The impacts of Climate Change on Agriculture

A vision for our rural landscape

Monday 7 February 2005
Jurys Great Russell Street, London
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Executive summary

In addition to social and technological developments and changes to agricultural policy in the coming decades, UK agriculture will face the challenge of climate change. Agricultural businesses will need to adapt to the effects of changing climatic conditions to ensure economic viability, while at the same time continuing to improve sustainable practices to reduce agriculture’s impact on the environment.

The seminar on 7 February 2005 aimed to help inform an agenda for awareness-raising in the stakeholder community and identify potential practical adaptation strategies within UK agriculture. Sir Brian Bender, Defra Permanent Secretary, introduced four expert speakers:

- Professor Chris West (UK Climate Impacts Programme) described future scenarios that are helping stakeholders assess climate change impacts and plan adaptation strategies.
- Professor Chris Pollock (Institute of Grassland and Environmental Research) highlighted the direct effects of warmer wetter, winters and drier summers to specific sectors of agriculture.
- Professor Keith Duff (English Nature) spoke of the predicted impacts on UK biodiversity.
- Pamela Taylor (Water UK) communicated the water industry’s perspective, highlighting the linkage between water use and land management.

Defra Ministers Lord Whitty and Elliot Morley presented the policy context for the day’s discussions, which focused on three key areas: agriculture, biodiversity and water management.

There was broad support among delegates for a catchment-based approach to adaptation planning that encourages the participation of farmers and land managers at local level. The need for organisation of farmers at the catchment level was also noted. It was recognised that land managers would need incentives and support in making the changes that will be essential if they are both to adapt effectively to the impacts of climate change and to take advantage of the opportunities presented. Current policy tools are limited in achieving adaptation to, and mitigation of, climate change, and our future approach needs to be integrated across the key policy areas rather than considering each one independently.

A number of market-driven barriers to adaptation to climate change were identified. Attention was drawn in particular to the importance of economic quantification when considering the value of biodiversity, water and agricultural land.

Delegates urged the Government to provide a clear policy steer and vision to support the stewards of our landscape in meeting the challenges posed by a rapidly-changing climate.
Introduction

Climate change and the UK

Climate change is one of the most pressing and complex environmental issues that we face today. Recent reports from the Intergovernmental Panel on Climate Change (IPCC) suggest that the problem may be worse than previously feared.

Since Kyoto in 1997, the UK has been pressing ahead and introducing innovative policies which have been devised to have a significant impact on reducing greenhouse gas emissions. However, these policies will have no effect on climate change in the next few decades, which has already been determined by past and present emissions. So the UK Government also recognises the need to adapt to this unavoidable climate change. The Government and devolved administrations are taking a lead in preparing for the effects of climate change, and these steps are outlined in the UK Climate Change Programme, currently under review and out for consultation.¹

Agriculture and the future climate of the UK

In addition to social and technological developments and changes to agricultural policy in the coming decades, UK agriculture will face the challenge of climate change. Agricultural businesses will need to adapt to the effects of changing climatic conditions to ensure economic viability, while at the same time continuing to improve sustainable practices to reduce agriculture’s impact on the environment.

As part of the Defra-funded UK Climate Impacts Programme (UKCIP), potential scenarios of future climate change across the UK were published in 2002.² These are referred to as the UKCIP02 scenarios. A summary of the key projected climate changes relevant to agriculture is provided below.

Temperature

- The UK climate will become warmer
- High summer temperatures will become more frequent, while very cold winters will become increasingly rare

Rain and snow

- Winters will become wetter and summers may become drier throughout the UK
- Snowfall amounts will decrease throughout the UK

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¹ Climate Change: The UK Programme was published in 2000 and is currently under review. A consultation is open until 2 March 2005. The Programme is available online at http://www.defra.gov.uk/environment/climatechange/02.htm. The review consultation can be accessed online at http://www.defra.gov.uk/corporate/consult/ukccp-review/index.htm

² Full report of the UK climate change scenarios is available from www.ukcip.org.uk
• Heavy winter precipitation will become more frequent

**Sea Level Changes**

• Relative sea level will continue to rise around most of the UK’s shoreline

• Extreme sea levels will be experienced more frequently

**Aims of the seminar**

The seminar looked at adaptation to the threats and opportunities posed by projected changes in climate. The event had a UK focus, but issues were considered within the wider EU and global context.

The main aims of the meeting were:

i. awareness-raising among key stakeholders and policy-makers;

ii. identification of key policy interactions and synergies between the main themes; and

iii. identification of potential practical adaptation strategies.
Presentations

UK Farming and Climate Change: Adapting to the challenges

Lord Whitty of Camberwell, Parliamentary Under-Secretary (Lords), Farming, Food and Sustainable Energy

I’d like to start by welcoming you all to this meeting. It’s heartening to see that so many key players have been able to join us.

Climate change is of course a topical and fiercely-debated issue. It is important, however, that we consider carefully the science and evidence, if we are to establish a solid basis for opinion and decision. I’m pleased, therefore, that the real experts have agreed to speak to you today.

Most of you will be aware that, last week in Exeter, the Secretary of State addressed a conference which focused on how we can avoid dangerous climate change. The conference reviewed in depth the scientific, technical and socio-economic aspects of global warming. An underlying theme at the meeting was the extent to which it might be possible to identify an optimum response, which avoids both dangerous impacts and unacceptable mitigation costs.

The meeting concluded that there was strong evidence that climate change due to human emissions of greenhouse gases was already occurring and that future emissions were likely to raise global temperatures by between 1.4 and 5.8 degrees centigrade during this century. This would have a wide range of impacts on the natural world and human society.

The conference also concluded that substantial reductions in the emissions of carbon dioxide are now needed to mitigate climate change, and major investment would be required for both reducing emissions and to minimise future impacts which cannot be avoided in the near to medium term.

There has been much recent interest in the media and among the general public in the possibility that global warming might, paradoxically, lead to a drastic reduction in temperatures in Northern Europe, as a result of a slowdown in the North Atlantic conveyor circulation - popularly known as the Gulf Stream. This ocean current carries huge quantities of warm water northwards from the tropics to the coasts of north west Europe. And without the Gulf Stream, temperatures in the UK would be 5 degrees centigrade or so cooler.

The current scientific consensus is that global warming, on the timescale of the next 50 to 100 years, may result in a weakening of the Gulf Stream but not a complete halt to it.

Indeed, the predictions of the best computer models, including that of the UK’s Hadley Centre, are that the net effect will still be a warming for Northern Europe. That is to say that the cooling effect of the reduced Gulf Stream will not completely counteract the warming effect of enhanced greenhouse gas concentrations. This is an important issue, however, that requires further research, and to that end Defra is supporting the Hadley Centre to improve our understanding of the likelihood of future changes to the Gulf Stream. The UK Natural Environment Research Council is also
funding a major research programme aimed at increasing our understanding of rapid climate changes.

Recent events, here in the UK, and across the world in the Indian Ocean, have been a stark reminder of just how vulnerable we are to the forces of nature. The impacts of a changing climate will be no less powerful. But we are in a position, now and for the next couple of decades, to limit the dangers that we may face.

This is why we are pushing forward with a package of policies and measures to help us achieve our Kyoto greenhouse gas emission target and to move us towards our domestic goal to reduce UK carbon dioxide emissions by 20% by 2010.

We are on track to meet our Kyoto target, but more needs to be done if we are to meet our domestic goal. A review of the Climate Change Programme is currently underway, as part of which we are assessing the success of existing policies and measures and the scope for further emission reductions.

And now of course the UK holds the Presidency of the G8 Group of Nations, and from July we will take up the Presidency of the European Union. Climate change will be a priority for both and we are proceeding with a full programme of events to revitalise our vision for putting the world on a path to a sustainable low carbon future.

Mitigating climate change by cutting greenhouse gas emissions is a key part of the solution. But this will not affect the changes in climate that we'll experience over the next few decades. These changes are already unavoidable as a consequence of past and present emissions and inertia in the climate system. So we also need to adapt – both to manage the risks and to take advantage of the opportunities.

This leads us to the reason we are all here today - a seminar which brings together key stakeholders and industry representatives so that we can focus on the key challenges that climate change poses for agriculture and land use.

The farming industry in the UK has shown itself to be very adaptable to change, but some uncertainty exists about what climate change poses for farming in the future. As we all know, agriculture is particularly affected by changes in temperature, rainfall and extreme weather, such as drought and storms, and these may pose an increasingly serious threat. Of course, extreme weather is already within the experience of most farmers, but it is the increased frequency of these events under future climate change that presents greater risks to farm businesses. This, in itself, demands the development of suitable adaptation responses. In addition to these pressures, UK farmers will continue to operate in an internationally competitive market, and - as you will be discussing today - within the UK there will be increasing pressures on land use beyond agriculture.

The key objective of today’s event will be to prioritise practical strategies which farmers and land managers can consider in effectively planning and responding to future threats and opportunities. We will also be exploring the synergies between three key policy areas – agriculture, biodiversity and water management - to assess where policy needs further development.
Our discussions today will be underpinned by an excellent UK track record in the field of climate science. Our particular strengths lie in the field of climate modelling and prediction, spearheaded by the UK Climate Impacts Programme, and Hadley and Tyndall Centres.

By building on scenarios, which describe possible future climatic conditions, the UK Climate Impacts Programme is helping stakeholders to assess climate impacts and plan adaptation strategies. I’m delighted therefore that Professor Chris West, who leads the Programme, will be speaking to you this morning.

Although there are still gaps in our understanding of climate change, and, in the context of today’s discussion, its likely impacts on agriculture, there has been considerable investment in research to help both policy makers and the industry plan for the future. A recent review of this research - undertaken by the Institute of Grassland and Environmental Research - has indicated that there are a number of clear threats to farming in the years ahead.

For example, water availability and water management are likely to be critical issues for UK farmers. Hotter and drier summers are likely to lead to a fall in the availability of water in drier parts of the UK. At the same time, increased risks of drought will lead to higher irrigation demands for crops such as potatoes, sugar beet and vegetables. And of course, farmers will not be the only ones affected - they will have to compete with the increasing demand for water from other sectors. And since adequate and reliable water supplies are a pre-requisite for effective irrigation, the consequences could be stark.

But there are solutions. Farmers could offset these risks by improving water conservation through the use of more efficient technologies and sustainable management practices. For instance, in water stressed regions, farmers might consider installing winter storage reservoirs to reduce the need to abstract water for irrigating during the critical summer months.

Climate change will also affect livestock farming in the UK. Recent hot summers, as in 1995 and 2003, have demonstrated that elevated summer temperatures can lead to increased heat stress in animals, affecting beef and dairy cattle, pigs and broilers. Increased heat stress will have implications for milk yield, herd fertility and general welfare. Warmer summers may also lead to increased incidence of pests and diseases affecting livestock.

Again, there will be ways to reduce these deleterious effects of climate change, and awareness and planning throughout the industry will be critical. And by planning ahead we can see that climate change will also offer new opportunities.

For instance, climate change is expected to modify both the yields and quality of crops and forages, as well as the length of the growing season in the UK. In some areas, which may at present be unsuited for crops such as maize and early potatoes, climate change may provide new opportunities to produce these.

Case studies of extreme seasonal weather - predicted to occur more frequently in the future - such as the hot, dry summers of 1976 and 1995 and the exceptionally wet autumn of 2000 have provided an insight into the possible economic impacts of
climate change. For instance, in assessing the effects of the 1995 summer, it was estimated that the agricultural industry lost around £457 million through reduced income and increased costs. In both the 1995 and 2000 cases, there was strong evidence to suggest that farmers who had implemented adaptations and management changes secured advantages over others.

Case studies are particularly valuable in assessing the effects of climate change but they also provide pointers to how UK agriculture might adapt – for example by choosing alternative crops for particular sites, shifting crops from areas that are vulnerable to drought, or investing in equipment that helps to reduce the severity of the impacts.

Given the range of possible effects on farming in the future, the current evidence suggests that climate change reinforces the need for robust, risk-based approaches for land management and for local solutions delivered via effective policy mechanisms.

So what is the Government's role in this process?

We must strike a balance between the need to regulate the industry and our duty to support farmers' efforts in adapting to the new challenges global warming may bring. I can assure you that we will continue to take climate change into account in the development of new policies, be it in planning reform, water resource and flood management, agriculture, biodiversity or health.

I look forward to supporting the momentum generated by this landmark event and I trust we can build on the foundations established here today.

Slide 1
International Symposium on Stabilisation of Greenhouse Gases
1-3 February, Met Office, Exeter

• Review of scientific, technical and socio-economic aspects to identify an optimum response which avoids both dangerous impacts and unacceptable mitigation costs

• The conference concluded that:
  • future emissions were likely to raise global temperatures by between 1.4 and 5.8 degrees centigrade during this century
  • a wide range of impacts on the natural world and human society
  • major investment is needed now in both mitigation and adaptation.

UK action to avoid a low carbon economy

• UK Climate Change Programme published in 2000. Set out policies and measures to support:
  • Kyoto target to reduce greenhouse gas emissions by 12.5% below base year levels by 2008-12
  • National goal to reduce carbon dioxide emissions by 20% below 1990 levels by 2010
  • Energy White Paper (2003) set out goal to reduce carbon dioxide emissions by some 60% by about 2050

Progress towards a low carbon economy

• Well on track to meet Kyoto target: greenhouse gas emissions down 14% from 1990 levels in 2003

• More needs to be done to achieve national goal – currently predicted to be 14% below 1990 levels in 2010

• UK Climate Change Programme Review launched in September 2004:
  • Consultation published in December, seeking views on success of existing programme and scope for further emission reductions.
  • Aim to publish revised Programme in first half of 2005.
Climate change impacts on UK agriculture

- A stakeholder seminar to focus on the key challenges that climate change poses for UK farming and land use
- Objective will be to prioritise practical adaptation strategies which can be used to effectively plan and respond to future threats and opportunities
- Exploring synergies between three key policy areas:
  - Lowland and upland agriculture
  - Water (resources, flooding and quality)
  - Biodiversity

Responding to the challenges

- Recent research has identified likely impacts for a range of farming systems
- UK agriculture is highly adaptable
  - Most effects of weather-related climate change are already with the experience of farmers
- Some uncertainties remain in our understanding of climate change, its impacts and the most effective responses
- Awareness and long-term planning will be critical
Climate Change and Agriculture in the UK
Professor Chris West, Director, United Kingdom Climate Impacts Programme

Slide 1

Climate Change and Agriculture in the UK
Ministerial Seminar, Jurys Hotel, Great Russell Street
7th February 2005

Chris West
UK Climate Impacts Programme

Slide 2

Global Changes

More greenhouse gases…

- Global energy imbalance
- Higher global temperatures
  - Sea level rise
  - More water in atmosphere
  - Changed weather patterns

Slide 3

UK - Anticipated Climate Changes

- Temperature:
  - Higher mean (2 - 5°C warmer)
  - Higher extremes
  - Greatest effect in SE

- Precipitation
  - Wetter winters (5 – 30% more)
  - Drier summers (15 – 50% less)
  - More falls in extreme events
  - Less falls as snow

- Storms
  - More storms cross UK in winter (up to 60% more)

- Sea Level Rise
  - Global, isostatic, storm-surge (19 – 79 cm higher)

Figures in red give 2080s changes for SE England under low emission and high emission scenarios
UKCIP Socio-economic Scenarios

Four possible probability-free directions for development

<table>
<thead>
<tr>
<th>UKCIP</th>
<th>Emissions</th>
<th>Flavour</th>
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<tbody>
<tr>
<td>World Markets</td>
<td>High</td>
<td>globalisation, privatisation</td>
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<tr>
<td>National Enterprise</td>
<td>Medium-High</td>
<td>top-down direction, selfish people</td>
</tr>
<tr>
<td>Local Stewardship</td>
<td>Medium-Low</td>
<td>emphasis on society, green issues</td>
</tr>
<tr>
<td>Global Sustainability</td>
<td>Low</td>
<td>consensus, internationalism</td>
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Different: GHG emissions
Vulnerabilities
Adaptive capacities

UKCIP02 Climate Scenarios

One Climate Model
Different scenarios for societal change
Good at averages and big areas
Less good at short-term, local events

UKCIP Scenarios Gateway

Global temperature (2000 - 2100)
Slide 7

**Global temperature (2000 - 2100)**

Some change inevitable

Slide 8

**Global temperature (2000 - 2100)**

Some choice later

Slide 9

**Competition or Co-existence?**

1. The climate change we expect in the next 30-40 years will be due to our past greenhouse gas emissions.
2. Climate change later this century is being determined by the emissions we allow now.
3. We need to alter our way of life so that we can adapt to the changes that are already in the climate system.
4. ...as well as limiting our future greenhouse gas emissions.
Slide 10

UK Climate Impacts Programme

Slide 11

UK Climate Impacts Programme

Slide 12

Changes in average temperature

UK Climate Impacts Programme
Slide 13

**Daily maximum temperature:**

**Central England summer**

Baseline (1961-90)
31°C has 1% chance
(~1 day per summer)

2080s, medium-high emissions
31°C has 11% chance
(~11 days per summer)
39°C has 1% chance

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Slide 14

- Across Europe, a summer like 2003:
  - Would have been extraordinary for the 20th Century
  - Will be completely average by 2040

From P.A. STOTT et al, Nature 432, 2 Dec 2004

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Slide 15

**Changes in average precipitation**

Winter  Summer
**Slide 16**

**Daily precipitation: probability of exceedance**

Baseline (1961-90)
24mm/day has 0.5% chance
(Winter and Summer)

**2080s, medium-high emissions**
24mm/day has 0.15% chance in Summer (3 x risk reduction)
But 1% in Winter (2 x risk increase)

**Slide 17**

**Frequency of UK depressions**

*Medium-High Emissions*

**2080s - red**
**baseline - blue**

**Slide 18**

**Other changes by 2050s**

- Summer relative humidity down (0 to –12%)
- Summer soil moisture down (10-30%)
- Summer cloud cover down (0 to –12%)
- Snowfall down by 20% to 70%
- Fog days down
- No significant change in average wind speed – uncertain
Temperature increase

• Three targets:
  • Built infrastructure
  • Human systems
  • Natural systems

• Four aspects:
  • Higher mean temperatures
  • Higher extremes
  • Longer above thresholds
  • Loss of cold events

Impacts of temperature increase

• Impacts on natural systems:
  • Longer seasons
  • Earlier springs
  • Later autumns
  • New relationship between light (latitude) and temperature
  • New exotic arrivals

Impacts of Winter rainfall increase

• Heavier, more intense winter rainfall will increase risks of:
  – Damage to property from driving rain
  – River flooding
  – Soil loss (water erosion)
  – Fungal disease
  – Soil water-logging
  – Difficult access to land for animals/machines
Impacts of reduced Summer rainfall

- Reduced summer rainfall will increase risks of:
  - Irrigation water shortages
  - Conflicts over water use
  - Not enough water flow to dilute pollution
  - Soil being unable to absorb rainfall
  - Reduced crop yields
  - Soil loss (wind)
  - Difficulty in tilling
  - Wild fires

Climate Change and Agriculture

- Three Issues for today:
  - Lowland and Upland Agriculture
  - Water (flooding, quality, resources)
  - Biodiversity

A Few Cross-cutting Issues

- Landscape and Society
  - What does society want from the countryside?
- Renewable energy generation
  - Biomass, wind-farms, local schemes?
- Global marketplace
  - Is UK best place to grow new crops?
  - What will rest of world be doing?
- Who adapts?
  - EU & Defra set context with policy and regulation...
  - …build adaptive capacity for all farm-to-fork actors
Predicting the Impact of Climate Change on UK Agriculture
Professor Chris Pollock, Director of Research, Institute of Grassland and Environmental Research

Slide 1

PREDICTING THE IMPACT OF CLIMATE CHANGE ON UK AGRICULTURE
Chris Pollock & Alan Hopkins
Institute of Grassland and Environmental Research

Slide 2

SYNOPSIS

• Predicted effects of climate change
• Direct impacts on arable systems
• Direct effects on pastoral systems
• Priorities for adaptation
• UK agriculture and climate change mitigation
• Challenges:
  – Dealing with uncertainty
  – Indirect impacts
  – Impacts on other outputs from UK land use
PREDICTED EFFECTS OF CLIMATE CHANGE

- Warmer (1-5°C depending on region)
- Warming greater in summer and autumn than in winter and spring
- Summer warming greater in SE than NW
- Little change in overall annual rainfall but:
  - Wetter winters and drier summers
- Sea level rise will take some land out of production

PREDICTED EFFECTS OF CLIMATE CHANGE

- Increased variability of winter rainfall
- Increased frequency of hot dry summers
- Increased frequency of mild wet winters
- Increased winter wind speed

**WARMER; WETTER WINTERS; DRIER SUMMERS; MORE VARIABILITY (MORE CARBON DIOXIDE)**

DIRECT IMPACTS ON ARABLE SYSTEMS

- Increased temperature will lengthen growing season (consequences differ with species)
- Warmer winters may affect vernalisation
- Opportunities for crops not previously grown in UK
- Elevated CO₂ may increase yield but interactions complex
DIRECT IMPACTS ON ARABLE SYSTEMS

• Warmer, drier summers will increase probability of drought stress
• Increased storminess increases damage risks (soil erosion, damage to perennial woody crops, horticultural crops)
• Wetter winters may affect establishment of winter-sown crops
• Glasshouse temperature control needs to cope with higher outside temperatures

DIRECT IMPACTS ON ARABLE SYSTEMS

• Earlier attacks of pests and diseases because of warm, wet winters
• Winter wheat production fairly resilient
• Sugar beet, potatoes and vegetables sensitive to summer drought
• Maize cultivation will be more widespread

DIRECT IMPACTS ON PASTORAL SYSTEMS

• Grass growth will start earlier and finish later in the season
• Herbage yields will increase if water and N are available
• Forage utilisation by grazing in spring or autumn will be difficult because of increased rainfall
• Warmer temperatures will favour mixed grass/legume swards
• Increased emphasis on conservation as silage or hay
DIRECT IMPACTS ON PASTORAL SYSTEMS

• New managements and/or more maize will be needed where summer droughts are prevalent
• Need to maintain soil structure to minimise animal damage when wet or droughted
• Welfare concerns related to heat stress and reduced water availability for livestock in the summer

DIRECT IMPACTS ON PASTORAL SYSTEMS

• Both winter storms and hot summers will favour planting of shelter belts and/or isolated trees
• Farm building design needs to allow for warmer summers and wetter/stormier winters

PRIORITIES FOR ADAPTATION

• Arable:
  – Plan for greater need for irrigation
  – Possible shift away from autumn sowing in some locations
  – Incorporate climate change responses in breeding programmes (temperature, water, CO₂)
  – Monitor changes in soil health
  – New crops, new managements
  – Monitor pests and diseases
  – Glasshouse design to cope with warmer summers
PRIORITIES FOR ADAPTATION

- Pastoral:
  - Manage winter forage (growth, utilisation and water management)
  - Alter conservation practice for dry summers
  - More tree planting for shelter from sun, wind, rain and storms
  - Animal house design for hotter summers
  - Drinking water availability for summer pasture
  - Breed for grass-clover compatibility under warmer, drier conditions

RED CLOVER - High yielding protein source for silage

Fodderbanks

- Stockfeed reserve of drought resistant grasses, legumes, herbs, shrubs
- Manage to ensure moisture retention and good root reserves
MITIGATION OPPORTUNITIES

- Biomass crops
- Feedstock crops
- Reduced emissions of methane, NO_x and ammonia
- Increased efficiency of CO_2 uptake
- Landscape management (water, pollutants etc)

WHITE CLOVER IMPROVES SOIL STRUCTURE

INTEGRATED BEEF & SHEEP

Developed and tested systems that meet production and environmental objectives

Emphasis on integrated use of improved pastures and semi-natural rough grazings
Slide 18

CHALLENGES

- Projections are uncertain (range of possible emissions scenarios, uncertainty within and between models)
- Interactions are very complex, likely to be some unpredictable effects
- Must maintain resilience and adaptability of land use options

Slide 19

CHALLENGES

- GW likely to have overall adverse effect on global food production capacity
- If this is significant, it may reduce certainty of supply from some countries and possibly open up new markets for UK foodstuffs
- These indirect effects on supply side could be more significant than the direct effects

Slide 20

CHALLENGES

- UK farming systems also deliver environmental goods
- Little is known of the resilience of “natural” ecosystems within farmed land
- Only rudimentary ideas of how to manage “ecosystem transfer”
- Some management activities may have an agricultural “cost”
Changes in biodiversity attributable to the development of agriculture

Redrawn from Edwards & Hilbeck, 2001
Biodiversity issues

Dr Keith Duff, Chief Scientist, English Nature

Slide 1

**Biodiversity Issues**

Dr Keith Duff  
Chief Scientist  
English Nature

Slide 2

**Aims**

- Why is Biodiversity important?
- How is Climate Change affecting it?
- What policy areas do we need to think about?
Slide 3

Policy drivers for biodiversity

- EU Habitats Directive
- EU Gothenburg target
- PSA targets
- UK Biodiversity Plan

Slide 4

Ecosystem Services

- Water storage
- Carbon storage
- Pollinators
- Genetic resource
- Soil processes

Slide 5
Slide 6

Biodiversity Action

Slide 7

Fragmentation and isolation

Slide 8

UKCIP Scenarios

By 2050s:
- 20% increase in winter precipitation
- 20% decrease in summer precipitation
- Hotter summers
- Colder winters rarer
- Sea Level rises
Slide 9

**Perspective**

Britain

250 and 400 million years ago

Slide 10

Slide 11

**Biodiversity response**

- **Red Admiral**
  - emerges 36 days earlier
  - flies 40 days longer

- **Green-veined White**
  - emerges 14 days earlier
  - flies 24 days longer
Plants are earlier

Lesser celandine – now flowers in Cumbria
Winter aconite – 1 month earlier in Norfolk
Primrose – now emergent
Snowdrop – out in south in November

Animals responding too

Saltmarsh
Essex estuary saltmarsh losses

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Coastal habitats: balance

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We have good Models

- Direct effects - species and habitat response, sea level rise (MONARCH)
- Indirect effects - land and water use, mitigation effects (REGIS, ACCELERATES)
- Observing biological change and climate relationships (MarClim, ECN, surveillance schemes)
Slide 18

**MONARCH:**
habitats under pressure

- Beech woodland loses climate space in S & E, likely to gain in N & S
- Montane heath most sensitive of all, since all species lose climate space
- Dune slacks may dry out in S & E (other freshwater wetlands also dependent on hydrology)

Slide 19

**MONARCH:** broader issues

- Species with northerly distributions generally contract
- Species with southerly distributions generally expand
- Many habitats show changed species composition as species or dominants lose climate space
- Rare arctic fish species in Lake District will become very vulnerable

Slide 20

**Hawfinch**

- Observed
- Simulated Current
- 2020 High
- 2050 High

**SPECIES model, incorporating land cover from MONARCH 2**
European context

- Flowering 1.4 – 3.1 days earlier per decade over a 30-50 year period
- Elevational shift of 1 – 4 metres per decade
- Appearing 2.8 – 3.2 days earlier per decade over 35-63 year period

European land use change scenarios - ACCELERATES

<table>
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SPECIES model for Silver Spotted Skipper (ACCELERATES)

- Observations
- Simulations
- Records from NBN
**Slide 24**

ACCELERATES: Summary of results

Slide 25

“Surplus” land in 2080

Slide 26

**Significant issues to consider**

- Ability to meet EU and national policies on biodiversity
- Need to “re-connect” the countryside
- What are the implications of land use changes and potential new crops
- Changes in water availability, and increased competition for it
- Coastal management pressures
Slide 27

**Biodiversity policy**

Need to factor in climate change when:

* reviewing commitments such as SSSI and PSA targets, or HAP and SAP lists and targets
* making long term investments such as habitat restoration, species recovery, or coastal realignment

Slide 28

**Site management responses**

- Reduce other pressures, and achieve favourable condition, so that ecosystems are more resilient to change
- Use management techniques to protect features by mitigating climate effects where possible – i.e. controlling water levels, and competitive/invasive species
- Manage sites within an ecological network, facilitating dispersal and colonisation
- Re-think conservation objectives to reflect the dynamic ecological situation, and develop appropriate methods of assessment

Slide 29

**Re-connect the countryside**

- Improve permeability of landscapes to facilitate dispersal, using landscape ecology principles
- Minimise further loss of semi-natural habitats, including small patches, even where they currently have no special features of interest
- Identify and safeguard areas with good existing adaptive capacity – i.e. extensive or linked habitats, altitudinal gradients, topographic complexity
- Support new habitat creation, taking advantage of land "released" from intensive agriculture
- Secure more effective targeting of agri-environment schemes
- Consider translocation of species where necessary
Slide 30

Benefits of targeting

Slide 31

Potential land use changes

- New crops
- Maize viable further north?
- Grapes more extensive?
- Grass season longer?
- Winter grazing harder because of wetter winters?

Slide 32

Water issues

- Competition between biodiversity and agriculture, housing and industry
- Cumulative effects, especially in SE - combination of development and increased dryness
- Biomass crops - water balance
- Flood plain functionality
Coastal management

- Managed realignment is the only environmentally sustainable solution, but is not always welcome
- Coastal development principles
- Eutrophication in coastal waters and estuaries
- Fishing down the food chain

On the way to Adaptation

Scope the Impacts
Quantify the Risks
Devise Adaptation Strategy
Review Adaptation Strategy

Building Adaptive Capacity

Adaptation pervades the operation

Acknowledgements

Andy Stott
Chris West
Mike Harley
Climate change and the challenges for the water and wastewater industry

Pamela Taylor, Chief Executive, Water UK

Water UK is the representative body for the licensed water and wastewater operators, private companies in England and Wales and public sector organisations in Scotland and Northern Ireland.

I am going to talk to you about the impacts of climate change on the water industry and the sector’s reaction to these new challenges. The water industry like the farming industry is closely attuned to natural processes, we influence and are influenced by natural processes. And land and water management sectors will be the first to experience climate change; so much of what I say about water and the water industry is also true for land and the farming industry.

Climate change is of critical importance to the water industry. It is already affecting the water industry from its source materials to its customer base and to its disposal routes. There is no question that companies who do not plan for this issue now will have insufficient capacity to continue to deliver their current levels of service. Without factoring in climate change effects water and wastewater service provision will become unsustainable. Whilst, of course, we are considering long-term mitigation, we are at present focusing on the pressing needs of adaptation.

In one sense we have a good framework for water management in the UK with water resource plans and drought plans these are all based on dealing with a known situation and one-off exceptions, rather than a completely different underlying climate. Historically, the way we have planned to deliver water to customers 365 days a year has depended on predictable rainfall patterns.

During 2003 the UK experienced the driest consecutive ten months on record and whilst there were no interruptions to supply, due in part to measures that had been taken since the drought of 1995, the system was severely tested. Companies up and down the country had to apply for drought permits and orders in order to prepare for the prospect of a continuing drought. Without winter rainfall there was a very real prospect of supply restrictions being imposed during summer 2004 and the industry was on the verge of starting a national public information campaign.

In common with agriculture, climate change is not the only issue challenging the industry, there are various directives to be implemented, changing patterns of household formation, large-scale new housing development, and changes in life style and demands for water and changes in land use, but climate change is the least predictable and the issue which has the largest potential long-term impacts on the industry.

Average temperatures have risen by 1°C since 1990 after more than 300 years of temperature stability. If this trend is projected into the future this will mean a much more Mediterranean climate with little summer rainfall, changes in habitats and loss of habitat for native species.

So let me run through the impacts on the industry.

Firstly, climate change will impact on resource availability.
Whilst the annual average rainfall may not change dramatically, there will be changes to the patterns and seasonality of rainfall. Rainfall events will be more intense and rainfall will generally increase during the winter and decrease in the summer. This means that there will be less available and lesser quality surface water for summer abstraction and there will need to be a greater reliance on winter storage. We believe that farmers should be encouraged to develop on-farm reservoirs for winter storage; in Spain this extra storage capacity is also available to augment public supply.

This will also apply to groundwater abstraction due to the increased reliance on groundwater supported base flow to provide stream flow. There may also be a long-term threat to groundwater reserves, as the more intense rainfall events may result in surface flooding rather than infiltration to groundwater (however this is the most uncertain aspect of the hydrological cycle). Higher temperatures may lead to increased evapotranspiration and a reduction in groundwater recharge.

The main concern relating to supply is not a slight change in the climate but fundamental changes to the patterns of climate and an increased incidence of extreme conditions. Long-term droughts and flooding events lasting more than one year will severely stress the water and wastewater infrastructure.

Linked to this lack of resource is an increase in salt-water intrusion, as coastal communities pump more groundwater to meet demand saltwater is sucked into coastal aquifers making them unfit for abstraction and the land unsuitable for agriculture. This is a worldwide phenomenon. In low lying areas salt water intrusion can also be intensified by rising sea levels, thereby affecting fresh water resources.

**Now, let’s look at the impacts on our assets**

Climate change will present a number of threats to assets and potentially increase the cost of asset maintenance. Dams will be more prone to siltation due to increased soil erosion; soil dams will also face a greater threat of slippage as a result of rainfall; increased wind speeds will mean that wave erosion on upstream dam faces will increase.

Pipe systems for both supply and sewerage will be more prone to cracking as climate changes lead to greater soil movement, desiccation and freeze-thaw cycles.

Changes in location of supply may lead to increased infrastructure for pumping water from winter storage as summer supplies become unavailable. As both groundwater and river levels drop, abstraction wells will have to be deepened or abandoned, and surface water intakes may have to be relocated.

In areas that are prone to flooding existing infrastructure for water supply may have to be re-located.

The design standards for existing sewerage systems did not take climate change into account. Future rainfall events are likely to exceed the current hydraulic capacity of parts of the network leading to localised flooding. Accounting for climate change in new sewer design and improving current combined sewer overflow performance will be extremely costly.
Most water treatment and sewage treatment works are close to rivers on flood plains. These assets are at risk of being flooded or stranded and inaccessible during flooding events.

**There will also be impacts on infrastructure operation.**

Changes to water treatment works may be required to deliver treatment that is effective at a changed operating temperature. Changes in temperature will lead to changes in the biological status of waters with increased eutrophication and associated threats to quality.

The operation of sewage treatment works may be compromised by changes in operating temperature. Generally an increased temperature should improve the level of operation, but we are already seeing that it may also lead to increased odour problems from treatment works.

Sewerage networks will also be affected under climate change. Many combined sewer systems worldwide were designed for a certain return period of rainfall event. As the climate changes the actual likelihood of occurrence of events changes and the systems may no longer be able to support levels of surge flow associated with more intense rainfall.

**There will also be impacts on water quality.**

There will be problems associated with changes in pests and pathogens. As the climate changes the habitats of pests and pathogens will change and this will require more agricultural pesticide use and will lead to a reduction in raw water quality.

Quality may also be threatened by changes in farming leading to increased soil erosion and changes in types and loads of pesticides. These changes in land use may mean that water companies will have to deal with different types of diffuse pollution from those they are accustomed to.

Floods and fluctuations in water levels will cause water quality problems through the mobilisation of pollution in the unsaturated zones and damage to industrial sites. Damage to housing and industrial areas during floods will result in increased pollution of surface water and groundwater with all kinds of stocked chemicals.

In general the current diffuse pollution problems will be exacerbated by climate change.

The water industry will also face environmental challenges, relating to climate change.

Lower river flows, saline intrusion, and reduced groundwater surface water interactions in the summer will all have an impact on ecology. Defining and predicting what will happen is difficult, as ecological systems will adapt to the changing climate.

Like farming, the water industry owns large areas of designated nature sites and the stewardship of such sites is already a water industry obligation. Looking forward
there will need to be flexibility in the UK’s views on environmental protection; this may have to be more holistic and less prescriptive. For example there are currently no mechanisms for de-designating European Natura 2000 sites, which may be necessary if a changing climate removes the reason for their designation or makes it prohibitively expensive to think of preserving such sites in aspic. Likewise we may have to consider ecological corridors, a series of specific isolated designated sites with no interconnections means that it is difficult for species to adapt or migrate between sites; this is particularly true of invertebrates. The river system and riparian lands are the ideal areas for such corridors and we may have to reassess the way we manage river systems.

Worldwide one of the most concerning issues relating to climate change is the loss of wetlands. Wetlands are an essential part of the water cycle and help protect both water resource quantity and quality, as well as being important habitats and buffers against desertification.

The water industry will also face impacts on water demand.

Climate change will impact upon demand in the domestic, agricultural and industrial sectors.

Domestic

Rising temperatures will have impacts on customer behaviour, which is likely to lead to more water usage. Personal washing and clothes washing will increase, as would leisure use of water in the garden and the demand for facilities such as swimming pools. However, prolonged dry periods may also lead to increased interest in water efficiency amongst customers.

Industrial

Industrial response to climate change is highly variable depending on sector; however there may be addition demand for cooling waters.

Agricultural

There will be increased demand for animal watering and crop irrigation, both in volume and area.

These are the likely short-term response to climate change; there may also be larger more structural response, which will have a much greater impact on water resources. Such as changes in industrial production or cropping and changes in population and migration.

All of these challenges relate to increased uncertainty and the need for long-term planning

One of the few certainties of climate change is that the climate is becoming more uncertain. The return periods for droughts and floods, the temperature ranges and the average rainfalls and streamflows we can expect are no longer certain. This absence of stationarity makes planning, prediction and therefore investment
extremely difficult for the water and wastewater industry. It is therefore essential that this issue be fully factored into forward planning and investment. In short there is a cost associated with preparing for climate change, and we must prepare if we are to maintain quality, service and environmental standards in the long-term.

The current 5-year periodic review of water industry prices and investment does not encourage long-term investment. And the lack of Ofwat commitment on climate change has been disappointing. It is also concerning that although the water sector is a major energy user we are still effectively excluded from most of the Government funding streams on climate change mitigation, the structure of the climate change levy and the trading schemes are not helpful and this should be addressed.

So this is the picture for the water industry. How does this link to farming?

The water and agricultural sectors are inextricably linked; climate change will influence both sectors and the way they interact. For example:

Climate change points to a greater water demand for both public supply and agriculture.

Climate change points to an increase in water pollution from agriculture, due to greater storm run-off in winter and lessened dilution during summer low-flows.

In general climate change will accelerate and magnify the problems we already face. There are lots of things Government can do, but the key action lies with the water industry and agriculture themselves. We need better dialogue and we are currently working on an MoU that will benefit both sectors.

So to summarise.

The impacts of climate change are already a day-to-day reality for the providers of water and wastewater services and whilst we are considering long-term mitigation we are at present focussing on the pressing needs of adaptation.

This is the single most important issue facing the water and wastewater sector, climate change is affecting the water industry from its source materials to its customer base and to its disposal routes. Higher temperatures, more intense rainfall events, and rising sea levels will have a major impact on all areas of operation from security of supply and water quality to sewer capacity and the maintenance of assets.

In the Mediterranean Basin, we are already seeing an almost annual cycle of droughts and flash floods, leading to desertification and extreme water stress. The water industry in these areas is responding through an increase of water-reuse, ‘aquifer storage and recovery’ and desalination, but the long-term trends indicate that current levels of water supply in some areas are insufficient. Is this the future for the UK?

World water resources are already being influenced by the changes in climate. Globally there is decreased water quality and quantity, particularly in areas already prone to drought. At the same time an increase precipitation intensity is leading to
widespread global flood damage. In short the future of water is more floods and more droughts, both of which equate to less available water resources.

What I have presented to you is a fairly bleak picture of floods, droughts and pestilence. What should we be doing about this? Well you may be surprised to hear industry praising Government, but we believe that the UK is leading on this issue. But there is more to do.

Climate change cannot be addressed in isolation, a climate change strategy must link land and water management, the Water Framework Directive will be a key tool in meeting the future challenges of a changing climate.

All regulation should consider climate change. And we must consider adaptation as much as mitigation. Industries like water and farming are dealing with climate change impacts on a daily basis. We don’t need emissions trading and the climate change levy to make us think about climate! It is ironic that at the same time we are being pressed to cut emissions, we are facing new regulations that will increase our energy use. You might even like to consider emissions within Regulatory Impact Assessments!

It is time to focus more attention on adaptation for the water and land based industries. The sort of things we should be looking at are the sharing of resources. The consideration of effluent re-use, the use of farmland to mitigate flooding and the enhancement of recharge.

Shared resources means the consideration of an agricultural take for any new reservoir as laid out in the Environment Agency’s ‘Water Resources for the Future’ document, and likewise the potential for water companies to draw upon agricultural storage in times of water stress. There are issues of payment and compensation in both cases but the new Defra grants for IDBs may have a role to play here and there are European examples of this type of approach. Likewise there are examples of agricultural use of wastewater treatment effluents for irrigation, in Sweden wastewaters are stored for three months to reduce biohazard and then sold to farmers. There are also possibilities for trading of licences between farmers and water companies.

I also think that we should be looking more at the role farmers and growers can play in water management. There are good examples of farmland wetlands being used to attenuate diffuse pollution; there are also examples of off-line and on-line storage of floodwaters on agricultural land and the use of storage ponds to increase aquifer recharge. We would like to see even greater use of CAP funding to promote river renaturalisation and the positive management of water by farmers and land owners.

In almost all of these areas the current direction of Government policy is positive, and this is visible across all the nations of the UK.

The current push towards catchment officers will facilitate many of these collaborative and inter-disciplinary initiatives. The work streams on diffuse pollution and environment sensitive farming are very welcome, and the progress on the Water Framework Directive is positive.
Our criticisms are not on the direction but on the pace. We would like to see more action, we should not fear gold-plating when it comes to water management, we would like to see early action – the checks on over-regulation will come from the full participation of stakeholders and we would like to see greater involvement of the farming and water sectors in decision making. A good example of participation should have been the WFD characterisation where the water industry and farming should have been involved at the highest level from the start. We would also like to have seen more on catchment management in PR04. Our other concern is the need for more European co-ordination on water, agriculture and climate change policy.

But even on issues of pace, political will and European co-ordination the signals are good. The plans for the UK presidency, the new working group on CAP and WFD set up by the UK and the European Commission and the working groups on floods and droughts are all positive and we welcome Defra’s work in this area.
Closing remarks

Elliott Morley MP, Minister of State for Environment and Agri-Environment

I’d like to start by thanking everyone for taking the time to attend this seminar, with particular thanks to our four speakers and to those who chaired the break-out groups. It’s good to see that we have been able to gather together such a breadth of expertise, to contribute towards what I understand has been a very productive day of discussions.

Today’s seminar has focussed on the impacts of climate change on farming here in the UK, but we must also keep in mind the severity of its effects elsewhere in the world. I have just come back from a trip to India, where global warming is expected to have a dramatic impact on agriculture. Findings from phase 1 of the joint UK-India Climate Impact Project have shown that a 2 degree Celsius rise in temperature in sub-tropical environments would result in a decrease in wheat yields of between 1.5 and 5.8%, while in tropical areas the fall in wheat yields would be between 17 and 18%, suggesting that warmer regions can expect greater crop losses.

As Lord Whitty mentioned this morning, climate change is of course a topical and fiercely-debated issue. With that in mind, it is important that we consider carefully the evidence referred to by today’s speakers and the findings of the break-out groups, if we are to establish a solid basis for opinion and decision-making in the future.

Dr West from the UK Climate Impacts Programme started proceedings by highlighting the fact that temperatures are already rising in the UK, and that this is having a direct impact on farming. Human activities, as he rightly pointed out, are clearly a major cause of climate change. We need to alter our way of life so that we can adapt to the changes that are already in the climate system, be they natural or man-made. We must find ways of changing our practices to deal effectively with these changes. Adaptation strategies will need to take into account a number of factors, such as longer growing seasons and the possibility of cultivating new, more exotic and profitable crop varieties.

Drawing on a review of recent research, Professor Pollock from the Institute of Grassland and Environmental Research followed with an overview of the predicted impacts of climate change on agriculture. His presentation highlighted opportunities and threats to specific sectors of agriculture as a result of warmer wetter, winters and drier summers.

Professor Pollock also emphasised the many challenges facing the industry, given that a changing climate is likely to have an adverse effect on global food production as a whole.

Professor Duff from English Nature spoke of the predicted impacts on UK biodiversity. Changing temperatures would have a knock-on effect on the breeding cycles and locations of many species, and therefore threaten the existence of a number of important and rare wildlife habitats. It is true to say that new species will start to appear in this country, but we mustn’t neglect the rare wildlife habitats that we already enjoy. This shift will have to be managed carefully.
As you will have considered today, farming in this country is becoming increasingly diverse, with opportunities for agri-tourism linked to farmland biodiversity and scenic landscapes. This means that ecosystem vulnerability carries implications for farm businesses.

Pamela Taylor from Water UK finally spoke about the impacts of climate change on the water industry. Her presentation also highlighted the linkage between water use and land management. The main issue is how the industry tackles the likely increase in demands for water.

Lord Whitty reflected this morning on our vulnerability in the face of global warming. And it is clear that international consensus is vital if we are to both reduce the level of climate change, and respond effectively to its consequences.

So I am pleased that this year the UK will lead the way on meeting these challenges. Climate change will be a priority for both our Presidency of the G8 Group of Nations, and our Presidency of the European Union, and are proceeding with a full programme of events to revitalise our vision for putting the world on a path to a sustainable low carbon future.

The farming industry has a long history of showing itself capable of responding and adapting to changing circumstances. However, as Lord Whitty mentioned earlier, UK farmers operate in an internationally competitive market, and within the UK there are also increasing pressures for land to be used for functions other than agriculture. Awareness of potential problems, and well developed plans are essential if the industry is to retain its competitive position and contribute to wider goals of improved sustainability.

As you have discussed today, some actions can be implemented, now whereas others will need to be considered over longer timescales. Some strategies, which individual farmers can implement, will be specific to particular enterprises or land types while others will have a more general application.

A number of adaptation practices are appropriate for farmland in general, especially exposed land or steep slopes where problems arising from an increased frequency of storms can be expected. These could include: planting of windbreaks to help protect buildings from storm damage; siting and designing of farm buildings to specifications that meet increased frequency of storms; and changes in cropping practices to reduce rate of run-off and soil erosion.

One of the other objectives of today’s event was to develop our strategy for raising awareness of the issues to which I’ve referred. Awareness-raising remains a high priority, but this needs to be coupled with information on adaptations that are realistic in the context of the difficult conditions within which many, if not most, farm businesses now operate.

As the government, we try to support and engage with farm businesses as far as we can. But we are aware that key industry bodies, such as yourselves, provide a vital link in this process.
I know that the discussions today will provide a catalyst for action in the UK. In turn, this will support our role in the world-wide effort to respond to these challenges.

Once again I would like to thank everyone here today for your contributions. I look forward to reviewing our progress on this front in the near future.
Findings from breakout groups

Breakout session – Biodiversity

Chairman: Dr David Baldock, Institute for European Environmental Policy

Key Questions

- What are the key policy challenges for conservation planning when bearing in mind the effects of climate change?

- What actions might be suggested as part of a strategy for sustaining biodiversity in the context of climate change?

Morning and Afternoon session

1. We need to get on and meet the challenges. Discussion/research is useful, but action is vital.

2. An integrated approach is needed, looking at landscape concerns as a whole, rather than biodiversity issues in isolation. The ‘Integrated Agency’ will hopefully bring together advice to government and land managers on these issues, and will take a visionary role.

3. There was support for a catchment-based approach, which takes advantage of a naturally occurring situation. Biodiversity needs to be built into current work on catchment sensitive farming and the Water Framework Directive.

4. Linkages between sites are crucial, and farmers should be encouraged to think about how their holding fits into an overall context. A ‘porous’ landscape (rather than ‘wildlife corridors’) should be the ideal. Semi-natural habitats should be made more resilient, but at the same time they aren’t the only support for biodiversity (hence the importance of a porous landscape).

5. Importance of engaging farmers at an individual level: while a strategic approach is valuable, it is farmers who are in the end responsible for the management of agricultural land.

6. Need for flexibility within legislation, e.g. on Special Areas of Conservation. Natural systems are dynamic: we should work with this process rather than against it, and should think about our approach to conservation sites (do we want to preserve existing biodiversity or allow for natural changes?). There is some flexibility for Member States within the Habitats Directive, and we should take advantage of this. There is also room for evolution of cross compliance standards, which could be put together to reflect climate change adaptations. Any new definitions must reflect society’s aspirations in relation to biodiversity.

7. Market-driven barriers: Need for national buy-in in terms of biodiversity and food security – a huge job that must be driven by Government. Land use is driven by consumers (e.g. ‘buying British’). Must seek views at local, regional and national levels.
8. Link between economics and biodiversity. If we’re to create permeable landscapes, we have to demonstrate the economic gains. So economic analysis rather than scientific research is needed, although bearing in mind that the ‘willingness to pay’ measurement doesn’t always work. More economic analysis could be done on ways of valuing biodiversity benefits, e.g. effects of tourism. HM Treasury may be willing to look at the role of land management in preventing/mitigating flooding.

9. In general, we need a long-term view of how balance can be achieved between ecological and economic concerns, without losing the moral imperative: environmental progress shouldn’t be subsidiary to socio-economic progress. We need to appeal to people in terms of what they are trying to deliver.

10. Although further research was not seen as of the same importance as economic analysis, some possibilities were discussed, including looking at the implications of possible adaptation scenarios. Experimentation should be broad, looking at sustainable development rather than only environmental concerns, and in particular talking directly to landowners and local communities. Although practical experimentation in relation to the effects of future climate change is difficult, studies could look at environments that are already changing quickly, e.g. on the coast. Any work carried out should build on existing research on conservation management and the extensive literature around landscape ecology. Must be scientific rather than anecdotal.

Breakout session - Lowland & upland agriculture

Chairman: Prof. Jules Pretty, University of Essex

Key Questions:

- What are likely to be the key agricultural policy challenges when bearing in mind the effects of climate change?

- What are the most important steps that farmers should take in order to minimise risks and maximise benefits created by the changing conditions?

1. Members spoke about the possible adverse effect on food production. The fact that the good food policy models are not climate changed proofed was mentioned.

2. Economic development has to be taken in account and it was also suggested that basic scenarios were developed.

3. Protecting the UK’s ability to produce food was seen as a policy priority.

4. Caution in relation to changes to flood protection policy should be carefully considered. It was said that 60% of Grade 1 land is currently under sea level which Defra currently protects.
5. There was a request by the group that Defra should produce a new agriculture land classification taking into account climate change.

6. Regulation was perceived by some as a burdensome issue and it was the view that land managers should be incentivised to take action. This may be achieved through a modified Single Payment Scheme or industry-led initiatives such as assurance schemes.

7. Policy that encourages organisation of farmers to manage catchments was seen as a policy priority. A move from centralised top-down command and control structures to local participatory and co-operative partnerships was seen as the best way forward. The Australian Landcare project was identified as a successful example.

8. Communication with land managers to facilitate change in practice was highlighted as an area of importance. Areas to focus on were issues relating to the following:
   
   - the need for communication with consumers so that they understand the impacts of their food choice has on climate change e.g. food miles
   
   - messages should demonstrate the practical necessity and benefits of change. For example, the need to produce more conservation feed to compensate for later turnout resulting from extended wetter periods in spring.
   
   - Monitor farms to demonstrate proactive where identified as a useful mechanism to disseminate good practice. Defra’s demonstration farms should move from central to local and connect local land managers with catchment management.

9. Looking at possible adaptations, time constraints came into the discussion. A decision was needed with which adaptation strategies that needed to be done and whether others can be decided on at a later date.

Breakout session – Water

Chairman: Prof. Tim O’Riordan, University of East Anglia

Key Questions:

- What are the key policy challenges that need to be addressed when considering the relationship between climate change, water and agriculture?

- What should be the focus of the agricultural industry when planning adaptation strategies?

  1. The Whole Farm Approach in terms of adaptation to the effects of climate change was viewed as inadequate.
2. A more holistic approach that goes beyond a farm-by-farm focus toward catchment-based management was deemed necessary.

3. Future frameworks to bring about appropriate catchment management should comprise: -

   - Incentives
     
     The importance of incentivising land managers to encourage change in land management to adapt to climate change was noted.

     In Scotland, interpretation of the WFD provides an incentive for land managers to change practice with Sustainable Flood Management being incorporated into Environmental Stewardship.

   - The need for advice so that landowner adaptation to climate change and management decisions protect the water resource.

   - Encourage co-operation among land managers and local ownership for improving catchments were seen as priority issues to facilitate change. Leveraging policy tools combined with advice and social marketing will facilitate this change.

4. There is also a greater need for research & development but the lack of joining up needs to be addressed first. There are also gaps in R&D in modern farming processes.

5. Policy: There are a number of policy contradictions in existence that need to be looked at, such as the planning permission water storage issue and the fact that there is a need for more housing and OFWAT regulation and financing controls.

6. OFWAT regulation and financing controls are restrictive and seen as a barrier when planning an adaptation strategy relating to water. For example, financing local catchment-management schemes is difficult compared to that of capital assets, although the former was viewed as more sustainable.

7. Cost is also another barrier for farmers, when it comes to storage tanks for water. Some form of co-funding is needed.

8. It was recommended that the Rural Climate Change Panel be reconvened.
# List of delegates and affiliations

**Chairman**
Sir Brian Bender Defra

**Speakers**
- Lord Whitty of Camberwell Parliamentary Under-Secretary (Lords), Farming, Food and Sustainable Energy
- Dr Chris West UK Climate Impacts Programme
- Prof Chris Pollock Institute of Grassland and Environmental Research
- Dr Keith Duff English Nature
- Pamela Taylor Water UK
- Elliot Morley MP Minister of State for Environment and Agri-Environment

**Breakout group Chairmen**
- Prof Jules Pretty University of Essex
- Prof Tim O'Riordan University of East Anglia
- Dr David Baldock Institute for European Environmental Policy

**Delegates**
- Jo Hossell ADAS
- Sir Crispin Tickell Agricultural Forum
- Liesel van Ast Citigate Publishing
- Mark Hudson Country Land & Business Association
- Tanya Olmeda-Hodge Country Land & Business Association
- David Parker Countryside Council for Wales
- Tom Oliver CPRE
- Ian Holman Cranfield University
- Andy Fraser Defra
- Rachel Solomon-Williams Defra
- David de Borja Defra
- David Burrows Defra
- Andrew Lebrecht Defra
- Stuart Gibbons Defra
- Matthew Bell Defra
- David Richardson Defra
- Rhian Mewis Defra
- Mike Walker Defra
- Nigel Atkinson Defra
- Judith Stuart Defra
- Lisa Horrocks Defra
- Peter Costigan Defra
- Jeremy Eppel Defra
- David Jones Defra
- Ericka Rowe Defra
- John Speers Department of Agriculture and Rural Development
- Stephen Trow English Heritage
- Fiona Mulholland Environment & Heritage Service
- Merylyn McKenzie Hedger Environment Agency
- Simon Gardner Environment Agency
- Michael Hamell European Commission DG ENV
- Christine Tacon Farmcare
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<tr>
<th>Name</th>
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<tr>
<td>Malcolm Beatty</td>
<td>Forest Service</td>
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<td>Carol Somper</td>
<td>Forum for the Future</td>
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<td>David Hughes</td>
<td>Imperial College London</td>
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<tr>
<td>Alan Hopkins</td>
<td>Institute of Grassland and Environmental Research</td>
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<td>John Kerr</td>
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<td>Paul Fisher</td>
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<td>Charlotte May</td>
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<td>Nicholas Saphir</td>
<td>OMS Co (Organic Milk Products)</td>
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<td>John Conway</td>
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<td>Mark Griffiths</td>
<td>Royal Institute of Chartered Surveyors</td>
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<td>Mark Avery</td>
<td>RSPB</td>
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<td>Mike Donaghy</td>
<td>Scottish Environment Link</td>
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<td>Colette Backwell</td>
<td>SFFS/Defra</td>
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<td>Mike Summerskill</td>
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<td>Rebecca Marshall</td>
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<td>Gundula Azeez</td>
<td>The Soil Association</td>
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<td>Richard Smithers</td>
<td>The Woodland Trust</td>
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<td>John Gummer MP</td>
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<td><strong>Press</strong></td>
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<td>Tom Levitt</td>
<td>Farmer's Guardian</td>
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<td>Sarah Mukherjee</td>
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Seminar Feedback Questionnaire

Feedback Form: The Impacts of Climate Change on Agriculture
Monday 7th February 2005

To help Defra to assess the success of this event, and to ensure that we have taken into account as much stakeholder input as possible, we would appreciate a few minutes of your time to complete this questionnaire. Please tick the boxes that relate to your views (✔) and add any further comments as appropriate.

1 What were your main objectives for attending this event?
- Learning about Climate Change and agriculture for the first time
- Updating your Climate Change and agriculture knowledge
- The opportunity for networking
- Other (please state) ........................................................................................................

Were your objectives for attending this event met?  Yes [✔]  No [ ]
If no, please comment why not:
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2 The Presentations
How useful/relevant were they to your organisation?
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3 The breakout sessions (How useful were they?)

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4 Please add any additional comments you may have about the breakout sessions
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5 Were there any topics that you felt were not addressed sufficiently on the day?
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6 Do you feel there are any policy areas that Defra should look at urgently?

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11 Please could you complete your contact details (optional):

Name................................................. Job title..........................................................

Organisation....................................................................................................................

Address............................................................................................................................

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Town................................................. County.........................................................

Tel......................................................... Fax.............................................................

E-Mail......................................................

12 Do you have any other comments?

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THANK YOU FOR YOUR HELP

Please return your completed questionnaire to Rachel Solomon Williams, Defra, Area 8B, 9 Millbank, c/o 17 Smith Square, London SW1P 3JR,
The data will protected under the terms of the Data Protection Act 1984