Government Office for Science

Foresight

One Year Review

January 2011 – March 2012

Foresight Project: Global Food and Farming Futures

Foresight, Government Office for Science

Contents

Executive Summary

The Foresight Global Food and Farming Futures (GFFF) Project (the Project) published its findings as the report *The Future of Food and Farming: Challenges and choices for global sustainability* (the Report) on 24 January 2011. This one-year review (the Review) sets out the Report's impact on government and other organisations' policy development and strategic thinking, on the work of the research community and on business. **The main body of the Review comprises statements from the stakeholder organisations themselves**.

The Project explored the increasing pressures on the global food system between now and 2050. The Report highlights the decisions that policy makers need to take today, and in the years ahead, to ensure that a global population rising to 9 billion or more can be fed sustainably and equitably.

The Report makes a compelling case for urgent action to redesign the global food system to meet the challenge of feeding the world over the next 40 years.

The Project analysed five key challenges for the future:
A. Balancing future demand and supply sustainably – to ensure that food supplies are affordable.
B. Ensuring that there is adequate stability in food prices – and protecting the most vulnerable from the volatility that does occur.
C. Achieving global access to food and ending hunger - this recognises that producing enough food in the world so that everyone can potentially be fed is not the same thing as ensuring food security for all.
D. Managing the contribution of the food system to the mitigation of climate change.
E. Maintaining biodiversity and ecosystem services while feeding the world.

The Project applied leading-edge scientific and other evidence and futures analysis to identify critical issues and their consequences, and to identify and analyse possible policies and interventions for addressing those challenges.

Foresight has set aside resources to disseminate its reports and to help ensure that the Report and its key messages are used to achieve impact. Since the Report's publication, this Foresight 'Follow-up' Team has worked with many of the Project's stakeholders to help catalyse action. The Review is not intended as a comprehensive record; rather, it highlights the wide range of the initiatives that the Project has informed. Some of this impact is described below.

UK Government

The Project's departmental sponsors, the **Department for Environment, Food and Rural Affairs** (Defra) and the **Department for International**

Development (DfID), have used the Report to inform and help shape actions across several of their major priorities.

Defra's Secretary of State and others have been active on the global stage in drawing on the Report to support action to open up global markets, to manage volatility of food prices, to combat and adapt to the challenges posed by climate change, to protect the world's resources and biodiversity and to embed sustainable practices in agricultural production. Specifically, Defra has used the Report in preparation for the *Rio +20* meetings in June 2012, in developing its contribution to the *G20* process and to the *United Nations Climate Change Conference* in December 2011. Domestically, and in recognition of the UK's responsibility to play its part in tackling the Foresight challenges, Defra has used the evidence laid out in the Report to *inform its Climate Change Risk Assessment* and its *Natural Environment White Paper* and is examining the practicalities of sustainable intensification through its *Green Food Project*.

DfID has progressed several strands in line with its commitment to action in light of the Report. For example, DfID has commissioned a number of *systematic reviews* in key areas to strengthen the evidence base for its policy and practice to link climate change, hunger, poverty, biodiversity and energy. DfID has also directed funding from its *Policy Research Fund* to climate change, agriculture and food security, and supports activities to increase agriculture growth rates in the face of resource scarcity by addressing the yield gap and developing new technology.

The Report has influenced the **Welsh Government** in producing a new strategy for food, *Food for Wales, Food from Wales 2010:2020: A Food Strategy for Wales*, which aims to develop the food production and processing industry in Wales. In **Northern Ireland** Foresight has reinforced the key messages of the **Department of Agriculture and Rural Development**'s overall food strategy *Focus on Food*, which was jointly developed with industry and influenced in the Department's decision to create a new *Food Strategy Board* to develop a longer-term strategic vision for the agri-food sector.

Research

The Report has continued to help inform the development of the **Biotechnology and Biological Sciences Research Council**'s (BBSRC) activities relevant to food security – one of its three strategic research priorities – within and beyond the UK's multi-agency, Council-led *Global Food Security Programme* (GFS). The Report has helped shape strategic thinking in a number of key GFS areas such as resilience, resource efficiency, sustainable production and sustainable healthy diets.

The Report has also resonated with and informed international research priorities. In particular, through the **EU Joint Research Council**, it will help the Commission to prioritise and direct its efforts for the greatest impact on the global food situation. Furthermore the JRC will expand its activities to

include the launch of a food security foresight study in 2012 to be finalised in 2014. The Report was also 'very valuable inspiration' for France's **National Institute for Agricultural Research**'s (INRA) development of programmes on price volatility and, in a more general way, the insights of both INRA's *Agrimonde* analysis and the Project help INRA's consideration of its research priorities, targeted on impact and innovation; the sustainable intensification of agricultural and sustainable food systems as well as their resilience to climate change. The Foresight study also contributed to enhancing the **Brazilian Agricultural Research Corporation**'s (Embrapa) efforts to play a leading role in the development of technologies and innovations for the sustainable production of food, fibres and bioenergy in the tropics. The Report corroborated various elements of Embrapa´s research agenda and the relevance it assigns to increasing sustainable agricultural productivity, addressing environmental challenges and using cutting-edge knowledge such as biotechnology, nanotechnology and genetic modification of living organisms to tackle pressing agricultural problems.

UK Stakeholders

The Project provided the **National Farmer's Union** (NFU) with a strong and compelling evidence base, which has been helpful in articulating the critical role agriculture has to play if the NFU is to secure a long-term food supply. The Report has either been fundamental to the initiation of, or influenced and shaped outcomes of, activities relating to research and development (R&D) and knowledge transfer and exchange, and to reconciling the challenge of increasing food production whilst also enhancing the environment. The Project has also helped the NFU align its goals and messages in the area of sustainable intensification and the need to 'produce more and impact less'.

The **Soil Association**'s (SA) new strategy, *The Road to 2020*, echoes some themes of the Report, principally the need for bold innovation in agriculture, land management and food systems. Foresight has clearly given these themes, and the notion of a 'perfect storm' of emerging challenges, much greater currency among UK policy-makers and stakeholders, significantly influencing the environment in which the SA has developed and launched its strategy. The Report has also influenced **Natural England**'s (NE) work including its commissioned research into the ecosystem services that support agricultural productivity, its discussions on sustainable intensification, and its strategic futures thinking and scenarios with regard to the natural environment in England.

The Report has been fundamental to the work of the **Prince's Trust Charities International Sustainability Unit** and, at 'precisely the right time', provided a clear and comprehensive exposition of the interconnected drivers that affect global food security. The depth and breadth of the 'Evidence Reviews' that underpin the Project's analysis lend powerful weight to its central message. This stresses the now urgent need for governments to consider how food security might be assured for all.

International stakeholders

The Foresight study has had a marked impact on the global stage. For example, the **Food and Agriculture Organization**'s (FAO) recent report *State of the World's Land and Water Resources for Food and Agriculture* (SOLAW) shares several conclusions with the Report and provides complementary information to better inform decision-makers in future policy reforms. Additionally, the Report's arguments on sustainable intensification and food security contributed partly to the impetus of establishing a new FAO initiative: the *World Agricultural Watch Initiative* (WAW), which focuses on monitoring the social, economic and environmental impacts of agricultural transformations at all scales. Foresight has also had close interactions with FAO's Fisheries Department and some of the Projects outputs have closely connected with its flagship publication *The State of World Fisheries and Aquaculture*, SOFIA. The FAO Agriculture Department (AG) found substantial common ground with the Report, for example with its policy-maker's guide to the sustainable intensification of smallholder crop production, *Save and Grow***.**

The **European Commission Directorate General for Agriculture and Rural Development** has used the Report and its evidence base in its pluralist and multidisciplinary approaches to the complex issues of the future of the global food system. The Report has directly informed the third foresight initiated by the EU Standing Committee for Agricultural Research and, in 2013, the European Commission will prepare a cross-cutting initiative on *Sustainable Food* to promote the food system transition towards sustainability, which will be a further opportunity to draw on the Report.

The ***Organisation for Economic Co-operation and Development*** (OECD) Secretariat found the scope and clarity of the Report extremely useful. Its publication came at a key time as the *Committee for Agriculture* sought to translate the broad directions defined by Ministers into concrete proposals. The Report's key findings assisted in the development of the OECD's *Green Growth Strategy for Food and Agriculture*, in particular, in the areas of technologies and farming, fishing and food chain practices and systems. It also helped inform the OECD Agriculture Knowledge Systems Conference in June 2011.

The **World Bank** (WB) agrees with the Report that that food security, poverty and climate change are closely linked and should not be considered separately. The Report's insistence on the need to take a much broader perspective than hitherto, and to approach the global food system in an integrated manner, is of great value. For example, based on the Report, the WB is strongly convinced that Climate-Smart Agriculture (CSA) offers triple wins for food security, adaptation and mitigation, and Foresight's role in the *Global Science Conference on Climate Smart Agriculture: Science into Action* in the Netherlands was instrumental in helping to forge a scientific consensus around inclusion of agriculture in the climate negotiations.

As one of 16 major studies considered by the **Commission on Sustainable Agriculture and Climate Change**, the Report's very thorough set of specially commissioned studies and the rigorous synthesis were a notably important contribution to the Commission's work. The Report's holistic focus and its high credibility across a broad range of stakeholder communities assisted the Commission in achieving a broad focus on the global food system rather than constraining its attention to food production.

The Report also informed the work of several other international organisations. For example, the **World Trade Organization** found the Report's findings on improving governance directly relevant to its work and that the other parts were also very useful in providing a perspective and a framework for its analysis. Also, the **International Union for Conservation of Nature**, which promotes forms of agriculture that conserve biodiversity at a landscape scale, and which requires a long-term perspective, felt that the Report has provided an authoritative insight into options for the future. The Project was very influential in **Conservation International**'s (CI) development of its *Food Security strategy*; from key priority actions for non-governmental organisations (NGOs) and for the research community and research funders. The **Centre for Agriculture and Biosciences International** (CABI) welcomed the Report, especially as it acknowledged the critical balance required between efforts to grow more and to 'lose less'. The Report's findings on strengthening and revitalising extension systems underpin CABI's pragmatic and pluralistic approach to implementing the global food security programme *Plantwise*, which it leads, in conjunction with over 70 international partners.

Elsewhere in the NGO community, the **Bill and Melinda Gates Foundation** regarded the Report, and the many 'impressive' scientific reports that lay behind it, as a very useful input into the *Gates Foundation Agricultural Development Strategy Report*. Also, the Project has provided **Oxfam** with a series of platforms both in the UK and in the European Union to highlight the Report's issues and for Oxfam to be strongly supporting key messages. The Report has also expanded Oxfam's networks; particularly, the nexus between environmental concerns and social justice concerns as they relate to food security.

Business

The **British Chamber of Commerce,** specifically, the Chamber´s Food Security Safety and Sustainability Task Force, organised two events during 2011 to support of the Report's dissemination. On 30 March 2011, Sir John Beddington presented the Report's key conclusions to an audience of about 80, with representatives from the international business community, including the following multinational organisations: Novartis, Kellogg's, Monsanto, Delhaize Group, Nestlé, Coca-Cola, BASF, Diageo, Bayer CropScience and Procter & Gamble. An important message which emerged was the need to develop ways of measuring agricultural sustainability. In order to build on this challenge, Sir John Beddington also contributed to the Task Force's *How*

Green Is My Apple? event on 7 December, alongside speakers from Microsoft Research, the World Wide Fund for Nature (WWF) and BASF. In addition, outreach to a more specialist audience was achieved by posting these videos on various members' and associated web sites, including WWF Europe, Microsoft Research, The European and BASF.

The Report was being prepared at the same time as **Unilever** made the final preparations for the launch of its *Sustainable Living Plan*, in November 2010. The basis of the sustainable sourcing commitment in that plan (100% sustainable sourcing of all renewable ingredients by 2020) is our *Sustainable Agriculture Code*, which was published in April 2010. Unilever believes that its *Sustainable Agriculture Code* is fully in line with all major recommendations in the Report, and Unilever placed enough trust in the validity of these recommendations that it put this bold 100% sustainable sourcing commitment in its *Sustainable Living Plan*.

The **Crop Protection Association** (CPA) took several 'key positives' from the Report and welcomed its accounting of differing views ranging from smallholders and environmental groups to the plant science industry and major food manufacturers and retailers. The CPA also welcomed the Report's call for new technologies and the need for more public and private investment in agriculture research to tackle the magnitude of the food security challenge. The CPA usefully highlights some of the key challenges ahead including ensuring that food security remains a key political priority around the world and that science-based approaches to agriculture and food production are developed and maintained.

The **Food and Drink Federation** (FDF) undertook a review of all its *Five-fold Environmental Ambition* targets to see how it might start to address the wider issues that Foresight had examined. The FDF concluded that, in addition to continuing to bear down on impacts under its direct control, it needed also to extend its influence with its supply chain partners and customers to put resource efficiency at the heart of decision-making and to promote life-cycle thinking across the value chain in order to deliver more sustainable patterns of production and consumption throughout the food system. The FDF has strongly supported the Foresight analysis and argued the need for a more coherent and strategic cross-government approach to food policy, prioritising comparative advantage and seeking to optimise productive potential in this country, as part of its response to the longer-term global challenges identified by the Project.

In summary, the Report has had, and continues to have, significant UK and international impact with multiple stakeholders. This extensive impact has made its mark at a national level in the UK and elsewhere and with multinational bodies such as the UN, EU and OECD. The Report methods and findings have found particular resonance with policy and research communities and with several non-governmental organisations and the business community.

1 Introduction

This Review (the Review) records the impact which the Foresight report **The Future of Food and Farming** (the Report) has made in the year following its publication in January 2011. The Report has informed and influenced government and other stakeholder initiatives in the area of land use by providing a robust and comprehensive evidence base.

Foresight has set aside resource to disseminate its reports and to facilitate impact. This 'Follow-up Team' works with government and other organisations, particularly in the year following the publication of a report, to help ensure that its evidence base and key messages are used to inform policy making, strategic thinking, research, and investment in technology development. This Review is a record of those activities and impact. The Review is not intended to be comprehensive, recognising that some impact will be indirect or intangible and not clearly attributable to the Foresight study.

Impact has been achieved by engaging a wide range of stakeholder organisations, spanning government, research bodies and NGOs, that have been influenced by the findings from the Report.

This Review records the progress of initiatives set in motion by the publication of the Report. These stakeholders were invited to submit summaries of findings of impact that, using the contributors' text for the main part, have been drawn together to form the main body of this document. It is important to note that the Report does not make policy recommendations as such; rather it seeks to develop the evidence to inform them, as do all Foresight reports. The breadth and depth of this particular report has led to multiple impacts involving a wide range of other stakeholders.

This Review begins with an overview of the Foresight Global Food and Farming (GFFF) Project (the Project), including its background, aim, process and principal outputs in Chapters 2 and 3. Chapter 4 sets out the wide range of impact that it has had in the year since publication; in particular within government departments, the academic and research communities, and with other organisations. Information on the dissemination of the Report are set out in Chapter 6.

2 Project Overview

2.1 Background

The Project published its findings on 24 January 2011 under the title *The Future of Food and Farming Futures: Challenges and choices for global sustainability* (the Report). The culmination of two years' work, the Report brought together over 400 leading experts and stakeholders from 35 countries covering subjects ranging from ecology and biology to economics and agriculture.

Commissioned by the Government Chief Scientific Adviser, Professor Sir John Beddington, the Project was co-sponsored by the Department for Environment, Food and Rural Affairs (DEFRA) and the Department for International Development (DfID), which co-chaired the Project's High Level Stakeholder Group (HLSG). The HLSG consisted of a host of international experts from the UN, the EU, the World Bank, industry and civil society. The Report was overseen by a Lead Expert Group (LEG), chaired by Professor Charles Godfray, which provided the best available scientific scrutiny for the Project.

2.2 Aim

The Project aimed to use the best available scientific and other evidence to explore the pressures on the global food system between now and 2050 and identify the decisions policy-makers need to take, today and in the years ahead, to ensure that a global population rising to 9 billion or more can be fed sustainably and equitably.

The Report concluded that the food system is moving into a new era of uncertainty and pressure. To prepare policy-makers accordingly, comprehensive strategic analysis is required that looks both across adjacent policy areas and ahead to the future challenges and possible solutions. The Report aims to make a contribution to that goal. It builds on the *Food Matters* Report published by the UK Cabinet Office in the wake of the food price spikes of 2008, which called for a major new Foresight Project to examine future global food systems.

The Project aims to add value by:

- Taking a long-term, strategic outlook at likely challenges over the next 20 years to 2030 and the next 40 years to 2050. It has used futures techniques to embrace the many uncertainties inherent in the future, and to identify choices that are resilient to a range of outcomes.
- Taking a very broad view of the food system. It has considered the concerns and experiences of many different types of stakeholder, from

African smallholder to multinational retailer, from issues of governance to evolving consumer demand.

- Commissioning new economic modelling to explore possible future trends in food prices.
- Involving participants from a very wide range of disciplines: natural and social scientists and experts in risk management, economics and modelling.

2.3 Structure

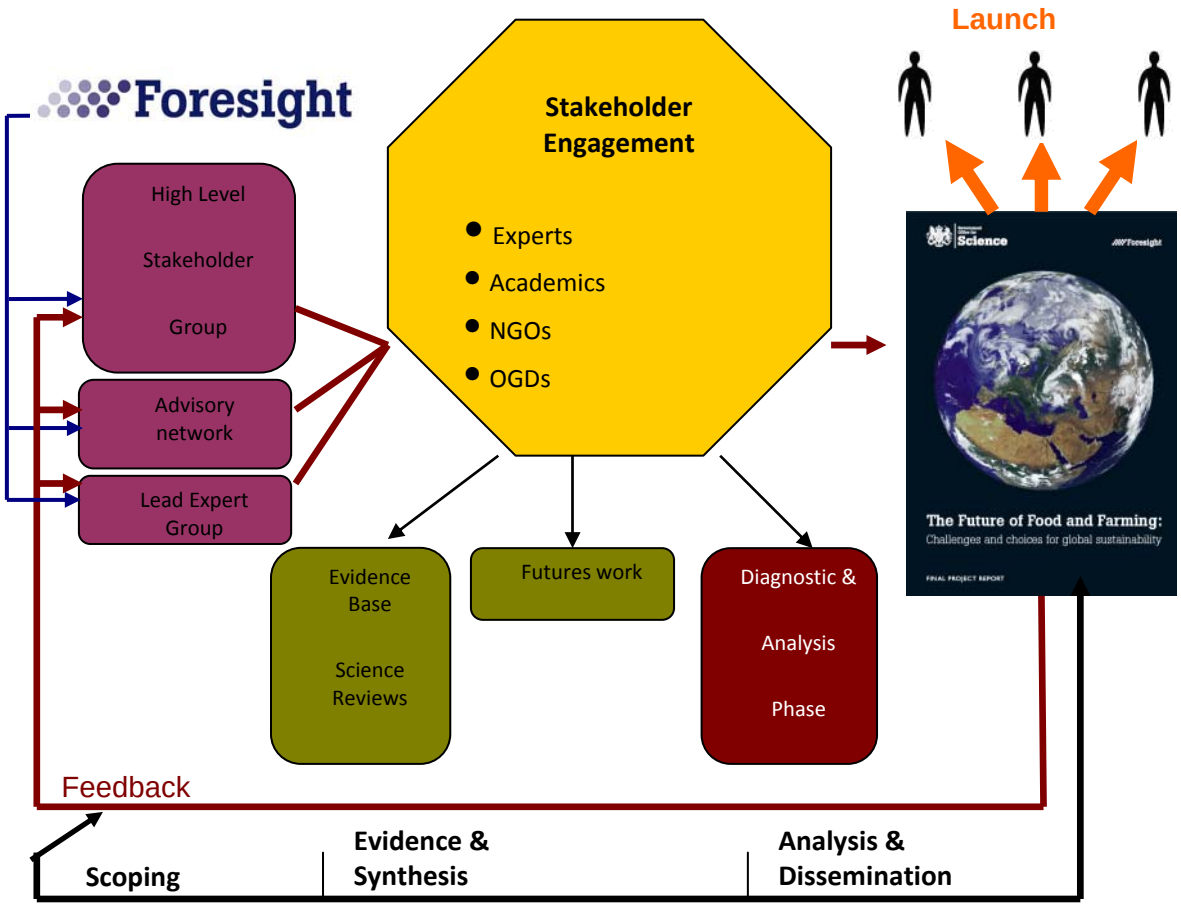

Figure 2.1 Project structure

The overall structure of the report is outlined in Figure 2.1, demonstrating the relationship between the various teams, individuals and committees put in place by the Project. This is a similar process to that undertaken by most Foresight projects, and allows for continual feedback between the contributors to ensure their most effective input.

3 Project Outputs

3.1 Project Report

The Report represented the main body of output from the Project, signifying a synthesis of the evidence reviews, futures work and systems analysis.

The global food system will experience an unprecedented confluence of pressures over the next 40 years. On the demand side, global population size will increase from nearly 7 billion today to 8 billion by 2030, and probably to over 9 billion by 2050; many people are likely to be wealthier, creating demand for a more varied, high-quality diet requiring additional resources to produce. On the production side, competition for land, water and energy will intensify, while the effects of climate change will become increasingly apparent. The need to reduce greenhouse gas emissions and adapt to a changing climate will become imperative. Over this period globalisation will continue, exposing the food system to novel economic and political pressures.

Any one of these pressures ('drivers of change') would present substantial challenges to food security; together they constitute a major threat that requires a strategic reappraisal of how the world is fed. Overall, the Project has identified and analysed five key challenges for the future. Addressing these in a pragmatic way that promotes resilience to shocks and future uncertainties will be vital if major stresses to the food system are to be anticipated and managed. The five challenges are:

A. Balancing future demand and supply sustainably – to ensure that food supplies are affordable.

B. Ensuring that there is adequate stability in food supplies – and protecting the most vulnerable from the volatility that does occur.

C. Achieving global access to food and ending hunger. This recognises that producing enough food in the world so that everyone can *potentially* be fed is not the same thing as ensuring food security for all.

D. Managing the contribution of the food system to the mitigation of climate change.

E. Maintaining biodiversity and ecosystem services while feeding the world.

These last two challenges recognise that food production already dominates much of the global land surface and water bodies, and has a major impact on all the Earth's environmental systems.

Whilst the global food system currently delivers for many, it is currently failing in two major ways, which demand decisive action:

- it is consuming the world's natural resources at an unsustainable rate; and
- it is failing the world's poorest, with almost 1 billion still suffering from hunger.

In view of the current failings in the food system and the considerable challenges ahead, the Report argues for decisive action that needs to take place now. A broader perspective and therefore a *global food system* from production to plate need to be considered by policy-makers.

The Report concludes that interconnected policy making is of critical importance, with policy in other sectors outside the food system also needing to be developed in much closer conjunction with that for food. These areas include energy, water supply, land use, the sea, ecosystem services and biodiversity. Any policy decision needs to be informed by being built on a strong evidence base.

Additionally, action is required simultaneously on four fronts:

- More food needs to be produced sustainably through use of existing technology; this needs more investment in new science and technology and social infrastructure.
- Demand for resource-intensive types of food needs to be contained.
- Waste in the food system should be minimised.
- Political and economic governance of the food system should be improved.

Addressing climate change and achieving sustainability in the global food system need to be recognised as dual imperatives, with nothing less than a redesign of the whole food system being needed to bring sustainability to the fore.

The Report concludes that it is necessary to revitalise moves to end hunger, with food and food production needing to move up the political agenda. Additionally, greater priority should be given to rural development and agriculture as a driver of broad-based income growth.

The Report rejects food self-sufficiency as a viable option for nations to contribute to global food security, but stresses the importance of crafting food system governance to maximise the benefits of globalisation and to ensure that they are distributed fairly.

Through analysing these five challenges and conclusions, the Report identifies the following key priorities for action for policy-makers:

1. Spread best practice.
2. Invest in new knowledge.
3. Make sustainable food production central in development.
4. Work on the assumption there is little new land for agriculture.

5. Ensure long-term sustainability of fish stocks.
6. Promote sustainable intensification.
7. Include the environment in food system economics.
8. Reduce waste – particularly in high- and low-income countries.
9. Improve the evidence base upon which decisions are made and develop metrics to assess progress.
10. Anticipate major issues with water availability for food production.
11. Work to change consumption patterns.
12. Empower citizens.

3.2 Evidence Reviews

The Project's evidence reviews contain a comprehensive set of cutting-edge studies of future developments in science, technology, policy and practice relevant to the challenges facing the global food system. These reviews form part of the independent evidence base of the Project, which sets out to answer the central question of 'how can a future global population of 9 billion people *all* be fed sustainably and healthily?'

The reviews span the natural and social sciences and are authored by leading experts in their fields from across the world. They have been commissioned around the five challenges identified by the project as critical to the food system in 2050: sustainably feeding the world against ever-increasing resource pressure; increasing resilience to cope with a more volatile world; ending hunger; meeting the challenges of a low-emissions world; and feeding the world while maintaining ecosystem services and biodiversity. The reviews cover both current 'state of the art' developments and likely future trends in science, technology, policy and practice.

Driver reviews

To assess specific drivers that may affect future food security, such as soil quality, 22 driver reviews were commissioned. These were reviews of critical drivers of change affecting the global food and farming system, and discuss new developments in the state of the art of science in diverse fields ranging from demographics to climate science to macroeconomics of trade.

Regional reviews

The Report demonstrated the magnitude of the potential global food crisis and set out how the natural and social sciences can contribute to feeding sustainably the world's population, and what this means for UK and broader policy. Seven regional reviews were commissioned to explore the effect of the factors affecting food security in those key regions. These regions were chosen on two criteria:

1. The particular region/country is or will be very important internationally and therefore a case study of this area will inform the project's global analysis (e.g. India, China, North America).

2. The particular region/country is an interesting exemplar that can be used to bear down in greater detail on important issues within the project's scope (e.g. Africa and the Nile catchment and the issue of sharing water across national boundaries; South America and Brazil and the issue of land use for agriculture vs. land use for ecosystem services).

Regions and factors reviews included:

- UK – Sustainably increasing productivity
- China – Investment in agricultural research and development
- Africa – Nile catchment – Transnational water sharing
- India – Determinants of demand for food
- Brazil – Competition for land in the face of increasing food production
- Mekong – Inland fisheries and aquaculture
- Eastern Europe – Production possibilities

State of science reviews

To underline the Project's scientific rigour, and to consider how new science, policies and interventions might best address those future challenges, Foresight commissioned 40 short reviews from leading experts on a number of key topics considered as vital to an understanding of future developments in science, technology, techniques, policies and practices relevant to the global food system. These were published in leading journals: *Food Policy*, *Journal of Agricultural Science*, *International Journal of Agricultural Sustainability* and *World Development.*

Food Policy

Foresight commissioned the publication of a set of reviews in a supplement called 'The Challenge of Global Food Sustainability' in the journal *Food Policy.* These reviews focused on issues other than production per se and have contributed towards the evidence base that underlies the exploration of the policy options to address these challenges, and the authors are drawn from a broad range of disciplines.

Journal of Agricultural Science

To explore three of the five challenges identified by the project as critical to the food system in 2050 – sustainably feeding the world against ever-increasing resource pressure; meeting the challenges of a low-emissions world; and feeding the world while maintaining ecosystem services and biodiversity – Foresight commissioned a special issue within the *Journal of Agricultural Science* titled 'The Future of Sustainable Production in Global Food and Farming'.

They covered both current 'state of the science' developments and likely future trends in science, technology, policy and practice, spanning the natural and social sciences, and were authored by leading experts in their fields from across the world. This issue contained a comprehensive set of cutting-edge reviews of future developments in science, technology, policies and practices relevant to the challenges facing the global food system in relation to sustainable production.

Sustainable Intensification in Africa

To explore the impact of sustainable intensification in African countries, GFFF commissioned analyses of 40 projects and programmes in 20 countries where sustainable intensification has been developed during the 1990s–2000s. The cases included crop improvements, agroforestry and soil conservation, conservation agriculture, integrated pest management, horticulture, livestock and fodder crops, aquaculture, and novel policies and partnerships. This led to the publication of the 'Sustainable Intensification: increasing productivity in African food and agricultural systems' report, consisting of 29 reviews containing examples of sustainable intensification-related programmes throughout Africa. These reviews were then published in the *International Journal of Agricultural Sustainability.*

'100 Questions'

In order to produce a framework to guide policy support and priorities for agricultural research programmes in coming years, the Project compiled a list of 100 key questions, which led to the production of the 100 questions paper. The objective of the top 100 questions, if addressed, was to lead to a significant impact on global agricultural practices worldwide, while improving the synergy between agricultural policy, practice and research. In order to meet this objective, a collaborative and inclusive horizon-scanning approach was deployed, designed to maximise openness to different perspectives, democracy in consolidating these perspectives, and scientific rigour. The paper, titled 'The Top 100 Questions of Importance to the Future of Global Agriculture', by Pretty et al. (2010)[1], was published in the journal *International Journal of Agricultural Sustainability.*

3.3 Synthesis reports

Thirteen synthesis reports were grouped around the five key future challenges identified by the Report and provide detailed analysis around the Project's robust scientific evidence base. These reports aimed to assess and address the following challenges:

A: Sustainable Supply and Demand

B: Volatility

[1] PRETTY, J; SUTHERLAND, W. J.; ASHBY, J; AUBURN, J; BAULCOMBE, D; BELL, M; BENTLEY, J; BICKERSTETH, S; BROWN, K; BURKE, J; CAMPBELL, H; CHEN, K; CROWLEY, E; CRUTE, I; DOBBELAERE, D; EDWARDS-JONES, G; FUNES-MONZOTE, F; GODFRAY, H. C. J.; GRIFFON, M; GYPMANTISIRI, P; HADDAD, L; HALAVATAU, S; HERREN, H; HOLDERNESS, M; IZAC, A-M; JONES, M; KOOHAFKAN, P; LAL, R; LANG, T; MCNEELY, J; MUELLER, A; NISBETT, N; NOBLE, A; PINGALI, P; PINTO, Y; RABBINGE, R; RAVINDRANATH, N. H.; ROLA, A; ROLING, N; SAGE, C; SETTLE, W; SHA, J. M.; SHIMING, L; SIMONS, T; SMITH, P; STRZEPECK, K; SWAINE, H; TERRY, E; TOMICH, T. P.; TOULMIN, C; TRIGO, E; TWOMLOW, S; VIS, J. K; WILSON, J; PILGRIM, S. 2010. The top 100 questions of importance to the future of global agriculture. *International Journal of Agricultural Sustainability*, Volume 8 (4), pp. 219-236(18)

C: Hunger

D: Climate Change Mitigation

E: Maintaining Biodiversity

3.4 Modelling

As with all Foresight projects, the Project included an exploration of future uncertainty. The principal futures technique used in the Project was through commissioning new food system modelling as well as a review of existing studies. Foresight has convened three international meetings of modellers to review existing global agricultural models and links to climate modelling.

4 Impact

4.1 Government Departments and Agencies

4.1.1 Department for Environment, Food and Rural Affairs (Defra)

The Foresight report presented a compelling case for concerted action on the future of food. Defra is building on the strong evidence and analysis underpinning the report and taking action at all levels: internationally, within the EU and nationally. Defra's food security agenda includes action on food resilience and access to global markets. It recognises the links to climate change and biodiversity, managing ecosystems and demand for resources such as water and energy.

Working internationally

Active engagement on the global stage, by the Secretary of State and others, has been essential in promoting Foresight evidence. We use this evidence to support action to open up global markets, to manage volatility of food prices, to combat and adapt to the challenges posed by climate change, to protect the world's resources and biodiversity, and to embed sustainable practices in agricultural production.

In preparation for Rio +20 Defra is leading efforts across government, industry and civil society to ensure that food security and sustainable agriculture are high on the agenda. Our aim at Rio +20 is to push for an integrated approach to environmentally sustainable agriculture, including promotion of sustainable agricultural intensification and 'climate smart' agriculture; seeking to reduce post-harvest losses and other waste in the food chain; and improved research and investment to improve development and deployment of sustainable technologies and practices. We are also pressing for new global goals to drive international action on major global challenges. Food security and sustainable agriculture is a good example of where a more integrated approach is needed. Following the success of the UK Food Security Assessment, Defra is also working to establish better global indicators of food security.

At the **G20 Agriculture Ministers meeting** in June 2011 the Secretary of State was instrumental in the agreement of an Action Plan creating the Agricultural Market Information System. This System will share market data on commodity prices, with the aim of reducing food price volatility. The meeting focused on the importance of a long-term production response, as well as effective short-term confidence-boosting measures to avoid volatility. It included actions on analysis of biofuels mandates, research to improve production in developing countries and work on mitigation of climate change and greenhouse gas (GHG) emissions.

This year the **Mexican G20 Presidency** has identified food security as a priority, and will ensure compliance with the commitments set out in the Cannes Declaration; the Action Plan on Food Price Volatility and Agriculture; and the Seoul multi-year action plan on food security. They will also generate consensus on new specific initiatives that can help increase world agricultural productivity, with emphasis on smallholders.

In Durban at the United Nations Climate Change Conference in December 2011 Defra played a key role in actively pushing for consensus that the 2012 Conference should consider reaching an agreement on sustainable agriculture and climate change.

Biodiversity: Defra is identifying those species for which targeted conservation action will deliver a broad range of consequential benefits, including for ecosystem services. The UK is playing a leading role establishing the Intergovernmental Platform of Biodiversity and Ecosystem Services (IPBES). IPBES will enhance the scientific evidence base for international biodiversity decision taking and improve the state of knowledge in relation to the links between biodiversity and the provision of ecosystem services.

International collaboration: Defra and DfID are working with the Chinese Ministry of Agriculture on agricultural research, working closely through the UK–China Sustainable Agriculture Innovation Network (SAIN) to stimulate innovative thinking and research on all aspects of environmentally sustainable agriculture and its relation to the local, national and global economy. Defra is also proactively involved with the development of the Global Research Alliance on agricultural GHG emissions, and UK researchers are engaging with their counterparts from over 30 countries worldwide, sharing knowledge and technology to address these highly complex global challenges.

Working with the EU

Collaboration: Defra is working with other Member States to ensure the best outcomes for policies on food security. In 2011 the UK and the Netherlands agreed to a partnership on sustainable food. Both countries are using this opportunity to share best practice, and policy cooperation has already delivered benefits in work on palm oil and waste. A food waste workshop involving the two countries and Sweden was held in December 2011, which helped build on the success of the UK in reducing and remodelling packaging and reducing food waste.

Defra engaged with other Member States when it chaired a session on food waste at the Sustainable Agri-Food Conference in Madrid during 2011, resulting in an agreement that the issue of food wastage in the global food chain needs to be addressed as part of a sustainable agri-food sector. The UK also co-leads with France an EU Joint Programming Initiative on Agriculture, Food Security and Climate Change (JPI-FACCE). Over 20 European countries are working to align their national research programmes and encourage collaborative research on food security, adapting agricultural systems to climate change and mitigating the impact of greenhouse gas emissions.

Common Agricultural Policy (CAP) negotiations: The UK wants to see a reformed CAP that provides better value for money by encouraging improved productivity and innovation in the agriculture sector. A reformed CAP should provide public goods, especially natural environment measures and climate mitigation, which will help increase long-term food production across the EU. To achieve this, Defra is trying to help farmers reduce their dependence on direct payments (income support), and will negotiate for measures that help the industry become more competitive and market orientated.

Common Fisheries Policy (CFP): The UK is committed to fundamental reform of the CFP to achieve healthy fish stocks, a prosperous fishing industry and a healthy marine environment. Defra believe that a reformed CFP must be underpinned by robust science and should integrate fisheries management with other marine environmental policies, so that fishing is not treated in isolation from other marine uses.

Work in the UK

Defra recognises that the UK has a responsibility to play its part in tackling the Foresight challenges. That is why we are leading the way with our Climate Change Risk Assessment, and our Natural Environment White Paper. We are examining the practicalities of sustainable intensification through our Green Food Project, continuing to tackle waste in our food systems and using our expertise in research and development to find appropriate solutions. It is through effective competition and growth that the food chain will rise to the challenge of feeding a rising population sustainably; we are working to provide the skills and environment to facilitate this.

Natural Environment White Paper (NEWP)

The UK Government published a Natural Environment White Paper in June 2011 setting out plans for the natural environment and biodiversity for the next 50 years. It is part of Defra's recognition of the role the natural environment plays in securing our future, including that of food security. Following publication of the NEWP, Defra has played a significant role in establishing a global indicator framework for biodiversity. This indicator framework will track progress on the new strategic plan for biodiversity reached at Nagoya. In response to this England has already published its own biodiversity plan, which will be presented to the 11th Conference of Parties to the Convention on Biological Diversity in October 2012 in Hyderabad, India.

Sustainable agriculture

Green Food Project: Resulting from the NEWP commitment to examine how we might increase food production in England, whilst simultaneously enhancing the environment, this project examines how we might address the sustainable intensification of agriculture and how we might reconcile any tensions that this challenge poses. Due to publish its conclusions in summer 2012, the project will be used to shape future Defra food and farming policy, and the way in which we contribute to the global debate on food security.

Similarly, aquaculture can play an important role in global food security. In 2011 the aquaculture industry in England developed (with Defra support), a consultation looking at the potential for growth in English aquaculture. Defra launched this consultation, on behalf of the industry, in early 2012 and will continue to provide support to the industry in developing any subsequent proposals.

Skills development: We recognise that skills are essential to improve competitiveness in the farming industry and to meet the challenges of sustainable intensification. Defra is working with the industry-led Agri-Skills Forum to promote lifelong learning and skills development as part of normal farming business activities. Activities the Forum is addressing include support for continuing professional development to provide both the infrastructure and the impetus to increase professionalism along with technical and business skills. Defra facilitated the industry-led Food Supply Chain Skills Action Plan: Feed Your Ambition. This is an example of industry from across the food chain working together with the Sector Skills Councils, and includes commitments on building pre-employment skills to supply an industry-ready pool of people, providing career information to promote the industry to new entrants, and creating apprenticeships.

Climate change

The **Climate Change Risk Assessment**, independent analysis funded by Defra, is new research looking at a range of potential future scenarios and their potential impact on the UK. A National Adaptation Plan is due to be published in 2013.

Within the EU Defra actively participates in the EU Climate Change Adaptation Strategy (2013) work, which will be used to influence policies such as the next multi-annual financial framework (2014–2020) and CAP reform. We continue to work with the FCO, DfID and DECC on cross-government activity on the security, political, development and economic views of climate impacts, which includes food.

Water is identified by Foresight as the resource most under pressure in the predicted future of increasing competition for limited resources putting pressure on future food security. Defra continues to work within the UK to ensure a **sustainable water system** in this country, and published a Water White Paper in December 2011. Defra is leading a project reviewing the way UK water policy can best be used internationally, to ensure that water resources are used in the most sustainable way.

The Government will publish its bioenergy strategy shortly, which will set out our approach for ensuring the expansion of bioenergy proceeds sustainably, including in respect of its impact on food production and prices.

Sustainable consumption and waste

Government Buying Standards (GBS): Introduced by Defra for food and catering services in June 2011, GBS will help ensure that food procured by government departments meets sustainable standards of production, for

example a mandatory requirement for 100 per cent sustainably sourced fish and that 10 per cent of produce meets higher environmental standards.

In December 2011, the Defra-sponsored Waste and Resources Action Programme (WRAP) published results covering the first year (2009–2010) of Courtauld Phase 2, a responsibility deal between UK central and devolved governments and grocery manufacturers and retailers. It includes targets to **reduce UK household food and drink waste** by 4 per cent and reduce product and packaging waste in the grocery supply chain by 5 per cent by the end of 2012, as well as a commitment to reduce the carbon impact of grocery packaging by 10 per cent. WRAP, all four UK administrations and the hospitality and food service sector (which includes restaurants, hotels, pubs and canteens) are working together to develop a new voluntary agreement. This aims to reduce food and packaging waste and manage the waste that does arise more sustainably.

Where food waste cannot be avoided or re-used, we must deal with it in the best way possible. Defra published in June 2011 an Anaerobic Digestion Strategy and Action Plan. This sets out Defra's aim of removing the barriers to increasing energy produced from food and other wastes through anaerobic digestion. Defra has set up a steering group with industry to monitor implementation of the plan.

Research and development

R&D and innovation play a key role in addressing the Foresight actions by providing the tools and knowledge for crop genetic improvement, integrated management of pests and disease, sustainable and resource-efficient farming, and supply chain systems to drive competitiveness, optimise and increase outputs whilst reducing GHG emissions and other environmental impacts.

Defra recently reviewed the UK Food Security Assessment, which looks at six key indicators for the UK's food security, both global and national. This showed that the UK's supply chain was resilient. The government continues to work with industry on resilience planning, including leading a sub-group of the Food Research Partnership looking at resilience and commissioning research in a number of areas, e.g. energy dependency.

Defra and the devolved administrations are funding a £12.6 million R&D Platform to measure more precisely GHG emissions from UK farming systems and identify key mitigation options for the industry to focus on. The Demonstration Test Catchments project is working with farmers to develop and demonstrate improved farming methods with reduced impacts on water resources. R&D funded in collaboration with industry through the £90 million Sustainable Agriculture and Food Platform, led by the Technology Strategy Board, is stimulating technology and informing knowledge to increase food productivity, whilst decreasing the environmental impact of the agri-food sector.

Defra works in partnership with other funders, industry and the research community to deliver a coordinated framework for research and innovation set out by the government's Chief Scientific Advisor to address the Foresight challenges. It does this through joint research initiatives including the Global Food Security Programme and the Living with Environmental Change programme, and at an EU level through the EU research Framework Programme, European Research Area-Networks, and Joint Programming Initiatives.

In June 2011 Defra released its policy on genetic modification (GM), which recognises that GM technology could deliver benefits provided it is used safely and responsibly, in particular as one of a range of tools to address the longer-term challenges of global food security, climate change and the need for more sustainable agricultural production.

4.1.2 Department for International Development (DfID)

DfID achievements with reference to the Action Plan were agreed following publication of the Foresight Report on the Global Future of Food and Farming in January 2011.

DfID committed itself to:

- support the work of the G20 to improve global food security and mitigate the impact of food price volatility on poor people in developing countries;
- promote a more effective approach to global food security by national governments and international organisations, based on a strengthened evidence base that makes the links with climate change, poverty, biodiversity, energy and other policies;
- strengthen international public policy by conducting a series of systematic reviews of evidence linking agriculture, economic growth, hunger and nutrition with climate change.

In June 2011 at the meeting in Paris, the UK joined other G20 Agriculture Ministers in committing to increase agricultural production and productivity on a sustainable basis. It requires improvements in land and water management, improved agricultural technologies, an appropriate and enabling environment that could lead to increased investments, notably from the private sector, well-functioning markets and means to mitigate and manage risks associated with excessive price volatility of agricultural commodities. This was endorsed at the Cannes G20 summit in November 2011.

DfID has commissioned a number of Systematic Reviews that have examined in detail some key areas to strengthen the evidence base for DfID policy and practice linking climate change, hunger, poverty, biodiversity and energy. Those completed to date include:

- What is the evidence of the impact of agricultural trade liberalisation on food security in developing countries?
- A systematic review of agricultural interventions that aim to improve nutritional status of children.
- The effectiveness of micro-insurance in helping smallholders manage weather-related risks.
- What are the projected impacts of climate change on food crop productivity in Africa and South Asia?
- How effective are cash transfer programmes at improving nutritional status?: a systematic review of programmes' effects on anthropometric outcomes.
- Is the use of renewable natural resources in the developing world more or less sustainable, pro-poor and profitable under controlled access than open access?

3IE, the International Initiative for impact Evaluation, has also undertaken Systematic Reviews on behalf of DfID on the effectiveness of extension and technology transfer systems and on land rights. These were:

- Under what circumstances does adoption of technology result in increased agricultural productivity?
- Does strengthening land property rights for poor people in low-income countries lead to increased productivity gains?

Funding from the **DFID Policy Research Fund** under the Research and Evidence Department has been used to support the following relevant research:

- Climate Change, Agriculture and Food Security through University of Vermont, the Overseas Development Institute and International Institute for Environment and Development
- Assess adaptive and indigenous innovations and their respective impacts on economic development, including job creation, which is still under development and to be submitted.
- Develop a joined-up approach to addressing nutrition that includes health and agriculture inputs and is based on strengthened evidence. This will include continued investment in the development of bio-fortified crops, crops that have higher levels of essential micro-nutrients.

DfID has scaled up its investment in the development and promotion of bio-fortified crops by the Consultative Group on International Agricultural Research (CGIAR), Harvest Plus and the African Agriculture Technology Foundation. Release of new bio-fortified food crops to farmers in three countries by the end of 2012/13 (vitamin A maize in Zambia in 2012/13; high-iron beans in Rwanda in 2012; high-iron pearl millet in India in 2012).

DfID has hired a Senior Nutrition Specialist from the London School of Hygiene and Tropical Medicine to strengthen its work on agriculture, nutrition and health. This work will concentrate on supporting a mapping exercise to review evidence linking nutrition and health outcomes and a basis for new programming in this area.

DfID also supported the January 2011 **IFPRI** (International Food Policy Research Institute) Conference in Delhi, India, 'Leveraging Agriculture for Nutrition and Health', with $200,000 funding.

DfID will continue to support increasing agriculture growth rates in the face of resource scarcity by addressing the yield gap and developing new technology. Annual agriculture productivity is increased, contributing to faster economic growth and poverty reduction. This will include:

- Investing in the development of new agriculture products (crop and livestock varieties, farming systems) which will be more resilient to climate change, less dependent on external inputs and more productive. This will lead to increased productivity of major cereals such as rice, wheat and maize to sustainably meet the food needs of growing populations, through better pest, drought and flood resistance and tolerance to salinity, by integrating research in molecular biology and plant breeding.

- Through the core funding to the CGIAR, the UK has continued support for major new research programmes to boost the productivity and tolerance of staple crops(rice, wheat, maize, cassava, sorghum) and livestock, the resilience, productivity and efficiency of farming systems and the profitability and accessibility of value chains for smallholders. DfID has initiated two research programmes addressing biotic and abiotic stress in staple crops by developing collaborative research that links UK research institutions with developing-country partners. DfID will continue to develop and strengthen our links with the private sector.

- Improved institutional arrangements to develop and adapt innovations that improve incentives, to assess and improve the competitiveness of the poor, and to improve input and output markets suited to small-scale agricultural production.

- Expansion of its support to innovation by (1) reviewing the evidence through four systematic reviews, (2) improving the evaluation of innovation pilots though the application of more rigorous methodology including randomised control trial (RCT) approaches to establishing why technology is adopted; (3) funding large-scale pilots to assess the effectiveness of new institutional models that can successfully link smallholders to markets and stimulate rapid technological innovation.

- Continued support for international efforts to increase domestic investment in agriculture and food security in Africa. We will support the

implementation of the AU Comprehensive African Agriculture Development Programmes.

- Strong support for the implementation of the Comprehensive Africa Agriculture Development Programme (CAADP) of the New Partnership for Africa's Development (NEPAD) and the African Union. DfID is supporting the CAADP process through a £10 million grant to a multi-donor trust fund with the World Bank, which facilitates the implementation of CAADP. Britain routinely discusses factors affecting economic growth and food security with partner governments in Africa. UK government officials also participate in twice-yearly meetings of the CAADP. DfID uses these meetings, and its country-level work, to review the programme with the African Union and Member States and urge progress towards the Maputo productivity and expenditure targets.
- Improved evidence and understanding of agricultural systems in diverse and vulnerable systems that leads to interventions to reduce vulnerability to shocks and trends for smallholders, both men and women.
- A 2011 discussion paper was produced on ‘Protecting Gains, Minimising Losses: Putting Resilience at the Heart of DfID’s Development Work’, building in particular on the prior work in Resilience undertaken by CHASE and setting it in a development context.
- This paper concludes by saying: ‘The Increasing effects of climate change, population growth, the expansion of cities and the likelihood of future natural resource scarcity and food price volatility means that development gains are almost certain to face major challenges in the future. Without a focus on building resilience, DFID could be wasting money on development gains that are reversed by the first shock’.

4.1.3 Department for Energy and Climate Change (DECC)

DECC’s main interest in the Report was from the point of view of the broader message on climate change and the risks to agricultural production in the future. It is important for DECC to understand the risks of climate change better and to use this understanding to communicate the need for mitigation action. The main value to DECC, therefore, is the fact that the report provides further evidence that it is worth taking strong action to mitigate climate change.

The report has been a helpful reference in DECC’s interest in exploring the nexus between bioenergy and food security.

4.1.4 Food Standards Authority (FSA)

The FSA is a non-ministerial department responsible for food safety across the UK, and for healthy eating in Scotland and Northern Ireland. The Report did not focus specifically on food safety or include detailed analysis of this aspect of the food system, although it does highlight (as a result of our input) the importance of considering food safety and other aspects of the food system in a coherent, joined-up manner (which is welcome).

Given this, the Report has not provided detailed insights for our immediate, day-to-day priorities on food safety, but its detailed and extensive analysis of the wider food system does provide a wealth of context for our strategic thinking about the wider context of this work, in general and in relation to sustainable development. The Report has also been useful in providing detailed context and analysis for the cross-government initiatives in which we are playing a part, not least the Global Food Security Partnership and the Food Research Group/Food Research Partnership. The FSA also thinks that the key messages of the report, backed up by the detailed evidence, have been helpful in promoting UK priorities in this area in the Commission's planning for the EU's next research programme, Horizon 2020. The FSA has drawn the Report to the attention of its Board, the General Advisory Committee on Science, and to its planning teams.

The FSA's involvement in the Project and its *Project Advisory Group* (PAG) was very helpful in building its understanding of this wider context and our awareness of issues, expertise, evidence and contacts in other departments and in the wider expert community.

4.1.5 Environment Agency (EA)

To date it is probably fair to say that the report has not specifically influenced the EA's work, but has raised awareness of the issues. The EA is certainly aware of land and water issues around sustainable intensification and works hard to balance the needs of different stakeholders around land use for food production and other environmental and people considerations, particularly flood risk management.

4.2 Devolved Administrations

4.2.1 Welsh Government

The Report has influenced the Welsh Government in its producing a new strategy for food, *Food for Wales, Food from Wales 2010:2020: A Food Strategy for Wales*. The Welsh Government's strategy aims to develop the food production and processing industry in Wales and it takes account of the often conflicting pressures of food production, sustainable farming, environmental factors, community development and creating sustainable food businesses and food chains.

The strategy is for up to 2020 and sets matters out in broad-brush terms. More detailed work to create a delivery plan is under way. All of this is overseen by a group of advisers, the Food and Farming Advisory Panel, who are drawn from the food and farming industries and are external to the Welsh Government. The Panel will provide on-going advice to the Welsh Government on policy as the strategy is taken forward.

Foresight will undoubtedly influence the Welsh Government's response to CAP reform and it will also shape the next *Rural Development Plan for Wales*. The Welsh Government's policies will of course be dictated by the scope of the European regulations for these matters, which have not been finalised. However, when proposals are drawn up they will make use of Foresight when shaping policy options and making decisions. In the run-up to this work Foresight is already having some influence in that the Welsh Government is aware of the need to balance a need to increase food production with environmental sustainability and to take account of climate change. The Welsh Government is working with the Countryside Council for Wales on a study to explore the concept of sustainable intensification on behalf of the UK Land Use Policy Group. The study will be based on surveys with farmers and will attempt to provide evidence, using farm-level case studies, of environmental and production gains occurring in situations where farm management is consistent with a ‘sustainable intensification approach’.

Finally, the Welsh Government is under a legal duty (Government of Wales Act 2006) to promote sustainable development in terms of how it exercises its functions. Foresight may influence the Welsh Government's proposals to legislate further on sustainable development to make it central to all activities and decisions of the Welsh Government and public bodies in Wales and also for its proposals to create an independent sustainable development body for Wales, which will bring together the Environment Agency (Wales), the Forestry Commission (Wales) and the Countryside Council for Wales. Currently it is planned to introduce a Bill to the National Assembly for Wales in autumn 2013.

4.2.2 Department of Agriculture and Rural Development, Northern Ireland (DARD)

The Report has had a considerable impact on policy development and strategic thinking within DARD. The Report highlights the important challenges facing food production and the global food system in the next few decades. While globally relevant, the report underlines the challenge for the Northern Ireland farming and food industry in making the most productive use of its natural resources. In particular, the report highlights the need for food production to become more sustainable, whilst adapting to the effects of climate change and contributing to climate change mitigation.

In relation to impacts on policy development, the GFFF Report reinforced a number of key messages within our overall food strategy *Focus on Food,* which was jointly developed with industry and published in June 2010. Recommendations from the GFFF Report also had an influence on the decision of the Department to create a new Food Strategy Board (currently being established), which aims to develop the *Focus on Food* strategy into a longer-term strategic vision for the agri-food sector.

The concept of sustainable intensification, which was a key recommendation of the report, has also been taken into consideration in the development of a greenhouse gas reduction strategy and action plan for the agri-food sector in Northern Ireland. This strategy and action plan, which was developed in partnership with the main agriculture, food and forestry stakeholders, including DARD, aims to promote and encourage improved technical efficiency as a means of reducing costs whilst lowering greenhouse gas emissions per unit of food produced.

4.3 Research and Academia

4.3.1 Biotechnology and Biological Sciences Research Council (BBSRC)

The Report has continued to help inform the development of BBSRC's activities relevant to food security – one of its three strategic research priorities – within and beyond the UK's multi-agency Global Food Security programme, which the Council leads. BBSRC's new Food Security Strategy Advisory Panel includes representation from the Project's Lead Expert Group.

BBSRC has taken forward a variety of activities reflecting aspects of the Report's findings. With the US National Science Foundation, the Council has funded innovative, multidisciplinary research to enhance the efficiency of photosynthesis – 'high-risk, high-reward' science with the potential, if successful, to underpin a step change in crop productivity. A similar approach is being explored for other research topics with the potential to make a major impact on food production.

Other international activities include a major programme of crop research for developing countries, led by BBSRC and supported jointly with DfID, the Bill and Melinda Gates Foundation and the Government of India. The Council is also pursuing opportunities for bilateral activities in animal health and crop science with India's Department of Biotechnology.

To address skills needs for food security, BBSRC has provided funding for four *Advanced Training Partnerships*. These are innovative collaborations between users and providers of high-level scientific and technical skills that bring together agri-food businesses in consortia with research and training organisations. In addition, the Council's principal support for postgraduate research training has been aligned more closely with its food security and other strategic priorities through new Doctoral Training Partnerships.

BBSRC is reviewing its roles in support of aquaculture and horticulture, and has recently announced a call for collaborative research with industry on horticulture and potatoes. The scope for collaborative activity with the animal health industry is also being explored.

Global Food Security programme

The Report was timely and informative, and the Global Food Security (GFS) partners welcome its findings. The Report provided detailed context and analysis on the global food system and this has helped shape strategic thinking in a number of key GFS areas such as resilience, resource efficiency, sustainable production and sustainable healthy diets. The GFS programme is taking forward activities in these areas, as well as in other important areas not covered in detail by the Report, such as food safety.

The GFS programme has a key role to play in providing research and evidence to help address some of the recommendations from the Report. In June 2011, a joint GFS–Foresight workshop was held, focused on a paper produced as part of the report by Pretty *et al.* entitled 'The Top 100 Questions of Importance to the Future of Global Agriculture'.

The workshop brought together a sub-set of the Project's Lead Expert Group (LEG), a number of key stakeholders and the GFS Programme Coordination Group, with the aim of prioritising one question per GFS programme theme to be tackled first. The outputs from this joint workshop have informed the programme's initial set of priorities, and these are currently being taken forward. The four theme areas and questions are:

1. *Economic Resilience*: global food systems and UK food imports; resilience, safety and security (public policy seminar brief);
2. *Resource Efficiency Priorities*: improving input-use efficiency in agricultural systems; reducing waste across the food system (cross-cutting);
3. *Sustainable Production and Supply*: nitrogen supply and use-efficiency (with theme 2); biotic stresses of crops and livestock; agri-ecosystems;
4. *Sustainable, Healthy, Safe Diets Priorities*: defining a sustainable healthy diet; microbiological food safety.

The LEG Chair, Professor Charles Godfray, chaired the GFS–Foresight workshop and is now a member of the GFS Strategy Advisory Board. This appointment ensures the findings from the report continue to feed into BBSRC's strategic thinking.

4.3.2 European Union Joint Research Centre (JRC)

The Report has been welcomed by the JRC as a timely piece of research; it has been instrumental in drawing the JRC's attention to a host of issues associated with global food security. Together with other reports and studies, the Report has also contributed to the generation of a high level of interest in this topic from several Commission services. The material the Report contains is extremely well documented, highly readable and well organised and adds considerably to current knowledge. The five 'key challenges for the future' in particular succinctly summarise the messages of the report on the key issues for policy-makers.

The Report has underlined the fact that the global food security equation is very complex and involves many different actors; some would argue that, in its global dimension, it is close to being intractable. Its resolution will require not only more concerted action across policy domains – as recommended by the Report – but also the development of a keener sense of priorities. Indeed, the challenges raised by any attempt to combine sufficient production for a population of 9–10 billion with equity of access to such production and with the maintenance of the quality of the environment need to be addressed by a

clear set of priorities. The Report will help the Commission services to make choices about where the EU could put its efforts in order to have the greatest impact on the global food situation (e.g. short- or long-term horizon, geographical focus, innovation or implementation, clusters versus individual issues, economics along scales, enabling environment, stability versus adaptation, resilience, parts of food chain). Together with other sources of knowledge, the Report provides valuable material for embarking upon such a prioritisation exercise and the JRC counts on continuing cooperation with UK Foresight on those issues.

The Director-General, JRC, will follow up the Food Security Conferences of 2011 by expanding its activities related to this topic. Among these, a food security foresight study will be launched in 2012 to be finalised in 2014.

The JRC's foresight on food security will be oriented towards the identification of critical issues on which the EU can take significant action and efficiently intervene in the global food availability context. For this work, review of major outcomes of relevant studies on food security will be essential to identify those areas that could be positively influenced through European action (key priorities). The Report has been instrumental in identifying key challenges associated with global food security up to 2050. The importance given by the report to interconnected policy analysis is especially relevant to the JRC's policy support objectives.

The Report's emphasis on the new knowledge required for making food production systems of the future more sustainable is also most welcome. Currently there is a high level of interest given to food security amongst several Commission departments, notably in the context of the emerging Green Economy. The Report provides several valuable insights for debating the next steps at the EU level.

4.3.3 Defra Food and Environment Research Agency (Fera)

For Fera, as an agency of Defra, a main responsibility is to provide evidence in support of plant health for the UK and the EU. Traditionally, the UK plant health policy mindset has been mainly UK-centric; for example looking to protect against quarantine organisms at borders rather than at source. However, Fera has increasingly recognised the increased vulnerability of the UK and Europe from pests originating from ‘overseas’ due to greater import trade, especially from developing countries that lack effective plant health and crop pest surveillance systems, and the need to influence global plant health systems. Recent examples include the new variant of Black Stem Rust of Wheat (Ug99) originating in Uganda and spreading through the wheat belts of Asia, and Cassava Brown Streak Disease (CBSD) on cassava in East Africa, which, though cassava is not a food crop of the UK, may destabilise food chains beyond the immediate affected areas. The greater connectivity of food chains was evident with the food spike of 2007/8, and points to the need to secure food globally. The Project [and the Foresight project before on

infectious diseases (2006)] exemplified the one-world challenge around plant health and crop pest threats, especially outbreaks as shock events, and provided institutes such as Fera with greater leverage to communicate the need for address.

As part of the action taken by Fera that can be attributed to the Foresight projects, Fera convened a side event, entitled 'Crop Pest Outbreak: Prevention Better than Cure', at the Forum for Agricultural Research for Africa (FARA) 5th Assembly in Ouagadougou, Burkina Faso, alongside the GFFF team, which also and independently staged a stakeholder dialogue at this event. From the Fera side event theme, support was realised from the Food and Agriculture Organization, the European Food Standards Authority, the EU's European Phytosanitary Research Co-ordination, DfID and the Standards and Trade Development Facility amongst others and recommendations were tabled to the main forum for further consideration. The FARA Assemblies are apex events for Africa.

A second thread to Fera's approach on plant health has been to talk more with the private sector about potential roles that may be played in pest surveillance, noting that many of the major agricultural and food multinationals have a unique global outreach and potential for extension services. Again GFFF has given impetus to that approach. To this end, Fera convened a *Sustainable Dialogue Workshop* before Christmas, funded by and focused on the private sector, which gave play to the Report and the aspiration of agricultural intensification.

There has not been a 'eureka moment' with respect to addressing pest outbreaks with greater priority; and, as evidenced with CBSD and new outbreaks in Rwanda, Burundi and the Democratic Republic of Congo, fragile states that remain particularly vulnerable, much remains to be done. However, as a catalyst of change, of transition, the rhetoric and scale of the Project's thinking has provided a challenge and has provided the motivation to venture new ideas on how plant health can be shaped globally for a more secure one-world outcome. The threat and impact of crop pest outbreaks relates across the UK government, from Defra and plant health, to DfID and international development, to the Ministry of Defence and bioterrorism.

4.3.4 National Institute for Agricultural Research (INRA)

Both the Report The Future of Food and Farming: Challenges and choices for global sustainability and France's INRA-CIRAD Agrimonde Foresight Study Scenarios and Challenges for Feeding the World in 2050 make clear that meeting the food challenge in the decades to come will require significant investment in agriculture, including investments in agricultural research. The UK analysis concludes that more food needs to be produced from existing cultivated land by increasing yields using sustainable practices and systems, the so-called 'sustainable intensification' of agriculture. This conclusion is very similar to the one drawn from the second Agrimonde scenario but differs in

two main respects: the required increase in yields is much more modest thanks to decreases in both food consumption in excess, and shares of animal products in diets for richer countries and households. The second phase of the Agrimonde foresight project was launched at the beginning of this year (2012). It will be centred on the question of alternative land uses and agricultural land productivity in connection with the global food security issue. The Report was also a very valuable inspiration for INRA researchers, who develop programmes on price volatility, its determinants and its possible regulation. In a more general way, the insights of both the Agrimonde analysis and the Project, as well as those of similar exercises, help INRA think about its research priorities, targeted on impact and innovation; the sustainable intensification of agricultural and sustainable food systems as well as their resilience to climate change and other global changes are key issues.

4.3.5 Brazilian Agricultural Research Corporation (Embrapa)

The Report contributed to enhancing Embrapa´s efforts to play a leading role in the development of technologies and innovations for the sustainable production of food, fibres and bioenergy in the tropics. It corroborated various elements of Embrapa´s research agenda and the relevance it assigns to increasing sustainable agricultural productivity, addressing environmental challenges and using cutting-edge knowledge such as biotechnology, nanotechnology and genetic modification of living organisms to tackle pressing agricultural problems. In addition, it created a good opportunity for the wide dissemination of the results from the study *Productive Capacity of Brazilian Agriculture: A long-term perspective*, which was commissioned from Embrapa by the UK Government Office for Science as a collaboration with the Foresight Project. The main elements of this study were presented at the annual conference of the Brazilian Society of Agricultural Economics, Rural Administration and Sociology (SOBER) as well as to the Agribusiness Council of the Federation of Goias State Industries (FIEG). Moreover, they were communicated in the form of an article published in the magazine *Agroanalysis*.

The results from the Project have also drawn Embrapa's attention to the challenge faced by all countries: feeding the world population in the coming decades in a context of great pressure on natural resources and of threat to the environment and biodiversity. They have also emphasised Brazil's role and responsibility for significantly contributing to overcome this challenge by means of the sustainable expansion of the national agricultural production. Given these aspects, the Report motivated Embrapa Studies and Training and the Centre for Strategic Studies and Management (CGEE, Centro de Gestão e Estudos Estratégicos) to elaborate and start executing the project entitled *Sustainable and Sustained Food Production: Brazil's role in a global scenario*. By recognising that domestic food production is a strategic theme for Brazil and for food security in other countries, the project´s objective is to identify lines of action that promote proactive action towards the sustainable

and sustained growth of Brazilian food production in a global context, with emphasis on scientific, technological and innovatory aspects.

The implementation of this project involves, among other activities, the elaboration of 12 studies and 48 technical papers/articles/position papers. Among other aspects, this set of documents will analyse the current situation and the prospective performance of different elements of the Brazilian food system in the next four decades. Moreover, it will examine the factors that are critical to a sustainable and sustained national food production, as well as to the good operation of the different elements of the domestic food system. The documents will also identify how new scientific knowledge, new technologies and specific policies can strengthen the promotion of sustainable and sustained food production in order to meet the needs of the domestic market and to contribute substantially to international trade. Finally, they will present recommendations for policies and other initiatives that promote the consolidation of the Brazilian position in food production in the 2012–2050 period.

In summary: contributions of the Report to Embrapa:

- enhanced Embrapa´s efforts to play a leading role in the development of technologies and innovations for the sustainable production of food, fibres and bioenergy in the tropics;

- corroborated various elements of Embrapa´s research agenda;
- corroborated the relevance it assigns to increasing sustainable agricultural productivity;

- paper presented at the annual conference of the Brazilian Society of Agricultural Economics, Rural Administration and Sociology (SOBER) (http://www.cecat.embrapa.br/estudos-estrategicos/tecnico-cientificas/SOBERjul-2011.pdf);

- paper presented to the Agribusiness Council of the Federation of Goias State Industries (FIEG) (http://www.cecat.embrapa.br/estudos-estrategicos/tecnico-cientificas/RevSafradez2011.pdf);

- article published in the magazine *Agroanalysis* (http://www.cecat.embrapa.br/estudos-estrategicos/tecnico-cientificas/agroanalysisset2011.pdf);
- motivated Embrapa Studies and Training and the CGEE to elaborate and start executing the project entitled *Sustainable and Sustained Food Production: Brazil's role in a global scenario*.

    - Overall objective: to **identify lines of action** that promote proactive action towards the sustainable and sustained growth in Brazilian food production in a global context, with emphasis on scientific, technological and innovation aspects.

- Among other aspects, the set of studies/documents that will be prepared (12 studies and 48 technical papers/articles/position papers) will analyse the current situation and the prospective performance of different elements of the Brazilian food system in the next four decades.

4.3.6 International Institute for Environment and Development (IIED)

IIED's portfolio of works aligns so closely with much of the Report's findings that much of what it has been doing over the last year serves to support effective follow-up to the Project. This includes building resilience in livestock and farming systems to climate change impacts in Asia and Africa; strengthening local rights to land and forest resources; assessing how to make REDD (Reducing Emissions from Deforestation and Forest Degradation) work for both carbon capture and livelihoods; getting farmers' voices heard in setting the agenda for agricultural research in West Africa.

In particular, the IIED Director, Camilla Toulmin, was lead author for the report on *Agricultural Investment and Land Tenure*, commissioned by the UN Committee on Food Security, High Level Panel of Experts; gave a number of public lectures, such as at the Institute of Social Studies, The Hague, on agriculture, investment and land; and acted as adviser, with Prof. Sir Gordon Conway, to Mo Ibrahim on developing agriculture In Africa, for the Mo Ibrahim annual Forum, Tunis, November 2011.

4.3.7 Agriculture for Impact, Imperial College London

The Report is a unique and interdisciplinary resource that has an important place in Agriculture for Impact's work to engage decision-makers in understanding and supporting agricultural development in sub-Saharan Africa. It has quickly become known as a cornerstone of evidence that comprehensively sets out the global challenges that we face on food and farming, and Agriculture for Impact often cites it as a key piece of research in its work. It has also supported the work of the Montpellier Panel, a panel of 10 experts from the fields of agriculture, sustainable development, trade, policy and global development in Europe and Africa convened by Sir Gordon Conway, Professor of International Development, Imperial College London. The Report has been very timely, and, in commissioning and supporting this work, Sir Gordon believes the Government Office for Science has been able to further inform and drive forward policy discussions on food security and agricultural development at national and international level.

4.4 UK Stakeholders

4.4.1 National Farmer's Union (NFU)

The Report was developed through rigorous analysis and backed by high-level global stakeholders. This has undoubtedly provided the NFU over the course of the last year with a strong and compelling evidence base, which has been helpful in articulating the critical role agriculture has to play if the NFU is to secure a long-term food supply. Importantly, the Report highlighted the UK's responsibility to increase productivity and make best use of the UK's resources, infrastructure and geography. It has helped shape numerous speeches, articles and publications produced by the NFU and was central to the NFU's President's speech at the 2011 NFU Conference and underpinned the NFU's mantra 'produce more, impact less' throughout the year. Some examples of the NFU's engagement with activities in which the Foresight Report has either been fundamental to the initiation, or influenced and shaped outcomes, are outlined below.

Influencing research and development

The Report has helped to give prominence to the roles of research and development and knowledge transfer/exchange, which are critical if we are to see agriculture equipped to deal with the challenges that lie ahead. The NFU has long argued that there is an urgent need for a coordinated government strategy regarding the research priorities for agriculture and horticulture in consultation with the private sector. The Report has helped to support this call and the messages of the NFU's 2008 *Why Science Matters* campaign. Therefore, the NFU has been pleased to see a number of new and positive developments over the last year including the Innovation in EU Agriculture Report from the House of Lords (2011)[2], which made a number of recommendations about the prioritisation of agricultural R&D spending and the importance of knowledge translation and exchange. Other steps in the right direction include plans to develop a high-level technology/R&D Roadmap for UK Agriculture by a number of industry partners including the NFU, the Agriculture and Horticulture Development Board and the Technology Strategy Board, as well as a planned meeting of key UK agricultural industry representatives providing applied research, knowledge exchange and training to explore options to optimise resources.

Reconciling the challenge of increasing food production whilst also enhancing the environment

Defra's *Green Food Project* is looking at the challenge of how the UK can increase food production and enhance the environment in England, and how the UK might reconcile any tensions that this challenge raises. The project

[2] HOUSE OF LORDS EUROPEAN UNION COMMITTEE. 2011. Innovation in EU agriculture report. *House of Lords.* London. Available: http://www.publications.parliament.uk/pa/ld201012/ldselect/ldeucom/171/171.pdf. Accessed: 15 May 2012

was launched in autumn 2011and is the direct result of a commitment by the government in the Natural Environment White Paper as well as the Report. The NFU is actively involved in the project co-chairing both the wheat and diary sub-groups. These sub-groups have the task of taking wheat and dairy as agricultural commodities that the UK is likely to continue to produce in 2050, and explore how productivity and environmental performance could be increased and where this might lead to tensions, and furthermore to make recommendations on how these tensions could be reconciled for both wheat and food production more generally. The output will identify 'pinch points' and knowledge gaps that need to be addressed in order to increase production, while enhancing resource protection and biodiversity.

Aligning goals and messages

Arguably one of the biggest challenges of addressing the need to feed 9 billion people by 2050 will be to promote consistency in messages and goals and see an alignment of national and international policies towards the aim of sustainable intensification. Foresight has provided a catalyst for developing such common ground across industry initiatives as well as the NFU's own policy formation and subsequent submissions to government policy development. For example:

- The NFU called for the goals of the *National Planning Policy Framework* (NPPF) to align with the Report. In a farming context the challenge of 'sustainable intensification' will set new patterns of food production, land use, marketing and processing. It will be vital that the NPPF give explicit guidance to local planning authorities reflecting the importance of supporting sustainable intensification in agriculture. This will be reflected in, for example, requirements for larger modernised buildings for livestock, crop storage and agricultural waste management.

- The NFU is involved in many industry initiatives to help address the current and future environmental challenges of farming. The Greenhouse Gas Action Plan, which was launched in April 2011, is one such example and has been a key to setting out how the industry will reduce its greenhouse gas emissions by 3 million tonnes of CO_2 equivalents from 2018 to 2022 without compromising domestic production. The Plan has objectives entirely consistent with the principles of the Foresight Report, with a clear focus on efficiency and producing more with fewer emissions. Importantly it aims to make the most of existing initiatives such as 'Roadmaps' and 'Tried and Tested'. The NFU has had a keen interest in the development of the UK National Ecosystem Assessment (NEA) and has tried to show that food production and environmental protection can go hand in hand. The NFU felt that the messages of the Foresight Report were particularly pertinent to the NEA and specifically asked for greater acknowledgement in its drafting.

- The Global Food Security (GFS) research programme (launched March 2010) has also started to take shape during the last 12 months, with the

aim of strengthening coordination and partnerships and building a more integrated community of scientists, funders and users. It will also promote more multidisciplinary research to ensure sustainable and secure food systems within a common strategy. The NFU participated in the GFS and Foresight joint workshop in 2011, which aimed to improve the linkages between the challenges of the Report and the research needed to address these challenges. It is too early to comment on the success of the programme, but it is good to see some action starting to take shape and the principles of the Foresight Report being incorporated. The NFU is also now an active member of the new GFS Communications and Public Engagement Group, which has the overarching task of raising stakeholder and public awareness of the food security challenge.

International activity

As Chair of the G20, France put food security at the heart of its agenda. Among its initiatives France called a 'G120' meeting of farmers' representatives in Paris in June 2011, in which the NFU played a prominent part, and the Foresight Report was a crucial part of the underpinning evidence.

The examples given above do not attempt to be exhaustive, but serve to demonstrate the NFU's involvement in implementing and embedding many of the messages of the Report in its work during the course of the last 12 months. The initiatives and recommendations the Report has triggered mark a step change in coordination and it has provided a positive rhetoric about the importance of UK agriculture.

However, there is still much to be done in terms of setting the timescales and assigning the many actions urgently needed to see real progress. The expectations on farmers are high and time is short, so the UK needs forward-thinking policies, effective and rewarding supply chains and a clear strategy on the role of the public sector in funding R&D that are aimed at increasing our productivity and sustainability. The NFU can do this only if the government takes its own commitment to increasing food production seriously, recognises the value of domestic production and puts in place a policy framework that will enable Britain's producers to optimise productivity while protecting the environment in a changing world. This includes a 'Foresight-proofed' CAP, enabling evidence-based regulation that gives UK farmers access to the full range of tools and strong leadership from the government in its funding strategy for agricultural research.

4.4.2 Natural England

The Report has influenced Natural England's (NE) work in a number of areas. For example, NE has commissioned research into the ecosystem services

provided by agri-environment schemes that support agricultural productivity. NE is also contributing to discussions on 'sustainable intensification' and the work of Defra's Green Food Project, and is continuing to engage in strategic futures thinking and scenarios with regard to the natural environment in England and key drivers such as food security and land use change, in which the Report is referred to frequently.

4.4.3 Soil Association

Overall Influence: The Soil Association's (SA) new strategy, *The Road to 2020*, echoes some themes of the Report, principally the need for bold innovation in agriculture, land management and food systems.[3] Foresight has clearly given these themes, and the notion of a 'perfect storm' of emerging challenges, much greater currency among UK policy-makers and stakeholders, significantly influencing the environment in which the SA has developed and launched its strategy.

However, the SA cannot attribute Foresight much influence on its own approach to these issues. The SA's thinking had already been shaped by the preceding International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD) report and, while Foresight underlined many of the points made by IAASTD and sometimes expressed them more clearly, the SA found few fresh insights relevant to its work.[4] Indeed the SA considered that the participatory style of the IAASTD process, though cumbersome, was better aligned with good practice in innovation for sustainable development.

Citation

The SA recognises that IAASTD and a substantial body of cognate literature have had only a limited influence on some important audiences, including in UK policy and in food businesses. Foresight has appeared more successful in reaching these audiences. When the SA engages with these audiences, it therefore cites Foresight where appropriate.

The SA has cited Foresight where the Report aligns with longstanding concerns of the Soil Association, notably:

- the need for 'a redesign of the whole food system to bring sustainability to the fore';
- that innovation is needed not only in agricultural practices, but also in economic and social policies to address distributional issues;

[3] http://bit.ly/pedjK2
[4] http://www.agassessment.org/

- the current importance and future potential of agroecological systems such as organic, on which the Report comments that 'Substantial increases in productivity and sustainability can be achieved by targeted research in modern crop, animal and aquaculture management, often known as agroecology'; and

- the contribution that changes in consumption and reducing waste can make to food security and sustainability; the SA agrees that 'Scenarios suggest organic production systems can satisfy expected future global food demand but would require major changes in consumer diets'.

The SA has not sought to imply that Foresight represents a wholehearted endorsement of the Soil Association's work, because there are also points on which they differ.

Reporting

The SA welcomes that Foresight addressed these concerns. The SA has therefore been disappointed when media reports and public statements about the findings of Foresight have presented a narrower picture. The SA has sought to challenge these, emphasising the broad scope of the review and its conclusions.

4.4.4 Prince's Trust Charities International Sustainability Unit (ISU)

HRH The Prince of Wales's International Sustainability Unit (ISU) was established to help facilitate consensus on how to resolve some of the key environmental challenges facing the world. Since early 2012, the ISU's major focus has been food security; in particular, how a more comprehensive economic understanding of the risks to food systems from natural capital depletion could help policy-makers understand synergies and trade-offs across a nexus of related security issues to do with climate, environment, water, energy and food. Looking forward to the Rio +20 talks later this year, it is hoped that this more robust understanding of the economic implications of 'resilience' in food systems will also help governments substantiate the narrative link between immediate economic concerns (as perhaps typified by the G20 discussions) and longer-term strategic concerns to do with sustainability and the management of natural resources.

The Report has been fundamental to the ISU's work. At precisely the right time, the Report provided a clear and comprehensive exposition of the interconnected drivers that affect global food security. The Report successfully analysed and articulated these, building upon previous reports (such as the International Assessment of Agricultural Knowledge, Science and Technology for Development report of 2008) to provide what is perhaps the most comprehensive examination of the drivers of food security to date.

The depth and breadth of the 'Evidence Reviews' that underpin the Project's analysis lend powerful weight to its central message. This stresses the now urgent need for Governments to consider how food security might be assured for all, even as critical resources such as water, energy and land become increasingly scarce. This message, and the body of supporting evidence behind it, has been very useful in helping to move the discourse on food security forward.

4.5 International

4.5.1 United Nations Food and Agriculture Organization (FAO)

Natural Resources Management and Environment Department

FAO recently published the SOLAW report (*State of the World's Land and Water Resources for Food and Agriculture*), which, among other things, provides a rich geographic context to land and water issues and calls the world's attention to agricultural systems at risk. SOLAW shares several conclusions with the Report that cover the much wider field of global food systems, and contains a correspondingly comprehensive list of remedial options. These publications thus provide complementary information and could be read in conjunction to better inform decision-makers in future policy reforms.

The arguments on sustainable intensification and food security made in the Report, particularly with regard to Challenge E (Maintaining biodiversity and ecosystem services while feeding the world), and the recognition of the interdependence of policies and 'conservation' efforts, contributed partly to the impetus for establishing at FAO a new initiative: the *World Agricultural Watch Initiative* (WAW), focused on monitoring the social, economic and environmental impacts of the global phenomenon of agricultural transformations (spanning family farms to large agri-businesses) and linkages to existing policies originating in multiple sectors (food and non-food). The development of the methodological framework and approach to implementation in countries as well as partnership building are still at an initial stage. In this regard, the FAO feels that there may be significant opportunities for possible synergies with future activities being considered for the Report.

Interactions with and influences on FAO's work in the fisheries sector

UK Foresight has had close interactions with FAO's Fisheries Department (FI) from the outset of developing its programme, in setting out the characteristics of the aquatic food supply system, the driving forces determining their future directions, and the policy and development issues connecting the sector with the wider food system. A number of FAO staff (including recent retirees) contributed advice and information, and participated in drafting background texts. FAO's fisheries statistics were an important underpinning element throughout.

The Foresight process and its engagement with the sector had been very timely for FI, in engaging at a period when it was further shaping its strategic position in the sector, and structuring an approach that could accommodate major vectors such as climate change and globalised markets, while at the same time recognising the vital need for food security and hunger alleviation.

Partly through a small programme of collaborative support from Foresight, a series of discussions and a department-wide 'Future of Fisheries' workshop had been held in 2010/11, with presentations to EU Fisheries Advisers and others on the emerging issues and on the Department's potential responses. This has been further carried through with a joint programme currently under way with the International Food Policy Research Institute (IFPRI) and the World Bank on more detailed prospective analysis for the aquaculture sector to 2030 and beyond.

Outputs of the Foresight programme have also closely connected into the Department's on-going work, particularly its flagship publication SOFIA (*The State of World Fisheries and Aquaculture*), which in its last edition drew extensively from the Project's review on inland fisheries, and in its current draft is building further on various fisheries sector themes set out in the Foresight overview. In addition to addressing the Project's major topic of sustainably expanding future food supply, its resource base and its governance, the Department has also explored and developed topic areas such food access, climate change adaptation and mitigation, and genetics and biodiversity. The Department is also currently preparing a series of vision papers for capture fisheries, aquaculture, post-harvest and market systems, and for data and information. Inspired in part by the Foresight programme and its scope and insights, the aim is now to bring the more detailed knowledge of the Department and its global partners into a strong and clear-sighted perspective on meeting future needs within and around the sector.

Agriculture (AG) Department

The Report provides a synthetic approach, which is very useful for broad perspectives. Its background material is also very useful, particularly the various articles published by the Royal Society. The orientations they provide are often very close to the AG Department's. A good example is the work conducted on sustainable intensification of crop production by the FAO's Plant Production and Protection Division (AGP) division.

Save and Grow, a policymaker's guide to the sustainable intensification of smallholder crop production, was released at the FAO Conference in June 2011. The book is targeted at senior policy-makers in governments and is intended to promote an informed discussion on how countries might work towards sustainable crop production intensification (SCPI) while protecting and enhancing natural resources. It is a compilation of proven management practices and technologies that demonstrate how an ecosystem approach to SCPI can be implemented. The *Save and Grow* approach is based on conservation agriculture practices, good seed of high-yielding adapted varieties, integrated pest management, healthy soils, more efficient water

management, and integration of crops, pastures, trees and livestock. It recognises the importance of developing sustainable production systems through complementary actions at all stages of agricultural value chains.

The AG Department thus found substantial common ground in the Report, particularly with respect to the need to intensify food production sustainably while meeting the challenges of climate change and increasing competition for land, water and energy. It is important to recall that in the Foresight Report, of the 40 case studies identified under sustainable intensification in Africa, five are FAO 'success stories', of which three are on Conservation Agriculture (Tanzania, Zimbabwe and Lesotho), one on Integrated Pest Management (sustainable production intensification, Senegal and Niger River Basins of Francophone West Africa) and one on seed systems [promoting smallholder seed enterprises (SSE), Cameroon].

The *Save and Grow* approach has served as a framework to the work-planning process for the current biennium and is reflected in FAO's current strategic framework. The work of FAO to operationalise the *Save and Grow* approach requires collaboration with a broad range of partners in developing national SCPI strategies tailored to national priorities and capacities.

4.5.2 European Commission – Directorate General for Agriculture and Rural Development

During the recent period, the Directorate General for Agriculture and Rural Development of the European Commission has contributed to the formulation and negotiation of European and international initiatives related to the future of farming and of the Common Agricultural Policy; the volatility of food prices, agricultural trade and trade of commodity-related derivatives; the better functioning of the food supply chain; the fight against poverty, food insecurity and malnutrition in developing countries; and climate change mitigation, efficient use of natural resources and ecosystem conservation in relation to farming.

A number of preparatory works for these initiatives, including their impact assessments and studies conducted or commissioned by the Commission, were informed by national and international foresight projects devoted to the future of food and farming as well as by the exchanges with experts, interested parties and stakeholders of the food system that these projects have fostered.

Initiated since the crisis of 2007–2008, these projects participate in a foresight revival and explore in depth, with pluralist and multidisciplinary approaches, the complex issues of the future of the global food system. The Report, and the knowledge base constituted by the papers and the reports generated for the project, is the part that is most widely discussed and used.

The Report has directly informed the third Foresight initiated by the EU Standing Committee for Agricultural Research. Its promoters (the UK Government Office for Science – Foresight) co-organised with the Commission's Joint Research Centre a high-level seminar on the *Future of Global Food and Farming: How Can Science Support Food Security*. The identified needs have contributed to the formulation of guidelines for research, particularly in order to lessen the reliance of agriculture on industrial processes harmful to ecosystems and curb the exclusive focus on a small number of plants whose performance is developed separately from agriculture and which erode agricultural genetic diversity and resilience.

In exploring the food challenge with systemic approaches, recent foresight projects demonstrate that food system failures can no longer be approached solely as problems of supply needing to be adapted to global demand. They illustrate the need for policy coherence and synergies of actors across established boundaries of areas of action and responsibility. Their analysis of food insecurity, malnutrition and ecosystem degradation, despite the spectacular technical advances of recent decades, provides sufficient evidence that failures are not technical but failures of governance, requiring the invention of mechanisms whereby governments, agencies, civil society organisations and the private sector are induced to build consensus on the measures to ensure food security.

For 2013, the European Commission is preparing a cross-cutting initiative on *Sustainable Food* to promote the food system transition towards sustainability. This will be a further opportunity to draw evidence from the base built by the Project and from the follow-up work it has generated.

4.5.3 Organisation for Economic Co-operation and Development (OECD)

The Report was previewed to the OECD's Committee for Agriculture in December 2010 during the course of a Policy Forum on Global Food Security held as part of the OECD's 50th Anniversary celebrations. A little later, following full publication, it was presented to a meeting of Rural POVNET on 17 March 2011. It was extremely well received by delegations from both communities: agriculture and development. It was also widely read and discussed by OECD staff across a number of directorates, including agriculture, environment, science and technology.

From the point of view of the OECD Secretariat, the report has been extremely useful. It is probably the most comprehensive report of its kind, remarkable in its multidisciplinary scope, in the breadth of the approach and in its insistence on evidence-based analysis. It is also a model of clarity. Its publication came at a key time, after the OECD's Agriculture Ministerial meeting in February 2010, as the Committee for Agriculture was seeking to translate the broad directions defined by Ministers into concrete proposals for new work that would allow the COAG to contribute useful policy advice. The

key findings assisted in the development of the OECD's Green Growth Strategy for Food and Agriculture, particularly in the areas of technologies and farming, fishing and food chain practices and systems. It also helped inform the OECD Agriculture Knowledge Systems Conference in June 2011. The OECD's Committee for Agriculture is currently developing its work programme for the 2013/14 period and the Foresight report has become a reference in the internal discussion, framing and defining the issues and providing a blueprint for policy actions at global, regional, national and local levels. The OECD's Committee for Agriculture has already taken up some of the issues it raises during its 2011/12 programming period and will continue to do so in coming years.

The Report does not confine itself to just defining the problem, neither does it leave the reader with a pessimistic, Malthusian vision of the coming decades. In this sense it is a very positive report, putting forward constructive ideas for policy actions, which if taken, and taken in time, have the potential to solve the problems facing world food and agriculture system. The objective, evidence-based, multidisciplinary approach has been, and will continue to be, an important counterweight to the more alarmist and scaremongering voices that often dominate the media on these topics.

4.5.4 World Bank (WB)

The findings have global relevance and remind the WB of the scale of the challenge. Foresight's analysis clearly highlights for opinion-leaders and policy-makers how the global food system is consuming the world's natural resources at an unsustainable rate and failing the very poorest, with about a billion of the least advantaged still suffering from hunger and malnutrition even today. It provides clear evidence of the vulnerability of the global food system to climate change and other global threats. The WB agrees with the Report that that food security, poverty and climate change are closely linked and should not be considered separately. The Report's insistence on the need to take a much broader perspective than hitherto, and on approaching the global food system in an integrated manner, is of great value. This critical importance of interconnected decision-making requires that nothing less is needed than a redesign of the whole food system to bring sustainability to the fore. Based on Foresight's work, the WB is convinced that much can be achieved immediately with current technologies and knowledge given sufficient will and investment. However, as the Report analysis clearly indicates, coping with future challenges will require more radical changes to the food system and investment in research to provide new solutions to novel problems.

These reports, together with the work of the *Commission on Sustainable Agriculture and Climate Change* (CSACC), have helped the WB to make the case at a global level that while agriculture will be strongly impacted by climate change it can also contribute significantly to meeting climate mitigation targets. Based on Foresight's work, the WB is strongly convinced that

Climate-Smart Agriculture (CSA) offers triple wins for food security, adaptation and mitigation. CSA includes proven practical techniques – such as mulching, intercropping and improved water management – but also innovative practices such as better weather forecasting, early warning systems and risk insurance. The CSACC has been very instrumental in bringing the scientific community's support to the WB's CSA agenda through its contribution to the African Agriculture Ministerial Summit, jointly organised by South Africa, the African Union and the World Bank in Johannesburg last September, and to Agriculture Day at UNFCCC COP 17 Durban. In particular Foresight's role in the *Global Science Conference on Climate Smart Agriculture - Science into Action* in the Netherlands was instrumental in helping to forge a scientific consensus around inclusion of agriculture in the climate negotiations.

4.5.5 Commission on Sustainable Agriculture and Climate Change (CSACC)

The CSACC mandate is to clearly articulate scientific findings on the potential impact of climate change on agriculture and food security globally and regionally and to identify the most appropriate actions and pathways to achieve food security in the context of climate change. Beginning in February 2011, the head of the CCSAC Secretariat led a synthesis of 16 major assessment reports that was to serve as the primary foundation for developing evidence-based policy recommendations. The Report was among these 16 reports. Given the very thorough set of specially commissioned studies and the rigorous synthesis of this body of work, the Report was a notably important contribution. The holistic focus of the Report, and its high credibility across a broad range of stakeholder communities, assisted the CSACC in achieving a broad focus on the global food system rather than constraining its attention to food production.

The 'matrix of evidence' that housed the compiled findings from the 16 major assessment reports was shared with Commissioners and participants in a five-day workshop at the Rockefeller Foundation's Bellagio Center in September 2011. It will also be made available through the CSACC's webpage. The Report was a key reference for the interim product from the CSACC, a *Summary for Policy Makers* that outlined seven top-line recommendations for policy action, released in November 2011. Even more importantly, Foresight will be a key citation for a number of relevant statistics and synthesised scientific conclusions. The *Summary for Policy Makers* has already been widely circulated among policy makers and other leaders through direct contacts, websites and a major global media launch as well as targeted policy dialogues. The CSACC's recommendations were showcased at the Agriculture and Rural Development Day in Durban, South Africa, and will continue to be highlighted at upcoming events such as the *World Bank Sustainable Development Network* meeting, the *Planet Under Pressure* meeting and the ICSU science forum in Rio de Janeiro. As a critical precursor and robust scientific foundation for the Commission's work, the Report's impact has been amplified through the activities of the Commission.

4.5.6 World Trade Organization (WTO)

The Report Launch Presentation and the briefing note provide good summaries of the main issues and concerns, and helped clarify issues in its presentations or discussions. The part on improving governance was far more directly relevant to WTO's work, though the other parts are also very useful to provide a perspective and a framework for analysis. In addition, the WTO has also used the Report in its work and discussions/conferences, and the reports from other Institutions such as the OECD that have relied on inputs from the Report.

However, the WTO could have used the work much more if it had been informed about how the Action Plan has been implemented and to what extent there is any progress in it; and how one could give others, including policy-makers and NGOs, that evidence or some link to on-going efforts. It would be useful also to see which part of the Action Plan is being given greater priority either because of its importance or because of the ease of implementing it. Thus, the WTO looks forward to the report of this Review to see how work has progressed in terms of action taken.

It would also be useful to have a compendium of case studies or data (or data sources or data links) that show in a simple way how the key conclusions are being taken forward, e.g. how waste reduction policies have been implemented successfully. This will also help countries to better train their policy-makers and direct in a more practical way the attention of relevant stakeholders towards the main action points that would be useful to them. The more of these examples are from developing countries, the greater will be their relevance for a large part of the globe.

It may also be worthwhile to create an interactive system of information exchange in which the Members of the High Level Group inform others of the steps that take forward the insights from the Project. This could form the basis of a growing information source.

4.5.6 International Union for Conservation of Nature (IUCN)

Dr Jeff McNeely, former Director of IUCN, has been working on agriculture-related matters in developing countries since the mid-1970s, and in the early 2000s was co-founder and first Chairman of the Board of a new NGO called Ecoagriculture Partners. This organisation is promoting forms of agriculture that also conserve biodiversity at a landscape scale, which requires a long-term perspective. He has also been working on the UNEP Resource Panel, specifically on biofuels (report already published) and water (in progress). Both of these are deeply involved in the future of food and farming, so the Report has provided an authoritative insight into options for the future. Dr McNeely presented at a meeting convened by the Asian Development Bank

(in February 2012) that reviewed work in the Greater Mekong Subregion, with agriculture a particular focus. He speculated on the role of mismanaged agriculture and ecosystem services in the fall of civilisations, such as that centred around Angkor Wat, and how the region can adapt to the changes that will be coming in the next few decades. Again, the Report has provided valuable insights that will help provide options and advice for adapting to an uncertain future.

4.5.7 Oxfam

The twin concepts of a perfect storm on food security and sustainable intensification have supported the development of Oxfam International's campaigning and are a significant input for the development of the Oxfam International Strategic Plan.

The Project has provided a series of platforms both in the UK and in the European Union to highlight the report's issues and for Oxfam to be strongly supporting key messages. The Report has also expanded the networks of Oxfam's Campaigns and Policy Director, Phil Bloomer, and his colleagues: particularly the nexus between environmental concerns and social justice concerns as they relate to food security. The Report also led to Bloomer's involvement on the Global Food Strategy Advisory Board.

4.5.8 Conservation International (CI)

The Report was very influential in CI's development of its Food Security strategy:

<u>Key priority actions for NGOs</u>

1. Form a global alliance to communicate forcefully the extent of hunger in the world.

2. Work together across sectors recognising that problems of hunger, food supply, poverty, rights to land and natural resource assets, health, human and institutional capacity, economic and social development, climate change, biodiversity and ecosystem services are all interlinked.

3. In addition to helping to protect the vulnerable in times of crisis, emphasise the importance of development through investment in the food system.

4. Identify and plug gaps in research not supported by the private and public sectors alone (building, for example, on recent initiatives on biofortification and water-resistant crops for African smallholders); help

bridge gaps in the research and extension chain between researchers and farmers.

Key priority actions for the research community and research funders

1. Increase the priority of natural and social science research in the sustainable food system, from the fundamental knowledge base to outcome-led interdisciplinary work.

2. In addition to pursuing research in biotechnology, also target research investment in other relevant but currently neglected areas (for example agronomy, agro-ecology and soil science), and ensure a coherent approach to discovering knowledge important to the food system at a time of global change.

3. Pursue multiple scientific approaches to achieve growth in sustainable productivity and wider sustainability, and climate change adaptation; and rigorously assess the benefits and safety of novel technologies.

4. Increase and develop new partnerships between public, private and third-sector funders.

5. Recognising that most of the needs of the very poorest can be met using existing knowledge, engage with poor communities to explore where the development of new science and technology can be of value.

6. Develop indicators of hunger and poverty that are reliable and accurate, can be calculated frequently and are not prohibitively expensive.

7. Ensure the preservation of multiple varieties, land races, rare breeds and closely related wild relatives of domesticated species.

4.5.9 Centre for Agriculture and Biosciences International (CABI)

CABI welcomed the Report's publication, especially as it acknowledged the critical but necessary balance we see as being required between efforts to grow more and the sometimes overlooked case for losing less. A key aspect of delivering on the latter is on strengthening and revitalising extension systems, making existing institutions work more effectively in partnership so that all are strengthened in their actions to disseminate existing knowledge more effectively. Report C5, Producing more food sustainably, using existing knowledge and technologies, states in C5.4:

"Globally, producing food requires skills and knowledge as well as technology – not only the traditional skills that have always been associated with crop and livestock production, but increasingly the technical and economic expertise required to capitalise on scientific advances and to operate within the modern food system." It goes on to state, *"Food producers acquire information from*

each other and from individual innovators who have particular skills and expertise they can share; from non-state organisations such as farmers' associations, scientific and technical societies, NGOs, universities and colleges; from commercial organisations associated with the provision of inputs (seeds, fertilisers etc.) or that specialise in providing knowledge; and from state-funded organisations. There is widespread acceptance today of the importance of a pluralistic approach to obtaining information and advice, and with it the need to build relevant and trustworthy processes."

This approach underpins CABI's pragmatic and pluralistic approach to implement the global food security programme *Plantwise*, which it leads, in conjunction with over 70 international partners. By the end of 2012, a mix of government agencies, farmer' associations, NGOs and others in 22 countries will have been brought together to run regular plant clinics. They are expected to be operational in over 40 countries by 2016. These clinics, operated by CABI-trained plant doctors, all of whom are employed by existing national institutions, are providing advice that can be acted upon directly to farmers, helping them lose less and feed more from all of the crops they grow. There are now many years' experience that Plantwise clinics offer replicable, scalable means of building extension infrastructure. International donors, including DfID, SDC (Switzerland), ACIAR (Australia) and DGIS (the Netherlands), share these views and are enabling Plantwise to develop what will become self-sustaining plant health systems that guide farmers on the most appropriate courses of action for them.

Rightly, the Report examined the issue of waste. CABI's expertise is centred around minimising pre-harvest waste (which is believed to average 40% for key crops) created by existing and evolving threats from plant pests and diseases, or from the impact of invasive species. CABI has begun to address the Report's call for global positioning system (GPS) mapping of such threats that exacerbate hunger, through GPS plotting of all crop diseases, and will be releasing an open access knowledge bank of plant pests in June 2012. The development includes plans to create country-confidential dashboards of the key pests affecting indigenous agriculture, with treatment advice resources that can be made available to the national extension network for onward dissemination to farmers. Advice is being disseminated orally, on paper, on mobiles and through other multimedia channels.

Overall, much of the thinking within the Report is embedded within CABI's log frame of activities and expected results agreed with its major donors, including impact evaluation and gender outreach. CABI has now strengthened its dialogue with food retailers to see how they can become involved more closely with CABI's clinics and its partners, to strengthen their supply chains. CABI acknowledges that Plantwise can only be one aspect of the required armoury of initiatives which tackle the issue of sustainable intensification of food and farming, but it is encouraging that CABI's national partners, international donors and such policy insights as these from Foresight share a common view that *"There are multiple approaches to addressing food security, and much can be done today with existing knowledge."*

4.5.10 Bill & Melinda Gates Foundation (BMGF)

The Report – including the many and impressive scientific reports which lay behind it – was regarded as a very useful input into the Gates Foundation Agricultural Development strategy report.

BMGF goal and approach

The Foundation's ultimate goal is to reduce hunger and poverty for millions of poor farm families in sub-Saharan Africa and South Asia. BMGF believes the best way to do this is by helping small farmers grow and sell more food so they can improve their nutrition, become self-sufficient, and build better lives.

To succeed over the long term, BMGF follows these key principles:

• **Focus on small farmers.** These farm families work on small plots of land, on which they often rely for their food and income.

• **Focus on crops and livestock that are important to the rural poor in Sub-Saharan Africa and South Asia.** BMGF also concentrates on areas where most poor farmers live and where there is the greatest opportunity to help millions of people build better lives.

• **Listen to farmers to understand the realities they face in their local areas.** BMGF conducts research at the local and global levels to find out which solutions are most relevant and affordable for small farmers. BMGF then partners with organisations that understand the local context and realities and are best suited to address these problems.

• **Focus on helping farmers increase their productivity** while preserving and enhancing the viability of soil, water and other natural resources.

• **Put women at the centre of its work.** In sub-Saharan Africa and South Asia, women are vital participants on small farms but have limited support and little control over productive resources. BMGF believes that agricultural development programmes must address these gender gaps and inequalities to be truly effective.

• **Realise there is no single, simple solution to tackling the challenges farm families face.** That is why BMGF takes a comprehensive approach to helping farmers prosper that includes developing heartier seeds, helping people get access to new tools and farm management techniques, opening doors to markets and supporting effective policies.

• **Coordinate across its team to ensure they are getting the most out of their investments.** For example, if BMGF is funding the development of new seeds that withstand drought, BMGF coordinates within its team to ensure farmers learn about the benefits of these new varieties and any special growing practices, and are comfortable adopting them. BMGF also help connects these farmers to financing and markets.

• **Work closely with others in the field to leverage its investments.** In the last several years, BMGF has been encouraged by the growing interest in and momentum to support agriculture. This is particularly timely in light of rising food prices and the need to feed a growing population. Now more than ever, we need to align with others around the globe who are working in this sector, including funders, scientists, environmentalists, policy-makers and the private sector, to make sure BMGF gets the most out of its collective investments.

BMGF strategic initiatives
BMGF makes investments in three strategic areas. BMGF coordinates across these areas to build a robust system that addresses the local realities and challenges of farm families in the developing world.

1. Research and Development

BMGF supports agricultural research to develop more productive and nutritious versions of the staple crops grown and consumed by farm families. These include varieties that thrive in different soil types and are resistant to disease, pests and environmental stresses such as drought. BMGF funds research to find ways to better manage soil and water resources and reduce crop loss after harvest. BMGF also supports efforts that improve the health and productivity of farmers' livestock.

BMGF grantmaking priorities are:

• **Crop improvement:** developing crop varieties specially adapted to local conditions that have specific benefits farmers seek, such as increased yields; better nutrition; and tolerance to drought, flood and pests.

• **Crop and natural resource management:** helping farmers better manage and protect their staple crops and livestock through soil health management; effective water resource management; and minimising the amounts of crops and livestock that are wasted on account of spoilage and weeds, pests, disease and other threats.

• **Livestock health and improvement:** enhancing the health and productivity of small farmers' livestock, including cows, goats and chickens, by improving animal genetics and veterinary care.

2. Agricultural Policies

Timely, relevant and accurate information is crucial to the efforts of farmers. Policy-makers in developing countries also need good data to inform their decision-making. To this end, BMGF supports data collection, research and policy analysis related to agricultural development, including the results of its own work. This is critical in evaluating the impact of various approaches, getting accurate information to small farmers and assessing the effects of national and international agriculture policies. This also includes research to measure the progress of BMGF's grants to ensure they are delivering the anticipated benefits to farm families.

BMGF grantmaking priorities are:

• **Data and diagnostics:** collecting and analysing data from farmers, development partners and governments to help national government policy-makers and other partners – as well as the Foundation – assess the success of different interventions.

• **Country policies:** identifying and supporting policies and public investments that help farmers in sustainably increasing their yields, with a focus on research and development investment, seed systems, livestock enhancement, regulatory systems, input delivery and markets.

• **Optimising environmental, welfare and nutritional benefits, and mitigating impacts:** supporting research, evaluations and tools to ensure that grantmaking maximises returns to the environment and the welfare of farming households through increased agricultural productivity, and mitigating any consequences BMGF's work may have on the environment or the health of farm families.

• **Enhancing skill sets:** training individuals and organisations in sub-Saharan Africa and South Asia to conduct research and analysis.

3. Access and Market Systems

BMGF helps get new and appropriate tools and farming practices into the hands of small farmers and support efforts to link them to markets.

BMGF grantmaking priorities are:

• **Input delivery:** working hand in hand with the research and development team to ensure small farmers have access to the results of its work, such as improved seeds, better soil, and water and livestock solutions.

• **Knowledge exchange:** finding new ways to share information and knowledge that help small farmers improve their farming techniques through information and communications technology, such as mobile phones.

• **Organisational strengthening:** training farmer organisations to hone their business management skills, gain greater input purchasing power and marketing leverage, and learn how to improve their crop and resource management skills.

• **Post-harvest management:** improving storage and post-harvest activities to help farmers get the most from selling their crops.

• **Markets:** improving the ability of farmers to meet quality and quantity commitments for buyers; linking farmers with large-scale and reliable markets; and facilitating partnerships between buyers, processors and farmer organisations.

4.6 Private Sector

4.6.1. British Chamber of Commerce

Outreach to a more broad audience was achieved thanks to the participation of the Brussels-based trade press, including *New Europe*, *Agra-Europe*, *EurActiv*, *The Parliament Magazine*, *3E Intelligence Blog*, *l'Echo,* and *Agra-net*. Two short videos were also prepared and posted on the Chamber´s web site and on YouTube:
http://www.youtube.com/watch?v=ikukz_F8Znc
http://www.youtube.com/watch?v=qg9BdeaOsnw

In addition, outreach to a more specialist audience was achieve by posting these videos on various members' and associated web sites, including WWF Europe, Microsoft Research, The European and BASF.

The British Chamber of Commerce in Belgium provides an essential network for the Brussels-based business community. It organises an unparalleled diversity of events, with business leaders, policy-makers and a broad spectrum of stakeholders, providing a neutral platform for informed debate. The Chamber´s Food Security Safety and Sustainability Task Force was therefore pleased and honoured to be able to work with Foresight´s Follow-up Team, to organise two events during 2011 in support of the Report.

On 30 March, Sir John Beddington presented key conclusions of the Report to the an audience of about 80, with representatives from the international business community, including the following multinational organisations: Novartis, Kellogg's, Monsanto, Delhaize Group, Nestlé, Coca-Cola, BASF, Diageo, Bayer CropScience and Procter & Gamble. An important message that emerged was the need to develop ways of measuring agricultural sustainability. In order to build on this challenge, Sir John also contributed the Task Force's 'How Green Is My Apple?' event on 7 December, alongside speakers from Microsoft Research, WWF and BASF.

During lively discussions at these events, the following key messages were articulated:

- the need for greater investment in agricultural research, development and extension services, in both public and private sectors, to enhance agricultural productivity;
- the need for increased innovation and associated societal acceptance, in order to deliver innovative and sustainable technologies that are able to support increased agricultural productivity with reduced environmental impact;
- the need for metrics with which to measure and therefore manage agricultural sustainability; and
- the role that the business community could play in order to reduce food waste in both the developed as well as the developing world.

It is therefore proposed that these issues should be considered by the Foresight Follow-up Team.

4.6.2 Crop Protection Association (CPA)

The Crop Protection Association (CPA) took several 'key positives' from the Report. It found that the Report has been groundbreaking from both a national and international perspective and, for the first time, brought together leading experts from around the world to focus on the future of agriculture and food production to 2050. Unlike other food security reports it has taken account of differing views ranging from smallholders and environmental groups to the plant science industry and major food manufacturers and retailers. The Report has broken new ground by calling for new technologies such as genetic modification, livestock cloning and nanotechnology not to be excluded from the future of food production on ethical or moral grounds. It has rightly focused on the need for more public and private investment in agriculture research to tackle the magnitude of the food security challenge. The Project focused on the benefits that new science and technology in agriculture can bring to the poorest people in low-income countries, who face the greatest threat from rising food costs. Foresight focused attention on the need to use the world's energy water and land resources more efficiently and to minimise waste in the food chain, and has rightly called for improvements in the political and economic governance of the food system not just to increase productivity but also to protect the environment. The Report has put tackling climate change at the heart of the food security debate and focused on the importance of crop protection to maintaining food supplies.

The key challenges ahead include ensuring that food security remains a key political priority around the world and that science-based approaches to agriculture and food production are not restricted by bad science and fear campaigns by campaign groups and NGOs. It will be important to continue developing a more science-based approach in the EU to agriculture and food production issues that reflect the key concerns raised in the Report, and working on an international basis to better monitor the world's energy, water and land resources to more effectively deal with the food security threat. It will also be important to work on an international basis to reduce the over-reliance on fossil fuels in the global agriculture and food production system and maintain sufficient public funding of agriculture and food research in the UK to maintain our position as a world leader in tackling the food security threat. Also, focusing on the need to adapt to climate change and its impact on the future of agriculture and food production and involving consumers at every level of the food security debate from the role of science to reducing food waste and changing consumption patterns will remain crucial challenges, as will promoting a more joined-up debate across the food chain about the importance of science and technology to the future of agriculture and food production.

4.6.3 Food and Drink Federation (FDF)

As the trade association representing the country's largest manufacturing sector (which accounts for 15% of total UK output, with a turnover of around £76 billion and nearly 400,000 direct employees), FDF has consistently striven to show leadership in reducing the environmental impacts of production in members' own operations through its *Five-fold Environmental Ambition* (FEA), now entering its fifth year. This sets quantified targets for cutting carbon emissions (a class-leading 35% by 2020), saving water and reducing packaging, waste and transport use.

In parallel with the work of the Project, FDF undertook a review of all its FEA targets and aims during 2010 to see how it might start to address the wider issues that Foresight itself was examining. FDF concluded that, in addition to continuing to bear down on impacts under its direct control, it needed also to extend its influence with its supply chain partners and customers to put resource efficiency at the heart of decision-making and to promote life-cycle thinking across the value chain in order to deliver more sustainable patterns of production and consumption throughout the food system.

The publication of the Report provided the clearest possible framework for taking forward this agenda, supported by a comprehensive evidence base and priorities for action to overcome the challenges identified.

The headline messages which FDF has sought to embed in its revised FEA programme are:

- the need to produce more, from less and with less impact;
- a better understanding of the concept of sustainable intensification; and
- the importance of getting smarter with science and improving technology transfer.

During 2011 the FDF held successful workshops with a wide group of industry stakeholders and others on the role of biodiversity in food production and on the issues that need to be taken into account in developing sustainable sourcing policies for raw materials – which account for the largest single share of total food chain impacts – using wheat as a test case. FDF now hopes to develop this into a set of principles, which it intends to issue as guidance for all concerned, along the lines of its *Every Last Drop* leaflet published just before Christmas 2012 on managing and saving water throughout the supply chain.

FDF has also been actively participating in Defra's *Green Food Project*, which is looking at the tensions between increasing output and protecting and enhancing the environment (in England) in the light of the *Natural Environment White Paper* and accompanying *National Ecosystem Assessment*. Some FDF members are additionally involved in the *Ecosystem Task Force*, which is seeking to find ways of internalising external impacts through payments for ecosystem services. In its contributions to these projects, FDF has strongly supported the Foresight analysis and argued the

need for a more coherent and strategic cross-government approach to food policy, prioritising comparative advantage and seeking to optimise productive potential in this country, as part of its response to the longer-term global challenges identified by the Project.

Building on this, FDF is planning to hold an awareness-raising event in London ahead of the Rio +20 global summit, showcasing what its members have achieved and underlining the importance of food security and natural capital in the context of sustainable development.

On the science side, FDF would welcome a more open and rational debate about the use of new technologies, in both food production and processing. FDF is also working with the *Food Research Partnership, Technology Strategy Board* and *Knowledge Transfer Networks* to promote innovation and resource efficiency and to better define the research needs of the UK food and drink manufacturing industry.

FDF's approach to all these issues is directly inspired by the Foresight findings, as was its decision to adopt *Delivering Sustainable Growth* as the new FDF logo, informing its work on health and wellbeing and competitiveness alongside its core *Five-fold Environmental Ambition*. This is also reflected in FDF's recently launched 20/20 growth vision, shared with BIS and Defra, for increasing sustainable output by 20 per cent by 2020. To achieve this it will be essential to decouple growth from environmental impact – something that is also the key to achieving food security against a background of climate change in order to meet rising demand and feed an expanding world population in years to come.

4.6.4 Unilever

The Report was being prepared at the same time as Unilever made the final preparations for the launch of its *Sustainable Living Plan*, in November 2010. The basis of the sustainable sourcing commitment in that plan (100% sustainable sourcing of all renewable ingredients by 2020) is Unilever's *Sustainable Agriculture Code*, which was published in April 2010. Unilever believes that its *Sustainable Agriculture Code* is fully in line with all major recommendations in the Report, and Unilever put enough trust in the validity of these recommendations that it put this bold 100 per cent sustainable sourcing commitment in its *Sustainable Living Plan*.

4.6.5 Findus Group

As a leading UK supplier of fish and seafood, Young's Seafood Limited (YSL), along with the Findus Group (FG), welcomed the Report because it clearly articulated the challenges and choices for global sustainability. Balancing future demand and supply sustainably, and managing the contribution of the

food system to the mitigation of climate change, are fundamental drivers for the FG's business. Seafood is healthy and nutritious and, given the FSA's recommendation to eat fish twice a week (one oily), the challenges of supplying fish sustainably through responsible sourcing are highly important to the FG and our consumers. This is why the FG has developed its *Fish for Life* principles for responsible fish procurement. The FG is actively involved with fishery improvement partnerships and alliances on the European Common Fisheries Policy aimed at reforming and improving fisheries governance. This includes, for example, improvements to fishing methods, reducing by-catch and discards, and controls for illegal fishing.

Aquaculture makes a major contribution to global fish supply and its future development will be fundamental, alongside the focus on wild capture fisheries. Targeted research, improving scientific knowledge, is paramount for both wild and farmed fish, and the FG welcomed the higher profile that the Report brought to this issue. The Report also rightly focused on waste, which remains of significant interest to YSL given its company-wide initiative, "the relentless pursuit of zero". This initiative sets challenging reduction targets in areas such as CO_2 and water usage. Since 2007 there has been an 18 per cent reduction in group CO_2 equivalent, a 41 per cent reduction in water usage and the achievement of zero food waste to landfill.

The FG's consumers are at the core of all the FG does and it welcomed the focus that the Report brought to food security issues and fish in particular. Drawing on this, the FG's aim is to continue to provide its consumers with clear labelling about its products and their raw materials, and help them to make informed decisions about the benefits of consuming fish.

In summary, the Report has had, and continues to have, significant UK and international impact with multiple stakeholders. This extensive impact has made its mark at a national level in the UK and elsewhere and with multinational bodies such as the UN, the EC and the OECD. The Report's methods and findings have found particular resonance with policy and research communities and with several NGOs and the business community.

5 Communications

5.1 Media Coverage

Two press conferences were held on 24 January 2011. The first, for UK-based journalists, took place at the Science Media Centre. This saw Prof. Sir John Beddington sharing a platform with the Secretary of State for Defra, Rt Hon. Caroline Spelman MP, and a selection of the Project's Lead Experts to publicise the findings of the report. This was attended by journalists from a range of publications, including the BBC, the *Financial Times* (FT), *New Scientist*, *The Times*, *The Guardian*, Reuters, Channel 4, *Nature*, *The Telegraph* and *The Sun*.

The second was aimed at International journalists and took place, with Sir John Beddington and the Project's Lead Expert Group, at the Department for Business, Innovation and Skills.

The Report was launched at a stakeholder reception at HM Treasury by Prof. Sir John Beddington, Rt Hon. Caroline Spelman MP (Secretary of State for Defra) and Stephen O'Brien MP (Minister for DfID) on 25 January 2011.

There was heavy media coverage of the Report. A more comprehensive list of coverage is below. Highlights include the report being the lead item on the *Today* programme and lead story on the BBC website early in the morning, falling to second and then third for much of the day, and articles in the *Guardian*, *Telegraph* and FT to name a few.

The Report received broad media coverage (both in the UK and internationally):

- **No easy solution' to global hunger – *Today***
  A detailed analysis of the global food situation has found that a billion people are hungry, another billion malnourished, and that unless action is taken, there will not be enough food for the growing population.
  http://news.bbc.co.uk/today/hi/today/newsid_9371000/9371410.stm
- **Global food stocks face crisis, says chief scientist – *BBC Breakfast***
  There is a stark warning from one of the government's most senior advisors that urgent action must be taken to protect the next generation from a global food crisis. http://www.bbc.co.uk/news/uk-12264200
- **Report: Urgent action needed to avert global hunger – BBC online**
  A UK government-commissioned study into food security has called for urgent action to avert global hunger
  http://www.bbc.co.uk/news/science-environment-12249909
- **Era of low-cost food is over, study warns**
  The era of cheap food is at an end, with the real prices of key crops set to

rise 50–100 per cent during the next 40 years, according to a UK government report. http://www.ft.com/cms/s/0/59130262-27df-11e0-8abc-00144feab49a.html#axzz1ByybTAAR

- **Welcome for report on food security**
  Farming leaders and agricultural scientists yesterday enthusiastically endorsed a report calling for a fundamental change in world food production in order to feed the expected increase in population.
  http://business.scotsman.com/fooddrinkagriculture/Welcome-for-report-on-food.6700983.jp

- **Global food system must be transformed 'on industrial revolution scale'** The existing food system fails half the people on the planet, and needs radical change if world is to feed itself, report warns.
  http://www.guardian.co.uk/environment/2011/jan/24/global-food-system-report

- **Food crisis moves up agenda**
  GENETICALLY-MODIFIED crops could help meet the rising demand for food amid growing populations, the government's chief scientific adviser said yesterday. http://www.cityam.com/news-and-analysis/food-crisis-moves-agenda

- **FOOD PRICES SET TO DOUBLE 'IF WE DON'T USE GM CROPS'**
  FOOD prices could soar by 50 per cent within 40 years if we do not use genetically modified crops, a Government report warned yesterday.
  http://www.express.co.uk/posts/view/225103/Food-prices-set-to-double-if-we-don-t-use-GM-crops-Food-prices-set-to-double-if-we-don-t-use-GM-crops-#ixzz1C2eBmWvR

- **Agriculture needs 'greenest' revolution to cope with rising prices**
  Declining food prices are a thing of the past, and the world must reform its agricultural system to prepare for increasingly volatile prices, the UK government's Foresight Programme said today.
  http://blogs.nature.com/news/thegreatbeyond/2011/01/agriculture_needs_greenest_rev.html

- **Food prices could double without GM foods, scientists warn**
  Food prices could double unless farming undergoes the 'greenest revolution' including genetic modification, cloned livestock and nanotechnology, scientists have warned.
  http://www.telegraph.co.uk/foodanddrink/8279080/Food-prices-could-double-without-GM-foods-scientists-warn.html

- **Organic vs conventional row must stop**
  THE organic and conventional farming lobbies have been urged to put their differences behind them and stop bickering over which system is best to meet the global food challenge.
  http://www.farmersguardian.com/home/livestock/livestock-news/organic-vs-conventional-row-must-stop/36729.article

- **Government urged to keep door open to GM and cloning**
  CONTROVERSIAL new technologies such as GM and animal cloning should not be disregarded in the fight to beat global hunger and ease concerns over rising food prices, leading scientists have warned.
  http://www.farmersguardian.com/home/arable/arable-news/government-urged-to-keep-door-open-to-gm-and-cloning/36721.article

- **Scientists and Ministers call for new agricultural revolution**
  URGENT action is needed to boost food production and avoid the prospect of rising food prices and increasing global hunger, a report by leading scientists has warned. http://www.farmersguardian.com/home/world-news/scientists-and-ministers-call-for-new-agricultural-revolution/36715.article

- **'Revolution' needed to feed the world**
  DEFRA secretary Caroline Spelman has called for an agricultural revolution to feed a global population expected to reach 9bn within 40 years.
  http://www.fwi.co.uk/Articles/2011/01/24/125190/39Revolution39-needed-to-feed-the-world.htm

- **Food security report calls on IT to make the difference for farmers**
  Government-commissioned study says internet access can help agricultural sustainability.
  http://www.computerworlduk.com/news/it-business/3257935/food-security-report-calls-on-it-to-make-the-difference-for-farmers/#

- **Report warns of food shortages without urgent action**
  Food shortages could become common across the globe soon if governments don't know how to adapt to the increasing demands.
  http://www.greenwisebusiness.co.uk/news/report-warns-of-food-shortages-without-urgent-action-2060.aspx

- **Report warns global food system is broken**
  Think tank suggests minimising waste and removing trade barriers could help provide food for 2050 population.
  http://www.businessgreen.com/bg/news/1939083/report-warns-global-food-broken

- **Food shortage 'needs agricultural revolution'**
  A future food shortage could be tackled by genetically modified (GM) crops, the government's chief scientific adviser Professor Sir John Beddington has said in response to a report by Foresight on global food and farming futures.
  http://www.publicservice.co.uk/news_story.asp?id=15278

- **Spelman seizes on food report to promote free markets**
  Global markets must be opened up to deal with the rate of population growth over coming decades, Caroline Spelman has insisted.
  http://www.politics.co.uk/news/environment-and-rural-affairs/spelman-seizes-on-food-report-to-promote-free-markets-$21386821.htm#

- **GM food: the arguments we can't ignore**
  The Foresight Report on Food and Farming Futures, commissioned by the

British government and broken in The Independent by my colleague and our science editor, Steve Connor, is a timely contribution to the debate on food security.
http://blogs.independent.co.uk/2011/01/24/gm-food-the-arguments-we-cant-ignore/

- **Food inflation is only going to get worse in future, warn scientists**
The era of cheap food is over, and prices are likely to rise significantly in coming decades, due to the increase in the global population and a worldwide shift towards eating more meat and dairy produce, a major study into the future of farming has concluded.
http://www.independent.co.uk/life-style/food-and-drink/news/food-inflation-is-only-going-to-get-worse-in-future-warn-scientists-2193301.html

International Media

- **Urgent action needed to avert global hunger - report**
A study on food security commissioned by the British government is calling for urgent action to avert global hunger.
http://www.radionz.co.nz/news/rural/67012/urgent-action-needed-to-avert-global-hunger-report

- **World food production must double, says UK chief scientist**
A new British study has painted a bleak picture of the future of global food security.
http://australianetworknews.com/stories/201101/3120851.htm?desktop

- **Groundbreaking food security report calls for urgent action**
Urgent action needs to be taken in current food production systems in order to defend global food security, says a study commissioned by the UK.
http://story.malaysiasun.com/index.php/ct/9/cid/b8de8e630faf3631/id/735816/cs/1/ht/Groundbreaking-food-security-report-calls-for-urgent-action/

- **UK Government Releases Report on Food & Farming Futures to 2050**
The UK government Science & Technology think-tank, Foresight, has produced a report on the future of food & farming predicting a range of outcomes between 2011 and 2050. http://theglobalherald.com/uk-government-releases-report-on-food-farming-futures-to-2050/9746/

- **Commodities Buzz: Farming Needs New Green Revolution To Feed The World-Report** Food production must change more radically than during the industrial revolution if the world is to feed the more than nine billion mouths forecast by 2050, a U.K. report said. http://www.indiainfoline.com/Markets/News/Commodities-Buzz-Farming-Needs-New-Green-Revolution-To-Feed-The-World-Report/3502441943

- **Experts warn of spikes in global food prices**
LONDON—The current spike in food prices is a repeat of the 2007/08 crisis and indicates urgent reforms are needed to a stressed global agricultural

system, John Beddington, the U.K. government's chief scientist said on Monday.
http://www.thestar.com/business/recession/article/927441--experts-warn-of-spikes-in-global-food-prices?bn=1

- **World threatened by major food crisis, report says**
GLOBAL AGRICULTURE is living beyond its means, a major British report warned yesterday, and the world is threatened with a major food crisis within 20 years unless action is taken urgently.
http://www.irishtimes.com/newspaper/world/2011/0125/1224288248997.html

- **GM crops 'could feed the world' – Press Association**
Genetically-modified crops are among measures needed to tackle problems with global food supplies that could see prices soar, leading scientists have said.
http://www.google.com/hostednews/ukpress/article/ALeqM5hzubOsMYKUxCZMx99a1K72IOUVSg?docId=N03216512958573529 63A

5.2 Dissemination events

Date	Event
25 January 2011	United Kingdom Stakeholder launch of Global Food and Farming Futures project
2 February 2011	Department for International Development Seminar to Policy teams
7 February 2011	Department for Environment, Food and Rural Affairs Seminar to Policy teams
9 February 2011	United Kingdom Parliamentary Launch
16 February 2011	Royal Institute of Chartered Surveyors
16–18 February 2011	Government Chief Scientific Adviser (GCSA) United States visit – multiple stakeholders including World Bank, USAID and USDA
28 February 2011	Her Majesty's Government Interdepartmental Group on Food Policy
17 March 2011	Organisation for Economic Co-operation and Development Rural PovNet Conference
29-30 March 2011	European Commission Joint Research Centre launch of Global Food and Farming Futures project
31 March 2011	Westminster Food and Nutrition Forum – Keynote Seminar: Following the Foresight project on Global Food and Farming Futures – next steps for policy
11–13 April 2011	Wilton Park conference: Global food and agriculture: Policy options in response to increased volatility

Date	Event
13 April 2011	Department for Business, Innovation and Skills talking event
24 May 2011	United Kingdom–China Sustainable Agriculture Innovation Network Governing Board meeting
6–8 June 2011	BASF Colloquium: 'Livestock in the 21st Century – Opportunities & Challenges'
8 June 2011	Biotechnology and Biological Sciences Research Council '100 Questions' Workshop
9 June 2011	Bidwells Agribusiness Private Breakfast Meeting
15–17 June 2011	Organisation for Economic Co-operation and Development Agricultural Knowledge Systems conference
21 June 2011	United Nations Food and Agriculture Organization – Foresight Seminar
23 June 2011	Future Farm World Europe 2011 conference keynote speech: What Will the Farm Look Like in 2050?
27 June 2011	GCSA Talk at World Wide Fund for Nature
28 June 2011	Inside Government 'Meeting the Global Food Security Challenges of the Future through Science and Innovation' conference
13 July 2011	China Executive Leadership Programme 2011
20 July 2011	Syngenta Sensors University Innovation Centre at Manchester University: Landscaping Event for e-Agri Impact on Future Sustainable Agriculture & Food

Date	Event
27 July 2011	GCSA visit to Food and Environment Research Agency
29 July 2011	Sir John Beddington's visit to Oxfam
14–18 September 2011	International Federation of Agricultural Journalists
28 September 2011	European Commission Joint Research Council Conference on 'Scientific support for Food Security and Global Governance'
12–14 October 2011	World Food Prize Borlaug Dialogue
19 October 2011	Foresight Panel Debate at UN Food and Agricultural Organization's Committee for Food Security 2011
31 October 2011	Conference on Challenges Facing Marine Fisheries Science
31 October–2 November 2011	CropWorld Global Conference 2011
4 November 2011	European Food & Farming Partnerships Annual Conference 'Big Food Challenge' speech
22 November 2011	House of Lords and Farmers' Club 'Food security – European cooperation for research and development' speech
24 November 2011	University of Edinburgh Global Change Seminar 'Achieving food and water security in the context of climate change' speech

Date	Event
30 November 2011	World Agricultural Forum Congress 2011
7 December 2011	British Chamber of Commerce, Brussels ‘How Green is my Apple – Sustainable decision making’ conference
18 January 2012	Syngenta-hosted Parliamentary dinner
25 January 2012	Teagasc (Irish Agriculture and Food Development Authority) National Tillage Conference
7 February 2012	Government Science and Engineering Conference
9 February 2012	WWF and Royal Geographical Society ‘Navigating the Perfect Storm’ policy seminar

Foresight
1 Victoria Street
London SW1H 0ET
www.foresight.gov.uk
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