

REPORT AND ADVICE

FROM THE

STRATEGIC SCIENCE ADVISORY PANEL

2006-2007

FOREWORD FROM CHAIR OF STRATEGIC SCIENCE ADVISORY PANEL

The Strategic Science Advisory Panel (SSAP) was established in January 2006 as part of the recommendations included in '*Strategic Research for SEERAD: 2005-2010*' with a remit to provide independent advice to the Scottish Government's Chief Scientific Adviser for Rural Affairs and the Environment. I had the privilege of chairing the Panel which had an impressive membership of experts covering a wide spectrum of experience and knowledge.

The lifespan of the Panel was limited to 2 years and it met on 8 occasions. Given its limited lifespan it had to focus on a number of key areas and these included climate change; animal health and welfare; biodiversity and conservation; sustainable agricultural systems and rural development. During these discussions the Panel was assisted by experts within and outwith the Scottish Government. In addition the Panel was able to meet with the Directors of the Main Research Providers (MRPs) including the Macaulay Land Use Research Institute, Rowett Research Institute, Moredun Research Institute and Scottish Crop Research Institute, Scottish Agricultural College and Royal Botanic Garden, Edinburgh.

Within the short lifespan of the Panel a number of major developments occurred which influenced its work. The election of a new Scottish Government in May 2007 brought not only changes within SEERAD¹ but also a refocusing of Government priorities with regard to the environment. Externally there was a rapidly growing emphasis on world food prices, climate change and the future development of biofuels. These external factors are inter-related and will have profound effects on Scotland and its terrestrial, freshwater and marine environments.

A number of high level conclusions emerged from the work of the Panel and these form the main section of this report. They recognise climate change and its wide implications as a dominant and over-riding theme which will impact on all aspects of Scotland's environment in the future including changes in land use and food production, future threats to biodiversity, new and emerging diseases, changes in rural society and the achievement of sustainable economic development.

The Panel also emphasised the importance of the MRPs as key centres of expertise and a major asset for Scotland. It is vital that their long term and leading edge research is maintained and strengthened. It is equally important that in the future there is closer integration between the work of the MRPs and the strong research base within Scotland's leading Universities.

It is hoped that the work of this Strategic Science Advisory Panel will form a valuable foundation for the development of RERAD's Strategy from 2011 onwards.

Finally I wish to thank the members of the Panel and colleagues within RERAD for their generous support and commitment.

Peter H. Holmes, OBE, FRCVS, FRSE
Chair SSAP

¹ The election of a new Scottish Government in May 2007 brought about changes to the Scottish administration. The Scottish Executive was renamed the Scottish Government with Departments ceasing to exist and being replaced by Directors-General working across Ministerial portfolios. The Science and Analysis Group changed to the Rural and Environment Research and Analysis Directorate (RERAD) and is headed by the Chief Scientific Adviser for Rural Affairs and the Environment. **All references to SEERAD within this document should be read as referring to the Scottish Government**

Contents Page	Page No	
High level Conclusions and Advice to the Chief Scientific Adviser for Rural Affairs and the Environment	1-6	
Introduction	1	
Topics of Emerging High Strategic Significance	1	
Research Base Capacity	4	
Development of Future Science and Research Strategies	6	
 Annexes		
Annex 1	Acknowledgements	7
Annex 2	SSAP Membership	8
Annex 3	Report of the SSAP activities	9
	Working methods	9
	Discussions with the Main Research Providers	10
	Discussion of research needs in selected policy areas	10
	• Animal Health and Welfare (AH&W)	11
	• Biodiversity	12
	• Sustainable Agriculture	13
	• Climate Change	15
	• Rural Development	19

HIGH LEVEL CONCLUSIONS AND ADVICE TO THE CHIEF SCIENTIFIC ADVISER FOR RURAL AFFAIRS AND THE ENVIRONMENT

INTRODUCTION

The strategy for research on agricultural, biological and environmental science '*Strategic Research for SEERAD: 2005-2010*' published in January 2005, identified a need to set up an Advisory Panel to "advise on matters of research strategy and policy".

The Strategic Science Advisory Panel (SSAP) was therefore set up in January 2006 for a period of 2 years to provide and publish high level independent advice to the Scottish Government's Chief Scientific Adviser for Rural Affairs and the Environment on the implementation and development of its research activities and to advise on horizon scanning to inform the future development of its research programmes.

During the course of 2006-07 the Panel members, as a major part of their remit, were tasked with looking to the future and identifying where they saw the research needs in relation to the many challenges and opportunities which Scotland might face on rural, terrestrial, freshwater and marine environmental issues.

To help inform their thinking the SSAP took forward a number of structured discussions on the topics of Animal Health and Welfare, Biodiversity, Sustainable Agriculture, Climate Change and Rural Development. In choosing these topics it was acknowledged that they are not an exhaustive list of topics relevant to their remit. Rather each discussion identified a number of conclusions relevant to Scotland with respect to the main challenges facing the Scottish Government and the research needs to address these in the future which are reported in Annex 3.

The following is a brief summary of the high-level conclusions relating to rural and environment research funded by the Scottish Government (either directly or through public sector bodies) which emerged during the Panel's deliberations. It is recognised that the issues described in these conclusions overlap and should not be seen in isolation from one another. These conclusions include:

- Topics of emerging high strategic significance that need to be addressed in any future research strategy;
- Important points regarding research capacity in Scotland;
- How these matters should be taken forward in a future research strategy.

TOPICS OF EMERGING HIGH STRATEGIC SIGNIFICANCE

Climate Change

The Panel agreed that climate change and its wide impact is a dominant and overriding theme which will be one of the greatest challenges facing Scotland over the next decades. Scotland is keen to play its part in reducing Greenhouse Gas (GHG) emissions. Nevertheless, it is inevitable that there will be impacts on Scotland's terrestrial, freshwater and marine environments, land use activities and rural economy. Research will be needed to provide the understanding and knowledge

needed for solutions to address the demand for local mitigation and adaptation strategies to manage effects in terrestrial, freshwater and marine environments.

Land And Water Use Management

There will be ever more complex demands placed on management of the environment and the protection of soil and water resources will continue to be essential both for agriculture and biodiversity. Water management and, in particular, an economically viable land use industry is a prerequisite in the delivery of ecosystem services in their broadest sense, in both terrestrial and marine environments, in a rapidly changing world. The Panel therefore attaches considerable importance to ensuring that future R&D priorities not only recognise the challenges listed below but that they should also promote competitiveness and distinctiveness within the Scottish land use sector.

The issues surrounding land use and the environment can be expected to grow as global food prices rise and expectations on renewable energy sources increase, leading to an increase in the competition for, and debate on, the optimal use of Scotland's land.

The Panel believe that traditional, sectoral approaches to the management of Scotland's natural resources and to the science underpinning management will not deliver what is needed. For the development of evidence-based policies to meet these challenges, Scotland needs science, including social science, to support multifunctional environmental management, and to find optimum solutions where trade-offs will be needed. Better co-ordination in the management of land, freshwater and marine resources is required, including the cultural heritage.

Biodiversity

Continuing loss of and changes in biodiversity at both global and local scales will set challenges for both management and the protection and maintenance of ecosystem services. Robust evidence will be needed if we are to minimise unwanted effects of a broad spectrum of policy options on key elements of biodiversity and also to maximise the delivery of biodiversity conservation objectives and commitments, in addition to other environmental services. Understanding the interconnection which biodiversity has with both man-made and naturally induced pressures will remain a major challenge for the future.

Food Security

The increase in demand for alternatives to fossil fuels as an energy source could lead to a corresponding increase in the alternative use of existing crops and agricultural land being used for renewable energy sources. Climate change, urban development and large scale conservation projects are also predicted to lead to increasing loss of productive land. The increasing food requirement for a growing world population and from dietary changes in developing nations is incompatible with this predicted loss of productive land. This, in turn, could lead to massive price increases in raw materials which could have a profound impact on Scotland.

It is anticipated that there will be increasing emphasis on food of high quality which is produced locally.

Globalisation

Another challenge facing Scotland will be globalisation and its impact within a Scottish rural context. Interactions with global food supply will continue to affect food prices and agriculture both in Scotland and elsewhere. Shifts in human population growth and movement will impact on the economy of both rural and urban Scotland. One of the effects of climate change could result in large human migratory flows into Scotland leading to an increase in the population. We will therefore need a better understanding of what form population change is taking and consider the effects this will have on prosperity, diet, resource consumption and competition for land. The competitiveness of rural industries and the off-shoring of employment will be important issues. Questions regarding the sustainability of rural communities will need to reflect this uncertainty.

Diet And Well-Being

Food and diet research within Scotland plays both a national and international role. There needs to be co-ordination across human health and other disciplines to better understand how consumers make dietary choices and the means by which to understand and maximise the health benefit and quality of foods. The effects of diet on human health will become increasingly important. There will be important interactions between policies to address obesity and with those addressing nutrition and exercise, including outdoor activities. The positive and negative impact of the environment on human health and well-being are increasingly being recognised. A better understanding is needed about these interactions in order that appropriate policy implications can be addressed.

Emerging Diseases

Climate change is already increasing the incidence of new diseases in plants and animals, including fish, and this can be expected to accelerate and pose increasing risks to human well-being, both medical and socio-economic. Scotland's future capacity for adequate disease surveillance and research into emerging diseases will be a key issue. Our capacity to address these emerging risks must also encompass innovative research that looks beyond chemical, drug and vaccine development through better understanding of the genotypes of key species for Scotland.

Rural Development

There will be a continuing need for research to support the Scottish Government's rural development policies including, for example, promoting resilient and sustainable rural communities; accessible public services; strengthening rural economies and social inclusion; and engagement in the evolution of the Scottish Rural Development Programme (SRDP).

RESEARCH BASE CAPACITY

Main Research Providers (MRPs)

The Panel recognise the range and role of the Main Research Providers (MRPs) from a clear focus on delivery of strategic science as a conduit to applied outputs, through their excellence on a world scale, to delivering a dividend to Scotland in terms of the potential to inform policy, inward investment and adding value to industry, rural and agricultural sectors. The Panel considers that the MRPs remain key to meeting these scientific challenges in Scotland. The MRPs and Higher Education Institutions (HEI), Non Departmental Public Bodies (NDPB) (e.g. Scottish Natural Heritage (SNH), Scottish Environmental Protection Agency (SEPA)) and Non Government Organisations (NGO) together form a considerable pool of talent and human and physical resources. Scotland could benefit through these being more 'joined-up' and integrated.

The needs of policy-led research can be short term which can result in tension between these needs and the requirements of longer term research and monitoring, which the MRPs are well placed to undertake. Further attention must be given to addressing the flexibility/agility of MRPs to adjust to rapidly changing policy-led demands whilst having the ability to undertake longer term research. There is a continuing need for flexibility and adaptability to unforeseen events with a need to also retain and support young scientists.

The Panel support the changing role of the MRPs whilst wishing to safeguard the important scientific asset represented by the MRP community. The success of changes to date cannot be seen in isolation from considering the financial sustainability of the MRPs and other components of the research base into the future.

Many of the skills within the MRPs have global relevance and significantly contribute to the Scottish knowledge economy (and to horizon scanning). The Scottish research base, including the MRPs, has a very high international standing which should be built on, not only to tackle emerging problems, but also to attract high level personnel and relevant industries.

National Resources/Capability

The Panel considers there is a continuing need to ensure that national resources of long term importance, including data collections and long term monitoring sites, are safeguarded for the future. There is also an urgent need to identify facilities, other resources and expertise required on a long term basis to underpin ongoing policy requirements and how these should be maintained.

Monitoring and Surveillance activities

The Panel also considers there is a continuing need to support long term environmental monitoring and ensure the continued ability to monitor and control new diseases is maintained and safeguarded for the future.

Research Strategy

The Panel considers that the current Research Programmes and the ongoing development of the Cross Cutting Themes are steps in the right direction. However, the process of further refinement of these programmes remains an important element of work for the Chief Scientific Adviser and her colleagues over the next few years. As part of this process, it will be important to include effective mapping of research available in, and available to, Scotland to address issues of concern and to identify where gaps exist.

Research Management

The Panel considers that Scotland should facilitate a more unified approach to research management which would help achieve a more effective and efficient use of public funding in Scotland.

Research Coordination

The Panel recognise the need for greater coordination across research funders throughout the UK and greater interaction between research providers, policy makers and end users of research. Research in areas relevant to rural affairs and the environment will increasingly require the multidisciplinary and cross-sectoral approaches which can only be achieved through effective co-ordination of effort and funding. It is important that the organisations funded by the Scottish Government recognise the significant value that can be added to their research through collaboration with a diverse range of other research providers.

International Collaboration

Scotland needs to recognise how its research expertise contributes to policy making in the UK and the EU and to build on this with an increase in its European and wider international collaboration. The input to EU and UK scientific advisory mechanisms by research scientists based within Scottish organisations is an important route for ensuring 'joined up' policy as well as research.

Science For Policy And Other Stakeholders

Consideration needs to be given to the provision of effective delivery mechanisms for providing policy makers with the advice they need together with enhancing Scotland's research base to allow it to compete on an international scale (with benefits across the Scottish economy). This analysis needs to recognise the issues set out above as well as the topic areas set out in Annex 3. It is important that a resilient, responsive, adequately funded, well co-ordinated and effective research base is available within Scotland to provide for both internal needs and international competitiveness.

DEVELOPMENT OF FUTURE SCIENCE AND RESEARCH STRATEGIES

Research Strategy

The current research strategy runs from 2005 - 2010. Recent advances in science and the increasingly cross-portfolio nature of policy needs (e.g. climate change and sustainable development) present simultaneously an opportunity and a need to consider a change in emphasis for the content of the research to be commissioned in the next Research Strategy that will run from April 2011.

Panel discussions over the 2 years have recognised the need for evolution of the current Research Programme and have drawn out four broad themes which formed the basis of a scoping exercise carried out during 2007. The four themes are as follows:

- Local Responses to Global Change
- Sustainable Communities
- Sustainable Environment
- Support for nationally important rural, environment and marine capability and resource.

Further details of these themes are available at <http://www.scotland.gov.uk/Publications/2008/01/17154036/7>.

The Panel also identified the potential for a significant change in the nature of the skill base required to deliver research outputs from these 4 broad themes. This would have business implications for the MRPs in particular.

The Panel considered, therefore, that there is a need to identify the future direction of research as early as possible to facilitate business planning and smooth transition of the research base underpinning rural affairs and environment policy to meet future needs.

The Panel were encouraged by the Chief Scientific Adviser's proactive approach to developing the next research strategy and the intention to publish a framework for this by September 2008.

Science Strategy

While the Panel looked specifically at the research base funded by RERAD on behalf of the Scottish Government, there was a clear recognition that the use of research by agencies and others applying science in advisory, statutory and regulatory activities requires timely and effective knowledge transfer. The need for there to be efficient co-ordination and knowledge exchange between the different players is an important aspect of science strategy development.

ACKNOWLEDGMENTS

The Panel greatly appreciated the support and the constructive contribution made to the deliberations of the Panel from the observers of the other Government Departments who attended the meetings of the Panel and provided us with information on the research being undertaken by their respective organisations. Our sincere thanks to:

- Dr Faith Culshaw and Dr Pamela Kempton, NERC
- Professor Nigel Brown, Dr Alf Game and Dr Huw Tyson, BBSRC
- Professor David Gani, Scottish Funding Council
- Dr Steven Hill, Dr Sue Popple and Dr Zitouni Ould-Dada, Defra

The Panel would like to thank the representatives of the Main Research Providers for taking the time to attend the meetings of the Panel held in May 2006 and September 2007. In particular we would like to thank:

- Professor Julie Fitzpatrick, Director, Moredun Research Institute,
- Professor Bill McKelvey, Chief Executive, Scottish Agricultural College
- Professor Richard Aspinall, Director, Macaulay Land Use Research Institute
- Professor Peter Gregory, Director, Scottish Crop Research Institute
- Professor Peter Morgan, Director, Rowett Research Institute
- Professor Steve Blackmore, Regius Keeper, Royal Botanic Garden Edinburgh

Our sincere thanks also to Julian Pace and Neil Ferguson from Scottish Enterprise who provided us with information on the work they are undertaking on rural futures, their contribution to Smart Successful Scotland and the work they fund on rural development.

The Panel would also like to thank all the Scottish Government officials who attended the various meetings of the Panel and who provided us with the Governments position on the specific policy areas of research being considered by the Panel. We would like to thank in particular:

- Neil Ritchie, Nick Ambrose and Andrew Voas, Animal Health & Welfare
- Joanna Drewitt and Helen Jones, Biodiversity
- Collette Backwell and Cornilius Chikwama, Sustainable Agriculture
- Philip Wright and Linda Pooley, Climate Change.

The Panel was particularly grateful to Dr Linda Saunderson, Jean Gilchrist and Douglas Brown for their efficient administrative support and advice.

SSAP MEMBERSHIP

Appointments to the Panel were made in accordance with the procedures of the Commissioner for Public Appointments in Scotland and were confirmed in November 2005. Appointments commenced on 1 January 2006 and concluded on 31 December 2007. During its period of tenure the Panel acted as an advisory Task Force and comprised 9 independent members including the Chair and 2 co-opted members, drawn from end-users, the research community and other research funders.

Panel members were:

Professor Peter Holmes (Chair), University of Glasgow
Professor Janet Sprent, University of Dundee
Professor Chris Pollock, Institute of Grassland and Environment Research
Mr Ian Duncan Millar, farmer
Professor Joe Brownlie, Royal Veterinary College, London
Professor Mark Shucksmith, University of Newcastle upon Tyne
Dr Susan Walker, independent consultant
Dr Jeremy Wilson, Royal Society for the Protection of Birds
Dr James Robb, farmer.

Co-opted members (from May 2007)
Professor Bill Gurney, University of Strathclyde
Ms Maggie McGinlay, Scottish Enterprise.

REPORT OF THE SSAP ACTIVITIES

WORKING METHODS

The Panel was set up as an Advisory Task Force in accordance with the Office of the Commissioner for Public Appointments and in line with Nolan Procedures.

The Panel met on 8 occasions during 2006-07. The following working methods were agreed at the start of its operation:

- The Panel would report its findings to the Chief Scientific Adviser
- The Panel would be advisory only and would have no funds to direct research itself
- The Panel's proceedings would be open and transparent
- Advice given by the Panel would be published.

The remit of the Panel was 'To act as a source of independent advice to SEERAD on the research it funds and the underlying scientific issues'.

The Terms of Reference were as follows:

- To provide advice to SEERAD on its policies and strategies for the research it funds within the context of the SEERAD research strategy
- To provide advice on the implementation of the 'Strategic Research for SEERAD 2005-2010'
- To provide advice on the strategic development of the Research Programme including horizon scanning and foresight.

The suggested areas for the Panel to focus on were influenced by 3 main considerations:

- There is a significant amount of research on the subject within the current programme
- SEERAD has published a strategy/policy document on the policy needs in the area
- The area is likely to be of continuing or growing priority to SEERAD policies in the medium to long term and strategic research will be needed on a continuing basis.

Although the specific activities suggested for the Panel developed during the setting up process, the scope remained focussed on the Research Programmes outlined in the Research Strategy document. It was made clear in that document that the Strategy covered only a part of the science funded by SEERAD and that although the work of the Fisheries Research Service, the Scottish Agricultural Science Agency, the Forestry Commission and the environmental agencies are highly relevant, they are commissioned and managed from elsewhere. These organisations also have their own mechanisms for external and independent review of their activities and it was felt important that the Panel did not duplicate such efforts.

Research funded and described in the Programmes outlined in the Research Strategy document, is primarily strategic and underpinning in nature. It was

therefore important for the Panel to undertake a 'foresight' or 'horizon scanning' role. Strategic research set in place today leads to the capability and resources to allow the policy questions of the future to be answered quickly and effectively.

Panel members therefore took into account information from the research community on the opportunities afforded by scientific advances as well as from the relevant policy community to predict the challenges that lie ahead where science will help to provide solutions.

MAIN RESEARCH PROVIDERS

The Panel hosted discussions with the Main Research Providers. The Directors/Chief Executives (CEs) of the organisations were invited by the Panel to outline the work of their research organisation and discuss:

- Focus of the research undertaken by their organisation (mission, remit etc.)
- Level of funding received both from SEERAD and from other research funders
- Number and level of staff, location and specialist facilities
- Commercial arms and other subsidiaries and their contribution to the organisation
- Significant collaborations with other research organisations (Joint Programmes, Strategic Alliances etc.)
- Future plans and directions for the organisation

Copies of the presentations made by the MRPs and details of the discussions with them are available at:

<http://www.scotland.gov.uk/Topics/Research/15597/strategic-advisory-group>.

The Panel concluded that the research undertaken by the Main Research Providers makes an important contribution to Scotland's science and research knowledge base and felt that the Scottish Government should safeguard the important scientific asset represented by the MRP community. This is reflected in the high level advice and conclusions to the Chief Scientific Adviser.

DISCUSSION OF RESEARCH IN SELECTED POLICY AREAS

With the limited time available to the Panel to cover its remit it was considered better to cover a number of selected areas in sufficient depth rather than cover the totality of the Research Programmes in less detail.

The policy areas which were considered by the Panel during its lifespan included:

- Animal Health and Welfare
- Biodiversity and Conservation
- Sustainable Agriculture
- Climate Change
- Rural Development

The Panel hosted discussions with Scottish Government policy interests and related stakeholders including representatives from, BBSRC, Defra, NERC, the Scottish Funding Council and Scottish Enterprise in these important policy areas.

These discussions were able to map out, at a strategic level, the range and types of research resources which RERAD will need to be able to access in the future, where such resources might be located (Institutes, Universities; in Scotland, the UK or further afield) and the risks if these are not available. The Panel consider that this information will be important in RERAD's planning for its future research Strategy in the period after 2010.

Many of the issues identified within the Panel's discussions were relevant across a number of policy areas (e.g. the impact of global events; need to maintain access to nationally important resources) and these are reflected in the high level conclusions and advice to the CSA.

The Panel's full conclusions on these subject areas are attached below. All minutes and agendas from the Panel meetings along with the majority of the meeting papers are also available on the RERAD website at the following address:

<http://www.scotland.gov.uk/Topics/Research/15597/23164>

Animal Health And Welfare – Discussions held 23/24 May 2006

SEERAD officials presented evidence on the Animal Health and Welfare (AH&W) Strategy for Scotland and its delivery in Scotland, the background to the Animal Health and Welfare Advisory Group and the group's list of priorities and targets. SSAP were also informed of the policy and relevance aspects of the SEERAD funded Animal Health and Welfare Research Programme, and discussed future research requirements in this area.

The SSAP recognised the importance of research on Livestock Health and Welfare issues to rural development in Scotland in particular in maintaining the 'clean and pure' image of Scotland's environment and livestock production sector.

The SSAP members were pleased to note that current disease research targets had been drawn up following wide consultation. However, given the potential speed at which new diseases can emerge, SEERAD and the MRPs are recommended to ensure that there are effective systems to keep these under regular review.

The SSAP agreed that in order to maintain flexibility to meet evolving demands, the underpinning disciplines of immunology, microbiology and pathology should be supported. It is important to recognise, however, that much of the critical mass in these disciplines resides within the University sector. SEERAD should continue to encourage MRP scientists to build links to such groups to ensure that new ideas and discoveries are incorporated into the relevant Research Programmes, while recognising that the Institutes need to maintain expertise in the key disciplines, some of which will be funded through the SEERAD Programmes.

The SSAP recognised that there are considerable strengths in animal health and welfare research in Scotland. Parasitology and genetics/genomics research are particular areas which feature in the SEERAD programmes and are relevant to the needs of the SEERAD policy interests as well as to UK and international

stakeholders. The Panel members are of the view that future SEERAD Programmes should continue to encourage retention of these skills in Scotland.

The SSAP members were pleased to note the research being undertaken on breeding goals as a means of improving disease resistance in livestock but acknowledged the need to continue funding research on vaccines and genetics to combat disease threats.

The Panel also acknowledged that the majority of financial support for this research currently comes from Government sources. The Panel would encourage SEERAD to ensure that scientists put effort into ensuring that commercial, industry, charity and other funders are encouraged to contribute also to this important area of research. This would not only increase the funding available but also significantly encourage the process of knowledge exchange.

The SSAP agreed that it would be timely to carry out some research on effective ways to maximise the effectiveness of knowledge exchange mechanisms in the area of Animal Health and Welfare.

Biodiversity – Discussions held 21 September 2006

SEERAD officials presented evidence on the Department's current policy and research activity on Biodiversity Research and how well research is meeting policy needs. The Panel also heard evidence on BBSRC's role and Defra's current and future research strategies and priorities in the area of Biodiversity.

International trends and issues can have impacts upon Scotland's biodiversity, and the Panel felt that these should not be underestimated or overlooked. International trade and economics, and environmental or social changes in other countries will have consequences for biodiversity within Scotland. This was particularly true where there was uncertainty associated with, for example, climate change, coastal and marine change, emerging diseases and the invasion of non-native species.

Scotland (and the UK) needs to find ways of managing land and natural resources to sustainably deliver multiple 'public goods' including biodiversity, food and other goods and services such as water and soil quality and carbon sequestration and storage. The Panel felt that research should recognise and address the need for a more holistic and, where necessary, global approach which can study a number of agendas together (e.g. protection of biodiversity in the context of food production and wider environmental, social and economic sustainability).

The Panel felt that the biodiversity research in the Programmes was going in the right direction. However, they had concerns that research priorities should be more clearly set and that in doing so there should be more co-ordination between stakeholders and a robust, evidence-based approach ("due diligence") used to identify those priorities. The Panel suggested that SEERAD draw up a list of the national and international obligations which it was required to meet or deliver, so that any associated research needs can be prioritised. It also requested that a "map of expenditure" be drawn up across biodiversity research.

SEERAD is one of many funders of biodiversity research within the UK. The Panel felt that it is therefore important that SEERAD works together with other major UK funders to ensure effective co-ordination and prioritisation. The Panel suggested that the environmental research mapping exercise being undertaken by the Environmental Research Funders' Forum would prove useful in setting SEERAD's biodiversity research within a UK context and for identifying gaps or overlaps with other funders.

The Panel recognised the close relationship between research, evaluation and monitoring and the need to strike the right balance in allocating funding between these. The Panel felt that new technologies or monitoring methodologies should be explored as a means of achieving more with available funding. The use of indicators for monitoring was also highlighted.

The Panel acknowledged that there was increasing interest in the "ecosystem approach" which takes a more integrated, holistic view of environmental (including biodiversity), social and economic sustainability objectives. Nevertheless, there needed to be an appropriate balance between science to develop the ecosystem approach, and more focussed studies of the biodiversity resource (at genetic, species and habitat/ecosystem levels) and its conservation.

The Panel acknowledged the importance of strengthening research on protection of biodiversity as a key Cross-Cutting Theme and felt it was important to take a long term view of what can be achieved.

The Panel noted BBSRC's concerns on various aspects of the field of taxonomy (classification of living organisms). These included the need to train students, increase the utility and relevance of taxonomy by linking it with other disciplines (e.g. ecology and evolutionary biology) and development of scientific innovations offered by molecular taxonomy (including cladistics). The Panel felt that this needed to be considered within a global context.

The Panel were concerned that Knowledge Transfer (KT) of biodiversity research was not being actively developed and might be hindering the desired outcomes or impacts. The Panel felt that there should be more commitment to delivering the benefits of research through improved management practices. Land managers had a key role to play in translating the benefits of biodiversity research into action on the ground and should be integral to any KT activity.

The Panel discussed the constraints i.e. the extent to which biodiversity research activities were mandatory (driven by Government obligations) and what capacity or "wiggle room" remained.

Sustainable Agriculture – Discussions held 15/16 January 2007

Observers and representatives from SEERAD presented their strategies and needs for research in Sustainable Agriculture.

The SSAP recognised the need for a broad spectrum of research to underpin and inform a sustainable agricultural industry in Scotland. Studies on the social,

economic and environmental aspects of land use are required in addition to the biologically based knowledge that is the traditional output from agricultural research. Need for a focus for some of this work on the interaction between agriculture and other land uses in rural areas is of particular note. Such research should provide a robust and multifaceted evidence base which land managers and policy makers can use to make informed yet practical decisions. The SSAP considered that relevance to informing and developing future policy should be a major driver in the identification of future research needs in the area of sustainable agriculture.

SEERAD is one of the main funders of Sustainable Agriculture research within the UK. The Panel noted the research funded by the others (BBSRC, NERC and Defra) in this area and felt it was important that the funders work closely together to ensure effective coordination and prioritisation. The Panel also supported the need for active collaboration between the differing communities of scientists.

The SSAP agreed that support for research capacity in key areas needed careful consideration by SEERAD and the maintenance of nationally relevant 'public good' resources such as the soils data base is important for the future.

The SSAP acknowledged the importance of agriculture across Scotland and agreed that one of the research priorities lay in the area of the interaction with other land uses. They recognised the importance of the Less Favoured Area support.

The SSAP noted the effect of increasing land values and the issue of succession both of which could lead to a slow decline in the quality of the land being farmed in Scotland. They agreed there was a need for research on the economic impact of these and possible structural changes on sustainability of the rural areas and the avoidance of land abandonment.

Scotland needs to provide high quality produce in an economic, environmental and sustainable manner. The SSAP acknowledged that, in Scotland, livestock farming varies according to locality. They also noted the effect a decline in production within the livestock sectors might have on the rural economy and highlighted the need for research on the resilience of the livestock industry, particularly in the west, and the economic impact of this on the rural economy.

The SSAP also noted the effect of CAP Reforms, particularly decoupling and suggested research should be undertaken to assess its effect on the increased vulnerability of net farm incomes. They agreed research was also needed to further develop the environmental benefits of agri-environment schemes at field, farm and landscape scales.

The SSAP recognised the need for understanding the interplay of factors contributing to multi-functional land use and felt that managing the economic, ecosystem and social aspects in a holistic approach was an important area for research.

The SSAP also felt the impacts of land reform including community ownership and management should be investigated.

The SSAP acknowledged the funding provided by SEERAD in the area of food, nutrition and health. They felt that SEERAD has a role in translating results from basic research to encourage the food industry to develop foods/crops with enhanced nutritional quality, particularly where these would benefit local markets and the Scottish population.

The SSAP recognised the importance of Climate Change issues and although Scotland is not unique in respect to climate change scenarios they thought the public perceptions of it could be and agreed there was a need for research in this area.

The SSAP considered the impact of climate change on agricultural systems, in particular on soils and grassland and agreed there was a need to study the impact climate change is having on agriculture systems, soil health and biodiversity using a systems approach. They felt it was important to research both adaptation and mitigation measures to address the economic impact of climate change on land uses including farming systems.

The SSAP supported the use of social and economic modelling to develop scenarios and suggested the drivers such as climate change, new technologies, human behaviour, energy markets etc should be acknowledged and that a sensitivity analysis should be undertaken.

The Panel felt that systems research which focussed on social and economic sustainability should be a high priority.

Key research areas identified by the SSAP in the area of Sustainable Agriculture are: water management, livestock systems, the impact of regulation on sustainability, alternative energy sources, the potential for developing and producing innovative/niche/bioenergy and biodiesel crops and also for growing protein crops e.g. lupins.

The Panel acknowledged the need for greater engagement with society and, in particular, the need for improving education and awareness among consumers and the general public of high profile and challenging issues e.g. the genetically modified products debate.

Climate Change – Discussions held 21/22 May 2007

The SSAP noted the global trends in increasing temperature and CO₂ concentrations which have taken place over the years and the impact this is having including warmer, wetter winters, less snowfall and increased risk of flooding. They recognise the importance of research on Climate Change and the challenge faced by Scotland in meeting the ambitious target of the Scottish Parliament to a 3% carbon reduction per annum and in the longer term to cut emissions by 80% by 2050.

The Scottish Executive objective for a greener Scotland will require considerable focus of research effort to achieve. The SSAP noted the research being funded by the Scottish Executive on Climate Change but acknowledged that Scotland is a small country and can only contribute to a minor extent to global research efforts.

However the SSAP felt that, even as a small country, Scotland could show leadership in this area.

Collaboration

The SSAP noted the recent consultation on the UK Climate Change Bill and acknowledged that the UK is among the leading countries in climate change research and monitoring. They noted the research undertaken by the other funders (BBSRC, NERC and Defra) in this area and that many of the objectives and research interests within Defra chimed well with Scotland's priorities. The SSAP felt that there were considerable opportunities for some joined up approaches to gaining the understanding needed and felt it was important that the funders work closely together to ensure effective coordination and prioritisation.

The SSAP noted the need to include Scotland in the predictive models and to ensure that there was no needless duplication of work on climate change going on in Scotland.

Hydrology

The SSAP noted that climate change could lead to considerable difficulties associated with hydrology and headwater management. Effective headwater management is important to the future sustainability of agricultural production, pollution control and conservation of the natural environment. The SSAP felt there are many researchable issues in these areas, some of which might indicate potential 'win-win' scenarios. It was noted that a number of research issues are highlighted in existing floodwater management plans.

Behavioural Issues

The SSAP considered that understanding human behaviour and the concept of energy vs carbon is an important aspect of research on how to encourage the population of Scotland to adapt to and help mitigate the effects of climate change and felt that research on the social attitudes to responding to climate change would be important. They noted that the Economic and Social Research Council are setting up a collaborative research centre on this subject, to which Defra are contributing, and this would also be relevant to the interests of the devolved administrations.

The SSAP noted that in Scotland research on altering human behaviour is generally focussed on health. They also noted that consumer behaviour and retailers' policies can have large impacts on demand e.g. for 'locally' produced food. They also noted that world food security might come under more pressure with the increase in global population and greater demands being placed on land with a high potential for food production to be used for growing biofuels.

They noted the possible scenario that one third of the world's population could migrate as a result of climate change and suggested there could be merit in considering, from a Scottish perspective, the current trend in attracting migrant workers. If Scotland benefited from a more 'desirable' or agriculturally productive

climate in future this might attract inward population flow which could put pressure on all sectors of society including rural areas. The need for research to understand potential impacts of these differing scenarios was considered important.

Scotland has more wind resources than many other countries yet little research on how winds might change or how they might affect land use, human behaviour and the like has been undertaken. SSAP members felt there might also be merit in looking at the impact of wind farms and community ownership.

The SSAP suggested that actions and some pragmatic solutions to the provision of appropriate instruments to encourage and regulate behaviour may be needed sooner rather than later and felt that researchers could be looking at current solutions as well as looking to what more could be achieved in future.

Land Management

At the previous meeting held in January, the SSAP considered the impact of climate change on agricultural systems, in particular, on soils and grassland and agreed there was a need to study the impact that climate change is having on agriculture, soil health and biodiversity. They felt it was important to research both adaptation and mitigation measures to address the impact of climate change on land use including farming systems.

Scotland places a high value on its environment and, perhaps as a country, Scotland should be showing leadership when it comes to addressing climate change issues. The SSAP felt that Scotland could take the lead in showing how systems could be adapted to achieve lower carbon and other emission 'footprints'.

A particular area for research could be looking at carbon efficient programmes of delivery with the various EU Directives which push in different directions. There was a trade-off between different types of environmental indicators e.g. groundwater/nitrates: water quality directives/regulations. Although some of this research is already included within the Research Programmes the SSAP felt this strength should be maintained.

The SSAP felt that information which informs 'carbon budgeting' approaches seems to be missing, in particular at the systems level. Again there is a clear need for good quality robust research to inform such analyses.

The SSAP noted the importance of the ECOSSE (Estimating Carbon in Organic Soils - Sequestration and Emissions) project on organic soils research and thought there was a need for a 'holistic' systems approach to Nitrogen emissions and that research is needed to develop this effectively.

Biofuels

The SSAP were concerned about the infrastructure to meet potential demands for renewable fuels. The SSAP noted the BBSRC policy of funding research on the use of non-tree crops for biofuels. The technology for use of solid biofuels for heating or

Combined Heat and Power is well established and increasingly being adopted in Scotland. They also noted that MLURI is actively researching this area.

Liquid biofuels are mainly (currently) being used for transport. They may be derived from waste oils/fats or from crops such as oilseed rape, wheat or maize. Growth of the latter diverts land from food production and is already leading to increased food prices. Full life cycle analysis of these problems is being addressed in various countries. Second generation biofuels, usually produced enzymatically from lignocellulose (e.g. waste straw) need to be actively investigated.

Plant/Animal Diseases

Members noted the increased risks of epidemics of exotic diseases including the emergence of animal diseases not previously seen in the UK e.g. bluetongue. They felt that expertise in core areas needs to be retained.

Datasets

The SSAP felt that long term datasets are crucial to underpinning future research and should be made widely available. They agreed that relevant capability was an area which needed careful consideration by the Scottish Executive and that key capabilities relevant to 'public good' research such as maintaining and refreshing the soils data base should be maintained.

Marine

The SSAP felt there was an opportunity for further research on the effect of climate change on the extensive marine ecosystems and environments around Scotland.

Funding

The SSAP noted concern that the more funding allocated to climate change would result in less funding for other areas and that funding for climate change should be 'new' money whilst recognising that this could prove difficult.

Specific Research Areas

The SSAP considered one of the main issues in identifying research needs was that the research undertaken should be of particular relevance to supporting future policy. Key research areas identified by the SSAP in the area of Climate Change include:

- Marine science relevant to Scotland
- Complex issues of compliance with the diversity of environmental regulations
- The impact of climate change on rural communities
- Environmental aspects of public transport developments
- The impact of a 'non-nuclear power policy' in Scotland
- Hydrology and water and flood management
- Food - local food/organic production, carbon 'footprint' and nutritional quality
- Development of decision support systems for land management

- Co-ordination between funders and between researchers – some problems require a much more joined up approach nationally and internationally
- Changing public attitudes and social responses to climate change – how and when to use ‘carrots and sticks’
- Biofuels – opportunities in the fermentation of lignin/cellulose
- Disease risk to native/agriculturally important plants/animals
- Economic aspects of science used for biotechnological solutions
- Potential impact of immigration into Scotland driven by climate change elsewhere
- Renewables – social issues e.g. community ownership of windfarms
- The social construction of climate change, the power relations underlying this and the consequences for social groups
- Sequestration in forests and (peat) soils
- Composting of food wastes for nutrient/energy recovery
- Improving understanding of the mechanisms underlying species, habitat and ecosystem responses (both terrestrial and marine) to climate change and the potential for adaptive management to counter climate change effects.
- Understanding the impacts of management for climate change mitigation (e.g. management for carbon storage/sequestration, biofuel and other renewable energy production) on biodiversity and species/habitats of high conservation concern. Identifying 'win-wins' and resolving conflicts
- Understanding the impacts of different agricultural landscape compositions/matrices on permeability of landscapes for species and habitat movement under climate change and the role of agri-environment mechanisms for delivery of desired landscape configurations.

Rural Development - Discussions held 21/22 May 2007

The Panel noted the significant work Scottish Enterprise are undertaking on rural futures, their contribution to Smart Successful Scotland, the rural group research agenda and the work they fund on rural development.

The Panel recognised the importance of the role of Scottish Enterprise in economic development and how they address social aspects of rural development. Members saw resilience of communities as an important consideration and that successful rural development relies on successful communities however they are supported.

The Panel were pleased to note the involvement of Scottish Enterprise in the Rural Group and the Rural Leadership project and their continuing links with the Scottish Agriculture Community. However, they remained concerned about the potential conflict between agriculture and tourism in the continuing need to maintain a sufficient food supply for an increasing global population.

Members noted the concern of Scottish Enterprise (SEn) on issues such as affordable housing and were also pleased to note that they continue to work closely with Communities Scotland in this area. They also noted the particular concern of SEn in the difficulty of obtaining land for the development of new businesses and economic opportunities within rural areas.

The SSAP members acknowledged the importance of the connection between SEn research and that funded by the Scottish Executive, particularly that of SNH and SAC but agreed with SEn that they should have a greater connection with UK and EU research programmes.

The SSAP members were pleased to note that SEn are developing a new skills strategy but felt this needed to be considered within a rural context, particularly the farming sector, with a need for an increasing focus on migrant workers.

A number of issues were identified from the discussion as follows

- Potential conflicts in access to development funding between the city and rural areas
- The differences in approach between the SEn and Highlands and Islands Enterprise, the different populations they serve and the strong social agenda that is part of the remit of HIE, but not SEn
- There is a clear recognition of the expertise in entrepreneurship and innovation within the farming sector
- The need for a more joined up approach to research between agencies active in rural development across the UK
- Lack of affordable housing within the rural communities and development sites
- The diminishing rural skill base and its impact within the rural sector in future.