

# **Review of BBSRC-Funded Research Relevant to Sustainable Agriculture**

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**A report for BBSRC Council  
October 2002**

# Foreword

BBSRC Council established the sustainable agriculture review group in February 2002 under the chairmanship of Professor Chris Pollock. The purpose of the group was to review current BBSRC-funded research on sustainable agriculture, to consider the future research priorities and to advise on how these research needs can be best met. The terms of reference and membership of the review group is at annex 1.

The political, social and economic agenda for agriculture is changing. Declines in farmland wildlife, BSE and the 2001 outbreak of foot and mouth disease foster a strong concern that many aspects of current agriculture are unsustainable. The Curry report<sup>1</sup> underlined the need for a UK farming sector that is internationally competitive, a good steward for the environment and provides safe food and a healthy diet. All of these sentiments are at the core of sustainable agriculture.

The creation of DEFRA, with its central aims of ‘sustainability’ has set the scene for a new agenda in the UK. However the move towards more sustainable agricultural systems will require interdisciplinary basic and enabling research with good connectivity through to the strategic needs of Government, industry and the wider marketplace.

In this report we – the review group – set out our views on the basic and enabling research requirements for sustainable agriculture over the next ten years and consider ways in which the research needs could be better delivered. We consulted widely on an early draft of this report and are grateful to all of the respondents (see annex 2) for their helpful comments. We were struck by the overwhelming view that there needs to be more co-ordination of research activities at a national level. There is much that BBSRC Council can do to help drive forward a research strategy in sustainable agriculture but it will only be truly effective if that strategy is taken forward with partners in other research councils, such as ESRC and NERC, and with the close involvement of DEFRA. We hope that this report will form the basis for Council to seek a more collaborative and strategic approach to sustainable agriculture research.

## Structure of the report

We begin in Chapter 1 with a broad sweep of the current research activities in the UK on sustainable agriculture. We consider briefly the current strengths and weaknesses of BBSRC funded research but recognise that current strengths do not necessarily match future needs. Chapter 2 sets out the research needs for the next ten years to support the development of more sustainable agricultural systems. We acknowledge that this is a broad spectrum of research but the strategic priorities and policies of DEFRA are not yet sufficiently advanced to enable us to recommend specific priorities. In Chapter 3 we make a number of recommendations for Council’s consideration. These are intended to improve the co-ordination and delivery of sustainable agriculture research both within and outwith BBSRC.

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<sup>1</sup> Farming and Food a sustainable future. Report of the Policy Commission on the future of farming and food. January 2001. [www.cabinet-office.gov.uk/farming](http://www.cabinet-office.gov.uk/farming)

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# Executive Summary

Changes to the political, social and economic agenda for agriculture in the UK and the EU are strong drivers for a move towards more sustainable agricultural systems. Basic and enabling research will be essential to support and inform developments in all aspects of a more sustainable food chain.

Sustainable agriculture encompasses a very broad range of research and development, and it is therefore difficult to get a precise figure for current spend in this area. Additionally, much of the research that BBSRC funds into the basic biology of plants and animals, although not directly on sustainable systems, makes a significant contribution to the knowledge base that will support advances in sustainable agriculture. The main funders of sustainable agriculture research in the UK are the Research Councils (BBSRC and NERC), Government (DEFRA and SEERAD) and industry in the form of Levy Bodies (see tables 1 and 2, pages 9-11). We estimate that in the order of £100 million is invested annually in the UK.

BBSRC contributes about £24m pa on research of direct relevance to sustainable agriculture and has traditional strengths in the areas of genetic improvement of crop and livestock species, plant genomics, transgenesis and infectious diseases of both livestock and plants. There are further strengths in the infrastructure at BBSRC institutes and long-term studies.

We identify three main priority areas for future research to support and develop sustainable agriculture systems (see table 3, page 16):

- **Innovative Agricultural Practices**
- **New Crops and Systems**
- **The Ecology of Managed Landscapes**

Effective delivery and co-ordination of future sustainable agriculture research is essential. We make a number of recommendations (below) to help improve delivery and co-ordination both within and outwith BBSRC.

The value of any BBSRC funded portfolio of research in sustainable agriculture will be greatly enhanced by complementary basic and enabling research by both NERC and ESRC. Current Research Committee themes and priorities do not clearly promote interdisciplinary research consortia or explicit links with NERC or ESRC.

**Recommendation 1: We recommend that Council considers whether the current research committee structure could be improved to better recognise the broad and integrative nature of sustainable agriculture research. Council may wish to note that we strongly encourage concerted funding actions in this area involving BBSRC, ESRC and NERC. The group favours establishing a dedicated Sustainable Agriculture Research Committee that is preferably a joint committee with NERC and involving ESRC - for which Council would clearly need the agreement of the other parties. The joint committee would promote basic and enabling research into sustainable land use, and provide necessary long-term continuity and scale of research in a way that is very difficult to do with short bursts of integrative funding for initiatives.**

While responsive mode funding is the sole delivery mechanism for university-based research on sustainable agriculture, a substantial proportion of grants are allocated to BBSRC research institutes, which provide important national resources for strategic and long-term research. BBSRC institutes therefore have an advantage and there is a risk that the important contribution of the university sector to BBSRC's sustainable agricultural research could be lost in the current responsive mode system.

**Recommendation 2: We question whether it is desirable to see a narrowing of the sustainable agriculture research base because the universities are unintentionally disadvantaged. We therefore recommend that Council considers mechanisms to encourage partnerships between BBSRC institutes and universities when bidding for responsive mode funding.**

As well as fostering co-ordination amongst the funders of basic and enabling research, BBSRC funded research must be aligned to strategic relevance, especially the requirements of DEFRA. Efforts to score strategic relevance and balance that against research excellence have not been successful to date within BBSRC committees.

**Recommendation 3: We recommend that Council explores ways in which the strategic relevance of projects (which meet the criteria of excellent science) can be better taken into account, and that there is effective oversight to ensure that the sustainable agriculture research portfolio is balanced. One option would be to extend preferential treatment to projects that have funded links to DEFRA or to other funders of relevant strategic and applied research. The remit of BBSRC Strategy Board could be altered if necessary to provide effective oversight of the programme aims and coverage as a whole.**

CSG programmes are developed to help institutes meet their missions and that of BBSRC. They are evaluated via the Institute Assessment Exercise (IAE) and subsequent discussions with Council. In principle, this gives BBSRC the opportunity to agree with Directors the alignment of their CSG portfolios with various elements of BBSRC science strategy.

**Recommendation 4: We recommend that a formal part of the annual presentation to Council by institute Directors should involve endorsement by BBSRC of (a) the proportion of the CSG spend in a particular institute that should be aligned with the Sustainable Agriculture Programme and (b) the aims and objectives of the relevant projects. Council should take into account the breadth and cohesion of the collective institute portfolio in this area, together with the effectiveness of links to other Research Councils and to strategic funding, when deciding upon CSG allocations.**

We would encourage the development of mechanisms to integrate institute strategic spend among relevant BBSRC institutes and between BBSRC and NERC institutes. *Ad hoc* discussions of this type already take place between BBSRC and NERC at Director level. However, considering the national importance of sustainable agriculture research there could be merit in establishing a more formal arrangement, for example a 'virtual institute' or network model to share and combine expertise or facilities at a national level.

**Recommendation 5: We recommend that Council considers the merits and demerits of more formal mechanism(s) to integrate core funding on sustainable agriculture, preferably with the involvement of NERC and DEFRA.**

DEFRA funding is the largest single element of support for strategic land-based research within the UK. Effective provision of relevant underpinning science cannot proceed without close integration with DEFRA's aims and objectives. If BBSRC (and NERC) is to develop its strategy to align more closely with DEFRA's strategic and policy needs, then there needs to be an equivalent acceptance by DEFRA of the importance of continuity of support in these areas.

**Recommendation 6: We recommend that the cycles of review and assessment at a strategic level within the Research Councils and DEFRA should be integrated in order to support the sustainable agriculture programme. We realise that Council cannot do this alone. DEFRA in concert with BBSRC/NERC should take conjoint action to ensure that the DEFRA funding and objectives setting process and the Research Councils' quadrennial reviews are synchronised.**

LINK represents a useful additional route where the programmes are relevant and where there is strategic industrial interest.

**Recommendation 7: We recommend that BBSRC Council review the LINK portfolio to ensure that it aligns, where appropriate, with the Sustainable Agriculture strategy and that the BBSRC review mechanisms are appropriate to ensure that strategic relevance is given due weight.**

BBSRC has taken steps in recent years to create generic platform facilities in structural biology and genomics. These allow widespread access via individual grant applications to central expertise and specialised facilities. There is an equivalent requirement within sustainable agriculture related systems-based studies. A number of large-scale systems experiments or long-term studies already exist within the UK such as the Environmental Change Network, CEDAR and a range of Institute sites. Successful delivery of an integrated programme of the type indicated above will rely upon continued and wider access to such experimental facilities, and the possible development of new facilities and long-term studies to meet evolving research needs.

**Recommendation 8: We recommend that Council reviews (where possible with NERC, DEFRA and SEERAD) the facilities and long-term experimental requirements of the sustainable agriculture programme. This should aim to ensure (a) that suitable sites are identified and supported in order to provide appropriate coverage in terms of the overall strategic aims of the programme and (b) that priority is given to responsive mode bids that utilise such facilities to deliver added value. The current NERC soil microbial process programme is clustered around a single experimental platform in this way.**

The preceding recommendations, if adopted, will make a significant contribution to the way in which sustainable agriculture research is delivered by BBSRC in partnership with other research councils and DEFRA. However, we believe that the activities described must be set against and overarching national policy or strategy on sustainable agriculture and the associated basic, strategic and applied research requirements. Such a national policy is currently lacking in the UK. We urge DEFRA, in consultation with the research councils and other stakeholders to develop and publish an overarching national policy on sustainable agriculture as soon as possible. The proposed Priorities Board should have a key role in the overarching coordination of national policy and research in this area.

**Recommendation 9: We endorse BBSRC's input into the recent DEFRA consultation on the Priorities Board and consider it extremely important that**

**BBSRC is represented if the Board is to go ahead. The Priorities Board should be encouraged to provide a framework for the high-level strategic oversight of all elements of sustainable agriculture research.**

# CHAPTER 1

## Current BBSRC-Funded Research Relevant to Sustainable Agriculture

### Introduction

- 1.1 Sustainable agriculture is a broad concept for which it is difficult to find a single, widely accepted definition. However, in the context of this report sustainable agriculture is defined as ‘socially acceptable systems for the production of crops and farmed animals that are maintained in a stable and productive equilibrium with the broader environment, so that environmental and financial risks are minimised and the choice of future agricultural practices is not compromised’
- 1.2 The definition of sustainable agriculture given above should be seen in the wider context of government policy on Sustainable Development, which the government describes as ‘a better quality of life for everyone, now and in the future’<sup>2</sup>. Achieving it requires four objectives to be met at the same time:
  - Social progress which recognises the needs of everyone
  - Effective protection of the environment
  - Prudent use of natural resources
  - Maintenance of high and stable levels of economic growth and employment
- 1.3 Sustainable agriculture encompasses a very broad range of research and development, and it is therefore difficult to get a precise figure for spend in this area. Additionally, much of the research that BBSRC funds into basic plant and animal sciences, although not directly on sustainable systems, does contribute to the knowledge base that will support advances in sustainable agriculture.
- 1.4 BBSRC currently supports research into sustainable agriculture via four main routes:
  - **Responsive Mode** research grants to a range of UK Universities and BBSRC-sponsored institutes
  - **Core Strategic Grant (CSG)** to its Institutes
  - **Research Initiatives**
  - **LINK**

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<sup>2</sup> [http://www.sustainable-development.gov.uk/what\\_is\\_sd/what\\_is\\_sd.htm](http://www.sustainable-development.gov.uk/what_is_sd/what_is_sd.htm)

## Responsive Mode and CSG

- 1.5 **Table 1** illustrates BBSRC Responsive Mode and CSG funding for sustainable agricultural research.
- 1.6 Responsive Mode funding of relevance to sustainable agriculture is covered mainly by three research committees; Agri-Food, Plant and Microbial Sciences and Animal Sciences. The Sustainable Agricultural Systems theme, in the Agri-Food Committee, is particularly relevant, and places emphasis on research into innovative agricultural systems, soils, the impact of agriculture on biodiversity, genetic modification and its consequence, mathematical modelling and farm animal welfare. The remits of the remaining five BBSRC research committees are less directly related to sustainable agriculture than are those above. However, they will inevitably generate information and approaches that impact on sustainable agriculture research.

## Initiatives

- 1.7 A number of recent BBSRC Initiatives have supported research of relevance to sustainable agriculture. These include:
- **Gene Flow in Plants and Microorganisms** (BBSRC/NERC) (~£4.6 million committed to projects with relevance to sustainable agriculture)
  - **The Mathematics and Modelling of Agricultural and Food Systems** (~£2 million of direct/indirect relevance)
  - **Investigating Gene Function** - of relevance to sustainable agriculture were the resources for Arabidopsis (GARNET), Brassica, yeast and plant fungal pathogens (COGEME), cereals and farm animals, for which ~£14 million has already been invested.
  - **Exploiting Genomics** - amongst the successful projects was a £1.2 million project to exploit the genome of an insect pathogenic bacterium as a potential source of new insecticides and nematicides.

## LINK Programmes

- 1.8 BBSRC is involved in three DEFRA-led LINK schemes with direct relevance to sustainable agriculture, namely Sustainable Livestock Production LINK, Horticulture LINK Programme and Sustainable Arable LINK Programme. These schemes enable relevant pre-competitive research to be supported jointly by Government Departments, Research Councils and Industry. BBSRC is contributing £800k towards four LINK grants under these programmes.
- 1.9 BBSRC also contributes to the LINK component of the Sustainable Technologies Initiative (STI), through which the Council is able to support projects in that area of non-food crops. In addition, BBSRC supports LINK projects across the whole of Council's remit using the franchise arrangement. Currently several projects with relevance to sustainable agriculture are supported by this route.

## Strengths and Weaknesses of BBSRC Funded Research on Sustainable Agriculture

- 1.10 BBSRC funded research of direct relevance to sustainable agriculture is traditionally strong in the areas of genetic improvement of crop and livestock species, plant genomics, transgenesis and infectious diseases of both livestock and plants. Institutes such as Rothamsted Research (RR), John Innes Centre (JIC) and the Institute for Animal Health (IAH) are (respectively) world leaders in the fields of integrated crop management, basic plant sciences and control of animal disease. There are further strengths in the infrastructure at BBSRC institutes (i.e. experimental farms, extensive glasshouse facilities, containment facilities) and long-term studies, such as the Broadbalk field experiment at RR and the Rowden Plots at Institute of Grassland and Environmental Research (IGER).
- 1.11 BBSRC funded research, particularly through responsive mode, has tended to be skewed towards ‘reductive’ studies at the molecular and cellular level. Whilst these are important, it has led to a relative weakness in integrative and systems studies of relevance to sustainable agriculture at the whole organism, field, farm or catchment level. BBSRC’s activities driven by the responsive mode are also weak with respect to the level of strategic oversight used to generate the research funding ‘portfolio’ in sustainable agriculture. Although Institute CSG spend recognises the strategic linkages within individual institute remits, there has been little overarching strategic planning. There needs to be more consideration of the strategic relevance of the basic research being funded, and this is an issue that we return to in Chapter 3.
- 1.12 It is important to state, however, that past/current strengths and weaknesses in sustainable agricultural research are not reliable indicators of future needs. The political and social agenda for agriculture is changing, yet sustainable agricultural systems cannot be divorced from the demands of the marketplace. The future research requirements to support and inform agricultural policy and the needs of consumers/industry will not be the same as those in the past. In Chapter 2 we consider what the future research needs are likely to be and how well they map onto current strengths and capacity.

## Other Main Funders of Research on Sustainable Agriculture

- 1.13 In addition to BBSRC, there are a number of other funders of research into sustainable agriculture in the UK. It is beyond the scope of this report to list all of these but **Table 2** provides an overview of the key organisations involved, the type of work being done and the approximate level of financial commitment. In addition to the funders shown in table 2, the EU Framework programmes have contributed to research in this area. However the wide variance between the objectives of successive framework programmes means that it is difficult to assess accurately the level of involvement.

## Conclusions

- 1.14 It is not possible to get a precise figure but, through a diversity of routes, BBSRC invests approximately £39M per annum (~15% of total R&D spend) in basic and enabling research that is directly or indirectly relevant to sustainable agriculture. NERC also funds relevant basic research, with DEFRA, SEERAD, Levy Boards, Industry and other government departments funding strategic and applied research and Knowledge Transfer. We estimate that in excess of £100M is spent per annum in the UK on research of relevance to sustainable agriculture.
- 1.15 Analysis of the main funders and their interactions reveals that although there is a significant annual investment there is little overall co-ordination of programmes or effort, nor is there an overarching strategy for sustainable agriculture R&D in the UK.
- 1.16 In Chapter 2 of this report we identify some key priorities over the next 10years for R&D to support sustainable agricultural systems in the UK. The priorities cover basic, strategic and applied research.

**Table 1: BBSRC Funding for Sustainable Agriculture Research Through Responsive Mode and Institute Core Strategic Grant (CSG)**

| <b>Responsive Mode Funding - Basic and Enabling Research</b>   |   |  |
|--|---|--|
| <b>Research Committee</b>  | <b>Current Themes and Priority Research Areas</b>   | <b>Approximate Annual Spend</b>              |
| Agri Food  | <ul style="list-style-type: none"> <li>• Sustainable agricultural systems (various subjects)</li> <li>• Mathematical modelling of agricultural systems and food processes</li> <li>• Evolutionary and ecological processes</li> <li>• Sustainability of soil functions</li> </ul> | £4 million (directly relevant)               |
| Plant and Microbial Science  | <ul style="list-style-type: none"> <li>• Photosynthesis, respiration and partitioning of resources.</li> <li>• Interactions between plants and other organisms</li> <li>• Soil and rhizosphere biology –</li> </ul>   | £4 million (indirectly relevant)             |
| Animal Sciences  | <ul style="list-style-type: none"> <li>• Livestock diseases and development of therapeutics.</li> <li>• Insect physiology and semiochemicals</li> <li>• Livestock growth and digestive physiology</li> <li>• Animal welfare (livestock and other animals)</li> </ul>              | £3 million (indirectly relevant)             |
| <b>Core Strategic Grant to BBSRC-sponsored Institutes - Basic and Enabling Research</b>  |   |  |
| <b>Institute</b>   | <b>Main Research Areas</b>  | <b>Approximate Annual Spend</b>              |
| Rothamsted Research (RR)   | <ul style="list-style-type: none"> <li>• Pest, disease and weed management</li> <li>• Soil science and crop nutrition</li> <li>• Ecological and environmental sciences</li> <li>• Crop performance and genetic improvement</li> </ul>   | £8 million (directly relevant)               |
| Institute for Grassland and Environmental Research (IGER)  | <ul style="list-style-type: none"> <li>• Agro-ecology</li> <li>• Soil science</li> <li>• Plant-animal interactions</li> <li>• Durable resistance and crop breeding</li> </ul>   | £2.5 million (directly relevant)             |
| Silsoe Research Institute (SRI)  | <ul style="list-style-type: none"> <li>• Precision agriculture</li> <li>• Decision support systems</li> <li>• Reduction of environmental impacts of land use</li> </ul>   | £1.5 million (directly relevant)             |
| John Innes Centre (JIC)  | <ul style="list-style-type: none"> <li>• Basic plant and microbial sciences</li> </ul>  | £7million (directly and indirectly relevant) |
| Roslin Institute (RI)  | <ul style="list-style-type: none"> <li>• Farm animal breeding</li> <li>• Animal welfare</li> </ul>  | £1 million (directly relevant)               |
| Institute for Animal Health (IAH)  | <ul style="list-style-type: none"> <li>• Controlling animal disease</li> </ul>  | £6.5 million (indirectly relevant)           |
| Horticulture Research International (HRI)*<br>* HRI is a non-Departmental Public Body sponsored by, and responsible to, DEFRA. BBSRC CSG to HRI is ~£3 million pa. | <ul style="list-style-type: none"> <li>• Crop protection</li> <li>• Soil science</li> <li>• Plant nutrition</li> </ul>  | £1.5 million (directly relevant)             |

**Notes:** The remnants of the two remaining BBSRC institutes, Institute of Food Research and Babraham Institute, lie substantially outside the scope of this review.

**Table 2 Funding for Sustainable Agriculture Research – Organisations other than BBSRC**

| Organisation  | Main Research Areas  | Approximate Annual Spend   |
|---|--|--|
| <p><b>NERC</b><br/>(basic and enabling research)</p>                              | <ul style="list-style-type: none"> <li>• Basic Hydrology, optimisation of irrigation practices, reuse of saline/waste waters, surface water abstractions/sustainable baseflows to rivers</li> <li>• Pollution from agriculture (ammonia gas, nitrate in groundwater)</li> <li>• Climate change – impact on agriculture</li> <li>• Biodiversity and impacts of land use changes, soil biodiversity and biodiversity indicators, restoration ecology</li> <li>• Catchment scale studies of hydrology/chemistry/ecology</li> <li>• Agroforestry, water resources, carbon sequestration, water quality, biofuels, alternative crops</li> </ul> | <p>£5 million of direct relevance to sustainable agriculture. Further £10-15 million of indirect relevance</p> |
| <p><b>DEFRA</b><br/>(Strategic and applied research)</p>                          | <ul style="list-style-type: none"> <li>• Precision agriculture</li> <li>• Breeding for lower inputs</li> <li>• Reduced pesticide inputs</li> <li>• Alternative crops</li> <li>• Conservation</li> <li>• Animal health and welfare</li> <li>• Reduction of pollution from agriculture</li> <li>• Organic farming</li> <li>• Plant health</li> <li>• Improved animal management systems</li> </ul>   | <p>£50 million</p>   |
| <p><b>SEERAD</b></p>  | <ul style="list-style-type: none"> <li>• Animal and crop health including disease diagnosis, host pathogen interactions and disease resistance</li> <li>• Reduced use of pesticides</li> <li>• Precision farming approaches</li> <li>• Non-food crops, high value niche market products</li> <li>• Pollution and other environmental concerns.</li> </ul>  | <p>£20 million in 2002/03</p>  |
| <p><b>Levy Bodies*:</b></p> <p>* main bodies for which figures were available</p> | <p><b>Home Grown Cereals Association (HGCA)</b></p> <ul style="list-style-type: none"> <li>• Reduced reliance on agrochemicals, durable resistance to pests and diseases</li> <li>• Precision farming, sensor development</li> <li>• Organic production</li> <li>• Increased biodiversity in cereal production</li> <li>• Soil management – zero/minimal/ono-inversion tillage</li> </ul> <p><b>Horticultural Development Council (HDC)</b></p> <ul style="list-style-type: none"> <li>• Crop protection</li> <li>• Varieties and product quality</li> <li>• Waste and environment management</li> </ul>                                   | <p>£4 million</p> <p>£2 million</p>  |

| Organisation              | Main Research Areas  | Approximate Annual Spend |
|---------------------------|--|--------------------------|
|                           | <p><b>British Potato Council (BPC)</b></p> <ul style="list-style-type: none"> <li>• Improved understanding of crop nutrition and resource utilisation</li> <li>• Understanding of disease and epidemiology</li> <li>• Diagnostics</li> <li>• Improved aphid management</li> <li>• Improved storage</li> </ul>  | £1 million               |
|                           | <p><b>Meat and Livestock Commission (MLC)</b></p> <ul style="list-style-type: none"> <li>• Animal breeding for improved efficiency and quality</li> <li>• Improved animal nutrition</li> <li>• Multidisciplinary systems research addressing costs, environment welfare and food safety</li> <li>• Improving animal health</li> </ul>  | £2 million               |
| <b>Environment Agency</b> | <ul style="list-style-type: none"> <li>• Sources and impacts of point and diffuse agricultural pollution</li> <li>• Sustainable farming and land management practices</li> <li>• Sectorial best practice research: sheep dairy and outdoor pigs</li> <li>• Soil erosion and sediment delivery</li> <li>• Flood management and land use</li> <li>• Farm-scale advisory and decision support tools for environment management</li> </ul> | Not readily available    |
| <b>Others</b>             | The category 'others' refers to a raft of organisations such as industry, charities and wildlife agencies, that to a greater or lesser extent fund research into sustainable agriculture.  | Not readily available    |

# CHAPTER 2

## Drivers for Sustainable Agriculture and Future Research Priorities: where we want to be by 2010

### Drivers

- 2.1 The background to the requirement to develop a BBSRC strategy in this area is driven by changes in the nature of agriculture and land use and by changes in the nature of fundamental biological research and its support in the UK. In the latter case, the recent quinquennial review and the subsequent formation of RCUK has highlighted the importance of integrated, strategy-driven research within the overall Research Council portfolio. This driver is reinforced by the increasing cost and complexity of biological research, and by the benefits that accrue from cross-disciplinary teams deployed in key areas to generate integrated approaches to problems.
- 2.2 Under these circumstances, the definition of a science strategy in this area must aim to improve the quality, relevance and integration of the basic and enabling research funded by the Research Councils and to link this both to the current strategic research priorities of government and industry and to the longer-term needs and shape of agriculture and land use in the UK and Europe. The needs and shape of agriculture are driven strongly by the market place and consumer demands.
- 2.3 There have been a number of recent discussion papers and policy documents covering agriculture and these contain many common elements. Predictions for the next 10-15 years are that commodity food prices will remain low (in developed country terms) and that food security is not likely to be a major concern within the EU. Thus the political drivers that condition the current state of EU agriculture will continue to change (albeit slowly) in a manner that will reduce direct production-based subsidy and encourage shifts in support to promote the delivery of environmental goods and promote global trade in produce. Promotion of this scenario is already implicit in recent statements from ministers and officials. In developing a research strategy on sustainable agriculture there needs to be recognition that EU policy and obligations under EU Directives (e.g. the Habitats Directive or the Water Framework Directive) are major drivers of agriculture in the UK. Any national strategy is therefore highly influenced by the wider EU agenda and by a raft of UK environmental regulations, such as the Biodiversity Action Plan, most of which stem from Brussels.

- 2.4 Delivery of environmental goods in the UK is, however, linked to the retention of economically viable agriculture. Across the UK as a whole, food production remains a major source of on-farm income. This multifunctional land use concept is central to the ideas on sustainability currently under debate, since it will help to deliver economic, environmental and social benefits. In terms of food production, issues of quality, safety, animal welfare and shifting of added value up the food chain are of increasing importance. However, in parallel with this, agricultural systems will increasingly be relied upon to conserve resources, to cause less pollution, to deliver a range of other goods (recreational, aesthetic, renewable resources etc.), and to underpin the conservation and sustainable use of biological diversity.
- 2.5 Within the scope of Research Council funded research, priorities need to be set that are consistent with the framework above and that will deliver research that is relevant to the strategic needs of government, industry and the EU.
- 2.6 One way in which this issue can be addressed is to identify and prioritise win-win-win opportunities. For example, precision agriculture reduces inputs, thus potentially minimising losses to the environment, reducing costs and increasing profitability. On the other hand, key elements of international conventions on climate change or biodiversity can only be met by the application of science to affect improvements in one area driven by changes in practice in others that will inevitably have some negative consequences.

## **Proposed Priority Areas for Future Research**

- 2.7 In this Chapter, we identify three main priority areas for research to support and develop sustainable agriculture systems (Table 3). We acknowledge that these areas encompass a broad spectrum of research – from basic to applied - but the strategic priorities and policies of DEFRA are not yet sufficiently advanced to enable us to recommend specific priorities for BBSRC-funded research. It is expected that the new DEFRA Science R&D Strategy (to be published in the new year) will set out the Department's aims and objectives for agricultural research. This will provide an opportunity for BBSRC Council to prioritise the sustainable agriculture research strategy (drawing on the research areas identified in table 3) in the light of DEFRA's strategic needs.
- 2.8 A number of respondents to the consultation made the point that table 3 needs to give greater consideration to specific issues such as food research, organic farming, animal health and animal welfare. We agree that these are all elements of sustainability. However, the research priorities in this report have to be seen in the context of the new BBSRC Strategic Plan 2003-2008 in which some of these other issues are considered more specifically. Animal health and disease is very important and this has been acknowledged explicitly both in the Strategic Plan and by this group in table 3. We consider that the welfare implications of novel sustainable systems should be considered, but that the existing committee structures are appropriate to support more generic and mechanistic research.. Finally, organic farming was flagged to us as deserving special mention. We intend this report to be applicable to a wide spectrum of agriculture and there is

much in the enabling and strategic research set out in table 3 that would inform and be of value to organic systems. We feel that it is important for BBSRC to maximise the generic relevance of its research, rather than highlight specific production systems that might benefit.

### **Innovative agricultural practices**

- 2.9 This area addresses innovations in crop and animal production arising from improved fundamental understanding of the biological processes relating to soils, plants and animals in agricultural systems. These may include improvement in the genetic properties or crops and animals, integrated management systems and utilisation of biological agents. This area encompasses “precision agriculture”; basic research on a range of information, engineering and management technologies to optimise agricultural inputs. There are opportunities across the BBSRC remit in plants, animals, microbes, engineering and systems. There are good existing links to strategic science (DEFRA) and a significant record of achievement. The requirement over the next decade for EU member states to meet challenging water quality objectives under the Water Framework Directive will give work in this area high social, economic and political importance.

### **Novel crops and systems**

- 2.10 This area addresses sustainability by offering new opportunities with (generally) lower inputs; together with reducing fossil fuel reliance. There has been significant strategic research in this area, which has already led to some new opportunities for non-food crops. It will be important to identify the medium- to long-term research challenges and to integrate them with the strategic portfolio. The recent Foresight programme dealt specifically with crops for industry as one of its priorities. With novel as well as current crops, there is a need to develop research programmes at the appropriate scale, of the catchment or flood-plain, which match the emerging priorities in soil and water science and lie at the BBSRC/NERC/DEFRA interface.

### **Ecology of managed landscapes**

- 2.11 The Sustainable Agricultural Systems theme of the Agri-Food Committee defines agricultural systems as “agricultural and associated natural habitats in the rural landscape that may affect or be affected by agricultural practices”. Agricultural and associated semi-natural ecosystems characterise much of our managed rural environment and are inextricably linked in the sustainable delivery of food, environmental goods and ecosystem services. Both face change from evolving agricultural practices as well as from the effects of climate and new species, including plant and animal diseases. Biodiversity research in these systems is important to the creation and validation of environmental stewardship programmes, as well as to the understanding of functionality in agro-ecosystems, particularly soils. Agricultural systems also provide important opportunities for research on disturbance and change, on ecology and evolution. Modern “omics” technologies offer new opportunities to study ecology/evolutionary biology in agro-ecosystems where genetic variation

in part of the system is well characterised. Studies at a range of scales are required to understand the basis of population and community abundance and maintenance and deliver key biodiversity targets.

## Developing Research Priorities for BBSRC

- 2.12 As indicated above, work funded by BBSRC in this area has to be relevant to its own mission and capable of generating added value via synergies with other basic and enabling studies (e.g. NERC) and with more strategic research funded by DEFRA, industry, EU and other government departments. Within the BBSRC portfolio, (including LINK), research ranges from highly mechanistic studies on basic biological processes through to "enabling" research that examines generic effects within a specific agricultural or land-use context. At the level of enabling research, economic and social research (e.g. ESRC) may be critical to defining options and setting priorities for development of new technologies, new crops and production systems and initiatives to monitor and maintain environmental health. There is no clear division of funding lines, but obviously enabling research is likely to have more immediate strategic relevance.
- 2.13 **Table 3** attempts to summarise those research priorities that would both support sustainable agriculture and deliver outputs of strategic relevance to other funders. Progress must be driven by the opportunities offered by new research findings as well as by strategic research requirements. Within the BBSRC portfolio, the progressive application of "omics" technologies will extend the precision of crop and livestock improvement strategies and help to delineate targets both in terms of reduced inputs and the generation of novel products from non-food crops. There are also significant opportunities to use such approaches to understand population structure and ecology, particularly in intractable ecosystems such as soil and rumen. In parallel, novel computational and modelling approaches will drive better managements and help us to understand emergent properties of important agricultural systems. However, as discussed in paragraph 2.7, the generation of improved alignment between RC-funded and DEFRA-funded research requires DEFRA to identify its revised strategic R&D needs. Once this has happened, the specific priorities for BBSRC can be further refined, drawing on table 3 and the comments above. Those areas marked in bold in table 3 represent current strengths of BBSRC funded science and would provide strong foundations on which to build. There is also recognition that basic and enabling research carried out by NERC is highly relevant to this area and specific synergies have been identified by shading.

**Table 3: Sustainable Agriculture Research Priorities**

- Shaded areas represent particular synergies between BBSRC and NERC in basic and enabling research.
- Areas in **bold** represent current strengths in BBSRC
- ESRC has wide interest in many of the priority areas – changes in agricultural practice must be socially and economically viable.
- Table 3 also to be read in association with BBSRC Strategic Plan 2003-2008.

|   | <b>Basic Research</b><br>(Responsive Mode, Some CSG)  | <b>Enabling Research</b><br>(CSG, Link, some responsive mode, DEFRA)  | <b>Strategic Research</b><br>(DEFRA/Industry)   |
|---|---|---|---|
| <p><b>Innovative Agricultural Practices</b></p> <p>Addresses innovations in crop and animal production arising from improved fundamental understanding of the biological processes relating to soils, plants and animals in agricultural systems.</p> | <ul style="list-style-type: none"> <li>• <b>Optimising genetic makeup of agricultural species (plants and animals) for quality and to improve resilience</b></li> <li>• <b>Process modelling of key inputs and pollutants</b></li> <li>• Sensor development and monitoring</li> <li>• <b>Durable resistance to pests and diseases (plants and animals)</b></li> <li>• <b>Identification of targets for intervention in pest and disease control (plants and animals)</b></li> <li>• Alternatives to chemical inputs</li> <li>• Mathematical modelling of disease</li> </ul> | <ul style="list-style-type: none"> <li>• Less invasive approaches to agricultural land and water management</li> <li>• Uniformity, heterozygosity and heterosis and their manipulation in plant and animal breeding</li> <li>• Integration of modelling and measurement for DSS</li> <li>• Integrated Management systems for grassland livestock</li> <li>• New management approaches for low input systems</li> </ul>  | <ul style="list-style-type: none"> <li>• Zero till</li> <li>• Bicropping</li> <li>• Economically and environmentally effective nutrient and waste management in intensive systems</li> <li>• Management of ammonia and methane emissions by livestock in grassland systems</li> <li>• Welfare-friendly animal systems</li> <li>• Development of catchment-based nutrient budgets</li> <li>• Breeding of plants and animals for resistance and improved resource utilisation</li> <li>• Development of vaccines and diagnostics</li> <li>• Pest and disease technologies for ICM systems (including Biocontrol)</li> </ul> |
| <p><b>New Crops and Systems</b></p> <p>Addresses sustainability by offering new opportunities with (generally) lower inputs; together with reducing fossil fuel reliance.</p>   | <ul style="list-style-type: none"> <li>• <b>Regulation of metabolic pathways</b></li> <li>• <b>Control of crop development</b></li> <li>• Resource utilisation efficiency</li> <li>• Manipulation of non-agricultural traits</li> </ul>   | <ul style="list-style-type: none"> <li>• <b>Key targets: (lignin, starch, fats and oils, high value primary and secondary products, controlled structural modifications)</b></li> <li>• <b>Key targets: (flowering, allometry, organogenesis, spatial control of metabolism)</b></li> <li>• <b>Interactions between acquisition and utilisation processes (carbon, nitrogen, phosphorus, water)</b></li> <li>• Mineral tolerance, water use efficiency, bioremediation</li> <li>• Defining alternative materials for industrial purposes</li> </ul> | <ul style="list-style-type: none"> <li>• Life cycle analysis to generate a framework for product development</li> <li>• Management of industrial crops to minimise inputs (including energy) and losses to the environment</li> <li>• Understoreys in industrial cropping systems</li> <li>• Development of multifunctional crops/systems for renewable materials for industry, bioenergy, floodplain or erosion management, bioremediation etc</li> </ul>  |

|  | <b>Basic Research</b><br>(Responsive Mode, Some CSG)  | <b>Enabling Research</b><br>(CSG, Link, some responsive mode, DEFRA)  | <b>Strategic Research</b><br>(DEFRA/Industry)  |
|--|---|---|--|
| <p><b>The Ecology of Managed Landscapes</b></p> <p>Addresses sustainability of agricultural and associated semi-natural ecosystems at the landscape scale.</p> | <ul style="list-style-type: none"> <li>• <b>Gene flow across physical and biological barriers</b></li> <li>• Invasiveness in weeds, diseases and pests</li> <li>• Regulation of biodiversity in farm and adjacent habitats</li> <li>• Managing ecosystems for climatic change</li> <li>• Functional agrobiodiversity</li> </ul> | <ul style="list-style-type: none"> <li>• <b>Soil quality; definition and manipulation</b></li> <li>• Interactions between management and soil that can improve quality</li> <li>• Developing mechanistic models for land management that can be used to promote or restrict gene flow</li> <li>• Use of models to develop and test managements that modulate invasiveness</li> <li>• <b>Scaling up and the definition of managements to promote landscape-scale diversity in arable and grassland agriculture</b></li> <li>• Manipulation of animal and plant communities (including grassland) for improved production and resilience</li> </ul> | <ul style="list-style-type: none"> <li>• The enhancement of biodiversity, particularly in grassland systems</li> <li>• Multifunctional management; (zero till, soil carbon banks, better soil processes).</li> <li>• Managing farmland to mitigate the effects of climate change on "natural" communities</li> <li>• Improved pest, weed and disease management at the landscape scale via management diversity (ICM)</li> </ul> |

# CHAPTER 3

## Delivery Mechanisms

### Introduction

- 3.1 The research priorities for sustainable agriculture identified in Chapter 2 of this report cannot be delivered effectively without more co-ordination of research activities between the main UK funders. The majority of respondents to the consultation on this report cited more co-ordination of research activities as being essential. The value of any BBSRC-funded portfolio of research in this area will be significantly enhanced by (a) parallel support for complementary basic and enabling research by both NERC and ESRC and (b) the integrated provision of strategic research funding by DEFRA (supported *inter alia* by other Government Departments, the Levy Bodies, the Devolved Assemblies, the Environment Agency and Industry).
- 3.2 Co-ordination of sustainable agriculture research needs to be improved at a number of different levels. There are actions that BBSRC can take to improve internal delivery of strategy. There are also, however, other actions that lie outside the direct power of BBSRC Council to deliver alone, but which Council should be seeking partnerships with others to help achieve. Below we make a number of specific recommendations to improve delivery of sustainable agriculture research strategy, both within and outwith BBSRC, where they impact on this Council.
- 3.3 Internally, BBSRC research priorities are delivered principally via responsive mode grants funded through the research committees and via Institute CSG programmes. In both cases there would be benefit from introducing a greater level of strategic oversight and direction to ensure that a balanced sustainable agriculture portfolio is being achieved.

### Committee Responsive Mode Portfolios

- 3.4 The research portfolios of the research committees are currently based on a balance between the research excellence of applications submitted to the committee and the priorities listed in the committee remit. Sustainable agriculture research has become an increasingly smaller and less central element of a BBSRC research programme that has been increasingly focused below the organismal level, on model animal and plant systems, and on physiological and molecular processes affecting human health. In contrast, the scientific priorities for sustainable agriculture emphasise systems-based, integrative research, and there is a need to preserve this distinctiveness.

- 3.5 BBSRC sustainable agriculture themes and priorities already encourage a modest amount of integrative research as ecological, evolutionary and modelling components of grants and studentships, but do not clearly promote interdisciplinary research consortia in these areas or explicit links with NERC or ESRC (the socio-economic elements of sustainable agricultural systems are very important). Research Initiatives have been used in the past to encourage interdisciplinary and cross-Council research, but by funding on the sole basis of excellent science it is difficult to achieve a balanced portfolio of research in the space of just one or two calls.

**Recommendation 1: We recommend that Council considers whether the current research committee structure could be improved to better recognise the broad and integrative nature of sustainable agriculture research. Council may wish to note that we strongly encourage concerted funding actions in this area involving BBSRC, ESRC and NERC (such as the RELU bid in SR2002). The group favours establishing a dedicated Sustainable Agriculture Research Committee that is preferably a joint committee with NERC and involving ESRC - for which Council would clearly need the agreement of the other parties. The joint committee would promote basic and enabling research into sustainable land use, and provide necessary long-term continuity and scale of research in a way that is very difficult to do with short bursts of integrative funding for initiatives.**

- 3.6 While responsive mode funding is the sole delivery mechanism for university-based research on sustainable agriculture, a substantial proportion of grants are allocated to BBSRC research institutes. Of 77 grants awarded in this area since 2000 through the Agri-food and other committees, 49 (64%) have involved BBSRC institutes. Of these, 24 (30% of total) represent joint projects between institutes and universities. This collaboration should be encouraged, as institutes provide important national resources for strategic and long-term research. BBSRC institutes are perhaps better positioned than universities to be responsive to BBSRC sustainable agriculture themes and priorities, and there is a risk that the important contribution of the university sector to BBSRC's sustainable agricultural research could be disadvantaged in the current responsive mode system.

**Recommendation 2: We question whether it is desirable to see a narrowing of the sustainable agriculture research base because the universities are unintentionally disadvantaged. We therefore recommend that Council considers mechanisms to encourage partnerships between BBSRC institutes and universities when bidding for responsive mode funding.**

- 3.7 As well as fostering co-ordination amongst the funders of basic and enabling research, it will be important to maintain the strategic relevance of responsive mode funding in sustainable agriculture. Efforts to score strategic relevance and balance that against research excellence have not been successful to date within BBSRC committees. However, the preferential treatment of applications linked to industrial funding does seem to have worked well.

Similar preferential treatment could be extended to projects with funded links to DEFRA or to other funders of relevant strategic and applied research. For this approach to succeed, adequate funding has to be provided, and there has to be a mechanism of effective oversight to ensure that priority is given to funding applications (providing they meet the criteria of scientific excellence) that are relevant to the sustainable agriculture strategy and that the overall programme is covered adequately.

**Recommendation 3: We recommend that Council explores ways in which the strategic relevance of projects (which meet the criteria of excellent science) can be better taken into account, and that there is effective oversight to ensure that the sustainable agriculture research portfolio is balanced. One option would be to extend preferential treatment to projects that have funded links to DEFRA or to other funders of relevant strategic and applied research. The remit of BBSRC Strategy Board could be altered if necessary to provide effective oversight of the programme aims and coverage as a whole.**

## Institute CSG programmes

- 3.8 CSG programmes are developed to help institutes meet their missions and that of BBSRC. They are evaluated via the IAE exercise and subsequent discussions with Council. In principle, this gives BBSRC the opportunity to agree with Directors the alignment of their CSG portfolios with various elements of BBSRC science strategy. Individual Institutes differ in their CSG aims and objectives, but the missions of a number of them would appear to be consistent with the aims of this strategy document.

**Recommendation 4: We recommend that a formal part of the annual presentation to Council by institute Directors should involve endorsement by BBSRC of (a) the proportion of the CSG spend in a particular institute that should be aligned with the Sustainable Agriculture Programme and (b) the aims and objectives of the relevant projects. Council should take into account the breadth and cohesion of the collective institute portfolio in this area, together with the effectiveness of links to other Research Councils and to strategic funding, when deciding upon CSG allocations.**

- 3.9 Success in delivering institute objectives against the sustainable agriculture programme should be a specific element in the IAE. DEFRA should, wherever possible, be directly involved in the IAE for those institutes that carry out a significant proportion of the sustainable agriculture research (see Recommendation 6). The DEFRA representation on Council will also help to ensure that basic, enabling and strategic research are aligned appropriately. It is important that a similar exercise should be undertaken by NERC in relation to the relevant elements of funding within appropriate CEH sites.
- 3.10 We would encourage the development of mechanisms to integrate institute strategic spend among relevant BBSRC institutes and between BBSRC and

NERC institutes. *Ad hoc* discussions of this type already take place between BBSRC and NERC at Director level. However, considering the national importance of sustainable agriculture research there could be merit in establishing a more formal arrangement, for example a 'virtual institute' or network model to share and combine expertise or facilities at a national level. This could take a number of forms but one option would be for an alliance of institutes and/or key research groups (either within BBSRC or between BBSRC and NERC institutes). The virtual institute or network might be given incentives for collaborative projects within the organisation (e.g. joint studentships) and with HEI groups or the ESRC and EPSRC communities. Depending on the institutes/groups involved it could apply for responsive mode funding from BBSRC or NERC under the umbrella of the organisation. There might be a steering group composed of the heads/Directors of the individual labs to provide oversight and report to BBSRC and NERC CEs and Councils.

**Recommendation 5: We recommend that Council considers the merits and demerits of more formal mechanism(s) to integrate core funding on sustainable agriculture, preferably with the involvement of NERC and DEFRA.**

## **Links to DEFRA.**

- 3.11 DEFRA funding is the largest single element of support for strategic land-based research within the UK. Effective provision of relevant underpinning science cannot proceed without close integration with DEFRA's aims and objectives. By the same token effective integration requires an element of continuity and cohesion from DEFRA in the definition of its R&D objectives. If BBSRC (and NERC) is to develop its strategy to align more closely with DEFRA's strategic and policy needs, then there needs to be an equivalent acceptance by DEFRA of the importance of continuity of support in these areas.

**Recommendation 6: We recommend that the cycles of review and assessment at a strategic level within the Research Councils and DEFRA should be integrated in order to support the sustainable agriculture programme. We realise that Council cannot do this alone. DEFRA in concert with BBSRC/NERC should take conjoint action to ensure that the DEFRA funding and objectives setting process and the Research Councils' quadrennial reviews are synchronised.**

## **LINK**

- 3.12 LINK represents a useful additional route where the programmes are relevant and where there is strategic industrial interest. This may be of particular value in the alternative crops area. BBSRC may wish to work with other agencies to

establish new Link priorities relevant to sustainable agriculture and including organic farming.

**Recommendation: 7: We recommend that BBSRC Council review the LINK portfolio to ensure that it aligns, where appropriate, with the Sustainable Agriculture strategy and that the BBSRC review mechanisms are appropriate to ensure that strategic relevance is given due weight.**

## **Platform facilities.**

- 3.13 BBSRC has taken steps in recent years to create generic platform facilities in structural biology and genomics. These allow widespread access via individual grant applications to central expertise and specialised facilities. There is an equivalent requirement within sustainable agriculture related systems-based studies. A number of large-scale systems experiments or long-term studies already exist within the UK such as the Environmental Change Network, CEDAR and a range of Institute sites.. However, successful delivery of an integrated programme of the type indicated above will rely upon continued and wider access to such experimental facilities, and the possible development of new facilities and long-term studies to meet evolving research needs.

**Recommendation 8: We recommend that Council reviews (where possible with NERC, DEFRA and SEERAD) the facilities and long-term experimental requirements of the sustainable agriculture programme. This should aim to ensure (a) that suitable sites are identified and supported in order to provide appropriate coverage in terms of the overall strategic aims of the programme and (b) that priority is given to responsive mode bids that utilise such facilities to deliver added value. The current NERC soil biodiversity programme is clustered around a single experimental platform in this way.**

## **High-level strategic oversight and a national policy for sustainable agriculture R&D**

- 3.14 The preceding recommendations, if adopted, will make a significant contribution to the way in which sustainable agriculture research is delivered by BBSRC in partnership with other research councils and DEFRA. However, we believe that the activities described must be set against an overarching national policy or strategy on sustainable agriculture and the associated basic, strategic and applied research requirements. Such a national policy is currently lacking in the UK. We urge DEFRA, in consultation with the research councils and other stakeholders to develop and publish an overarching national policy on sustainable agriculture as soon as possible.
- 3.15 The response to the consultation on this report made it clear that there needs to be more co-ordination and integration of sustainable agriculture strategy at a national level involving not just the three relevant research councils and

DEFRA, but also engaging a broader sweep of stakeholders including other government departments, devolved administrations, Environment Agency, rural industry and conversation/land use bodies. Various organisational models can be envisaged to achieve the level of co-ordination necessary for a fully effective national strategy, but we agree with a number of respondents to the consultation that the proposed Priorities Board should have a key role.

**Recommendation 9: We endorse BBSRC's input into the recent DEFRA consultation on the Priorities Board and consider it extremely important that BBSRC is represented if the Board is to go ahead. The Priorities Board should be encouraged to provide a framework for the high-level strategic oversight of all elements of sustainable agriculture research.**

### **REVIEW OF BBSRC-FUNDED RESEARCH RELEVANT TO SUSTAINABLE AGRICULTURE**

#### **TERMS OF REFERENCE FOR THE REVIEW GROUP**

1. To review the BBSRC's current research through CSG, responsive mode and other funding relevant to sustainable agriculture, analysing its strengths and weaknesses.
2. To consider how BBSRC's research priorities in this area relate to those of Government Departments, and in particular to DEFRA, in the light of its recently published aims and objectives, and other relevant reviews.
3. To advise how the Council's requirements for research relevant to sustainable agriculture can best be met in future, in particular to recommend:
  - synergistic structures and partnerships between BBSRC and other funders
  - synergistic structures and partnerships within and between BBSRC Institutes
  - the most appropriate funding arrangements for those Institutes to ensure they retain the capability to deliver the research in the medium- to long-term, and take account of DEFRA's on-going policy needs
  - mechanisms of delivery that optimise the contribution of non-BBSRC institute research through responsive mode
4. To report to Council by October 2002.

February 2002

## **Membership of the Sustainable Agriculture Review Group**

**Professor Chris Pollock**                      **Chairman**  
Director, Institute of Grassland and Environmental Research

**Dr Paul Burrows**                              **Secretary**  
Head, Science Strategy  
BBSRC

**Mr Mike Calvert**  
CE, Royal Agricultural Society of England

**Professor Alan Gray**  
Director, Centre for Ecology and Hydrology, Dorset

**Dr John Sherlock**  
Head, Agriculture, Environment and Food Technology Division  
Science Directorate  
DEFRA

**Professor Jeff Waage**  
Provost and Head of Department of Agricultural Sciences  
Imperial College at Wye.

### Responses to the consultation were received from:

Dr Geoff Andrews, on behalf of Northern Foods plc  
Professor Chris Bostock, on behalf of the Institute for Animal Health (IAH)  
Tim Brigstocke, on behalf of the Royal Association of British Dairy Farmers (RABDF)  
Huw Brodie, on behalf of the Welsh Assembly Government  
Professor Nigel Brown, University of Birmingham  
Dr Tariq Butt, University of Wales Swansea  
Professor Andy Cobb, Harper Adams University College  
Deborah Cosgrove, on behalf of the Natural Environment Research Council (NERC)  
Jonathan Cowie, on behalf of the Institute of Biology (IoB)  
Professor Ian Crute, on behalf of Rothamsted Research (formerly known as IACR)  
Professor Bill Day, on behalf of the Silsoe Research Institute (SRI)  
Dr Les Firbank, Centre for Ecology and Hydrology (CEH)  
Dr John Fisher, on behalf of the British Crop Protection Council (BCPC)  
Professor Margaret Gill, on behalf of the Macaulay Institute  
Harry Griffin, on behalf of the Roslin Institute (RI)  
Professor Keith Gull, University of Manchester  
Colin Harvey, on behalf of the Horticulture Development Council (HDC)  
Dr Lisa Hill, on behalf of the Economic and Social Research Council (ESRC)  
Professor John Hillman, on behalf of the Scottish Crop Research Institute  
Elizabeth Hogben, on behalf of the National Farmers Union (NFU)  
Professor John Hopkins, University of Edinburgh  
Professor Graham Jellis, on behalf of the Home Grown Cereals Authority (HGCA)  
Dr Brian Johnson, on behalf of English Nature  
Professor Chris Lamb, on behalf of the John Innes Centre (JIC)  
Professor Brian Legg, on behalf of the National Institute for Agricultural Botany (NIAB)  
Dr Brian Lindsay, on behalf of the Milk Development Council (MDC)  
Robin Maynard, on behalf of The Independent Farmers' Group  
Ian McKee, on behalf of the Department of Agriculture and Rural Development (DARD)  
Professor John Oldham, on behalf of the Scottish Agricultural College (SAC)  
Dr Alastair Robertson, on behalf of the Institute of Food Research (IFR)  
Dr Andrew Rushworth, on behalf of the Scottish Executive Environment and Rural Affairs Department (SEERAD)  
Michael Scott, on behalf of the Department for International Development (DFID)  
Dr John Sherlock, on behalf of the Department for Environment, Food and Rural Affairs (DEFRA)  
Dr Nick Sotherton, on behalf of The Game Conservancy Trust  
Dr Mike Storey, on behalf of the Potato Marketing Board  
Bob Treacher, on behalf of the Environment Agency  
Dr Roger Turner, on behalf of The British Society of Plant Breeders Limited (BSPB)  
Mr Chris Warkup, on behalf of the Meat and Livestock Commission (MLC)  
Professor Michael Wilson, on behalf of Horticulture Research International (HRI)  
Professor Michael Wolfe, on behalf of Elm Farm Research Centre