

## **RISING TO THE LAND-USE CHALLENGE: ISSUES FOR POLICY-MAKERS**

### **A DISCUSSION PAPER PREPARED BY VICKI SWALES AND ALAN WOODS**

#### **FOR THE RURAL ECONOMY AND LAND USE PROGRAMME**

1. We make multiple and complex demands on land and water resources - from growing food and fibre to providing the setting for many recreational activities. These resources are finite, vulnerable to damage and subject to growing pressures. What we want from land and water resources and how we best manage them to deliver desirable outcomes is now high on the political agenda. New land-use challenges and controversies are emerging all the time.
2. Diverse drivers at different political levels interact to set the policy context. These include: reform of World Trade and the CAP; the impacts of climate change on agriculture, and wider mitigation and adaptation efforts; population growth; concerns about security of supplies of food, energy and environmental services; consumer demand and market forces; the implementation of EU environmental legislation; strengthening of devolved government; diverse national policy strategies; and a strong agenda for innovation. Developing rounded policies in response to these is always going to be difficult. Through its body of interdisciplinary research, the Rural Economy and Land Use (Relu) programme<sup>1</sup> has an important contribution to make in helping policy-makers select the best options.
3. The attached paper presents our independent assessment for Relu of land-use challenges for policy-makers emerging from 20 Relu projects (see the **Annex**). We have drawn on discussions with Relu research teams, and inputs from the Relu Team, our Advisory Group, the People and the Environment Forum and the on-line Relu 'Land Use Debate'. Policy leads in Defra, the Scottish Government and the Welsh Assembly Government have all been involved, and links have been made with the Government's 'Foresight Project on Land Use Futures'. Most of the Relu projects we have reviewed are currently in their early stages.
4. We have identified three 'strategic' policy questions for further discussion:
  - How do we achieve multiple objectives from land and water?
  - How do we achieve more democratic and accountable decisions?
  - How can our use of land and water help tackle climate change?
5. **Comments on the attached paper are invited from researchers, policy-makers and other interested stakeholders. Please do not feel obliged to respond to *all* the questions. In addition to comments on the issues raised here, we would also welcome your overall comments on (a) research gaps in this field and (b) implications posed for/by the devolved or regional contexts.**
6. **Please e-mail your comments to [relu@ncl.ac.uk](mailto:relu@ncl.ac.uk) by 8 October 2008.**

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8 September 2008

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<sup>1</sup> See <http://www.relu.ac.uk/> for further information about the Relu programme

## **1. HOW DO WE ACHIEVE MULTIPLE OBJECTIVES FROM LAND AND WATER?**

- 1.1 Land and water resources provide a range of vital ecosystem services. But these resources are limited and vulnerable. How we manage them has implications for our well-being. The failure of the market to deliver the full range of ecosystem services is a real challenge.
- 1.2 In the past, we have zoned land primarily on its suitability for development, food and timber production ('white' land in local plans), and wildlife, landscape and recreation (e.g. Sites of Special Scientific Interest and National Parks). Each 'zone' has been supported with sectoral, single-purpose policies. This approach undervalues the much wider range of services which land and water can provide. Government now seeks to embed the ecosystem services approach in policy development and delivery. Set against the background of an embedded *sectoral* approach, this represents a major challenge.

### **Consultation questions:**

- a. ***How do we get the balance of services right?***
- b. ***What more do we need to understand about behaviours?***
- c. ***How should we value and trade-off different ecosystem services?***
- d. ***Who decides what ecosystem services we need and where?***
- e. ***What mix of mechanisms do we need to tackle market failure?***
- f. ***What supporting models and indicators are needed?***

### **How do we get the balance of services right?**

- 1.3 Certain kinds of agricultural and forest management enhance the provision of public goods. For example, extensive, low input farming systems are generally accepted as being of higher nature value than intensive, specialised farming systems. Native species, mixed woodlands tend to be more biodiverse and attractive than single-species stands of conifers. Which particular land and water management systems and practices need to be supported and encouraged if maximum public benefits are to be achieved? Are these management systems and practices under threat and, if so, what policy interventions are required to secure their future?
- 1.4 What will be the best mix of uses and management practices to optimise the range of ecosystem services from land and water? Options include:
- Changing the extent and mix of specific land uses (e.g. the balance between agriculture, forestry and other uses)
  - Adjusting management practices (e.g. more unsprayed field margins)
  - Adopting new technology (e.g. genetically-modified crops, grasses or trees)
  - Finding entirely new approaches (e.g. intercropping with biomass crops)
  - Using previously-developed or set-aside land for productive agricultural purposes
  - Restoring or 're-wilding' habitats (e.g. by converting intensively-managed arable to low-intensity grassland or heathland, or restoring degraded peatlands).
- 1.5 We need to know more about how to manage limited resources to respond to global challenges. We also need to include risk and uncertainty in our thinking, so as to retain the flexibility to adapt to changing circumstances and protect future options. Restoring peatlands to improve carbon storage is one focus of the *Sustainable Uplands* project. The *Hill Farming*, *Biodiverse Farming* and *Agri-environment* projects are assessing how land management practices affect biodiversity. The *Organic* project, by considering economic, social and environmental impacts, should help determine the place of organic farming in the overall mix. The *Water Framework Directive* project will indicate the sorts of changes in land use and management needed to respond not only to environmental legislation but also to changes in market conditions.

- 1.6 The substantial variation within and between farm enterprises, farms and farmers in any one valley, catchment or landscape also needs to be taken into account. Several Relu projects, including *Hill farming*, *Community Catchment Management* and *Livestock Waste* are providing insights here. We need better mechanisms to target interventions to the most appropriate areas. How can we develop much more fine-grained policies, so that intensive farming practices are directed away from areas of high biodiversity or from sub-catchments where the impact on water quality would be disproportionate?

### **What more do we need to understand about behaviours?**

- 1.7 Understanding the attitudes, motivations and interests of farmers, foresters and estate owners is critical in engaging them in providing public goods. For example, the *Agri-environment* project is showing that prescriptions presented to farmers to produce a better environment do not necessarily lead to the desired outcomes because farmers are not sufficiently engaged with the aims of the policy in the first place.
- 1.8 The work which many Relu projects are undertaking on decision-making frameworks could offer important steers for policy-makers. For example, how will farmers react to the loss of Single Farm Payments, increased regulation, and a 'bull' market for food and biomass which yields far better returns than agri-environment schemes? Understanding decision-making frameworks will also assist in designing effective incentive schemes and regulations, and in identifying advice and training requirements to support adjustment.
- 1.9 Policy-makers also need to understand why farmers adopt alternative land uses. The *Organic* project is examining why farmers convert to organic methods and the socio-economic and environmental scale effects. Reasons why farmers see organic farming as an attractive option include: suitability of land and existing farming systems; proximity of markets; neighbourhood effects; crisis episodes forcing change; and, a desire to maintain a family farm employing household labour. The project will also assess the likely impacts of new scenarios (e.g. 'a 20% increase in organic farming'). The *Livestock Wastes* project is exploring how public health concerns (over the presence of faecal indicator organisms in water used for recreation) can influence land management.
- 1.10 The *Energy Crops* project is surveying growers to understand why they grow short rotation coppice and *Miscanthus*. Responses include: the prospect of long-term contracts and, until relatively recently, low farm commodity prices; a desire to develop energy crops within a diversified business; the ease of managing these crops; and 'testing the water' for alternative enterprises. As with organic farming, there appears to be a 'neighbourhood effect' as the farmer who starts to grow the crops sets off a local chain reaction. Proximity of markets and infrastructure also influence the switch to energy crops.
- 1.11 An increase in regulatory controls to internalise negative externalities seems likely. The introduction of Water Protection Zones could give regulators the power to require farmers to cease or modify any one of 44 specific land management practices to meet the goals of the Water Framework Directive. Understanding the likely reactions of land managers involved in different enterprises both within and between regions will be important. It will also be important to understand the secondary impacts of implementing such land management practices (e.g. on biodiversity, ammonia emissions and greenhouse gases).
- 1.12 The *Hill farming* and *Sustainable Uplands* projects suggest that many farmers are uncertain whether food security, climate change or other environmental issues are now the dominant policy drivers. The *Floodplains* project reports that '*In the farmers' view, policy has tended to switch from one extreme (maximum food production) to the other (environmental stewardship) and back again, leaving farmers in confusion about which strategy (maximising output or relying on environmental payments) is the best to guarantee their livelihoods in future.*' What steer can policy-makers provide? Should farmers simply be

advised to keep their options open? Or to prepare for a market without subsidy - and with minimal incentives for providing public goods?

### **How should we value and trade-off different ecosystem services?**

- 1.13 Valuation issues immediately arise in determining what ecosystem services to seek where. Traditionally, and maybe now again, food has been valued more highly over biodiversity, landscape beauty, water quality and other services. All ecosystem services need to be appropriately valued. Yet the valuation frameworks of previous decades are still firmly embedded in policy structures and resource-allocation systems. For example, Single Farm Payments still dwarf the funds available for agri-environment schemes, and for securing management of Sites of Special Scientific Interest - the most biodiverse areas of land and water. To what extent does the funding balance need to shift to reflect the higher valuations placed on ecosystem services which have been relatively neglected? How could the necessary shift in funding be secured?
- 1.14 Identifying the conflicts and trade-offs between different ecosystem services is critical. Rising food prices and concerns about environmental impacts mean that the global expansion of biomass production is now questioned. The *Energy Crops* project will help us understand the full range of consequences of shifting land use towards biomass production. It is developing a framework for Sustainability Appraisal for short rotation coppice and *Miscanthus*. Should we develop and apply Sustainability Appraisals to existing land uses - not just 'new' ones? Would we find that current land uses are unsustainable over substantial areas of the country?

### **Who decides what ecosystem services we need and where?**

- 1.15 Our institutional structures also reflect the historic values attached to different services. Aspirations for a more integrated and holistic approach were reflected in the creation of Defra and Natural England. But responsibility for each 'pillar' of sustainable development remains scattered (e.g. the two environment (protection) agencies in Britain are separate from their conservation counterparts and in England much depends on the links between national agencies and Regional economic and spatial development structures). In Scotland, recent structural reorganisation around five strategic objectives may promote more joined-up policy making. However, do separate objectives for a 'greener', 'wealthier and fairer' and 'healthier' Scotland simply reinforce a silo approach which fails to see the environment cutting horizontally across all other policy areas? What further institutional changes are required within the public sector to reflect the higher valuations placed on hitherto neglected ecosystem services and to ensure a more integrated approach?
- 1.16 The *Floodplains* project is examining how to balance multiple roles for floodplains, taking account of different stakeholder interests and valuations. Their approach recognises that flood prevention is only one ecosystem service alongside several others. Their findings suggest that current rural land use policy is often fragmented, inadequately targeted and dominated by short-term thinking. How can we inject a longer-term strategic approach into planning the use and management of land for diverse purposes? What would a practical framework for joined-up policy and development planning look like?
- 1.17 UK land-use policy and planning has traditionally been centralised. Recent devolution marks a shift towards local and regional decision-making within a national framework. The *Catchment Management* project warns of the potential for EU Water Framework Directive measures to '*rush ahead of science and consensus*' and of '*the risks of a democratic deficit and poor governance*'. The *Livestock Wastes* project also highlights concerns about policy running ahead of the evidence base, with anecdote sometimes prevailing over evidence. There are real tensions here. International good practice may be relevant. How do we integrate top-down strategic planning with bottom-up decision-making and delivery?

- 1.18 One approach may be to devolve greater powers and resources to local authorities, and the local offices of national agencies, to work with local communities to prioritise ecosystem services and develop local solutions. The *Deer* project highlights the difficulties at local level of implementing multiple policies promoted by Government agencies and NGOs. The project suggests that engaging local deer managers with local agency staff at the outset of policy implementation could lead to a more sustainable relationship between national policy objectives and local community objectives.
- 1.19 There is growing recognition that voluntary bodies could play a stronger role in rural areas, alongside the public sector and private land managers. River Restoration Trusts, for example, have successfully funded the fencing of riverbanks to exclude livestock, delivering multiple benefits for fisheries and biodiversity and better fishing rents. The National Trust and Royal Society for the Protection of Birds deliver public policy objectives over their own land and through partnerships with others. What greater role could the third sector play in delivering land use policy? Do voluntary bodies need to take a more integrated approach?

### **What mix of mechanisms do we need to tackle market failure?**

- 1.20 It is widely accepted that governments should intervene in markets only where there is 'market failure'. For example, farmers may adopt damaging land management practices where the market provides no financial incentive to maintain a positive benefit (landscape beauty, clean water) nor penalty to discourage a negative impact (a despoiled landscape, polluted water). The interventions available to government include: information, advice, voluntary agreements, economic instruments (including taxes, levies, and incentives) and regulation. Finding the best mix of actions to internalise these 'externalities' is a continuing challenge for policy-makers. The difficulties are accentuated by the sheer variety of enterprises being run by some 300,000 land managers who have differing objectives and face diverse businesses challenges.
- 1.21 Given pressure to reduce global support for agriculture and the Government's stated commitment '*to a system where – by 2020 - public funds are used only for public goods that the market cannot deliver, in particular environmental benefits*', the debate over the appropriate balance between incentive and regulation in particular must intensify. If Single Farm Payments end, what will then secure the environmental benefits delivered through cross compliance conditions? Will agri-environment schemes continue, let alone grow? Will continuing high returns to some enterprises (not all) reduce the attractiveness of environmental schemes?
- 1.22 We also need to remember that policy mechanisms are fallible. The current focus on 'better' and 'modern' regulation reflects past failures to deliver desired outcomes. Agri-environment schemes have been criticised for not achieving their objectives or providing value for money. Now they need to incorporate climate change and flood alleviation too. The recent review of Environmental Stewardship found that '*some degree of additional advice and support will be needed if ES is to be successful.*' Five projects - *Catchment Management, Agri-environment, Biodiverse Farming, Water Framework Directive* and *Sustainable Uplands* - will all contribute relevant insights. To what extent do we need to adapt existing delivery mechanisms to new policy challenges? Should there be greater emphasis on advice and training for land managers to support policy initiatives?
- 1.23 Relu projects (e.g. *Community Catchment Management* and *Agri-environment*) are also finding that policy mechanisms can have unexpected outcomes. A net environmental loss can result if schemes to extensify practices in one area lead to intensification elsewhere. There is also a tension between *managing by prescription* (if the prescription is wrong, the result will be poor) and *managing by objectives* (where issues of motivation, skill and policing arise). The *Nutrition* project suggests that policies to promote a healthier diet with less red meat could impact severely on the beef and sheep sectors, particularly in remote areas, with impacts on both the economy (e.g. loss of output and employment ) and the

environment (e.g. undergrazing of habitats). Are we doing enough to identify and avoid potential unexpected and unwanted outcomes from policy interventions?

- 1.24 Defra has recently indicated that it favours a mix of regulation (Water Protection Zones), incentives (Environmental Stewardship) and advice (Catchment Sensitive Farming Delivery Initiative) to achieve its objectives for water protection. This same package of instruments is relevant to a wide range of environmental issues. Is there a need to strengthen these existing instruments and/or to think more creatively about alternative approaches to achieving multiple objectives from land and water?
- 1.25 The government has avoided pesticide or fertiliser taxes in favour of Voluntary Initiatives. Tendering approaches are widely used in Australia but here only in the National Forest (owners bid for funds to establish woodland and the most attractive tenders are selected). The USA Grassland Reserve Program purchases easements to protect grasslands while maintaining production. Owners receive an annual payment based on the length of the easement and the value of the land. 'Open space covenants' are used in New Zealand. The *Sustainable Uplands* project is considering a scheme under which local businesses would off-set carbon emissions and the money raised would fund peat and restoration projects to enhance carbon capture. Land swaps or land buy-outs could also have a role to play. Should we borrow and test new ideas from other countries? What is the most effective, efficient and affordable mix of delivery mechanisms to deploy?
- 1.26 Alongside public policy mechanisms, there may also be a stronger role for the market itself. Organic food and products sold under certification and labelling schemes tend to cost more than conventional products because the market price reflects the costs of avoiding environmental damage. In surveys, people say they will pay higher prices for food produced according to specific welfare or environmental standards, but this is often not reflected in their behaviour. The *Nutrition* and *Local Food* projects are both exploring consumers' willingness to pay for 'healthier' and 'local' food. Their results may help us to assess realistically how far food markets can drive the delivery of ecosystem services. What potential does the market offer to reward high standards of stewardship of natural resources, biodiversity, landscape and other values?

### **What supporting models and indicators are needed?**

- 1.27 The dramatic increase in computing power in recent years has enabled the development of sophisticated models. Many Relu projects are modelling interactions between land use, the economy, land managers and the environment. Six projects alone are working on farm production modelling. Key challenges relate to:
- Scale (field, enterprise, farm, catchment, regional, national).
  - The relationships between models at different scales, and scaling-up model outputs from local to regional and national scales.
  - The immense variation between farms and environmental conditions even in the same small area (variation between farms in one parish can be greater than variation between parishes).
  - Integrating models from different disciplines (economics, hydrology, ecology, etc).
  - The use of models to support learning and decisions as well as predicting impacts
  - Involving stakeholders meaningfully in the modelling process, incorporating their knowledge and communicating results transparently so that their assumptions and internal logic can be evaluated (avoiding the use of models as 'black boxes').
  - Ensuring that parameters used in modelling are meaningful, and that uncertainties are understood and made transparent.
- 1.28 This work challenges the traditional models employed by policy-makers. For example, there is currently a strong emphasis on using Linear Programming models to determine how to achieve the best outcome given a list of requirements expressed in the form of linear equations (e.g. how to maximise net farm income from a range of enterprises subject to

constraints of size, input costs and output prices). A complementary approach is to use Econometric models which employ regression techniques to analyse relationships, determine causation and/or predict the effects of changes in the system on outcomes (e.g. to understand the relationships between land use and diffuse water pollution, and to predict how these will be affected by a range of different actions to regulate pollution outputs).

- 1.29 We may not yet be fully exploiting the potential of econometric models to understand the world and inform policy decisions about how to change it for the better. Couple this with a reluctance to recognise that modelling is more about understanding *uncertainty*, than delivering *certain* answers, and the potential for missing important opportunities to advance policy-making is clear. Do we need a new government strategy for modelling the rural economy and land use which draws on the work of Relu projects and others to deliver more meaningful and useful models for policy-makers?
- 1.30 Considerable progress has been made in recent years in developing decision-support tools for land managers. Yet it is difficult to produce tools which can be applied to a wide range of situations without becoming extremely complicated. The *Livestock Wastes* project has found that a 'Kite' tool can help farmers to assess farm-scale pollution risks where data and understanding are poor. This decision and visual communication tool integrates both natural science and socio-economic risk factors to help determine where best to focus resources to reduce pollution. Where else are credible yet simple decision support tools needed to help land managers understand and act on risks?
- 1.31 Indicators help track policy outcomes, but need to be reviewed regularly to ensure that they are not themselves 'driving' policy (so that the aim becomes 'to improve the indicator' rather than to secure the underlying outcome). There are government indicators for 'sustainable development' and 'biodiversity', and other environmental indicators are being developed. The *Sustainable Uplands* project is examining how different land-use policies might affect sustainability indicators. One challenge is to assess and compare the impacts of agri-environment schemes at field, farm, catchment, regional and national scales. The *Biodiverse Farming* project suggests that it is easier, and just as valuable, to monitor arable weed species in fields as to monitor birds. How should we assess agri-environment schemes? Can we find ways to 'monitor once' to obtain meaningful data at different geographical scales?

## **2. HOW DO WE ACHIEVE MORE DEMOCRATIC AND ACCOUNTABLE DECISIONS?**

- 2.1 Stakeholder involvement in environmental decision-making is increasingly regarded as a democratic right and is being embedded in public policy. There are many methods of engaging 'stakeholders' (commonly defined as 'anyone who is affected by or can affect the outcome of a decision'). The degree of engagement relates to its purpose: from passive dissemination of information ('communication'), through gathering information ('consultation') to two-way engagement where information is exchanged through dialogue or negotiation ('participation'). This hierarchy places 'participation' on the higher rungs of the 'ladder' of engagement. Greater emphasis on 'participation' is increasingly seen as desirable in moving towards more democratic and accountable decision making.
- 2.2 We need to understand better the potential benefits and difficulties of stakeholder engagement. Participatory processes can build consensus and can also help stakeholders learn to live with differences. Such processes should lead to better-quality and more sustainable decisions. Participatory processes have also been subject to some criticism for creating consultation fatigue, and cynicism, and disproportionately empowering minorities, but there is growing consensus over best practice participation.
- 2.3 In particular, Relu projects suggest that much can be gained by involving 'non-experts' in policy-making. Obtaining a better understanding of issues and sensitivities from the perspective of those affected by them should help policy-makers to align policy more

effectively with real experience and aspirations. However, embedding participation in public policy is not without its difficulties: while stakeholders are numerous, the resources available for stakeholder engagement are constrained.

**Consultation questions:**

- a. ***Who should we engage in new conversations and how?***
- b. ***What can we learn from international perspectives?***
- c. ***How do we learn from local stakeholders and help them to learn?***
- d. ***How do we build confidence and capacity in stakeholder engagement?***
- e. ***Are long-standing assumptions about land managers still appropriate?***

**Who should we engage in new conversations and how?**

- 2.4 Numerous tools can be used to explore the complex inter-relationships between stakeholders and their interests. Techniques such as Social Network Analysis and Stakeholder Analysis are being used by a number of Relu projects (e.g. *Deer*, *Sustainable Uplands* and *Floodplains*) to illuminate complex inter-relationships between stakeholders. Do decision-makers need to make greater use of such tools in order to understand stakeholders' interests and engage with them?
- 2.5 The *Livestock Wastes* project has emphasised the importance of selecting approaches to engagement. 'Speaking the right language' and using familiar tools is very important. For example, they found that interviewing farmers about land and livestock management was interactive, efficient, and productive if the interview was conducted around an aerial photograph or map of the farm, which farmers could themselves annotate. Approaches which involved the researcher interviewing the farmer and ticking boxes on a questionnaire, or using a laptop (putting a barrier between the farmer and interviewer) were less effective.
- 2.6 Some groups are difficult to engage. The *Angling* project is showing that 'anglers' are not one discrete group but diverse individuals with different motivations and perspectives on river quality, design and management. Many are interested in only one stretch of water, so it is difficult to involve them in policy discussions at river-basin scale. Many are not affiliated to any particular body - and none can claim to represent all anglers. Consulting them necessarily involves complex negotiations through many different routes. Likewise, it can be difficult to engage non-traditional 'lifestyle' farmers in agri-environment policies. Which other groups are under-represented in land-use discussions and how could we reach them?
- 2.7 Some groups may exert undue influence: they claim to represent many, but in fact represent only a few. Should the major organisations which Government regularly consults on land-use issues be required to substantiate their policy positions with hard evidence from member surveys and other research? Should they inform the debate by exposing the range of views among their members rather than promoting one 'party line'? Are the 'usual suspects' too dominant in the debate? Can we find new 'left-field' perspectives on rural challenges – from more diverse stakeholders - to shift thinking?
- 2.8 Some Relu research projects are experimenting with new approaches. The *Sustainable Uplands* project has encouraged stakeholder-led visits to moorlands in the Peak District to discuss different values, options and threats for these landscapes. This has facilitated two-way learning and developed inputs for scenario modelling. The *Water Framework Directive* project has used large sample surveys, across both rural and urban populations, to address perceptions and preferences on land use issues. The *Deer* project has also examined public perceptions. The *Energy Crops* project has surveyed attitudes among town-dwellers living near to energy crop sites: it found that local people are more concerned about associated power plant infrastructure and the potential for increased noise and road traffic



than the crops themselves. It seems that local communities in and around case study sites have much to contribute to policy. Should *national* consultations on policy always be complemented by studies of how *local* communities view issues in order to better understand the context-specific nature of land and water debates?

- 2.9 The *Livestock Waste* project has used citizens' juries to tap local perspectives on whether contemporary livestock farming puts watercourses at risk of microbial pollution. Members of the public were asked to consider evidence from different perspectives and then come to a collective judgement or verdict. Should such approaches become a more integral part of Government consultation processes? Three further projects (*E. Coli*, *Animal Disease Risks and Water Framework Directive*) are engaging stakeholders on other important aspects of risk perception and management.
- 2.10 Obtaining data on distributional issues is an essential part of stakeholder engagement. The *Inequalities* project will offer insights into how inequalities are distributed geographically, and to what extent any inequality is also seen as *inequitable*. The *Water Framework Directive* and *Floodplains* projects are exploring the relative costs and benefits of land-use change for rural and urban communities. Does inequality matter if the person who, objectively, is relatively worse off, does not recognise this or has actively chosen to put up with it? To what extent should the government intervene in these circumstances - and how? Does there need to be a stronger focus on equity in all areas of policy for the rural economy and land use?

### **What can we learn from international perspectives?**

- 2.11 Several Relu projects are tapping international perspectives (e.g. *Catchment Management*, *Energy Crops* and *Water Framework Directive*). Learning from such experience is particularly relevant in tackling climate change, diffuse pollution, nutrient enrichment, and loss of biodiversity. For example, other countries adopt a different balance between regulation and voluntary action, use novel mechanisms (e.g. easements and covenants), and devolve responsibility to more local levels than in the UK. Much of this experience may be transferable, even though it has originated under different institutional frameworks and cultures. Should our policy proposals include a mandatory review of how other countries tackle similar challenges?
- 2.12 In practice it is often difficult to 'Think global, act local' (witness the lack of any reference to the UN Millennium Development Goals in the Defra Strategy for Sustainable Farming and Food). The challenges for policy from the interaction of different international goals are well-illustrated by the tension between climate campaigners who argue against air-freighting fresh produce from Africa to the UK, and poverty campaigners who actively promote such trade links in the interests of economic development overseas.
- 2.13 The *Local Food* project explores these tensions. It demonstrates the direct value of such trades to producers (a source of income), consumers (obtaining fresh food), and the environment (avoiding the higher energy costs of growing the same produce at home under glass, or in southern Europe and transporting them here by road). The finding that 'freshness' is by far the main reason why consumers value 'local food' has important ramifications. A fresher air-freighted product may be better all round than the alternatives.
- 2.14 These findings suggest that policy-makers should do more to bring together different international agendas (e.g. on climate change, development, resources, biodiversity and pollution). They also illustrate the valuable role which integrated life-cycle assessment can play in policy-making. Would undertaking a reality-check of policy proposals against the Millennium Development goals be one way of injecting a much wider social dimension into national policy which looks well beyond national boundaries? How can we embed life-cycle assessment into land-use policy-making, so that we gain a rounded *global* economic, social and environmental view of the impacts of local actions?

### **How do we learn from local stakeholders and help them to learn?**

- 2.15 The *Knowledge Controversies*, *Sustainable Uplands*, *Floodplains*, *Livestock Waste* and *Catchment Management* projects suggest that drawing on local knowledge and insights will greatly benefit policy. For example, local communities have sometimes rejected official 'science-based solutions' to flood-risk challenges. If modellers instead engage with local knowledge and draw on detailed, and often long-term, records and observations (e.g. about what direction the water takes and which areas flood first), they can develop better models, explore different scenarios with local people, engage them in discussion about costs and trade-offs, and deliver solutions which are widely owned. The *Deer* project is using 'participatory GIS' to integrate stakeholder and scientific knowledge to inform negotiations among neighbouring land managers about managing deer. This work is also relevant to other 'common-pool' resources. Should the use of methods which integrate scientific knowledge with local experience, become the norm?
- 2.16 The *Community Catchment Management* project underlines the importance of understanding locally-grounded knowledge. It challenges a view of the world in which policy interventions lead to logical land management responses which in turn deliver expected environmental outcomes. Their work to gather stories around local knowledge shows that, cause-effect processes in natural systems are often complex and that social, economic and policy processes may set in train equally complex interactions. How can we ensure that policies and protocols designed in the abstract are properly grounded in reality?
- 2.17 It is also valuable to exchange knowledge with stakeholders and enable them to understand and manage problems themselves. Researchers in the *Deer* project have helped to build understanding among local people about the impact of deer grazing on landscapes and habitats. A key finding is that people are less sensitive to deer culling than land managers often think - once they understand its role in creating desired landscapes. On what other land management and environmental issues is the contribution of local knowledge lacking?
- 2.18 Getting land managers to collaborate is often a difficult challenge. Choice experiments undertaken by the *Deer* project suggest that deer managers are strongly averse to enforced collaboration and may not respond to incentives to encourage it. In contrast, the *Catchment Management* project suggests that participatory approaches may make it harder for individuals in any one group to resist or veto the majority view. Do we need to rethink how to achieve collaboration where it is necessary - and recognise that the *process* of dialogue and negotiation is as important as providing other support such as incentives and advice?

### **How do we build confidence and capacity in stakeholder engagement?**

- 2.19 Consultation fatigue, cynicism about token consultations, and pessimism about the extent to which responses will be taken into account, are real risks for policy-makers. The *Knowledge Controversies* project suggests that using intermediaries with no vested interest to lead engagement work builds confidence and delivers better outcomes. People can be more willing to engage with an independent party than with officials. This approach may be particularly valuable for controversial issues. By acting as a facilitator, catalyst, mediator and broker, the intermediary can gain feedback which would not otherwise have been possible. Should policy-makers make more use of intermediaries or professional facilitators to engage stakeholders in consultation exercises and participatory approaches?
- 2.20 Although participation is increasingly becoming embedded in policy, the requirements of participatory processes do not always fit well with the organisational structures charged with implementing these policies. Administrative costs and time may also frustrate engagement. Policy-makers may also fear a loss of control: will involving local people in designing local solutions lead to costly proposals that do not fit within national frameworks? Decision-makers may feel uncomfortable committing themselves to implement and

resource the as-yet unknown outcome of a participatory process. In many cases, to do so would represent a radical shift in the organisational culture of government agencies and other institutions.

- 2.21 There may be ways around these concerns - such as clearly setting out the environmental limits and cost constraints. Policy-makers should weigh against these challenges the clear benefits of tapping wider sources of expertise and knowledge and in so doing promoting wider ownership. Other challenges that might need to be addressed include stakeholder fatigue and the costs to citizens of giving non-paid time to participate. What institutional or cultural changes are needed to further embed participation in policy? To what extent should government trust local people to work with technical experts on local challenges and to deliver tailor-made solutions? How can public participation be encouraged?

### **Are long-standing assumptions about land managers still appropriate?**

- 2.22 Land managers have a critical role as stakeholders because we largely depend on them for the delivery of ecosystem services. Over the years several assumptions about what land managers want and how they behave have become embedded in policy thinking. Relu projects suggest that we need to revisit some of these assumptions. For example:

- **‘Farmers are primarily food producers’**. Why people own and manage land is changing. Commodity-producers are only one part of the mix. Equine enterprises, lifestyle entrants focused on game and amenity, conservation bodies, and those producing for niche markets or for ethical reasons (e.g. organic farming), have different motivations. Is there still too much emphasis on ‘one size fits all’ commodity-focused policies rather than policies which reflect more diverse motivations among land managers? Do our data collection processes (e.g. the Farm Census), and approaches for predicting land-use change, likewise need to be widened to reflect this range of motivations?
- **‘Farmers are profit-maximisers’**. Farm businesses must make a profit to survive, but Relu projects show that this is not the only driver. For example, the *Biodiverse Farming* and *Water Framework Directive* projects are modelling economically-optimal actions and then interviewing farmers to discover why they deviate from these. This will inform questions such as ‘What would be the best policy measures to achieve targets for farmland bird populations?’ The *Catchment Management* project is similarly modelling the costs and benefits of changing farming practices to produce a healthy river environment, based on an understanding of both rational theory and real practice.
- **‘All land has to produce something’**: Under current rules, land in receipt of the Single Farm Payment need not ‘produce’ anything. It simply needs to be managed so that it could be readily brought back into production in the future, as necessary. Yet the long-standing belief that ‘all land should produce something’ is embedded in some land-use allocation models. The *Nutrition-driven food policy* project is tackling the challenge of adapting these models to reflect a shift towards recognising that farmland can serve a wider range of functions beyond simple commodity production.
- **‘If you ask farmers to farm for wildlife they will be able to deliver it’**. The *Improving agri-environment schemes* project suggests that this is not necessarily the case. Against a baseline of data on farmers’ attitudes, their environmental knowledge and their history of environmental management, the project compares success in creating flower-rich field margins between two groups of farmers, one receiving training, the other not. The project suggests that farming for wildlife is difficult - and requires strong motivation and investment in advice, training and practical demonstration. Should agri-environment schemes put more emphasis on training than incentives - with the implication that this will yield better results on fewer hectares? Would changing

schemes so that they set 'objectives to be achieved' rather than 'prescriptions to be followed' be more effective in engaging and motivating land managers?

### **3. HOW CAN OUR USE OF LAND AND WATER HELP TACKLE CLIMATE CHANGE?**

- 3.1 Against the background of the UK Climate Change Programme, and the Fourth Report of the Intergovernmental Panel on Climate Change, the UK Government has underlined the need for both mitigation and adaptation in relation to climate change across all areas of policy - including land use and the rural economy. What this means precisely is very difficult to define, given the huge uncertainty surrounding likely climatic changes and their impacts. Yet it is widely agreed that policy action is needed to maintain future options for society.
- 3.2 Key elements in the Government's Programme for 'agriculture, forestry and land management', and in more recent Ministerial statements, include:
- Ensuring that land use maintains key ecosystem services related to climate change - including flood protection and the provision of carbon sinks.
  - Tackling direct emissions - the sector accounts for 46% of nitrous oxide and 66% of methane emissions (e.g. through trading mechanisms).
  - Developing the sector's contribution to a low carbon economy through the production of energy crops, biomass and woodfuel.
  - Promoting resource efficient farm management, to reduce nitrogen and other inputs which contribute to greenhouse gas emissions.
  - Exploring how Environmental Stewardship can make a greater contribution to climate change objectives.
  - Developing Non-Food Crops as substitutes for products based on fossil fuels.
  - Ensuring that other measures (e.g. for Catchment Sensitive Farming and Nitrate) support climate change goals.
- 3.3 Relu projects have potential to inform policies in several of the priority areas for Government action, including the development of biomass crops as a source of fuel and power, strategies for utilising crops and wastes in anaerobic digestion, the role of peatlands (and other uses of land) as sinks for carbon, and integrated catchment management to store water resources and mitigate flooding. Land use is accordingly relevant both to the mitigation of climate change and adaptation to its impacts.

#### **Consultation questions:**

- The carbon challenge: what role for land?***
- Can modelling scenarios help future decision-making?***
- Can we move away from resource-hungry crops?***
- How do we put climate change at the heart of policy?***
- What policy adjustments are needed at the tactical level?***

#### **The carbon challenge: what role for land?**

- 3.4 Our understanding of the science surrounding the conditions in which land acts as a net source or sink for carbon is still imperfect; further research is required. The *Sustainable Uplands* project is highlighting the positive role which restoring degraded peatlands could play in capturing and storing carbon. The project is examining: how much carbon is absorbed by peatlands each year; the effects of different management regimes on carbon flows; and how peatlands, once restored, might themselves be affected by climate change. The project highlights the importance of safeguarding this carbon store, which covers 8% of the land area, in particular by reducing carbon exports through erosion.

- 3.5 This case illustrates some common dilemmas for policy-makers. Do we invest now on a precautionary basis in the hope of gaining future benefits or do we wait for further conclusive evidence? Do we have the right risk-management models to enable us to make reasoned decisions? How do our approaches to assessing environmental risks relate to our models for assessing financial risks for public expenditure?
- 3.6 Carbon-offsetting is a mechanism for attracting a wider range of funds beyond the public purse - though the public still looks to Government for assurance over such schemes. Their traditional focus has included planting trees and investing in renewable energy schemes. Relu research into restoring eroding peatlands by reducing grazing, blocking drains, and re-seeding eroded land, has helped to quantify the actual costs and the potential benefits of such action in relation to carbon storage. Is there now enough evidence to justify admitting 'peatland restoration' as a carbon-offsetting option? The CREDIT<sup>2</sup> project is currently examining this issue and seeking to develop a voluntary carbon abatement scheme.
- 3.7 Peatlands provide a critical carbon store, but cover a much smaller total area than grasslands. The role of grassland in locking-up nutrients is well known (as shown by the Nitrate Sensitive Areas Scheme of the 1990s). Yet its role as a relative carbon sink or source is less well understood. If existing rough grazing land and permanent pasture were to be ploughed up on a large scale, whether for arable crops, biofuels, or biomass crops, the impacts on carbon budgets could be significant.
- 3.8 Current market pressure to increase food production has led to the ploughing of grassland created under set-aside schemes, and of some permanent pasture for arable crops. Some restrictions on ploughing grassland could disappear with the reform of the CAP after 2013. Is stronger regulation needed - now or later - to prevent ploughing of grassland in the interests of mitigating climate change (as well as managing nutrient leaching)? Do incentives for creating grassland, peatland and wetland to deliver diverse ecosystem services (for landscape, biodiversity, and flood mitigation benefits), explicitly need to promote their potential value as carbon sinks too?

### **Can modelling scenarios help future decision-making?**

- 3.9 The Government's action plan for embedding the ecosystems approach recognises that '*Climate regulation...has often been overlooked or undervalued in decision-making*'. The focus in agriculture on more significant emissions of methane and nitrous oxide may have limited consideration of carbon. The potential contribution of peatland and woodland to carbon capture and storage is now recognised; so too is the potential for existing crops - or new biomass crops - as sources of fuel and power, but this work is still piecemeal. Several Relu projects are taking account of carbon in their modelling work (e.g. *Water Framework Directive, Floodplains, Sustainable Uplands*). Can we build on this work to model what a rural landscape managed primarily to capture, store and release carbon would look like? Would this help to establish the relative weight to be given to these specific services alongside others? Would it also illuminate where the trade-offs lie between different ecosystem services?
- 3.10 The *Water Framework Directive* project is assessing the costs and benefits of changing farming practices in order to produce healthy rivers. It will further develop existing practical tools for making land-use allocation decisions at a catchment scale. This will involve inputting values for carbon. However, an international consensus on how to value carbon is lacking: inputting different values for carbon into the models will produce quite different modelled outcomes and prompt quite different policy interventions. Can greater consensus be achieved on how to value carbon?

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<sup>2</sup> 'Carbon Reduction and investment Techniques for Yorkshire and the Humber' (CREDIT) is a group of organisations working through Carbon Action Yorkshire to establish a scheme for carbon-offsetting for local businesses. Researchers from the Relu *Sustainable Uplands* project have links with this project.

- 3.11 Climate change will take place in the context of many other future socio-economic and policy changes, which will interact in diverse ways. Examples of include: changes in livestock densities due to CAP reform; significant peatland restoration through access to carbon markets; expansion of arable agriculture and/or biofuel production; and large-scale re-wilding to meet water quality or conservation goals. It will be important to go beyond climate change scenarios to better understand what the future might hold and assess the knock-on effects on ecosystem services. Several Relu projects are expected to make important contributions to this work.

### **Can we move away from resource-hungry crops?**

- 3.12 Relu projects are examining diverse farming systems. Specific foci include management practices within conventional farms (*Biodiverse Farming, Agri-environment*), differences between 'organic' and 'conventional' farms (*Organic*), and the impacts of *Energy Crops*. The projects inevitably have to work with the crop, grass and livestock varieties which now available. None is considering what advances in genetics and genomics might deliver in terms of new and improved strains of grasses and other crops, and what in turn this might mean for the rural economy and land use.
- 3.13 The potential to breed crop or livestock varieties which can thrive in stressful environments (e.g. with low supplies of water and nutrients), which have specific environmental traits (e.g. more efficient uptake of nutrients), or which have strong inbuilt resistance to specific pests or diseases (hence reducing the need for pesticides), is manifold. Yet the legislative framework remains highly restrictive and public and political attitudes have been strongly coloured by early experiences with GM-crops. Should we now start to embrace relevant scientific and technological advances in plant and animal genetics and genomics? How otherwise will we be able to continue to raise productivity in systems which depend on unsustainable - and maybe unaffordable - energy-intensive inputs in the form of artificial fertiliser, pesticides, and cultivations? Should we invest in developing 'GM-organic' crops?

### **How do we put climate change at the heart of policy?**

- 3.14 Much has been done to integrate the interests of biodiversity, landscape and the protection of water, soil and air resources into land-use policy in recent years. More remains to be done to move from simple 'protection' and 'maintenance' towards active enhancement, particularly in relation to soil. Action is also needed to build greenhouse gas reduction into the overall policy framework. The challenge will be to minimise, and manage effectively, the possible trade-offs with other ecosystem services.
- 3.15 Much of our current UK legislation derives from EU Directives of the 1990s which were drafted before there was widespread realisation of the imperatives of climate change. Do we need to review and amend the Common Agricultural Policy, the EU Water Framework Directive, the EU Birds and Habitats Directives, and other legislation, to adapt their provisions to the challenges of climate change? For example, some sites designated under the Habitats Directive may not be able to support their valuable species and habitats under a changed climate (e.g. too wet, too hot), or under the conditions which it creates (e.g. saltwater inundation of freshwater coastal marshes). The legislation focuses on action to maintain the sites, rather than to explore opportunities to recreate them elsewhere, or to accept that one valuable habitat may replace another. Is there a need for better integration of climate change and land use policies and how might this be achieved?
- 3.16 Policy frameworks from other parts of government can also influence the ability of land managers to satisfy public goals in relation to climate change. The *Anaerobic Digestion* project is throwing light on the interactions of land use, waste and energy policy. Energy policy interventions give Liquefied Petroleum Gas (from fossil fuel) a strong price advantage over Biogas (from renewable sources). Waste policy creates the perverse

situation where slurry applied direct to land is exempt from regulation, but all the costly requirements of waste regulation apply to the same slurry if it is moved to a digester and the residual digestate is returned to the farm as a fertiliser. How can we avoid such perverse interactions and ensure that once identified, they are readily solved? There are wider waste policy implications here too for the goal of diverting organic waste from landfill.

- 3.17 The conditions developed under the Defra Energy Crops Scheme, which focus on establishing substantial plants to deliver power to the national grid, seem at odds with the desire of farmers and local communities to develop smaller-scale systems which will provide heat and power for on-farm or more local purposes. Relu research suggests that it is the infrastructure surrounding biomass plants which is of most concern to the public. This would tend to indicate the need to think small and local in this area. How can we ensure that the barriers within current policies to meeting Government objectives for managing climate change are removed? What proofing mechanisms need to be put in place to avoid frustrating actions which are widely supported by the public?

### **What policy adjustments are needed at the tactical level?**

- 3.18 There are also opportunities at the detailed policy level to review how existing schemes and interventions can contribute more to climate change mitigation and adaptation. Several Relu projects have the potential to offer practical advice on agri-environment schemes, management of flooding, and protection of water resources under changed conditions. Their value lies particularly in linking the decision-making frameworks of land managers with environmental outcomes. How should we adjust delivery schemes - guidance and prescriptions - to the challenges of mitigation and adaptation? How do we best transfer scientific knowledge of 'climate-proof management' to land managers?
- 3.19 Management of water levels in the substantial areas under pumped-drainage schemes provides one example (the *Floodplains* project). We reduce water tables to a far greater extent than in comparable situations in the Netherlands, thereby perhaps incurring undue energy costs, and even limiting productivity, especially in dry years. Do we need to change traditional drainage practices in pumped-drainage areas to allow the water table to rise, especially under a changed climate? Do other traditional land management practices (e.g. the timing of grazing periods and manure applications), and standard prescriptions and regulatory requirements (e.g. for cross compliance) also need to be questioned and reviewed in the light of a changing climate?
- 3.20 It may also be necessary to integrate carbon management more fully into wholly national frameworks. For example, landlord-tenant legislation now enables both parties to make agreements relating to a range of business activities on tenanted land, but does not impose specific requirements on either party in relation to environmental goals. Should agreements between the parties include specific clauses relating to environmental requirements? Or can the delivery of environmental services be safely left out of such contracts?

## **ANNEX: RELU PROJECTS REVIEWED**

Details of the 20 projects are provided below. The details include the short project title (used solely for reference purposes in this paper), the long project title, and the scheduled year of completion. The projects are listed in order of expected completion date.

### **1. Local Food (Merits of Consuming Vegetables Produced Locally and Overseas) (2008)**

Is importing food always a bad thing? This project is researching the advantages and disadvantages of consuming locally produced fruit and vegetables as opposed to fruit and vegetables produced overseas. Social and natural scientists are considering a range of relevant factors: greenhouse gas emissions, local employment, consumer perception of relevant attributes, nutritional quality of produce and community characteristics relating to local food cultures.

**Contact** Professor Gareth Edwards-Jones, University of Wales, Bangor **Email:** [g.ejones@bangor.ac.uk](mailto:g.ejones@bangor.ac.uk)

### **2. Nutrition (Implications of a Nutrition Driven Food Policy for the Countryside) (2008)**

Healthy eating is the mantra of the moment but are there ways in which we could enhance the nutritional qualities of the food we eat, and what would the effect of that be for the countryside? This project is investigating whether the type of pasture cattle graze on affects the fats in their meat, whether growing soft fruit and salad crops under new ultra-violet transparent film enhances the levels of antioxidants that can reduce cancer and what the consumer demand might be for such products.

**Contact** Professor Bruce Traill, University of Reading **Email:** [w.b.traill@reading.ac.uk](mailto:w.b.traill@reading.ac.uk)

### **3. Floodplains (Integrated Management of Floodplains) (2008)**

Recent flood events in Britain have heightened interest in exploring solutions that can join up multiple objectives such as managing flood risk, water resource management, enhanced biodiversity, enjoyment of the countryside, and support to rural livelihoods. The project is addressing these issues and re-examining a selection of agricultural flood defence schemes, previously studied by the research team in the 1980s, to identify and explain changes in land and water management that have occurred over the last 40 years.

**Contact** Professor Joseph Morris, Cranfield University **Email:** [j.morris@cranfield.ac.uk](mailto:j.morris@cranfield.ac.uk)

### **4. Energy Crops (Impacts of Increasing Land Use Under Energy Crops) (2008)**

Future policies are likely to encourage more land use under energy crops: principally willow, grown as short rotation coppice, and *Miscanthus*, a tall, exotic grass. These crops will contribute to the UK's commitment to reduce CO<sub>2</sub> emissions. However, it is not clear how decisions about appropriate areas for growing the crops, based on climate, soil and water, should be balanced against impacts on the landscape, social acceptance, biodiversity and the rural economy. This project integrates social, economic, hydrological and biodiversity studies in an interdisciplinary approach to develop a scientific framework for sustainability appraisal of the medium and long term conversion of land to energy crops.

**Contact** Dr Angela Karp, Rothamsted Research **Email:** [angela.karp@bbsrc.ac.uk](mailto:angela.karp@bbsrc.ac.uk)

### **5. Livestock Waste (Sustainable and Safe Recycling of Livestock Waste) (2008)**

Dairy and beef farmers provide consumers with reliable sources of milk and meat but can we be sure that the animal waste is disposed of safely and without environmental and social risks? This project is investigating current perceptions of farmers, retailers, consumers and local downstream industries, such as tourism and shell fisheries, about pathogen transfers to the food chain. Changes in management practices could help to address the problem, and a farm-scale risk assessment tool is being developed to assess this. The project is determining the impacts of such changes on farm costs, and the potential costs to other stakeholder groups and the region as a whole.

**Contact** Dr David Chadwick, Institute of Grassland and Environmental Research **Email:** [david.chadwick@bbsrc.ac.uk](mailto:david.chadwick@bbsrc.ac.uk)

### **6. Hill Farming (The Sustainability of Hill Farming) (2009)**

Moorland ecosystems are particularly fragile. This project is investigating how we can manage them in a way that delivers sustainable hill farming communities while also protecting the environment. Taking the Peak District as a case study, the researchers are examining how farmers respond to policy changes and how they can design business plans to cope with such changes most effectively. The team is developing new modelling tools for examining the dynamics of moorland change across whole landscapes, how the actions of one farmer affect those of neighbours and how upland bird species rely on a diversity of habitats across the landscape.

**Contact** Dr Paul Armsworth, University of Sheffield **Email:** [p.armsworth@sheffield.ac.uk](mailto:p.armsworth@sheffield.ac.uk)

### **7. Biodiverse Farming (Management Options for Biodiverse Farming) (2009)**

In this project, natural and social scientists are looking at the social, economic and political factors underlying farming practice, and the implications for biodiversity when farmers decide to change what they do or how they do it. They are using ecological models to predict how key biodiversity indicators such as weeds and birds will respond to the way the land is managed.

**Contact** Professor Bill Sutherland, Cambridge University **Email:** [w.sutherland@zoo.cam.ac.uk](mailto:w.sutherland@zoo.cam.ac.uk)

### **8. Inequalities (Social and Environmental Inequalities in Rural Areas) (2009)**

This project is examining patterns of inequality in the distribution of social, economic and environmental goods and services in rural areas. They are considering how methods for measuring inequality differ within the natural and social sciences and exploring ways to resolve these differences and find a common approach. Having identified inequalities the team will be focusing on their implications, considering whether they can be regarded as unfair, and consulting with local residents about their perceptions of local inequality and injustice.

**Contact** Dr Meg Huby, University of York **Email:** [meh1@york.ac.uk](mailto:meh1@york.ac.uk)

### **9. Sustainable Uplands (Sustainable Uplands: Learning to Manage Future Change) (2009)**

This project combines knowledge from local stakeholders, policymakers and social and natural scientists to anticipate, monitor and sustainably manage rural change in UK uplands. The result will be a choice of options to address future challenges that could never have been developed by any group alone. Factors driving future change are modelled with computers to develop detailed pictures of possible future social, economic and environmental conditions. Stakeholders and researchers then identify strategies that could help protect and enhance future livelihoods and the environment and evaluate them through computer models, site visits and other participatory methods.

**Contact** Dr Klaus Hubacek, Dr Mark Reed, University of Leeds **Email:** [hubacek@env.leeds.ac.uk](mailto:hubacek@env.leeds.ac.uk), [m.s.reed@leeds.ac.uk](mailto:m.s.reed@leeds.ac.uk)

### **10. Angling (Angling in the Rural Environment) (2009)**

This project focuses on the role that angling, as a leisure activity, plays in the economy and the UK countryside. Angling is seen as important for rural employment, but rivers are under pressure from a whole range of human activities so their ability to sustain flora and



fauna may be at risk. This project analyses the complex natural and socio-economic inter-linkages between river, fishing, biodiversity and institutions of governance and practice. The results will be used to inform policy on integrated development of the rural river environment.

**Contact** Dr Liz Oughton, University of Newcastle **Email:** [e.a.oughton@ncl.ac.uk](mailto:e.a.oughton@ncl.ac.uk)

#### **11. Deer (Collaborative Deer Management) (2009)**

There are many associated costs and benefits in the management of deer. Deer management creates jobs for stalkers on forestry and sporting estates and people in the meat industry, and deer create particular landscapes that attract tourists. However in some areas, high deer numbers cause damage to sensitive habitats, to crops and gardens and cause road traffic accidents. Therefore there are many different attitudes to deer and conflicts on how best to manage them. This project is investigating how well people involved in deer management work together and how this can be improved so that the benefits are maximised whilst the costs are minimised.

**Contact** Dr Justin Irvine, Macaulay Institute **Email:** [j.irvine@macaulay.ac.uk](mailto:j.irvine@macaulay.ac.uk)

#### **12. Organic (The Effects of Scale in Organic Agriculture) (2009)**

A move to organic farming can have significant effects on wildlife, soil and water quality, as well as changing the ways in which food is supplied, the economics of farm business and indeed the attitudes of farmers themselves. This project addresses two key questions: firstly, what causes organic farms to be arranged in clusters at local, regional and national scales, rather than be spread more evenly throughout the landscape, and secondly, how the ecological, hydrological, socio-economic and cultural impacts of organic farming may vary due to neighbourhood effects at a variety of scales.

**Contact** Dr Sigrid Stagl, University of Sussex **Email:** [s.stagl@sussex.ac.uk](mailto:s.stagl@sussex.ac.uk)

#### **13. Water Framework Directive (Modelling the Impacts of the Water Framework Directive) (2010)**

This project brings together hydrology, economics and other disciplines to examine both the physical impacts of the EU Water Framework Directive upon rivers and how the changes in land use needed to achieve a reduction in pollutants in water are likely to impact upon already fragile farming communities. The project also applies a variety of innovative techniques to attempt to value the likely benefits of improving outdoor water quality.

**Contact** Professor Ian Bateman, University of East Anglia **Email:** [i.bateman@uea.ac.uk](mailto:i.bateman@uea.ac.uk)

#### **14. Knowledge Controversies (Understanding Environmental Knowledge Controversies) (2010)**

Scientists, and those who use their work, are having to think again about how science should inform democratic decision-making and the role of public engagement in this process. Taking the example of flood risk management, this project examines how and why the scientific practice of hydrological modelling becomes subject to scientific dispute and public controversy, and with what consequences for public policy. With hydrological models now capable of connecting local flood events to land management practices at catchment scale, the project is developing 'competency groups' as a new method for bringing the knowledge of local people with experience of flooding to bear on the modelling of flood risk.

**Contact** Professor Sarah Whatmore, Oxford University **Email:** [sarah.whatmore@ouce.ox.ac.uk](mailto:sarah.whatmore@ouce.ox.ac.uk)

#### **15. Community Catchment Management (Testing a Community Approach to Catchment Management) (2010)**

This project investigates a specific catchment – Loweswater in the Lake District – and looks at how scientists, institutional stakeholders, farmers and residents can share expertise and work together positively for the benefit of their environment. They are considering questions such as whether the current "carrot and stick" initiatives are the best option to ensure that landowners look after the environment, and whether involving local people more in decision making and using their local knowledge and expertise would be a viable approach.

**Contact** Dr Claire Waterton, Lancaster University **Email:** [c.waterton@lancaster.ac.uk](mailto:c.waterton@lancaster.ac.uk)

#### **16. Catchment Management (Catchment Management for Protection of Water Resources) (2010)**

Reductions in water pollution have so far mainly been achieved through regulation and investment in waste water treatment, but the underlying water quality problem in much of the UK remains diffuse pollution derived from current and past land use plus atmospheric deposition. Best management practices and buffers that protect water courses and recharge zones can achieve much, but ultimately changes in land use may be needed in the worst affected areas. This project looks at the means, the governance needs, and the costs and benefits of alternative approaches, drawing on an analysis of international experience and investigation of two UK case study catchments.

**Contact** Laurence Smith, University of London (SOAS) **Email:** [l.smith@soas.ac.uk](mailto:l.smith@soas.ac.uk)

#### **17. Anaerobic Digestion (Energy Production on Farms Through Anaerobic Digestion) (2010)**

This project is examining the potential for the development of anaerobic digestion on farms, and the contribution that this could make to diversification of agricultural practice by enhanced land use planning for bioenergy production. The research addresses the policy issues, both within the broader European Community and the UK, to identify the drivers and obstacles that could stimulate or inhibit the development of on-farm digestion as part of a wider strategy for rural development.

**Contact** Professor Charles Banks, University of Southampton **Email:** [c.j.banks@soton.ac.uk](mailto:c.j.banks@soton.ac.uk)

#### **18. E coli (Reducing E coli Risk in Rural Communities) (2010)**

E coli is a very serious threat to human health. It can be devastating and sometimes fatal, and children and elderly people are at particular risk, but we still know little about how it is spread in rural environments. Researchers from a wide range of natural and social science disciplines are working on the project and investigating how we can reduce the risk of people becoming infected.

**Contact** Professor Ken Killham, University of Aberdeen **Email:** [k.killham@abdn.ac.uk](mailto:k.killham@abdn.ac.uk)

#### **19. Animal Disease Risks (Assessing and Communicating Animal Disease Risks for Countryside Users) (2010)**

Many people enjoy spending leisure time outdoors, but with changes in environmental conditions and use of the countryside, some risks, such as tick-borne diseases, could become more acute. This project is examining the risks, what can be done to reduce them and the kinds of information that people need to keep themselves safe, without being inappropriately alarmed.

**Contact** Dr Chris Quine, Forest Research, Roslin **Email:** [Chris.Quine@forestry.gsi.gov.uk](mailto:Chris.Quine@forestry.gsi.gov.uk)

#### **20. Agri-environment (Improving the Success of Agri-environment Schemes) (2011)**

Agri-environment schemes are intended to improve natural habitats but the results are mixed. This is a five year study of how well wildlife habitats are created under such schemes, and whether training for farmers improves the outcomes.

**Contact** Professor James Bullock, CEH Wallingford **Email:** [jmbul@ceh.ac.uk](mailto:jmbul@ceh.ac.uk)