The issues raised reflected both the 'landscape' - the broader context of food security and dietary health – as referred to in the keynote presentations, as well as points directly relevant to likely developments in primary production.

55. On the broader matters, there was appreciation of the global context of the future supply of food in the UK. Although currently, the UK is 60% self-sufficient in all foods and over 74% self-sufficient in foods that can be produced in this country[19], there are, especially as some foodstuffs will continue to need to be imported, uncertainties over the future resilience of the food supply chain (group 3) – not least because of the suggested challenges of population growth and climate change.

56. Participants suggested (in group 2) that it was appropriate to speculate on the trends and challenges to the future food supply chain, and (in group 3) to recognise that incidents such as disease outbreaks, or decisions made, in one country can affect food supply and food price(s) in the UK. Participants (in group 3) suggested that global supply and demand trends may impact negatively on local availability of staple foods – and therefore consumer choice. The importance of effective trading agreements and efficient systems to distribute products was also recognised, as was the possibility of trade competition from the developing world restricting food availability (in group 2).

57. It was acknowledged that in future years the global food system is likely to come under pressure from climate change and resource-related issues, as land use changes. Pressure on land use is likely to affect availability of foodstuffs. (group 7) Water as a resource will also be an issue for primary production as it gets scarcer and needs to be used more efficiently, as well as it not being available where it is needed. (in group 2 and 9) The implications of these factors as constraints on the supply of food generally, and the importance of sustainability, was mentioned in several groups. It was suggested (in group 2) that climate

[19] Defra - Ensuring the UK's food security in a changing world 2008

change has already led to more fungal infection, and it was anticipated that pests would pose an increased problem and need for pest-resistant agriculture in the UK. There was a suggestion that better intelligence should be obtained from other countries and that more should be done to model trends and risks across the whole food chain with better use made of the data. (group 2, 3 and 7)

58. While most group discussion addressed the difficulties for food supply caused by environmental changes, some participants believed that environmental concerns would actually drive the choices that people make about foods, and that this could in turn lead to changes in farming. (group 6). Other participants remarked on the potential for agriculture and farming to generate pollutants (group 9), and that environmental changes would in turn impact on the composition, cost and availability of food (group 7). In particular, the effect of farming and food production on wildlife and biodiversity was noted, it being suggested that high biodiversity wards off zoonotic disease. (group 6) Decreased pollinators reduce the ability to produce certain fruits and vegetables. (group 10)

59. It was suggested that climate change effects might themselves be linked with pollution levels and that there would be a need to develop 'tolerant' crops as well as drought-resistant crops. (groups 2 and 10). It was also suggested that climate change will affect food security – at least the supply of targeted foods (group 11). Importantly, in respect of the workshop's specific topic, it was noted that climate change will affect not just productivity but also the nutritional profile of key foods. (group 11) It was queried whether there might be a need to strike a balance between yield and nutritional composition? (group 8)

60. On farming and land use, participants questioned whether land use was efficient for primary production (group 9); with the suggestion that there should be more efficient use of land and that farming based on genetic modification might help. (group 3) It was noted that soil erosion decreases yield. (group 10) Also queried were the possible effects of promoting land use for foods for nutritional benefit, for example fruit and vegetables. (group 6) The impact on farming of dietary changes, for example decreased milk and meat consumption but increased demand for fish and poultry, were discussed. (group 6) If consumers were to increase consumption of fruit and vegetables to bring intakes in line with recommended levels, it was suggested that such a change would bring opportunities to producers - currently the supply of fruit to the UK market is

particularly reliant on global trade, the UK being only 10% self-sufficient in this sector. (group 4)

61. On fish and aquaculture, participants felt that it would be appropriate to optimise the balance between the export and domestic consumption of fish naturally high in omega-3 levels. They also suggested that there is an opportunity to expand omega-3 fish consumption by recognising that shellfish is a substantial source. (group 5).

62. Participants questioned whether increased production necessarily meant moving to more intensive farming? (group 8) A variety of alternative approaches or techniques that might lead to increased, and sustainable, production were put forward. There was a challenge to growing on soil. (group 8) Alternative sources of fish oils and omega 3 fatty acids were proposed. (groups 4, 5 and 6) It was also suggested that biotechnology should be used to optimise the protein quality in grain legumes to improve sources of amino acids (group 10) Additionally, one unusual suggestion was the possibility of 'in vitro meat production' (group 11). However, several participants attached greater importance to lower technology solutions, such as improving the nutritional quality of foods through enhancing the quality and nutrient capacity of soil as the growing medium. (groups 6, 8 and 10).

63. Participants noted that improving the nutritional quality of food through the growing medium could be an effective method of addressing the facts that historically consumers have been reluctant to change their habits and public health strategies may not provide benefits to vulnerable groups. There was evidence to show that food quality can be influenced through improving the soil quality, however, it was felt that the lack of development, by the industry, of products enriched through the growing medium has been due to the high risk associated with financially expensive development of products with unknown market acceptability and environmental impact. It is also known that enriching soil with a micronutrient to increase its presence in the food may be an inefficient process. For example, when enriching soil with selenium, the bioconversion rate to meat is around 1%. In this case, there is also a risk that soil contamination may outweigh the potential benefits, particularly as the selenium content of meat is not significantly improved. (group 6) It was noted that research in the area of soil quality had been carried out previously in USA and Australia, and it was suggested that use could be made of those research findings. There seemed to

be a divergent view on the suitability or legitimacy of using fertilizers to benefit soil quality. (groups 2 and 9)

64. The use of food or feed modification in primary production in order to improve the nutritional quality of food, and livestock feeding regimes designed primarily to improve the nutritional quality of products, was discussed (groups 2, 6, 9 and 10); for example increasing the unsaturated fatty acid content of livestock feeds has been shown to increase the level of unsaturates in milk. (group 6) Other participants proposed that the composition and patterns of consumption of milk and milk products can shift in ways that improve the balance of benefits and risks. (group 11). Also mentioned was the possible use of 'nano-nutrients' in livestock feed. (group 11)

65. There was discussion in several groups of the possibility of increasing individual components in foodstuffs, as well as the desirability of removing or lowering the content of less desirable components from a health perspective. (group 10) Examples in the former category included developing foods with increased omega-3 levels (groups 5 and 6), optimising omega 3: omega 6 ratios in plants (group 10), increasing bioactive constituents in foods of plant origin and bioactive peptides in milk (group 6), and enhancing the selenium content of livestock produce – milk, meat and eggs (group 6). However, in relation to using technological solutions, it was felt that – even if acceptable to the consumer – the possible higher price of the product may mean that such products were not affordable by the consumer and were not taken up. Additionally, participants noted that if some foods, such as meat or milk, were consumed less there might be a need to find alternative dietary sources of particular nutrients. (groups 2 and 11) Also questioned was whether it would be possible, as a general principle, to minimise nutritional losses in the food chain. (group 10)

66. The importance of the challenge of population growth – in respect of the global demand for food -was noted by participants, although it was felt that concern should not be just about the total amount of food, but also the type of food that is consumed. (group 2) Additionally several groups commented on the importance of considering the aging population, who have diminishing incomes and because they are living longer have increased risk to foodborne illness. As a result they may need more nurturing/sustaining and help to alleviate health issues that come with aging. (groups 3, 5 and 7)

67. While it was recognised that a healthy diet may vary from individual to individual in the general population and be dependent on factors including exercise, calorie intake, genetics and disposable incomes (group 3), it was felt there was a need for better co-ordinated delivery of public nutrition advice and one coherent set of evidence-based guidance on diet and health – reviewed and updated regularly (groups 7, 9 and 11). However, it was also felt there was a need to develop our understanding of consumers demands, behaviours, what they will find acceptable – including in respect of religious sensitivity - and what they want from their food. (groups 2 and 4) In particular, there was a need to understand better consumers' perception of technological innovation, especially if this would result in healthier foods (groups 3 and 4). It was suggested there was also a need to understand how factors such as price and seasonality will impact on the importance placed on 'healthy eating' by consumers (group 7)

68. Some participants felt it would be easier to make minor modifications to the foodstuffs people do eat than to achieve big changes in their food choices. (group 8). For example, by promoting healthier eating by improving the nutritional content or value of foodstuffs consumers already eat, rather than trying to change peoples' diets. (groups 4, 8 and 10) Even so, participants also supported the idea of better dietary education and influencing strategies; noting that the eating habits of the young can determine the future health of the individual (groups 5 and 10) and suggesting there should be an emphasis on educating the future generation to eat healthily and safely. (group 3) Also pointed out was the need for healthy eating programmes for pregnant women and young families (group 6) and for pre-natal and post-natal women (group 9) - noting that babies and children had a special need of nutrients. However, it was considered that there was a need to understand how consumers learn and to design and use better and attractive communication strategies. (groups 8 and 9) It was also thought to be important to lead rather than drive change. (group 8)

69. In respect of the latter, participants suggested, it was important to frame the positives and remove the barriers to dietary improvement, using a range of different messaging options as different people respond positively to different stimuli. (group 8) The latest technology should be used to inform the public and help them make the right choices. (group 6). There was also a need to understand the impact of 'pseudoscience' on consumers' behaviours. (group 7)

70. There was support for joined up nutritional and agricultural policies (groups 3 and 5), though in respect of policies on food and agriculture, it was felt current markets and tariffs do not encourage behaviours that support long-term sustainable activities by the food industry. Participants suggested that there was a possible role for governments to support healthy foods, for example by subsidy, and also locally produced foodstuffs. It was noted that the latter production helped the local economy (group 3) as well as lowering the carbon-footprint associated with distribution costs. The use of economic and other measures to make healthy food equally available to all socioeconomic groups was considered. (group 4). It was also felt there was a need for predictive modelling of costs and benefits in the food chain, as well as long term modelling of the economic costs of health consequences such as obesity (groups 3, 7 and 8).

71. Overall, participants felt that investment in research was not sufficient to address the food quality issues and challenges for the future, suggesting that there was a need to develop the knowledge basis of science and agronomy associated with the production of the food crops, but where information was available then optimal use should be made of that evidence. The knowledge and scientific skills were considered an important tool that enabled the required research to be undertaken in order to develop the desirable solutions to ensure healthy eating. (group 2) An example was given of the negative effect on the UK economy of not investing appropriately in other technological developments in the past. While the importance of sharing research information openly was accepted, some participants queried if ownership rights from research were too complex, and suggested that 'ownership' of the different issues that formulate the bigger picture along with who is accountable for delivering solutions should be challenged. There was also concern that there was insufficient continuity of knowledge and scientific expertise, and that the experienced-knowledge base is eroding. (group 2) A similar concern was made about the retention of skills for farming and agriculture if the UK is to be more self-reliant.

72. Finally, it was felt there was a role for better monitoring to understand what impact any interventions/changes in the food chain are having, and to shape subsequent actions. (group 9)

Syndicate Group Discussions – part 2 (identifying evidence needs)

73. In the second group sessions, participants selected particular topics from their list of key issues (identified in session 1) and for the chosen topic(s) completed a pro-forma to identify the surrounding issues and evidence needs (presented in annex 4). The topics they chose for further discussion in the groups were as follows:

- **Develop the knowledge basis of science and agronomy associated with the production of the food crops (group 2)**
- **Develop food crops (both GM and non-GM) that will be resistant to pests, diseases, droughts and floods in order to ensure food availability under the newly formulated conditions (group 2)**
- **Food security is more important than obesity (group 3)**
- **The acceptability of new technology for nutritional enhancement (group 4)**
- **Using economic and other measures to make healthy food equally available to all socioeconomic and ethnic groups (group 4)**
- **Change in demographics of UK population in terms of number, age, composition and distribution (group 5)**
- **Eating habits of young determines future health of individual (group 5)**
- **Imports/Sustainability/Food Security (sustainable agriculture/aquaculture) (group 5)**
- **Improving the nutritional quality of food through the growing medium (group 6)**
- **Using modern agricultural-biotechnologies, such as GM, as a tool to address improvements in productivity and yield as well as nutritional quality (group 6)**
- **Environmental changes impacting on the composition, cost and availability of food (group 7)**
- **Availability of affordable, attractive and nutritious food (group 7)**
- **Counteracting the increasing amount and accessibility of 'Pseudoscience' (group 7)**
- **Improving the nutritional content of the diet (group 8)**

- **Using Food/Feed modification in primary production in order to improve the nutritional quality of food (group 9)**
- **Boosting the nutrient capacity of soil and the availability of the nutrients to improve the delivery of nutrients into the food chain (group 10)**
- **The composition and patterns of consumption of milk and milk products can shift in ways that improve the balance of benefits and risks (group 11)**

74. For each of these selected topics the following specific findings and evidence needs emerged using the line of argument' technique. The information, as mapped out in note-form in the respective individual proformas, is presented in full in the following paragraphs.

75. **Develop the knowledge basis of science and agronomy associated with the production of the food crops (group 2):** 'There is a need to safeguard the knowledge base and plan effectively to bring about a more sustainable long-term future for the agri-food industry, as well as to develop appropriate solutions and incentivise behaviours for healthy eating.

76. There is a need for improved dedicated funding, with government in particular pump-priming innovation and supporting research. The industry should put in resources and, finally, the consumers can contribute in the research decision-making by making educated choices and providing feedback.

77. While there is adequate evidence from completed and on-going research on the status of research globally and regionally (cf Jameson report: an assessment of the research gaps and funding in agriculture and horticulture), there is a need to challenge ownership and to combine available evidence/knowledge and make better use of this information/data in order to meet aims'.

78. **Develop food crops (both GM and non-GM) that will be resistant to pests, diseases, droughts and floods in order to ensure food availability under the newly formulated conditions (group 2):** 'The consideration of development of such crops (both GM and non-GM) is not helped by the current market framework which is not effective at maintaining the long-term sustainable interests of the food sector. Government, with industry, has responsibility for setting up the framework for the new plants to be utilised.

79. The researchers can provide the information to address the issue and to help provide solutions, but they should also communicate this information effectively – as research is sometimes not made publicly available. However, in order to enrich our understanding of the issue we should re-formulate the questions, produce a risk analysis on all the critical factors that affect the crop production and decide on how to use the data more efficiently. It should be borne in mind that this issue is formed by lots of separate and distinct issues linked together e.g. water availability, pollution, genetics.

80. It was also suggested that there was a case for re-examining culture collections in terms of genetics. In particular, the ownership of the different issues that interlink and form the bigger picture, along with who is accountable for delivering solutions, should be challenged'.

81. **Food security is more important than obesity (group 3): '**Change will need to be shaped at a national level and should include encouraging demand for local produce and alteration of consumer perceptions and attitudes to technological advances of crop and food production – though security of national food supply is a complex issue, and would require input and involvement form many 'players' of the food supply network and consideration of risks to the global food chain/supply network.

82. There is a need to define what is meant by 'healthy eating' and to understand food-related health issues in terms of health economics. There is also need for research on effecting behavioural change, and evidence to support educating the future generation about food safety and healthy eating, as well as formal education on how not to eat unhealthy, and addressing the needs of vulnerable groups such as the elderly. There should also be better labelling to allow individuals to make better choices'.

83. **The acceptability of new technology for nutritional enhancement (group 4):** 'It would be necessary to demonstrate that any changes made to food production methods using new technologies are safe and beneficial, both to the consumer and the environment. A gradual change to the use of nutritionally enhanced foods would give the public time to learn about these and make an informed decision on whether to accept them.

84. If this change is to happen, the food industry needs to develop the new technologies that can lead to nutritionally enhanced products. As these currently may not be publicly acceptable they may need a lead or incentivisation from government or consumer groups. The government needs to consider if this is a suitable means of improving public health and if so take action. These actions could include encouraging industry to produce new products and demonstrating safety and public health benefits to the consumer. Consumers groups need to be engaged by the industry so that they can pass informed messages on to consumers.

85. Therefore, evidence will be needed (i) that such technology is possible, with practical methods for increasing nutrient levels in food (ii) to confirm the assumption that the current state of public acceptance is low and to find out how willing consumers are to change (iii) to confirm that there are real health benefits. This could range from a literature review of what technologies are already available and industry driven methodological research to social science research on consumer attitudes. Market surveys to confirm the current market status of this type of product would also confirm knowledge.

86. It will also be necessary to show that (i) there are no long term risks to enhancing foods, both to the consumer and the environment (ii) increasing the nutritional value of the food leads to increased levels of those nutrients in the person who eats the food. This would require long-term controlled trials to demonstrate safety, absorption properties of the nutrients and whether this is safe for all population groups. Whilst these safety and benefit aspects would need to be demonstrated by the food industry as part of their development process, government has a role to play in ensuring that there is sufficient evidence to provide impartial safety advice to the consumer or providing a regulatory process which is trusted by the consumer so the consumer can be confident in anything that is on the market. Use should be made of international collaboration so that lessons could be learned from other cultures where technologically enhanced foods are more acceptable to the general public.

87. There is also a need for evidence to (i) know what foods and supplements are appropriate together (ii) understand the diets of different population groups (iii) know whether it is possible to target certain population groups with nutrients they need by enhancing specific food products (iv) understand how such products can

be marketed and labelled (v) know who is willing to pay for product improvements', for example whether in the long-term consumers would pay increased prices or whether subsidies would be necessary? These evidence needs would require collaboration by industry and government.

88. There would also be evidence needs to demonstrate that (i) it is necessary to add nutrients to diet, as people may choose to eat healthily by themselves (ii) the expected effect on the environment of meeting that demand for healthy food would be as expected - this would require modelling. It would also be necessary to know, from past lessons, about how to communicate changes in the way food is produced, as well as if there is an optimum level of public health which the nutritional enhancement was aiming towards – at what point are foods sufficiently enhanced to have a positive public health effect'.

89. **Using economic and other measures to make healthy food equally available to all socioeconomic and ethnic groups (group 4):** 'If a change to healthier eating is to happen it is necessary to understand what effect different measures will have. Any financial measures that are put in place may require cooperation from retailers to be successful. There will be a need for (i) reliable (up to date) data on food consumption in relation to socioeconomic and ethnic groups (ii) comparison of that food consumption data with health statistics (iii) reviews of what data is already available (iv) suggestions of the measures that could be taken and whether these are acceptable to the public (v) Further modelling and theoretical studies (vi) consumer research.

90. There is historical data on food consumption in relation to population groups along with modelling on the effect of fiscal interventions. This would need to be extended and confirmed to ensure that any interventions would have the expected effects. Retailers might have a role to play in helping to provide consumption data that could be added to that collected by Food Standards Agency and Department for Health in their dietary surveys. Consumer research would provide evidence as to what measures would be acceptable to the public and how effective these could be.

91. Consumer choices of food are driven by a complex range of factors and there should be consumer research to understand these factors and to provide more evidence to explain the complexity of the issue.

92. An important challenge would be to consider whether the costs associated with improving the diet are lower (or more worth incurring) than the costs associated with treating the problems caused by poor diet. Another is to investigate what effect other factors have in causing poor diet in certain groups, for example poor health in low income population groups is also going to be affected by smoking rates and types of occupation. Will intervening in diet have enough of an effect on overall health?'

93. **Change in demographics of UK population in terms of number, age, composition and distribution (group 5): '**There is a need for more, healthier, affordable food to alleviate health issues (for example, that are a legacy of age) and as income levels especially for older age groups will decline. All stakeholders are affected but in different ways – however there is a need to seek/forge a common vision and understanding of the scale and extent of the problem. There is a need for (i) government, in its key role, to give strategic direction and as regulator to be dynamic and facilitate change (ii) the consumer must take more responsibility for own health, through lifestyle or dietary responsibility.

94. Much of the evidence required to describe the issue already exists but needs to be brought together in a clear and coherent document. A fundamental understanding and acceptance of the gravity and scale of change that the combined impacts of the population (demographic change), health and the "energy gap" will have as they become manifest over the next 30-40 years is seriously lacking. Understanding and explaining the complexity of the issue is a key task'.

95. **Eating habits of young determines future health of individual (group 5): '**A specific problem is the rise in diabetes in children. Feeding babies and weaning children is an area where more information is required. There is also a need to understand parents/carers perception of what constitutes healthy eating in children. Education of adults responsible for children's diets through focus groups and community centre/schools would support the teaching done to educate the children themselves.

96. The situation is very complex, and requires a balance of some sort between individual responsibility (i.e. parental) and society/government. Messages need

to be adapted to ensure they reach ethnic communities. Do we know whether advertising (of food) influences children's diet/preferences? Does the food industry have a responsibility not to target children in advertising campaigns, if that food is unhealthy? Historical records of food consumption and parameters of child development should be studied in further detail'.

97. **Imports/Sustainability/Food Security (sustainable agriculture/aquaculture) (group 5):** 'There is a need to be aware of historical data on food production, consumption and trade patterns to understand the driver for imports and, since the UK currently exports fish high in omega-3, optimise (from the nutritional perspective) the balance between imports and exports. This understanding can be enriched by looking at ways varying drivers can be influenced in the future. Possible actions that could be undertaken to refine the complexity of the issue include looking at trade flows and patterns and then using these to forecast and predict changes. There is also an ethical dimension that should be studied, in that third world supplies to the UK are income generating and supporting.

98. There is an assumption that under-developed countries move to Western diets and therefore disrupt the current Trade Flow (same for energy/climate change) – this should be challenged'.

99. **Improving the nutritional quality of food through the growing medium (group 6):** 'Possibly, the lack of development by the industry, of products enriched through the growing medium has been due to the high risk associated with financially expensive development of products with unknown market acceptability and environmental impact – and this would need to be addressed. It was felt that there was a need for government to intervene and to lead research looking at whether or not there is a causal link between improving foodstuffs through the growing medium and improvement in uptake of beneficial nutrients in the population, including vulnerable groups.

100. The costs versus benefits of such schemes needs to be assessed and comparisons made to alternative methods of enriching foods, such as fortification during processing. If benefits can be shown to outweigh the costs, market pressures should in theory drive change. Interdisciplinary research funded by the public sector that addresses the efficacy of the agricultural process required

to make these changes is needed. This would need to involve agricultural economists, industry and government.

101. Understanding how consumers would perceive such products once they reach the market is a particularly important factor when considering the risks associated with development of enriching the growing medium to industry. Consumer research could be effective here in assessing consumer attitudes. The US and Australia lead in the area of enriching foods through the growing medium and if US products come to the market these might provide examples of consumer reaction to such products.

102. Consumer acceptance and demand for such products could be improved through consumer education and involvement using social marketing as well as ensuring the legislative burden is not too high, for example allowing claims to be made to help drive consumption'.

103. **Using modern agricultural-biotechnologies, such as GM, as a tool to address improvements in productivity and yield as well as nutritional quality (group 6): '**There is a perception that consumers are reluctant to accept the use of modern agricultural-biotechnologies in the production of foodstuffs. There is a need to understand how and why consumers may adopt this view and these assumptions should be tested. Up-to-date research is needed to establish the true extent and nature of any scepticism. Any such research would need to be undertaken independent of industry, with government taking the lead.

104. In addition to conducting research into consumer perception, government should also take a lead in driving positive change through consumer education and involvement, for example using by social marketing techniques. Translating scientific evidence and presenting the costs and benefits of modern practices to a lay audience should be a priority. Media coverage is a key driver of opinion and could be a major factor in driving the use of modern techniques.

105. For additional strategies, the UK and Europe can look to the rest of the world for examples of how consumer acceptance of modern agricultural techniques, particularly GM, can be encouraged. The US, for example, have grown and consumed GM foodstuffs for over two decades.

106. Perhaps if market acceptability of foodstuffs containing produce derived using modern agricultural techniques could be improved and products started to appear on shelves in the UK and Europe, this would reduce the risk to the food industry and encourage innovation. Market acceptability could be improved by government lead schemes that highlight to consumers the benefits, for example improved nutritional quality through labelling schemes. In order to assess how such products could be brought to the UK and Europe, it was felt that research into the dynamic between consumers and supermarkets would be needed.'

107. **Environmental changes impacting on the composition, cost and availability of food (group 7):** 'If there is increased cost and reduced availability of food as a consequence of the amount of land designated to agriculture declining, then it will be vital to understand how these changes could impact on the health of populations. There should be greater focus on trend analysis and modelling across the whole food chain from production to consumption to health. With this knowledge policies can be shaped to determine healthier diets in this new framework.

108. As responsibility for modelling the whole food chain from production to health falls across different government departments, they should work together to identify the changes. There needs to be a cost/benefit analysis of interventions in the food chain taking into account the long-term health costs not just short-term production costs.

109. One viewpoint could be that tackling obesity contributes to the ageing of the population. What are the associated costs of such intervention? For example there will be added pressures on public services, most notably health care. In addition we have to address the sceptical opinions of a significant number of people that climate change does not exist to the extent reported. As such, an understanding of consumer attitudes to the issues is vital'.

110. **Availability of affordable, attractive and nutritious food (group 7):** 'There is a need to shape change and get stakeholder involvement in all parts of the food chain e.g. primary producers, food manufacturers, retailers and policy makers. The only way that significant change will occur is by getting the major retailers on board as they possess the power and influence needed to make change happen.

111. We need more evidence on what constitutes a healthy diet and what will lead people to choose that diet. Social science should play a crucial role in this.

112. Epidemiology only shows associations; there is therefore a need to develop biomarkers of early risk of diet-responsive disease and understand individual variability. Food choice is extremely complex and diet/ health only make up a component of a consumer's decision-making process. Therefore, there is a need to understand how factors such as price and seasonality will impact on the importance placed on health by consumers.

113. There is a need to assess whether current dietary guidelines are appropriate in light of changing attitudes and ever-evolving research. Will education work and if so what is the best approach to take? Is it legitimate to use fiscal policy to increase consumption of fruit and vegetables (and fish)?

114. We have affordable food. We have nutritious food. The key question is how to make it attractive to produce and consume?'

115. **Counteracting the increasing amount and accessibility of 'Pseudoscience' (group 7):** 'Consumers appear confused by information that is currently available to them. Much of the so-called science on offer, for example through media outlets, is bad or 'pseudoscience'. It was agreed that the media have too much influence at a time when an objective voice would be more suited. Researchers are too often encouraged to 'find' trends and interesting results/data and to then go ahead and publish such findings often prematurely.

116. There is a need to understand what the impact of pseudoscience is on behaviours. Will an article in a tabloid newspaper actually alter a person's shopping and consumption behaviour for example? Using reputable high-profile scientists to explain the difference between good and bad science could prove worthwhile'.

117. **Improving the nutritional content of the diet (group 8): '**There is a need for an evidence-base to support or challenge the contention that lower-technology solutions (that may be cheaper) are better than high-tech solutions.

118. It is recognised that there is public suspicion about genetic modification, therefore there is a need for assurance that the technology is reliable and safe, that it works and that the environmental impact is assessed. Predictive modelling might be used to address unintended consequences. Essentially, there is also a need to understand why, if it is safe, the technology has not been introduced - this would probably involve looking at attitudes.

119. Allied to these needs, there is also a requirement for evidence about the extent of benefit that the technology can deliver, and any trade-offs, the costs and extent to which reliance is placed on individual companies as well as any legislative requirements. Since a lot of knowledge may reside within industry/food companies, could this be accessed while equitably respecting the 'ownership' of the innovator(s) ideas?'

120. **Using Food/Feed modification in primary production in order to improve the nutritional quality of food (group 9): '**It is important to include evidence from other countries, and there is a need to review RDAs, reports on toxicity levels, evidence as to whether there is a linear relationship between concentration and outcome, and monitoring practices.

121. There is also a need for more reliable data on, and an accurate measure of, what people are eating – possibly utilising biomarkers - and their purchasing patterns and preferences; with challenges of the baseline data. There is also a need for combinations of food to be taken into account during risk assessments. An additional evidence need is knowledge on effects on environmental pollution, and possible interaction with other nutrients in crops'.

122. **Boosting the nutrient capacity of soil and the availability of the nutrients to improve the delivery of nutrients into the food chain (group 10):** 'Evidence is needed to identify the micronutrients, and possibly phytonutrients, that are desirable for healthy eating. There is then a requirement for the scientific community to develop the technology, identifying best practice, and to provide soil compositions linked to consumers' needs, as an alternative to adding nutrients at the food or feed processing stages of production.

123. The evidence needed is based on confirming the assumptions underpinning the usefulness and the feasibility of this development. For example whether

consumers prefer naturally healthy food, the differences between different consumer groups in their willingness to adopt healthy eating, what is acceptable to consumers, and how to make this method of providing nutrients acceptable. In addition the consumer perception that the nutritional value of a particular food is independent of the soil and production method should be challenged.

124. Evidence is also needed that there are appropriate farming systems and that farming practice is linked to income (much of which is derived from subsidies which then drive practice). Proof is needed that this development is economically viable.

125. In terms of scientific research, as well as information on which nutrients are important for human health, there is a need for evidence on the presence and availability of these nutrients in the soil and how different soils contribute to nutrient availability. Proof that soil can be changed sustainably and a comprehensive analysis of soil nutrient and food interaction are needed'.

126. **The composition and patterns of consumption of milk and milk products can shift in ways that improve the balance of benefits and risks (group 11): '**There is a need for one coherent set of evidence-based guidance on diet and health and this needs both to be reviewed and updated regularly and to be communicated actively by government, including through education at all ages. Evidence should be provided on the interactions between milk/milk products and other components of the diet (including from the perspective of possible substitutes for milk/ milk products).

127. There is additionally a need for evidence from studies using existing/better biomarkers of effect to provide a more robust evidence base for links between consumption and longer-term health end points. Also needed are studies that will improve understanding of the underlying mechanisms of the effects of milk and milk products on health – positive and negative – to help interpret the epidemiology and inform risk/benefit assessment and advice. A further requirement is for evidence on the prevalence and effects on sufferers of intolerance and allergy to milk and milk products in different population groups – needed to give a better base on the extent and pattern of the problem to factor into assessment of risks and benefits of different approaches – and an

investigation of the hypothesised link between certain milk types and triggering of particular behaviours in autistic children.

128. To assist technological development there should be data from extension of experimental studies on manipulation of milk lipid composition- to confirm that these changes reduce disease risk using intervention studies with modern functional markers of vascular disease outcome in particular. Also to show what can be achieved on the larger/industrial scale in real milk production/processing and economic conditions. Also there should be more detailed data on consumption of milk and milk products (and substitutes) across the different product types and sections of the population (differentiated by gender, genetic, social/lifestyle, life stage, cultural factors).

129. An additional evidence need is for information on the attitudes, beliefs and values of consumers (in different groups) towards the different aspects of milk production and consumption, including sustainability, and towards the possible manipulations being considered. What do they want? What would they accept, or pay for?

Closing remarks

130. In summing up, Professor Blakemore outlined his initial impressions from the workshop, that included:

- the importance of having a robust evidence base to support any decisions made;
- the apparent need to understand better the data coming from epidemiology and intervention studies in dietary health
- the need to recognise and gain public acceptability for any changes proposed to the way that food is produced

131. He thanked participants for their contributions and said he looked forward to GACS consideration of these, when it discusses the possible ways forward for future food production.

Annex 1 List of registered participants

Title	First Name	Surname	Affiliation	Table Number
Prof	Peter	Aggett	GACS/Scientific Advisory Committee on Nutrition	2
Prof	Janet	Bainbridge	GACS	2
	Cate	Barrow	Agricultural Development & Advisory Service	11
Dr	Anthony	Biddle	Processors & Growers Research Organisation	2
Prof	Colin	Blakemore	GACS	11
Dr	John	Bourne	Dept for Environment Food & Rural Affairs	8
	Charles	Bourns	National Farmers Union Poultry Board	3
Dr	Jo	Bray	Dept for Environment Food & Rural Affairs	7
Dr	Martin	Broadley	Nottingham University	7
Ms	Viviane	Buller	Advisory Committee on the Microbiological Safety of Food	5
Prof	Judy	Buttriss	British Nutrition Foundation	11
Dr	Bruce	Cottrill	Advisory Committee on Animal Feedingstuffs	6
	Laurence	Cranmer	Delta	
	Jayam	Dalal	Advisory Committee on Novel Foods & Processes	9
	Jennifer	De Lurio	Environment Agency	11
Dr	Johanne	Ellis-Iverson	Veterinary Laboratories Agency	8
Dr	Andrew	Eldridge	Dept for Environment Food & Rural Affairs	4
Prof	Sue	Fairweather-Tait	University of East Anglia	5
Prof	Peter	Farmer	GACS/Committee on Mutagenicity	9
Dr	Helen	Ferrier	National Farmers Union	6
Dr	Paul	Gale	Veterinary Laboratories Agency	6
	Helen	Garry	Dept of Agriculture & Rural Development Northern Ireland	3
Prof	Ian	Givens	Advisory Committee on Animal Feedingstuffs	11
Mrs	Rosie	Glazebrook	Advisory Committee on the Microbiological Safety of Food	4
Mrs	Pamela	Goldberg	GACS	11
Dr	Hadden	Graham	British Association of Feed Supplement and Additives Manufacturers	6
Dr	Barbara	Haesler	Royal Veterinary College	8
Prof	Paul	Haggerty	Scientific Advisory Committee on Nutrition	9
Prof	Nigel	Halford	Advisory Committee on Animal Feedingstuffs	10
	Jon	Harman	Sea Fish Industry Authority	5
	Tony	Harrington	Government Decontamination Service	2
	Anne	Heughan	Unilever	4
Dr	Rick	Holliman	Advisory Committee on the Microbiological Safety of Food	2
Dr	Peel H	Holroyd	Chairman, Royal Agricultural College, 100 Club	3
	Simon	Hook	Home Grown Cereals Authority	4
Dr	Philip	Hughes	Probitas	10
Dr	Steve	Irving	Centre for Environment, Fisheries & Aquaculture Science	5
Prof	Tim	Key	Scientific Advisory Committee on Nutrition	3
Dr	Liz	Lund	Institute of Food Research	7
Prof	Duncan	Maskell	GACS	3
Ms	Diane	McCrea	Advisory Committee on Animal Feedingstuffs	3
Dr	Richard	Mithen	Institute of Food Research	9
Prof	Mike	Morgan	Leeds University	7

Mrs	Jenny	Morris	Advisory Committee on the Microbiological Safety of Food	8
	Helen	Munday	Food and Drink Federation	3
Prof	Anne	Murcott	GACS	5
Prof	Sarah	O'Brien	Advisory Committee on the Microbiological Safety of Food	3
	Alice	Pegg	Leatherhead Food International	10
Dr	Leen	Petre	GACS	10
Miss	Sarah	Pettitt	National Farmers Union	2
Prof	David	Phillips	GACS	5
	Gillian	Pope	Advisory Committee on Novel Foods & Processes	11
Prof	Chris	Ritson	Advisory Committee on Novel Foods & Processes	7
	Phil	Rix	Dunns(Long Sutton) Ltd	4
	Richard	Scales	Advisory Committee on Animal Feedingstuffs	6
Prof	Nigel	Scollan	Institute of Biological, Environmental & Rural Sciences, Aberystwyth University	6
	Louise	Shaxson	Delta	
Prof	Richard	Shepherd	Surrey University	2
Prof	Peter	Shewry	Rothamsted Research	4
Dr	Ron	Stagg	Scottish Government Rural and Environment Research and Analysis Directorate	9
Dr	Adam	Staines	Biotechnology and Biological Sciences Research Council	7
	Mark	Temple	Agricultural Development & Advisory Service	10
Mr	Marcus	Themans	Advisory Committee on Animal Feedingstuffs	8
Prof	Richard	Tiffin	Reading University	10
Dr	Steve	Tones	Horticultural Development Company	2
Dr	Bruce	Traill	Reading University	6
Dr	Mark	Tucker	Yara Ltd	7
Dr	Martina	Velasova	Royal Veterinary College	6
Prof	Jeff	Waage	London International Development Centre	4
Dr	Carol	Wagstaff	Reading University	10
Mrs	Stella	Walsh	Scientific Advisory Committee on Nutrition	9
Prof	John	Warner	Advisory Committee on Novel Foods & Processes	9
Dr	Rita	Weber	Lohmann Animal Health	8
	Richard	Weightman	Agricultural Development & Advisory Service	9
Prof	Christine	Williams	Reading University	7
Prof	Jeff	Wood	Bristol University	8
Dr	Andrew	Wadge	FSA	5
	Alisdair	Wotherspoon	FSA	
	Ranulf	Barman	FSA	
Dr	Paul	Willetts	FSA	
Dr	Julie	Norman	FSA	
Dr	Patrick	Miller	FSA	
	PK	Khaira	FSA	
	Richard	Laffar	FSA	
	Tim	Marshall	FSA	
	Ruth	Davies	FSA	
	Stephanie	Cossom	FSA	
	Irene	Hill	FSA	
	Chrissie	Tsampazi	FSA	
	Elli	Amanatidou	FSA	
	Aatifah	Teladia	FSA	

Annex 2 Agenda

FUTURE FOOD PRODUCTION FOR HEALTHIER EATING: OPPORTUNITIES AND CHALLENGES

24 June 2009

Smile Suite, Prospero House, 241 Borough High Street, London SE1 1GA

9.30 Coffee, Registration

10.00 Workshop opening: Professor Colin Blakemore, GACS chair

10.05 Keynote speeches
Two presentations will outline the diet & public health challenges facing the UK, the areas in which we need the developments that will make an impact on public health, and the wider economic, social and environmental landscape within which those challenges will occur. The presentations will be followed by a Q&A session, in which we encourage you to test out some of the ideas you bring to the workshop.

11.15 Coffee

11.30 Syndicate work: identifying the issues and developing lines of argument
The syndicate work will identify the key developments in foodstuffs we can realistically see happening over the next 10-20 years, and will clarify the lines of argument about whether action needs to be taken to help shape these developments.

13.15 Lunch

14.15 Syndicate work (cont'd)
Building on the morning's work, syndicates will then discuss what evidence would need to be available to facilitate these developments in support of Agency policies to promote healthier diets.

15.00 Plenary feedback and final discussion

15.45 Summary, close
Professor Colin Blakemore will close the workshop

16:00 Drinks reception

Annex 3 Syndicate Groups: Lists of 'identified key issues'

Group 2 (table 2): (Subject: Horticulture)

Participants

Professor Peter Aggett	GACS/SANC
Professor Janet Bainbrdge	GACS
Dr Anthony Biddle	PGRO
Mr Tony Harrington	Gov. Decontam. Service
Professor Richard Shepherd	Surrey University
Dr Steve Tones	HDC

The long list of issues that arose during this session fall into six categories as follows:

1. Nutrient supply

If having a healthier diet means that we should reduce the meat consumption, then we will have to find a way to compensate and/or replace the altered nutrient supply that will arise from the reduced meat consumption.

2. Experts aging

The demographics of the expert knowledge are such that within 5 years we will certainly not have the skills to maintain the research needed to support any attempt for a healthier and safer diet.

3. Globalisation

We should speculate what will happen to the globalisation trends as some food will continue being imported into the UK. For example world trade competition from developing world (e.g. China) may restrict food availability.

4. Education

Industry, education/academia and government do not understand how best to use economic instruments.

5. Climate changes - Environment

- Explore sustainability – improve plant/horticulture to facilitate local (regional) production
- Become carbon neutral
- Climate change will drive/assist/aid the movement of pests etc into the UK. Crops may be adversely affected by such changes and production will possibly decrease.
- Environmental constraints: the water supply in the UK is both insufficient and not located in the right place to support any significant changes in farming practice. In many cases it is also polluted.

6. Legislation

- Pesticide restrictions may limit production of crops/vegetables

- Environmental regulations - legislation to protect the environment will no longer allow the use of fertilisers to grow sufficient quantities of crops at the current, let alone the future levels needed.

7. Research

The research currently undertaken is not adequate to address the issues that arise with regards to food quality and both the government and the broader industry do not seem to perceive the need for further research.

Group 3 (table 3):

The long list of issues that arose during this session fall into five categories as follows:

Risks of global of food chain/supply network:

- **Food security:** securing food for UK population → self reliant as a country.
- Changing diets in developing world → increased demand for 'western style eating' increased costs of commodities/foods.
- Risks/ intelligence on risks from/in other countries e.g. melamine & China.
- Susceptibility to local political decisions in other countries which may affect supply → impact on price (affordability for UK population) e.g. ban on exports of rice in India, before a general election.
- Increase consumer perception and demand for locally produced food → e.g. British varieties of apples. [Bonus - impact on local economy (employment, experience)]

Cost of Food:

- Global financial crisis → impact on disposable incomes of individuals: quantity and quality of what individuals realistically have access to.
- Consumer perceptions to technological intervention in food production → GM produce: increased yields, higher nutritional content → cheaper food, better value.
- Government subsidisation of 'healthy foods' → provide incentives for consumers and increase demand.

Climate change and land use:

- Water availability
- Flooding/ draughts
- Intensive farming

Population:

- Demographic time bomb: ageing population → diminishing incomes & increased susceptibility to foodborne illnesses.
- Eating habits – quantity not quality.
- Genetic predispositions/factors.
- Lack of exercise.
- Emphasis on educating future generation to eat 'healthy and safely'.

Government intervention:

- Joined up agricultural and nutritional government policies.
- Food safety.

Group 4 (table 4):

Participants

Dr Andrew Eldridge
Rosie Glazebrook (Chair)
Anne Heughan
Simon Hook
Phil Rix
Prof Peter Shewry
Prof Jeff Waage
Ruth Davies (FSA Facilitator)

The long list of suggestions of key developments and issues in food production that could impact health in the next 20 years were:

1) Promote healthier eating by improving nutritional content of food rather than trying to change people's diets. For example:
   - If children won't eat vegetables is it possible to add the nutrients in vegetables to foods they will eat?
   - Lifestyle choices mean that people eat fast and often unhealthy food. Is it possible to make these foods healthier?

2) Making healthy foods cheaper, they are often seen as luxury items. Solutions to this could be:
   - Enhancing nutritional content of cheaper foods
   - Subsidising healthy foods
   - Education – cooking skills

3) Making healthy eating more sustainable. For example:
   - Fish are not sustainable but fish oils are necessary in a healthy diet. Alternative, sustainable foods need to be developed.

4) Sustainability and environmental concerns will result in changes to the choices people make about foods and therefore to farming. For example:
   - Mixed use cattle, while less efficient, would result in less methane release and less waste.

5) Are there medical solutions to the results of unhealthy eating that means it is not necessary to improve people's diets?

6) If the consumer becomes willing to accept genetic modification (or other enhancements) these will result in healthier food.

7) If the consumer wants healthier food, food producers will need to develop the means/agriculture system to provide it. For example,
   - At present only a small proportion of the farmland in the UK is used for growing fruit and vegetables
   - If consumers want to eat "5 a day" producers will have to start producing more fruit and vegetables or loose out to imported food.

Group 5 (table 5):

Participants:

Ms Viviane Buller	ACMSF
Prof Sue Fairweather-Tait	UEA
Mr Jon Harman	Sea Fish Industry Authority
Dr Steve Irving	CEFAS
Prof Anne Murcott	GACS
Prof David Phillips	GACS
Dr Andrew Wadge	FSA

The following lists the long line of issues identified by participants.

FIsh
- Marine fish stocks are declining.
- Most of the fish with high omega 3 levels, that we catch, we export. Most of the fish we eat is exported and low in omega 3.
- There is an opportunity to expand the omega 3 fish market by recognising that shellfish is a substantial source.
- Rising energy prices will have an impact on fish consumption

Research
- Alternative sources of long chain omega 3 fatty acids should be developed.
- There needs to be more research on omega 3 in fish, and fruit and veg.

Climate change
- The impact on what we can grow/transport/changing eating habits (people movements) and its relation to climate change.
- The impact of climate change on our food.

Food consumption
- There is a need to improve nutritional quality of convenience foods.

Policy
- Government needs a joined up food strategy.
- There should be enhanced support for nutritionally enhanced agriculture.
- A healthy public sector is possible, following procurement based on FSA guidelines.

Demographics
- Addressing food waste
- Incubated UK reliance on food imports
- Ageing population – demographics
- Population (size Vs demographics, UK – 77m:2050), Health (age, obesity, allergy), Energy (Biomass production and related effect on food prices). There is a lack of strategic thinking on these topics.

Imports/Sustainability
- Sustainable food sources: WTO – environmental recession – level playing fields
- Development of high level omega 3 fish the answer for reducing stocks? Aquaculture sustainability

Eating Habits/Attitudes
- There is a need to educate early, starting with under 8's.
- Mum (or principal carer) is gatekeeper to children's diet
- There is too much emphasis (e.g. via advertising) on pre-prepared foods, which diminishes the understanding of balanced healthy ingredients.
- We eat what we need. Evidence: we need to eat more fish as we get older.
- Eating habits (in general)
- Obesity; as with all diseases, prevention is better than cure.
- Value of interventions has limits and these will be reached.
- How to increase consumption of fruit and veg > 5/day
- Eating away from home
- Caterers and restaurants
- People do not tell the truth about what they eat…is this denial?
- Changing attitudes to diets – Facts and tools are needed NOT politics and fiction!
- Cultural/religious differences need to be accounted for: i.e. halal and vegetarianism

---

Group 6 (table 6):

Participants

Dr Bruce Cottril	ACAF
Dr Helen Ferrier	NFU
Dr Paul Gale	VLA
Dr Hadden Graham	BAFSAM
Prof Nigel Scollan	IBERS
Richard Scales	ACAF
Dr Martina Velasova	RVC

The long list of issues that arose during this session is as follows:

Production

- Effect of farming and food production on wildlife biodiversity: high biodiversity wards off zoonotic diseases
- More linked-up thinking regarding 'sustainable' animal production
- More sustainable animal production; continued grazing of up-land farms etc.
- GM technology: the future?
- Soil health and the impact on production and quality
- Increased bioactive (including polyphenols) in foods of plant origin and bioactive peptides in milk
- Enhancing Selenium content of livestock produce (milk, meat, eggs)
- Global increase in demand for livestock products will drive up prices
- Import and export of food
- Enriching foods with PUFA using GM crops as feed is inefficient
- Biofuel production: impacts on food costs and by-products
- Animal health: Effects of anti-microbial residues
- Developing foods with increased levels of omega-3 through feed or ingredients in foods

- Livestock feeding regimes that are designed primarily to improve the nutritional quality of products.
- What is the impact of decreased milk and meat consumption, but increased demand for fish and poultry? Can this be achieved by taxes or subsides or 'persuasion' (such as a meat-free day every week)
- What are the effects of encouraging land use for food production and products deemed of nutritional benefit (fruits and vegetables)?
- Less salt, sugar and fat added to, or present in, foods driven by consumers choosing to buy lower fat dairy and leaner meat.

Social

- Technology to improve education of the public to help them make the right choices
- More scientific media coverage; less food 'scares'
- GM is able to be used to improve yield and the nutritional quality of foods and feeds: will the public accept this?
- Social science aspects: framework for encouraging healthy nutrition in early life to achieve a major influence long term
- Focus on health and sustainability will drive down UK production causing global problems for the poor.
- Security of livestock to new diseases/ Disease control economics: relationship with climate change, global issues and social change.
- Healthy eating programs for pregnant women and young families
- Co-ordinated delivery of public nutrition advice
- Childhood obesity levels will level off and fall
- What is the impact of the population eating more or greater than 5 portions of fruit and vegetables per day?

Group 7 (table 7):

Registered Participants:

Chair:	Dr Adam Staines (BBSRC)
	Dr Joe Bray (DEFRA)
	Dr Martin Broadley (Nottingham University)
	Dr Liz Lund (IFR)
	Prof Mike Morgan (Leeds University)
	Prof Chris Ritson (ACNFP)
	Dr Mark Tucker (Yara LTD)
	Prof Christine Williams (Reading University)
	Prof Sue Fairweather-Tait (UEA)
Facilitator:	Ranulf Barman (FSA)

The long list of issues that arose during this session fall into five categories as follows:

- Volatility in food prices
- Lack of a food policy- free for all in production & supply
- An ageing population

- Climate change, resource use, legislation
- Nutrient density
- Changing dietary patterns- Peer pressure
- Consumer education
- Continued technology e.g. nanotechnology, GM
- Calorie in vs. calorie out
- Reduced participation in sport- sport can be a driver for healthier eating
- Micronutrient deficiency
- Subsidies for the next generation
- Changing family values
- Supermarket power/influence- they won't go away
- Reducing the gap between rich & poor and health outcomes from dietary changes
- Changing legislation
- Encouragement of lower socio-economic groups to take in health messages
- Environmental changes impacting on the composition, cost and availability of food
- Availability of affordable, attractive and nutritious food
- Counteracting the increasing amount and accessibility of 'Pseudoscience'.

Group 8 (table 8):

Participants		Interests
Jenny Morris	ACMSF (Inst of Env Health)	food safety, diet and health
Jeff Wood	University of Bristol	food policy especially for meat
Barbara Haesler	Royal Vet College	economic approaches to health
Rita Weber	Lohmann Animal Health	future markets/microbiol safety
Marcus Themans	ACAF	sustainable improvements

Key Points/Issues

1. **Campaigns** – tend not to work.
   - need to find intuitive ways to influence change

   (e.g. ways that link to what people find acceptable + 'fit' with what people 'do')
   - lower income groups may be less willing/able to take up advice
   - influence may be mix of 'carrot' (Tax break)/'stick (tax penalty)

2. **Choice** - depends on what is important to you/personal circumstances
   - will there be enough food to make a realistic choice
   - consumer should lead demand for mixed + balanced diet

   (e.g. not thinking of blanket change to vegan/vegetarian)
   - if thinking of 'balanced diets' is there opportunity to change individual components of foodstuffs (c/f manipulation/fluoride fortification of water (need to think about how industry + supermarkets work)

- if mass fortification should probably tell people (be open) – don't want 'frankenstein foods'
- needs to be more social science research/ consumer education
- when we make choices recognise we are in a global world e.g. importance of trade agreements

3. **Food supply** – recognise need to produce more Food
   - was recent price increase an energy-driven spike?
   - can't go on as we are to feed people
   - should we be thinking about technological fix or personally altering what/how much we eat?
   - even if use techno fix (e.g. gm) high prices may discourage consumer purchase
   - does increasing production necessarily mean moving to more intensive farming?
   - if we move sheep off the hills what would we grow? (climate change effects?)
   - is there a balance to be struck between yield and nutritional composition (compromise)?
   - can GM work for Poultry (make a case-by case assessment of value versus safety?
   - so are low cost/low tech solutions the answer? (should we enrich fertiliser rather than use GM? Stop trying to find middle class solutions to working class problems)

4. **Soil**
   - do we need to grow on soil (other sources e.g. bacteria?)
   - if continue to grow on soil should soil quality improve (need a rich soil)?
   - to increase yields we will deplete environmental (soil) components (as well as increasing pollution)

5. **Resources**
   - we use up too much energy (both in terms of people eating food and the oil etc to produce it)
   - distribute/manage available resources properly

6. **General points (they said important to consider)**
   - **Public acceptability/attitudes (e.g acceptability of risk)**
   - **Tie down better risk/hazard**
   - **Is it safe/does it work?**
   - **What is environmental impact?**
   - **Need better knowledge of low tech alternatives to high tech solutions**
   - **How <u>much</u> benefit would you get?**

- **What are the trade offs?**
- **Should we rely on companies that have a patent**
- **What if technology goes wrong (unintended consequences)**
- **Need knowledge of predictive modelling**

7. Overall conclusions

- **Needs not to be just about 'diet and health'. It need to be wider argument about sustainability**
- **We should VALUE RESOURCES**
- **We should make MORE FOOD and enough CHOICES available**
- **Solutions may lie in applying/adopting newer/alternative technologies**

Group 9 (table 9):

The long list of brainstormed development issues were:

- how to affect taste preferences in prenatal and post natal care that will result in healthy weight children and adults

- People will need to work for longer
- what are the implications for old people?

- how the young learn?

- the continued impact of working mothers on health habits of children

- the grazing culture of children mean they never experience hunger and always expect to be satiated with food.

- what will be the impact of the increasing age and affluence of the population on the health status of the uk? how should that change the dietary advice we give?

- How do we change behaviour?
- Do we need different health/dietary messages for different groups?
- or even for the same people at different times

- we need improved availability acceptability and consumption of chemopreventative foods, notably fruit and vegetables

- how do we address genetic factors that play a strong part in obesity and health status?

- Understanding genetic predisposition allows targeted interventions

- we need better screening to understand what impact any solutions are having, and shaping what we do about the results we find.

- GM is it the technology solution we need?

- Define the norm? Do we fix at a point in time when we had it right? Where do we then focus the definition of the problems and therefore the solutions?

- supplementation and fortification of fertilisers to make primary production create more nutritionally sound foods which might be enforced and regulated by government

- using retail and manufacturing to have an impact, eg using a fat tax, so that there is other consequences on foods available such as lower fat spreads etc

- how to help foster an increased demand for functional foods by consumers which has he benefit of not being targeted at those who do not need it

- water as a resource will be a huge issue for primary production as it gets scarcer, water is currently used incredibly inefficiently. How do we look at land use for primary production more closely related to the resources we will have available as we see deepening affects of climate change?

- the capacity to harvest fish culture will remain stable, and at the same time world demand will continue to rise

- using mass hypnotherapy at a population level to affect the levels of meat and dairy in the diet-or at least public information campaigns!

- most farmers are part time 50% capacity only-it is in steep decline with those skills not being replaced. How will this affect the change required in food culture in the UK and globally?

- do we simply need better pharmaceuticals to counteract the effects of a bad diet-use advancement sin medical science

- need to tailor diets to late middle age-above 5 a day using nutritionally enhanced forms of food

---

Group 10 (table 10):

The long list of issues that arose during this session fall into five categories as follows:

1. **Replace required nutrients in the soil in order to grow better plants for animals to consume and ultimately for the consumer**
2. Supplement animal feed with requirements for a healthy diet (e.g. omega-3) that go through into the end product
3. Increase levels of phytochemicals/bioactives in plants that are then available for human consumption

4. Remove/decrease those dietary components that are part of an unhealthy diet (e.g. saturated fats) during primary production of animals or plants, for example through breeding programs.
5. Use the healthy eating component of the national curriculum in primary schools to increase awareness in upcoming generations.
6. Increase general population's awareness of dietary health issues
7. As people live longer need to understand the effect this has on their dietary needs.
8. Biotechnology should be used to optimise the protein quality in grain legumes to improve the sources of essential amino acids.
9. Minimise nutritional loss in the supply chain.
10. The rapid development of technologies enabling detailed analysis of food composition leads to the identification and eradication of deleterious compounds.
11. Increase omega-3 and optimise omega-3:omega-6 ratios in plants
12. Changing consumption patterns lead to higher consumption of 'ready-made' meals.
13. Climate change affects the ability of different parts of the world to produce certain foods.
14. Decreased pollinators reduces the ability to produce certain fruits and vegetables.
15. The removal of peat from horticultural production results in increased cost to the consumer for fruit and vegetables.
16. Need to increase consumer understanding of the link between diet and health – possibly via food labelling.
17. Food production has to take place in the context of the changing demand for non-food agricultural products.
18. There is an increase in the real price of oily fish.
19. Food prices increase as a result of increased demand.
20. The price of healthy foods is deliberately lower than unhealthy foods.
21. Food price volatility occurs as a result of globalisation.
22. New production processes alter the nutritional content of food (intentionally or unintentionally increased or decreased).
23. Soil erosion and nutrient loss drastically decreases crop yields affecting the sustainability of the farming sector
24. Crops developed which are more tolerant of climate change and can be cultivated in a wider range of environments.
25. Primary production cannot keep pace with changing demand.
26. Techniques such as GM or breeding increase the nutritional value of foods, thereby removing the onus on people to choose healthy foods.

The following 2 entries are just copied as written, since they do not easily translate into developments.

1. Methods of production – meat bad? No just way cereal beef is produced or high N+P systems.
2. Teach kids at an early age what they <u>should</u> eat. Teach cooking. Two generations that don't know how to cook. Can't force people to eat the right things.

<u>Group 11</u> (table 11):

The long list of issues that arose during this session fall into five categories as follows:

- Requirements for food associated with changing demographics, including ageing population.

- Products will need to reflect changes in demographic patterns
- Focus on carbon footprint of products shift food production patterns, e.g. toward local foods
- Trends to less local food mean transport costs become an issue
- Shifts in economic power, e.g. to China and Asia, will affect the wider drivers that shape food behaviours and problems
- Shift in patterns of agricultural production as a result of climate change will affect security of supply of target foods
- Climate change will affect the productivity and nutritional profile of key foods
- Production shifts in response to/to better reflect the developing evidence base on the impacts of diet on health (for example randomised control trials vs. epidemiology)
- Synthetic biology in food production – assembling novel foodstuffs or ingredients from genetic building blocks to design nutrition
- Nanomaterials increasing nutrients in meat through feeding nano-encapsulated nutrients to animals
- *In vitro* meat production: using stem cells to grow meat in labs/factories, being pioneered in the Netherlands and the USA.
- Incorporation of pharmaceuticals in dairy & meat products – 'pharming' (for example, breast milk enhancing hormone in goats' milk FDA and EFSA approved).
- There is a real need for one, coherent set of evidence-based guidance on diet and health and this need to both to be reviewed and updated regularly and to be communicated actively by government, including through education at all ages.

Annex 4: Proformas of 'identified evidence needs

Produce group: Table 2

KEY DEVLOPMENT: we need to develop the knowledge basis of science and agronomy associated with the production of the food crops
.....

LINE OF ARGUMENT: Build the line of argument (use verbs, full sentences so non-experts will understand)	
1. Why is this issue important in terms of its impact on diet & health?	Because without knowledge and skills it will be difficult to undertake the required research or develop the appropriate solutions to ensure a healthy living
2. Why is change needed?	• The knowledge base is eroded overtime • Scientists and key people in the industry have an aging profile • Scientific knowledge in the area is changing • Stakeholders do not apply the current scientific knowledge
3. Why do we need to shape that change? Given the ethical, social and environmental issues that healthier foodstuffs may raise, we may want to nudge change more in one way than another. Why?	Current market system and tariffs do not incentivise behaviours which support a long term and sustainable approach for the agricultural industry. The dedicated to research funding is also not enough
4. Why do different stakeholders have different roles in the process of shaping change? What is their mandate?	Because they have different and conflicting vested interests • Government sets up the framework in which the market place will function and pump prime the innovation cycle •Industry/producers put in resources •Consumers make an educated choice and provide feedback

EVIDENCE NEEDS: Given the line of argument, identify evidence needs:

	What evidence will need to be available?	Who could contribute?
Confirm what we think we know about this issue	•Demographic data •R& D budgets •Company and government strategies •Jameson report: an assessment of the research gaps and funding in agriculture and horticulture •Tariff levels have not increased for several years	• HR departments of government/industry •Professional societies
Enrich our understanding of it (seek interdisciplinary evidence, develop a fuller understanding of the risks...)	• Combine all available evidence and knowledge is desirable but there does not seem to be a need for further evidence gathering •Make better use of the available data, e.g. looking more closely at the historical data	Government Industry
Explain the complexity of the issue (conduct detailed modelling, look for causal relationships)	The issue is not really complicated – no modelling appears necessary	
Challenge received wisdom on the issue (seek alternative explanations, check assumptions…)	The lack of ownership	
Understand the context and history of the issue (seek lessons from the past, understand the issue within the broad public health remit...)	Very similar issue to other parts of the British economy, such as aerospace where the industry allowed other countries to invest in research and innovation and as a result the UK lost market share	

Produce group: Table 2

KEY DEVLOPMENT: we need to develop food crops (both GM & non-GM) that will be resistant to pests, diseases, droughts and floods
.....

LINE OF ARGUMENT: Build the line of argument (use verbs, full sentences so non-experts will understand)	
1. Why is this issue important in terms of its impact on diet & health?	Because the climate change and the continually increasing earth population make it difficult to ensure that the entire population has access to enough, safe and healthy food
2. Why is change needed?	1. global demand for food is increasing 2. climate change affects adversely the plant production 3. legislation with regard to the water quality (pesticides/fertilisers, etc contents) becomes stricter 4. Water availability is decreasing 5. Carbon related costs are increasing and this affects the cost of crop production which will also go up
3. Why do we need to shape that change? Given the ethical, social and environmental issues that healthier foodstuffs may raise, we may want to nudge change more in one way than another. Why?	Because of the market failure of the rational allocation of costs. Fundamentally, costs and expenditure needs are not in the same place in the food cycle as where the income and revenue are. Current framework is not effective enough at redistributing and creating funds to maintain the long term interests of the food sector
4. Why do different stakeholders have different roles in the process of shaping change? What is their mandate?	Because they represent a different part to the food chain and as a result the have different and occasionally conflicting interests • The government departments set up the framework in which the market place will function and allocate funding •The researchers provide the solutions and they should communicate them effectively as currently produced research is hidden away •The industry and the producers put in resources and skills

EVIDENCE NEEDS: Given the line of argument, identify evidence needs:

	What evidence will need to be available?	Who could contribute?
Confirm what we think we know about this issue	• Climate change affects crops e.g. fungal infections are increasing as do mycotoxins •Water quality data: water is not enough and often it is polluted •There is evidence in cost inputs and agronomic economy, energy, crop protection •We know how target and non-target pesticides affect plants •Plant biology and genetics	• Environmental Agency •HGCA •HDC •Agrochemical industry •Academia •government
Enrich our understanding of it (seek interdisciplinary evidence, develop a fuller understanding of the risks...)	We should formulate the questions and decide on how to utilise the available data more efficiently We should do a risk analysis on the critical factors that affect the crop production	
Explain the complexity of the issue (conduct detailed modelling, look for causal relationships)	Lots of different and distinct issues link together to form this one e/g/ water availability, pollution, genetics	
Challenge received wisdom on the issue (seek alternative explanations, check assumptions…)	•Re-examine culture collections in terms of genetics •Identify who owns the different issues that formulate the bigger issue and who is accountable for delivering solutions •Usually when a report or a paper is not available I an electronic format it is not valued	
Understand the context and history of the issue (seek lessons from the past, understand the issue within the broad public health remit...)	Open sharing of international information to enrich history and inform problem formulation and contextualisation	

Produce group: Table 3

KEY DEVLOPMENT: FOOD SECURITY IS MORE IMPORTANT THAN OBESITY

LINE OF ARGUMENT: Build the line of argument (use verbs, full sentences so non-experts will understand)	
1. Why is this issue important in terms of its impact on diet & health?	The group was concerned with the intellectual framework that allows us to identify obesity and healthy eating as 'problems'. They identified food security as a more pressing issue that requires address. Securing food for the UK population is important for the heath and nutritional needs of the population. Growing global population, demand for 'western style diets', and globalisation off the food chain directly impact on the quantity, price, and quality of food available in this country, and thus on the health of individuals.
2. Why is change needed?	• Importance for the UK population of national self-reliance of food production. • Potential impact on local availability in the UK of global supply and demand trends of 'staple' commodities, Example discussed: depletion of available rice stocks on UK market shelves following the GM rice contamination in the US in 2006. • Impact on the supply chain of food imported into the UK of global disease outbreaks. Example discussed: containment of drivers and transport vehicles including goods, at national boarders following swine flu outbreaks in 2009. Increasingly pressing issues of climate change, fuel and water availability.
3. Why do we need to shape that change? Given the ethical, social and environmental issues that healthier foodstuffs may raise, we may want to nudge change more in one way than another. Why?	Change will need to be shaped at a national level and should include: • Encouraging demand for local (UK) produce. This will also have positive externalities for other aspects of the national economy. • Alteration of consumer perceptions and attitudes to technological advances of crop and food production. Example discussed: benefits of GM crops for improved and more efficient land use and higher yields.
4. Why do different stakeholders have different roles in the process of shaping change? What is their mandate?	Security of national food supply is a complex issue, and would require input and involvement form many 'players' of the food supply network.

EVIDENCE NEEDS: Given the line of argument, identify evidence needs:

	What evidence will need to be available?	Who could contribute?
Confirm what we think we know about this issue	What is the definition of 'healthy eating'? A 'healthy diet' is different for each individual and depends on a variety of factors including: Level of exercise performed Overall calorie intake Genetics Disposable income Social and religious choices	
Enrich our understanding of it (seek interdisciplinary evidence, develop a fuller understanding of the risks...)	• Health Economics: impact of obesity in the long term, not in terms of treatment but relative to other health and food issues, which may be significant, especially as we are an ageing population. It should also be recognised that there are multiple factors contributing to obesity and changing one part of the equation, such as food, will not necessarily lead to the outcomes. Social Science: effecting behavioural change.	
Explain the complexity of the issue (conduct detailed modelling, look for causal relationships)	• Lack of understanding and formal education on how not to eat unhealthy, in certain strata of society. • Recognition that not eating unhealthy is a difficult message to deliver, as subject matter is not intrinsically interesting, and more effort is required to ensure that message is delivered effectively to ensure change in behaviour and diet.	
Challenge received wisdom on the issue (seek alternative explanations, check assumptions...)	Better labelling of food to allow individuals to make better choices	
Understand the context and history of the issue (seek lessons from the past, understand the issue within the broad public health remit...)		

Produce group: Table 4

KEY DEVLOPMENT - The acceptability of new technology for nutritional enhancement
Examples:

- **Providing omega 3 oils through food stuffs other than fish as fish are not sustainable and some people find fish unpalatable (e.g. through genetic modification of foodstuffs or feed for food producing animals)**
- **Producing cattle with lower fat content to reduce saturated fat intake (e.g. through alterations to feed and/or selective breeding)**

LINE OF ARGUMENT: Build the line of argument (use verbs, full sentences so non-experts will understand)	
1. Why is this issue important in terms of its impact on diet & health?	In the interests of public health (for example to combat coronary heart disease) it is important that high nutritional quality foodstuffs are available. It is currently not possible, however, to supply all necessary nutrients to the entire population in a sustainable manner. There are also certain population groups that are less likely to eat the food groups that provide these necessary nutrients. Nutritional enhancement of food could be used to improve the nutritional content of foods that can be produced in a sustainable manner. It could also be used to improve the nutritional content of foods that people want to eat.
2. Why is change needed?	This change is needed as poor diet in the general population is resulting in increasing health costs and if no change is made these will continue to rise. As people become more aware of the health problems caused by poor diet many people choose to eat more healthily. Using current production methods, the increasing demand for healthy food will result in problems producing sustainable, healthy foods at a price accessible for poorer consumers. The use of technology for nutritional enhancement could be used to meet that demand for sustainable, healthy food. This would, however, have to gain public acceptance.
3. Why do we need to shape that change? Given the ethical, social and environmental issues that healthier foodstuffs may raise, we may want to nudge change more in one way than another. Why?	There is a good deal of public opposition to using technology in food and a lack of understanding about the way foods are produced. It would be necessary to demonstrate that any changes made to food production methods using new technologies are safe and beneficial, both to the consumer and the environment. A gradual change to the use of nutritionally enhanced foods would give the public time to learn about these and make an informed decision on whether to accept them.
4. Why do different stakeholders have different roles in the process of shaping change? What is their mandate?	If this change is to happen, the food industry needs to develop the new technologies that can lead to nutritionally enhanced products. As these currently may not be publicly acceptable they may need a lead or incentivisation from government or consumer groups. The government needs to consider if this is a suitable means of improving public health and if so take action. These actions could include encouraging industry to produce new products and demonstrating safety and public health benefits to the consumer. Consumers groups need to be engaged by the industry so that they can pass informed messages on to consumers.

EVIDENCE NEEDS: Given the line of argument, identify evidence needs:

	What evidence will need to be available?	Who could contribute?
Confirm what we think we know about this issue	• Evidence that such technology is possible with practical methods for increasing nutrient levels in food • Evidence to confirm the assumption that the current state of public acceptance is low and to find out how willing consumers are to change • Evidence to confirm that there are real health benefits This could range from a literature review of what technologies are already available and industry driven methodological research to social science research on consumer attitudes. Market surveys to confirm the current market status of this type of product would also confirm knowledge.	Food industry Social Scientists Market researchers Supermarkets/other retailers
Enrich our understanding of it (seek interdisciplinary evidence, develop a fuller understanding of the risks...)	• Evidence that there are no long term risks to enhancing foods, both to the consumer and the environment • Proof that increasing the nutritional value of the food leads to increased levels of those nutrients in the person who eats the food This would require long term controlled trials to demonstrate safety, absorption properties of the nutrients and whether this is safe for all population groups. Whilst these safety and benefit aspects would need to be demonstrated by the food industry as part of their development process, government has a role to play in ensuring that there is sufficient evidence to provide impartial safety advice to the consumer or providing a regulatory process which is trusted by the consumer so the consumer can be confident in anything that is on the market International collaboration would mean that lessons could be learned from other cultures where technologically enhanced foods are more acceptable to the general public	Food industry Food Standards Agency/other government departments Local authorities Researchers from other countries Governments from other countries
Explain the complexity of the issue (conduct detailed modelling, look for causal relationships)	• To know what foods and supplements are appropriate together • To understand the diets of different population groups • To know whether it is possible to target certain population groups with nutrients they need by enhancing specific food products • To understand how products like this can be marketed and labelled	

	• Who is willing to pay for product improvements. In the long term would consumers pay increased prices or would subsidies be necessary? These evidence needs will require collaboration by industry and government as to whether it is possible to target specific products. Government would also need to decide if it is ethical or appropriate to target people based on their population group and what they are likely to eat. The marketing evidence need could be collated from consumer research and would be required by the food industry. If, however, there was a decision by government that this was a good way to improve public health, government would also be interested in this evidence when promoting healthy eating. Labelling would be a major concern as this gives consumers choice over what they eat and having labelling that consumers and industry were happy with would require extensive consultation.	Food industry Food Standards Agency Defra Department for Health
Challenge received wisdom on the issue (seek alternative explanations, check assumptions...)	• Whether it is, in fact, necessary to add nutrients to diet as people may choose to eat healthily by themselves • Whether the expected effect on the environment of meeting that demand for healthy food would be as expected The expected environmental effects would require modelling by those with knowledge of agricultural practices, based in research institutes and academia and would need to be considered by government departments both with regard to healthy eating and development of an appropriate agricultural system.	Government departments (FSA and Defra) Research institutions/academia
Understand the context and history of the issue (seek lessons from the past, understand the issue within the broad public health remit...)	• There are lessons from the past about how to communicate changes in the way food is produced • It would be necessary to know if there is an optimum level of public health which the nutritional enhancement was aiming towards – at what point are foods sufficiently enhanced to have a positive public health effect	Food industry FSA Department for Health

Produce group: Table 4

KEY DEVLOPMENT - Using economic and other measures to make healthy food equally available to all socioeconomic and ethnic groups

LINE OF ARGUMENT: Build the line of argument (use verbs, full sentences so non-experts will understand)	
1. Why is this issue important in terms of its impact on diet & health?	It is not acceptable that some people do not have access to healthy food because of their background and there is evidence of some dietary linked health problems being more prevalent in certain population groups. For example there are higher rates of coronary heart disease in poorer socioeconomic groups.
2. Why is change needed?	Change is needed so that healthy food is seen as the easy choice and is cheaper than less healthy foods. It is also important that healthy eating messages are appropriate to all ethnic and socioeconomic groups. The benefits of eating healthier foods apply to everyone so the option to eat healthily and the knowledge of how to do so should be available to everyone.
3. Why do we need to shape that change? Given the ethical, social and environmental issues that healthier foodstuffs may raise, we may want to nudge change more in one way than another. Why?	It is often more expensive for the food industry to produce healthier foods so these foods often retail at a higher price. This may discourage people from poorer socioeconomic backgrounds from buying healthy foods and the fear of wasting food (and therefore money) may make them less inclined to experiment with new and healthier foods. The increasing population of different ethnic groups, with different eating habits, in the UK means that it important that advice on how to eat healthily is also relevant to these groups.
4. Why do different stakeholders have different roles in the process of shaping change? What is their mandate?	If this change is to happen it is necessary to understand what effect different measures will have. This will enable a judgement to be made as to whether they are worth carrying out. This is a role for government as they need evidence to back up any measures that are taken. This will need input from supermarkets, other retailers, the wider food industry and from consumers to ensure that there is a broad evidence basis. Any financial measures that are put in place may require cooperation from retailers to be successful.

EVIDENCE NEEDS: Given the line of argument, identify evidence needs:

	What evidence will need to be available?	Who could contribute?
Confirm what we think we know about this issue	• Reliable (up to date) data on food consumption in relation to socioeconomic and ethnic groups • Comparisons of that food consumption data with health statistics • Reviews of what data is already available • Suggestions of the measures that could be taken and whether these are acceptable to the public	
Enrich our understanding of it (seek interdisciplinary evidence, develop a fuller understanding of the risks...)	• Further modelling and theoretical studies • Consumer research There is historical data on food consumption in relation to population groups along with modelling on the effect of fiscal interventions. This would need to be extended and confirmed to ensure that any interventions would have the expected affects. Retailers might have a role to play in helping to provide consumption data that could be added to that collected by Food Standards Agency and Department for Health in their dietary surveys. Consumer research would provide evidence as to what measures would be acceptable to the public and how effective these could be.	Food Standards Agency Department for Health Food Industry Retailers (particularly supermarkets) Consumer groups Faith groups
Explain the complexity of the issue (conduct detailed modelling, look for causal relationships)	Consumers' choices of food are driven by a complex range of factors and consumer research to understand these would provide more evidence and explain the complexity of the issue.	
Challenge received wisdom on the issue (seek alternative explanations, check assumptions...)	An important challenge would be to consider whether the costs associated with improving diet are lower (or more worth incurring) than the costs associated with treating the problems caused by poor diet. Another is to investigate what effect other factors have in causing poor diet in certain groups, for example poor health in low income population groups is also going to be affected by smoking rates and types of occupation. Will intervening in diet have enough of an effect on overall health?	
Understand the context and history of the issue (seek lessons from the past, understand the issue within the broad public health remit...)		

Produce group: Table 5

KEY DEVLOPMENT.....Change in demographics of UK population in terms of number, age, composition and distribution…….....

LINE OF ARGUMENT: Build the line of argument (use verbs, full sentences so non-experts will understand)	
1. Why is this issue important in terms of its impact on diet & health?	There is a developing shift in the UK population and he projected demographic change in terms of number age, distribution and composition will have a profound impact on every aspect of our lives within the next 30-40 years. In terms of diet and health, this will mean an increased burden will be placed on the availability of our food, which will have to nurture and sustain an increasingly older and diseased population.
2. Why is change needed?	Change is needed for the following reasons: NUMBER – the total world population is set to increase, with EU and UK, such that the UK will be the largest nation within Europe (EU 27) [current figures are 6.7bm, with an estimated rise to 9.2bn by 2050]. AGE – Increasing numbers of the population will be over 65, who will be increasingly less well off (lower pensions), increasingly frail and/or diseased. This will result in an increased burden and more dependence on those reliant on food. DISTRIBUTION – Increasing imbalance on distribution (vast majority in England, and mostly based in urban areas) COMPOSITION – Increasing ethnic diversity as a result of increasing inward migration. These factors will together contribute to increasing inequality – leading to social, economic and political instability.
3. Why do we need to shape that change? Given the ethical, social and environmental issues that healthier foodstuffs may raise, we may want to nudge change more in one way than another. Why?	This change is needed as a result of the projected increased population and therefore there is an increased requirement for healthy food to alleviate health issues that are a legacy of age and obesity. More diverse foods are required to alleviate the needs of an increasingly diverse population (as a result of increasing inward migration). There is also a need for more, healthier, affordable food as income levels especially for older age groups will decline (pension's crisis).
4. Why do different stakeholders have different roles in the process of shaping change? What is their mandate?	All stakeholders are affected, but in different ways – however there is a need to seek/forge a common vision and understanding of the scale and gravity of the problem. 1. Government – key role of strategic direction 2. Regulator – must be dynamic and facilitate change 3. Consumer – must take more responsibility for own health, through lifestyle or dietary responsibility.

EVIDENCE NEEDS: Given the line of argument, identify evidence needs:

	What evidence will need to be available?	Who could contribute?
Confirm what we think we know about this issue	Much of the evidence required to describe the issue already exists, but needs to be brought together in a clear and coherent document. A fundamental understanding and acceptance of the gravity and scale of change that the combined impacts of the population (demographic change), health and the "energy gap" will have as they become manifest over the next 30-40 years is seriously lacking.	Contributions are multi-disciplinary, but require strategic/historic vision – perhaps of historian or political scientist.
Enrich our understanding of it (seek interdisciplinary evidence, develop a fuller understanding of the risks...)	Again, as the information is already present, it is more of a case of bringing it together	As above
Explain the complexity of the issue (conduct detailed modelling, look for causal relationships)	This is the principal task.	As above
Challenge received wisdom on the issue (seek alternative explanations, check assumptions...)	There is currently no received wisdom.	As above
Understand the context and history of the issue (seek lessons from the past, understand the issue within the broad public health remit...)	As above	As above

Produce group: Table 5

KEY DEVLOPMENT.....Eating habits of young determines future health of individual…….....

LINE OF ARGUMENT: Build the line of argument (use verbs, full sentences so non-experts will understand)	
1. Why is this issue important in terms of its impact on diet & health?	Eating habits of the young determines what they eat in the future and as a result their future health.
2. Why is change needed?	Calorific intake of children has remained constant for approx. 50 years but the current diet has more fat, sugar and salt. An increasingly sedentary lifestyle is driving health problems. Health children lead to healthy adults.
3. Why do we need to shape that change? Given the ethical, social and environmental issues that healthier foodstuffs may raise, we may want to nudge change more in one way than another. Why?	Availability of high fat foodstuffs. Targeting of unhealthy cheap foods at young. Peer pressure, decreased exercise, limited time for eating will lead to increased health costs. Processed cheap foods may be the current driver in this area as well as the prevalence of the obesogenic environment (child safety, transport – not walking).
4. Why do different stakeholders have different roles in the process of shaping change? What is their mandate?	Family and carers are the gatekeepers to their childrens' diets. The catering that is offered by education establishments to children is often as a result of inadequate budgets. The media require targeted advertising for the sales of their products. Peer pressure and the food service sector will also play a role.

EVIDENCE NEEDS: Given the line of argument, identify evidence needs:

	What evidence will need to be available?	Who could contribute?
Confirm what we think we know about this issue	There are ongoing surveillance exercises monitoring childrens' height, weight and dietary habits. A specific problem is the rise in diabetes in children. Feeding babies and weaning children is an area where more information is required	Department of Health Food Standards Agency Department for Children, schools and Families Sustain Caroline Walker Trust
Enrich our understanding of it (seek interdisciplinary evidence, develop a fuller understanding of the risks...)	There is a need to understand parents/carers perception of what constitutes healthy eating in children. Education of adults responsible for childrens diets through focus groups and community centre/schools would support the teaching done to educate the children themselves.	Parent organisations PTA groups Children food campaigns
Explain the complexity of the issue (conduct detailed modelling, look for causal relationships)	The situation is very complex, and requires a balance of some sort between individual responsibility (i.e. parental) and society/government. Messages need to be adapted to ensure they reach ethnic communities.	Social scientists
Challenge received wisdom on the issue (seek alternative explanations, check assumptions...)	Do we know whether advertising (of food) influences childrens diet/preferences? Does the food industry have a responsibility not to target children in advertising campaigns, if that food is unhealthy?	Children Food Campaign Advertising Standards Authority Trade Association Independent bodies
Understand the context and history of the issue (seek lessons from the past, understand the issue within the broad public health remit...)	Childrens diets change as they mature. In other cultures children and adults diets are more similar than in the UK. Yet a different diet for a child is not necessarily a bad thing, provided that diet is healthy. Historical records of food consumption and parameters of child development should be studied in further detail.	Epidemiologists

Produce group: Table 5

KEY DEVELOPMENT.....Imports/Sustainability/Food Security (sustainable agriculture/aquaculture) .....

LINE OF ARGUMENT: Build the line of argument (use verbs, full sentences so non-experts will understand)	
1. Why is this issue important in terms of its impact on diet & health?	We are becoming more dependant on imported food, primarily driven by price and value. This is not sustainable. (For example, fish – 80% of what we eat is imported)
2. Why is change needed?	Energy/Transport/Availability – Change is needed as climate change will potentially influence these factors in a 30 year time frame. Either we will have to pay more for food or change the type of food we eat. Also, third world demand will direct supplies and similar situation will be seen to China with dairy products, where as a result of increased consumption, prices increased.
3. Why do we need to shape that change? Given the ethical, social and environmental issues that healthier foodstuffs may raise, we may want to nudge change more in one way than another. Why?	We do not take opportunity to optimise on the food that we produce e.g. most of the fish we catch, we export (high omega 3) and most of the fish we eat, we import (white fish, low omega 3). There are a number of ethical considerations around this, sustainability of the fish we eat and eating healthier fish, with higher omega 3 levels. There are also opportunities around farming (agriculture and aquaculture). E.g. a lot of farming is dedicated to alcohol and non-food (biomass) production opportunities around shellfish farming and the provision of omega 3 around sustainable shellfish and marine based biomass.
4. Why do different stakeholders have different roles in the process of shaping change? What is their mandate?	Stakeholders mandate would be as follows: - To define and develop policy on food security, sustainable food and farming. - To identify opportunities on areas of exports and affordability as the economic picture changes - To modify trading patterns.

EVIDENCE NEEDS: Given the line of argument, identify evidence needs:

	What evidence will need to be available?	Who could contribute?
Confirm what we think we know about this issue	We know there is a historical trend by food group and projections have been made for the future. Data exists on food production, export, trade patterns and consumption. Using this and other information it is therefore possible to confirm the principal driver on the reasons for imports at present and move forwards with that.	DEFRA Research organisations & Universities Food Standards Agency Economists/Political Scientists
Enrich our understanding of it (seek interdisciplinary evidence; develop a fuller understanding of the risks...)	Understanding can be enriched by looking at ways varying drivers can be influenced in the future. It may also be possible to model different scenarios e.g. energy causing price raises, political disruption and climate change.	Social/behavioural scientists
Explain the complexity of the issue (conduct detailed modelling, look for causal relationships)	Possible actions that could be undertaken to refine the complexity of the issue include looking at trade flows and patterns and then using these to forecast and predict changes. It should also be possible to identify whether Trade Tariff interferes with or disrupts flows. There is also an ethical dimension that should be studied, in that third world supplies to the UK are income generating and supporting.	Economists Agencies (possibly a relevant consultant)
Challenge received wisdom on the issue (seek alternative explanations, check assumptions...)	There is an assumption that under-developed countries move to Western diets and therefore disrupt the current Trade Flow (same for energy/climate change). Initially, price has to be the key driver, and price inelasticity is needed.	Economist Industry information
Understand the context and history of the issue (seek lessons from the past, understand the issue within the broad public health remit...)	Water and/or food supply have been central to many international confrontations in the past. The focus on agricultural alcohol production is detrimental to health. The current omega 3 advantage should be optimised.	Policy leads (i.e. Food Standards Agency) could help in all these areas.

Produce group: Table 6

KEY DEVLOPMENT: Improving the nutritional quality of food through the growing medium

LINE OF ARGUMENT: Build the line of argument (use verbs, full sentences so non-experts will understand)	
1. Why is this issue important in terms of its impact on diet & health?	As people have historically been resistant to change dietary habits, nutritional quality of food must be improved to provide a positive impact on public health.
2. Why is change needed?	Change is needed in order to address the negative aspects of the diet of the general population, and to influence vulnerable groups who often do not benefit from public health initiatives.
3. Why do we need to shape that change? Given the ethical, social and environmental issues that healthier foodstuffs may raise, we may want to nudge change more in one way than another. Why?	Markets have demonstrated they are not able to deliver all these changes, and as consumers are not directing change, intervention is needed. There is a huge social cost of current dietary habits, such as sustainability issues and decreasing soil quality that need to be addressed.
4. Why do different stakeholders have different roles in the process of shaping change? What is their mandate?	Government must take a lead here to drive change. This could be achieved through consumer education through press-releases, eatwell schemes, social marketing, labelling standards etc and by driving research in particular areas. Industry will react to these changes and, lead by market forces, will produce foods with improved nutritional quality, such as foods with higher omega-3 content.

EVIDENCE NEEDS: Given the line of argument, identify evidence needs:

	What evidence will need to be available?	Who could contribute?
Confirm what we think we know about this issue	Evidence shows that food quality can be influenced through improving soil quality, for example, increasing unsaturated fatty acid content of livestock feed is known increase the level of unsaturates in milk. This is known to be passed through milk to the recipient.	-
Enrich our understanding of it (seek interdisciplinary evidence; develop a fuller understanding of the risks...)	The effect of crop quality on meat quality is unknown. Is bio-conversion efficient? What are the costs vs. benefits for enriching crops and would it be more efficient to fortify animal foods directly or through fortification of processed foods? For example, enriching the soil with selenium results in a 1% increase in selenium in animal products, which is not nutritionally significant, and what are the risks of soil contamination to provide small benefit to public health? Will this form of enrichment be environmentally sustainable?	Government funded research – interdisciplinary Soil and livestock scientists and modellers
Explain the complexity of the issue (conduct detailed modelling, look for causal relationships)	How will enriching foods impact of processing? For example, increasing the unsaturated fatty acid content of milk may impact on ice-cream production; will there be organoleptic changes to the foods that may not be tolerated? How will this be restricted by legislative standards? Will consumer tolerate nutritionally enhanced foods, as they may be seen as 'unnatural'? Is there a causal relationship between improving feed and improved beneficial nutrient uptake in the population, including vulnerable groups?	Government funded research – interdisciplinary Consumer research organisations
Challenge received wisdom on the issue (seek alternative explanations, check assumptions...)	A greater understanding of the dynamic between consumers and supermarkets would help establish whether products would be economically viable. Cost and consumer expectations (i.e. willingness to pay a premium for such products) curtail product development and primary production of foodstuffs. Will consumers accept these changes, particularly if the cost of enriching the growing medium is passed on? Are concerned about the quality of their food and their health not just the quantity of food available?	Government funded research – interdisciplinary Soil and livestock scientists and modellers Agricultural economists Consumer research organisations
Understand the context and history of the issue (seek lessons from the past, understand the issue within the broad public health remit...)	The US and Australia lead on this issue. US products may come to the market which would provide examples of consumer reaction to such products.	

Produce group: Table 6

KEY DEVLOPMENT... Using modern agricultural-biotechnologies, such as GM, as a tool to address improvements in productivity and yield as well as nutritional quality

LINE OF ARGUMENT: Build the line of argument (use verbs, full sentences so non-experts will understand)	
1. Why is this issue important in terms of its impact on diet & health?	Current methods of production are not environmentally or nutritionally sustainable nor are they able to deal with the required increase in yield and nutritional quality of foods. Biotechnology has the potential to address these issues.
2. Why is change needed?	Modern agricultural biotechnology techniques, especially GM, are met a with great deal of scepticism and resistance from consumers, who perceive these as unnatural and worse, unsafe. The environmental and socio-economic changes that are predicted, for example provided for in the presentation during the morning session, cannot sustain current crop and livestock production, without compromising the nutritional quality of foods.
3. Why do we need to shape that change? Given the ethical, social and environmental issues that healthier foodstuffs may raise, we may want to nudge change more in one way than another. Why?	Due to consumer resistance to any developments in this area, a change in social norms is needed. Education and consumer involvement could be a major driver for change. Environmental impact of using modern agricultural biotechnology techniques should be positive, reducing inefficiencies of current practices.
4. Why do different stakeholders have different roles in the process of shaping change? What is their mandate?	As consumer perception is the main limiting factor in restricting the use of modern agricultural biotechnology processes being used in the mainstream, consumer education and involvement is key. This can be achieved through government schemes, such as social marketing, labelling standards etc and by driving research in particular areas. Use of press-releases could help generate positive media coverage. A strong evidence base effecting positive media coverage is key. Legislative burden is high, though current policies allow changes to current practices to be made.

EVIDENCE NEEDS: Given the line of argument, identify evidence needs:

	What evidence will need to be available?	Who could contribute?
Confirm what we think we know about this issue	Consumers are resistant to the use of modern agricultural biotechnology techniques. Why is this? Is there a minority objecting influencing the majority? The evidence base supporting the role of GM in place of current practices is strong for improving agronomic characteristics.	Consumer Focus, Which? and other NGO's. Government research, such as COI qualitative research.
Enrich our understanding of it (seek interdisciplinary evidence, develop a fuller understanding of the risks...)	Evidence supporting the use of GM crops to address some of the shortfalls of current practices is robust and the risks well understood. Foodstuffs produced using modern agricultural biotechnological practices will not be produced until market acceptability is improved. A greater understanding of the barriers to achieving consumer acceptance could help develop key strategies. As above.	As above.
Explain the complexity of the issue (conduct detailed modelling, look for causal relationships)	Causal relationships between use of GM foods in improving nutritional quality of produce and these improvements being delivered to the final consumers, including vulnerable groups, must be established. Evidence required as per the proforma on "improving the nutritional quality of food through the growing medium". Prospective cohort studies would be needed to prove a link, but this may not be achievable in the UK and EU – could be taken from lessons learned in the US.	Universities, pharmaceutical companies, biotech firms, FSA – publicly funded research.
Challenge received wisdom on the issue (seek alternative explanations, check assumptions...)	-	-
Understand the context and history of the issue (seek lessons from the past, understand the issue within the broad public health remit...)	Precedents have been set in America, where GM has been used widely in foods for the past 10 years+. There is a growing evidence base in the developing world, for example China, Mexico, sub-Saharan Africa and India. Increased public awareness of hunger and poverty issues and how GM has been to address these problems could help improve public perception.	- FSA and DEFRA, through social marketing and the media.

Produce group: Table 7

KEY DEVLOPMENT... Environmental changes impacting on the composition, cost and availability of food**.....**

LINE OF ARGUMENT: Build the line of argument (use verbs, full sentences so non-experts will understand)	
1. Why is this issue important in terms of its impact on diet & health?	Environmental change will impact significantly on food composition, cost and availability. Many of the effects of these changes are unknown and unpredictable, especially the wider, long-term costs to health care.
2. Why is change needed?	Currently efforts are focussed towards changing current diets and not in identifying future pressures and the consequential impact on health. The amount of land designated to agriculture is likely to decline resulting in increased costs and reduced availability of food. Understanding how these changes could impact on the health of populations is vital.
3. Why do we need to shape that change? Given the ethical, social and environmental issues that healthier foodstuffs may raise, we may want to nudge change more in one way than another. Why?	Greater focus on trend analysis and modelling across the whole food chain from production to consumption to health. This will enable us to predict the future landscape and potential impact on health. With this knowledge policies can be shaped to determine healthier diets in this new framework.
4. Why do different stakeholders have different roles in the process of shaping change? What is their mandate?	Modelling the whole food chain from production to health falls across different government departments, and they should work together to identify the changes. There needs to be a cost/benefit analysis of interventions in the food chain taking into account the long-term health costs not just short-term production costs.

EVIDENCE NEEDS: Given the line of argument, identify evidence needs:

	What evidence will need to be available?	Who could contribute?
Confirm what we think we know about this issue	There will be lots of unknowns but the consensus is that there will be reduced availability. Prices of foods will become more volatile and the times of a guaranteed and cheap supply of food appear to be over.	
Enrich our understanding of it (seek interdisciplinary evidence, develop a fuller understanding of the risks...)	It is important that we understand how pressures on land will affect the availability which could for example, include flooding events. There is also an issue of government protectionism whereby certain countries may choose to 'buy up' land in a bid to secure it for agricultural use. Such a scenario could even lead to trade wars making food prices even more volatile. It is important that we understand what changes to food composition are likely to occur such as changing micro/macro nutrients in crops for example.	This process will require expertise from the environmental sciences, nutrition, agronomy as well as input from economists both in government and in industry.
Explain the complexity of the issue (conduct detailed modelling, look for causal relationships)	We must invest in complex computer models which can explore different scenarios such as a rise in temperature by 3◦C over 15 years for example. What effect would such a change have on food supply and composition? Reliable data is needed for such modelling to enable informed policy-making decisions. The issue's complexity is exacerbated by the unpredictability of climatic events. For example, a water shortage in China could lead to significantly reduced availability of fruit and vegetables on a global scale. The global nature of food supply chains means that the UK's food is now highly dependent on climatic conditions elsewhere in the world.	We will need expert statisticians and mathematicians who are capable of modelling such a complex range of eventualities. Following this, policy makers will have to be bold and direct policies in light of the gathered information.
Challenge received wisdom on the issue (seek alternative explanations, check assumptions...)	One viewpoint could be that by tackling obesity we are contributing to the ageing of the population. What are the associated costs of such intervention? For example there will be added pressures on public services, most notably health care. In addition we have to address the sceptical opinions of a significant number of people that climate change does not exist to the extent reported. As such, an understanding of consumer attitudes to the issues is vital.	Debate should be encouraged to inform and provoke further discussions. We will need solid figures from DH as to the extent of the health service's problems and potential breaking point.
Understand the context and history of the issue (seek lessons from the past, understand the issue within the broad public health remit...)	Placing the issue in a wider context, it could be envisaged that environmental changes could result in drastic changes in global trade with resulting implications to diplomatic relations between governments. One potential development could be a move towards vegetarianism which could result in deficiencies in certain micronutrients such as vitamin B12 for example.	The potential eventualities should be discussed at the highest levels of government in a bid to anticipate future conflict.

Produce group: Table 7

KEY DEVLOPMENT... Availability of affordable, attractive and nutritious food**.....**

LINE OF ARGUMENT: Build the line of argument (use verbs, full sentences so non-experts will understand)	
1. Why is this issue important in terms of its impact on diet & health?	This issue is important in terms of diet and health because the nation's diet will only improve if people **choose** to improve diets; or if a nutritious food supply is provided.
2. Why is change needed?	Change is required because current information and education are clearly not working. Health care costs are unsustainable and are set to increase further due to demographic reasons and the declining health of the UK population.
3. Why do we need to shape that change? Given the ethical, social and environmental issues that healthier foodstuffs may raise, we may want to nudge change more in one way than another. Why?	Intervention is needed as this is an example of market failure. If it is left to Market forces then the necessary changes simply will not happen. It is a difficult issue from a political standpoint due to the inherent long-term nature of changes and benefits.
4. Why do different stakeholders have different roles in the process of shaping change? What is their mandate?	Stakeholder involvement in this will be in all parts of the food chain e.g. primary producers, food manufacturers, retailers and policy makers (FSA, DH, BBSRC & DCSF). The only way that significant change will occur is by getting the major retailers (Tesco, Sainsburys, Asda etc.) on board as they possess the power and influence needed to make change happen. This was seen in the FSA salt campaign where retailers were given fixed targets for reductions in salt.

EVIDENCE NEEDS: Given the line of argument, identify evidence needs:

	What evidence will need to be available?	Who could contribute?
Confirm what we think we know about this issue	We know that obesity is rising and that diets are not currently meeting dietary guidelines. Cognitive dissidence and optimistic bias are barriers to dietary change.	
Enrich our understanding of it (seek interdisciplinary evidence, develop a fuller understanding of the risks...)	We need more evidence on what constitutes a healthy diet and what will lead people to choose that diet. Social science will play a crucial role in this.	
Explain the complexity of the issue (conduct detailed modelling, look for causal relationships)	Epidemiology only shows associations; we therefore need to develop biomarkers of early risk of diet-responsive disease and understand individual variability. Food choice is extremely complex and diet/ health only make up a component of a consumer's decision-making process. We need to therefore understand how factors such as price and seasonality will impact on the importance placed on health by consumers.	
Challenge received wisdom on the issue (seek alternative explanations, check assumptions...)	We must assess whether current dietary guidelines are appropriate in light of changing attitudes and ever-evolving research. Will education work and if so what is the best approach to take? Is it legitimate to use fiscal policy to increase consumption of fruit and vegetables (and fish)?	
Understand the context and history of the issue (seek lessons from the past, understand the issue within the broad public health remit...)	We have affordable food. We have nutritious food. The key question is how to make it attractive to produce and consume.	

Produce group: Table 7

KEY DEVLOPMENT... Counteracting the increasing amount and accessibility of 'Pseudoscience'. (please note that discussions on this matter were incomplete due to time constraints and so are described here in less detail).....

LINE OF ARGUMENT: Build the line of argument (use verbs, full sentences so non-experts will understand)	
1. Why is this issue important in terms of its impact on diet & health?	The group all agreed that there is a great deal of information available to consumers in the modern age and that much of the so-called science on offer is bad or 'pseudoscience'. It is important for diet & health to address this issue since many of the foods and diets touted as 'healthy', have no robust scientific backing.
2. Why is change needed?	Change is required in order to prevent confusion amongst the public and to restore faith in the scientific process. In addition, there is the danger that legitimate and sound advice on nutrition could be undermined by irresponsible reporting of bad studies.
3. Why do we need to shape that change? Given the ethical, social and environmental issues that healthier foodstuffs may raise, we may want to nudge change more in one way than another. Why?	We (regulators) must be in control of what is permitted in terms of health claims. FSA has a responsibility to consumers to ensure that labelling and advertising is accurate. If the change is not controlled or shaped by regulators then manufacturers will continue to make false claims and confuse the public.
4. Why do different stakeholders have different roles in the process of shaping change? What is their mandate?	Other stakeholders, in particular, large retailers must become involved if any progress is to be made. Retailers have a responsibility to only sell products that are backed up by sound science and as such they should place pressure on manufacturers to adhere to a code of practice.

EVIDENCE NEEDS: Given the line of argument, identify evidence needs:

	What evidence will need to be available?	Who could contribute?
Confirm what we think we know about this issue	We are sure that consumers are confused with the way things are at present. The public are bombarded with examples of bad science on a daily basis via various media outlets. It is agreed that the media have too much influence at a time when an objective voice would be more suited. Researchers are too often encouraged to 'find' trends and interesting results/data and to then go ahead and publish such findings often prematurely.	
Enrich our understanding of it (seek interdisciplinary evidence, develop a fuller understanding of the risks...)	We should understand what the impact of pseudoscience is on behaviours. Will an article in the daily mail actually alter a person's shopping and consumption behaviour for example?	
Explain the complexity of the issue (conduct detailed modelling, look for causal relationships)	Using reputable high-profile scientists to explain the difference between good and bad science could prove worthwhile.	
Challenge received wisdom on the issue (seek alternative explanations, check assumptions...)		
Understand the context and history of the issue (seek lessons from the past, understand the issue within the broad public health remit...)		

Produce group: Table 8

KEY DEVLOPMENT **Improving the nutritional content of the diet**

LINE OF ARGUMENT: Build the line of argument (use verbs, full sentences so non-experts will understand)	
1. Why is this issue important in terms of its impact on diet & health?	To address growing health problems. Difficulties in changing people's choices sufficiently (with foodstuffs currently available). So if we can improve the nutritional content then we can get overall gains (this may be – but not necessarily - by technology) • From point of view of consumer (and especially the consumer who may be most affected) • Growing impact of changes (to address growing health problems) • Need to influence content of diet • Comes down to choice (either of individual people or individual food constituents) • What do people want out of their food? (taste good?)
2. Why is change needed?	Need to change to healthier diet - current status quo does not 'deliver'. New solutions to old problems. World running out of resources • Need different approach/strategy - education alone does not work (esp for indifferent people) • Change to a healthier diet is problematic – i.e. people know they should change to eat 5 a day but don't (so need a range of different approaches e.g. social marketing for lifestyle changes?)
3. Why do we need to shape that change? Given the ethical, social and environmental issues that healthier foodstuffs may raise, we may want to nudge change more in one way than another. Why?	. **Giving people choice is the key point** **Lead rather than drive change** **Need to shape that change because need a range of different approaches, because people respond to different stimuli** **As we need to recognise that a 'step change' in GM needed (education?) Frame 'positives' +remove barriers before they come up.** **IN SUMMARY: it is probably easier to make minor modifications to what people already eat than to try to force them to major changes in the types of food they choose to eat** **(comes down to cultural and social norms)** **ALSO EUROPEAN SCIENCE WILL BE LEFT BEHIND**
4. Why do different stakeholders have different roles in the process of shaping change? What is their mandate?	Stakeholders are: THERE ARE TECHNOLOGICAL, ECONOMIC AND SOCIAL DIMENSIONS Consumers (from different social classes) Supermarkets Industry + Feed suppliers/farming industry Scientists

EVIDENCE NEEDS: Given the line of argument, identify evidence needs:

	What evidence will need to be available?	Who could contribute?
Confirm what we think we know about this issue	Making changes using cheap technology (e.g enrich fertiliser) is probably better than high tech solutions We know there is public suspicion about GM modification - is it safe, what is environmental impact So what is acceptable – why has it not been introduced?	Research institutions/industry?
Enrich our understanding of it (seek interdisciplinary evidence, develop a fuller understanding of the risks...)	Need to know does it work? How much benefit do you get? what are the trade offs? Costs and acceptability (trade offs and legislation) Need to go back and look at attitudes - ask 'would you think it would be a good idea to provide food with nutrients to prevent CD Should we rely on companies that have a patent (yes recognise industry stimulates innovation - real value is in the knowledge)	Processing and Feed Industry Retailers
Explain the complexity of the issue (conduct detailed modelling, look for causal relationships)	What if the technology goes wrong - have we got a fall back position? Note possible 'unintended consequences' - need predictive modelling Remember for acceptability of risk, a scientists acceptability of risk is different to a consumer's acceptability of risk	Risk assessors
Challenge received wisdom on the issue (seek alternative explanations, check assumptions...)	There is a lot of knowledge within food companies/industry. How much is accessible? Possibly reluctance to 'share' is down to a risk-based judgement (considering economic judgement) There needs to be an equitable treatment of people/groups (to allow them to protect their interests. They need to be able to feel they can go through peer-review' without having their idea pinched.	
Understand the context and history of the issue (seek lessons from the past, understand the issue within the broad public health remit...)	Is the level of regulation proportionate? For example if it is really 'safety critical', accept highest level of approval. But if not – go for 'softer approach'? If new (modified) products are going to come on to the market, is the 'level of evidence/proof needed right? (suggested this balance might not be right for recent 'health claims regulations)	Regulators

Produce group: Table 9

KEY DEVLOPMENT.....Using Food/Feed modification in primary production in order to improve the nutritional quality of food

LINE OF ARGUMENT: Build the line of argument (use verbs, full sentences so non-experts will understand)	
1. Why is this issue important in terms of its impact on diet & health?	Because it is (relatively) technologically easy and cost effective way of affecting change at a population level by working at the primary production level.
2. Why is change needed?	This is a good way of reducing health inequalities and addressing the socio-economic divide which relates to the nutrient status of the population which doesn't rely on changing behaviours and the free market to provide solutions. This solution is flexible to allow different commodities to provide balance for other food groups-eg using plants that express fish oil through genetic modification rather than having to rely on fish stocks, or other vitamin or mineral content that is deficient across the population.
3. Why do we need to shape that change? Given the ethical, social and environmental issues that healthier foodstuffs may raise, we may want to nudge change more in one way than another. Why?	There is a strong case for government regulation to support this method in agriculture and the whole food chain. There are some important technical, and ethical questions that would need to be explored and understood, as well as the potential consequences on the environment, such as nutrient leaching from the soil, and any accumulative affect on humans through the diet. It would need to be regulated for consistency of approach in the modification process but all parties would need to be involved in developing this issue.
4. Why do different stakeholders have different roles in the process of shaping change? What is their mandate?	As this issue would rely on changing agricultural practices therefore primary production through government legislation, a whole food chain approach is important. Media would also need to be engaged early on to understand and help interpret science correctly.

EVIDENCE NEEDS: Given the line of argument, identify evidence needs:

	What evidence will need to be available?	Who could contribute?
Confirm what we think we know about this issue	Really important to include evidence from other countries RDAs and toxicity levels reports, monitoring practices would all have to be reviewed. For example is there a linear relationship between concentration and outcome?	
Enrich our understanding of it (seek interdisciplinary evidence, develop a fuller understanding of the risks...)	Need more reliable data about what people are eating to have an accurate measure, consider biomarkers? Need a better understanding of what consumers will do-for example do they always buy the cheaper food?	
Explain the complexity of the issue (conduct detailed modelling, look for causal relationships)	Need risk assessments –take into account the combinations of foods taken in Unforeseen issues such as DDT –bioaccumulation issues, or BSE There is always a chance of being proved wrong at a later date when advice is based on the best scientific advice available e.g. COT and advice about peanuts during pregnancy	
Challenge received wisdom on the issue (seek alternative explanations, check assumptions...)	Would it work equally across all ethnic groups? -through genetics -some groups may not eat the target food Challenge what we know about the baseline levels-may vary with geographic regions or in certain ethnic groups	
Understand the context and history of the issue (seek lessons from the past, understand the issue within the broad public health remit...)	-what are the effects on environmental pollution -interactions with other nutrients in crops has a negative affect on crop growth -affect on taste and look of the produce -	

Produce group: Table 10

KEY DEVLOPMENT... Boosting the nutrient capacity of soil and the availability of the nutrients to improve the delivery of nutrients into the food chain**.....**

LINE OF ARGUMENT: Build the line of argument (use verbs, full sentences so non-experts will understand)	
1. Why is this issue important in terms of its impact on diet & health?	Soil delivers the nutrient of interest to the plants which are then consumed directly by humans. Alternatively the plant material may be consumed by animals and the nutrient would then pass into the meat to be consumed by humans. The principle targets would be micronutrients (e.g. Se; Mg) but changes in phytonutrients (e.g. flavonoids) might also be possible through manipulation of the soil/water balance. This approach would not require a change in consumer habits.
2. Why is change needed?	• The possibilities to change consumer behaviour to choose a healthier diet are limited, particularly among vulnerable groups, and therefore the food itself needs to become healthier. • It would allow us to deal with the possible effects of climate change on soil in the future. For example different rainfall patterns could affect soil processes and therefore nutrient content. • Agriculture is likely to become more intensive in certain areas of the UK, therefore the soil composition needs to be robust enough to cope with this.
3. Why do we need to shape that change? Given the ethical, social and environmental issues that healthier foodstuffs may raise, we may want to nudge change more in one way than another. Why?	To link primary production (i.e. the soil) with consumer needs. FSA should provide this link. This would then provide an alternative to adding nutrients at the food or feed processing stages of production.
4. Why do different stakeholders have different roles in the process of shaping change? What is their mandate?	Different stakeholders are key to each stage of production, all with different economic drivers: FSA – to define the micronutrients needed for health Defra – to provide the framework for implementation including the economic drivers Scientific community – to develop the t6echnology and identify best practice Farmers – to implement

EVIDENCE NEEDS: Given the line of argument, identify evidence needs:

	What evidence will need to be available?	Who could contribute?
Confirm what we think we know about this issue	1. Whether consumers prefer naturally healthy food. 2. Which nutrients are important for human health 3. The presence and availability of these nutrients in the soil 4. How different soils contribute to nutrient availability 5. Differences between different consumer groups in their willingness to adopt healthy eating 6. Farming practice is linked to income (much of which is derived from subsidies which then drive practice).	2. human nutrition researchers with funding from government or charitable bodies 3 and 4. soil scientists , NERC funding 1 and 5. retailers organisations, consumer pressure groups, ESRC funding 6. farmers organisations, EU
Enrich our understanding of it (seek interdisciplinary evidence, develop a fuller understanding of the risks...)	1. Comprehensive analysis of soil nutrient and food interaction 2. That soil can be changed sustainably. 3. Proof that this development is economically viable. 4. What is acceptable to consumers, and how to make this acceptable? 5. That there are appropriate farming systems.	1. Government funded research – interdisciplinary 2. Soil scientists and modellers 3. Agricultural economists 4. Consumer research organisations 5. e.g. Aberystwyth U.; SAC (increased research capacity needed)
Explain the complexity of the issue (conduct detailed modelling, look for causal relationships)	[covered above]	1.
Challenge received wisdom on the issue (seek alternative explanations, check assumptions...)	Consumer perception is that the nutritional value of a particular food is independent of the soil and production method – this should be challenged.	2. Biological research to provide evidence that this is incorrect 3. Consumer attitude survey to test perception.
Understand the context and history of the issue (seek lessons from the past, understand the issue within the broad public health remit...)	In the past research showed the scientific feasibility of this development but the concept failed due to farming practices at the time (post-war 1950s). Now farming policies have changed and consumers are concerned about the quality of their food and their health not just the quantity of food available.	

Produce group: Table 11

KEY DEVLOPMENT The composition and patterns of consumption of milk and milk products can shift in ways that improve the balance of benefits and risks

LINE OF ARGUMENT: Build the line of argument (use verbs, full sentences so non-experts will understand)	
1. Why is this issue important in terms of its impact on diet & health?	Liquid milk is beneficial as a vehicle for nutrients and other 'bioactives', but dairy products (mainly as cheese and butter) make the biggest contribution to intakes of total saturates. However, emerging research suggests that some saturates in milk products may be less harmful than thought. It is possible to manipulate the composition of milk and milk products to replace saturates with beneficial fats (mono- and poly- unsaturated fatty acids).
2. Why is change needed?	Other drivers (for example to reduce intakes of fats or to address issues of sustainable production) will tend to drive down consumption of milk and milk products, which could have unforeseen and/or adverse effects, or lost opportunities, with respect to the benefits of these products.
3. Why do we need to shape that change? Given the ethical, social and environmental issues that healthier foodstuffs may raise, we may want to nudge change more in one way than another. Why?	To ensure that unintended negative effects on diet are identified and avoided, and potential benefits realised. To ensure that the nutritional aspects are fully appreciated in the wider discussions on the desirable futures for milk production, from the perspectives of climate change, sustainability, requirements of different population groups, and parallel considerations of potential substitutes for milk and milk products.
4. Why do different stakeholders have different roles in the process of shaping change? What is their mandate?	Policy makers have a mandate and responsibility to develop policies on diet and health (FSA, DH,) and land use and sustainability (Defra, DECC), and to ensure a coherent, evidence based approach. Researchers and research funders have an interest and a responsibility to develop the evidence base and to communicate it. Consumers and their representative groups (particularly those for whom milk and milk products are particularly important, or avoided) have an interest in what they eat and a responsibility to engage and ensure their views are reflected.

EVIDENCE NEEDS: Given the line of argument, identify evidence needs:

	What evidence will need to be available?	Who could contribute?
Confirm what we think we know about this issue	Evidence from studies using existing, better biomarkers of effect to provide a more robust evidence base for links between consumption and longer-term health end points Evidence on the prevalence and effects on sufferers of intolerance and allergy to milk and milk products in different population groups – needed to give a better base on the extent and pattern of the problem to factor into assessment of risks and benefits of different approaches. Extension of experimental studies on manipulation of milk - to confirm what can be achieved on the larger/industrial scale in real production and economic conditions.	This answer applies across all five rows: To deliver the research: cross disciplinary approaches and needed To fund it: joined-up, strategic approaches are needed, across food security, production, consumption and sustainability - not an incomplete patch work of isolated pieces of evidence
Enrich our understanding of it (seek interdisciplinary evidence, develop a fuller understanding of the risks...)	More detailed data on consumption of milk and milk products (and substitutes) across the different product types and sections of the population (differentiated by gender, genetic, social/lifestyle, life stage, cultural factors). Investigation of the hypothesised link between certain milk types and triggering of particular behaviours in autistic children.	
Explain the complexity of the issue (conduct detailed modelling, look for causal relationships)	Studies that will improve understanding of the underlying mechanisms of the effects of milk and milk products on health – positive and negative – to help interpret the epidemiology and inform risk/benefit assessment and advice. Evidence of the interactions between milk/milk products and other components of the diet (including from the perspective of possible substitutes for milk/ milk products)	
Challenge received wisdom on the issue (seek alternative explanations, check assumptions...)	Studies to establish the true picture of prevalence and effects of allergy and intolerance, and other adverse effects in different groups	
Understand the context and history of the issue (seek lessons from the past, understand the issue within the broad public health remit...)	Evidence is needed on the attitudes, beliefs and values of consumers (in different groups) towards the different aspects of milk production and consumption, including sustainability, and towards the possible manipulations being considered. What to they want? What would they accept, or pay for?	