

SECURING INTEGRATED LAND MANAGEMENT

Issues for policy, research and rural communities from the Relu programme

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EXECUTIVE SUMMARY

- E1. This report identifies lessons and challenges for policy in the UK emerging from 20 selected research projects sponsored by the Rural Economy and Land Use Programme (Relu). It draws on meetings with research teams, discussions with policy-makers, and responses to a paper published through the Relu Network. The report is targeted at policy-makers, researchers, rural communities (including rural businesses), and research funders.

The land-use challenge

- E2. Section 2 sets the context. It shows that diverse drivers impact on land use and that the framework within which land managers make decisions is fraught with uncertainties. The 'ecosystem approach' is firmly endorsed as a framework for policy analysis, development and delivery. The benefits of taking an integrated approach to economic, social and environmental needs include more effective delivery of policy outcomes and better-informed decisions which take proper account of environmental impacts.
- E3. Adopting and embedding the 'ecosystem approach' to land use will require important shifts in mindset. Farmers perhaps need to see themselves as 'integrated land managers' providing a range of services, not just food. Policy-makers need to move away from a sectoral approach to different objectives, as evidenced by one-dimensional countryside designations. Section 2 suggests that the overall challenge for UK land-use can be articulated as 'securing integrated land management using an ecosystems approach'.

Setting objectives for integrated land management

- E4. Section 3 shows that Relu projects are improving understanding of how land can deliver different services, and whether these can coexist, or compete. This is particularly important for emerging land uses, such as energy generation based on renewable feedstocks, carbon storage, and flood risk management. Better understanding will help secure a wider range of services, against a background of continuing technological and environmental change.
- E5. Relu projects are contributing insights into the weightings given to different services. The 'appropriate value' to place on any service is perhaps 'that which brings about the desired change'. Hence, society should ask not 'What is the value of clean water?' but 'How much will it cost to persuade land managers to adopt practices which deliver it?' Relu projects are also showing that the spatial scale for *planning* must be appropriate to the specific ecosystem service concerned, while recognising that the scale for *delivery* will often be the private land holding. The need to adopt long-term perspectives on policy is also evident.
- E6. Section 3 also stresses the need for better understanding of the 300,000 land managers in the UK. Their role in delivering integrated land management, within a property rights framework, is critical. The projects will help characterise this diverse group and also show how they react to new business opportunities and policy interventions. This will in turn help policy-makers to design and implement policy, and to give land managers a clearer strategic steer – which might be: 'The future for UK land managers lies in delivering the full range of ecosystem services in a sustainable and integrated way'.

Governing integrated land management

- E7. Section 4 focuses on the governance of decisions about land use. If any one area of land could potentially be managed to deliver perhaps a dozen different services, how should priorities be established, and who should be involved? It appears that centralised policy-making needs to be complemented by local action. Relu projects are testing different ways of enabling local communities to contribute to policy. They show that combining scientific expertise with local knowledge usefully informs models and policy options.
- E8. Section 4 also shows how the projects are using new approaches and tools to engage people. These include using aerial photographs in discussing land management with farmers, and using independent intermediaries, rather than officials, to engage communities

on controversial flood risk management issues. Care needs to be taken to ensure that consultations involve minorities as well as the major players. *National* consultations on policy could usefully be complemented by studies of how *local* communities view issues.

Delivering integrated land management

- E9. Section 5 considers the range of policy mechanisms available to deliver integrated land management, given that the market alone is unlikely to do so. It raises several cross-cutting issues. In particular, integrated policy-making is needed, as well as integrated research, to ensure that opportunities are not missed and to avoid unintended impacts (e.g. action to improve farmland habitats and tackle diffuse pollution might have been better pursued in tandem, rather than separately). The ecosystem approach requires greater integration.
- E10. The projects are also underlining the scope to learn from international experience, even where the legislative, institutional and/or cultural frameworks differ. Other countries adopt different and novel approaches in implementing the many global conventions and EU laws which also bind the UK. It might be helpful to require Government proposals for land use to be accompanied by a review of how other countries are dealing with the same issues.
- E11. Section 5 also considers how ‘top-down’ and ‘bottom-up’ approaches could be better integrated. In England this could involve identifying and reflecting regional priorities for ecosystem services in Regional Spatial and Economic Strategies. There may be scope to delegate further responsibility to local authorities, but strong cross-border arrangements would need to be in place to ensure effective spatial planning for different services. Steps towards devolution could include equipping all local authorities with the levels of resources provided to National Park Authorities to support recreation and conservation objectives; and making greater use of local community ‘participatory budgeting’ to fund local priorities.
- E12. Suggestions have also been made for piloting new approaches at a local scale, building on the past successes of initiatives such as the Community Forests. For example, one local authority is planning to establish ‘Rural Environment Forums’ to enhance the capacity of local communities to ‘own’ environmental management. Voluntary bodies are also well-placed to bridge the divide between ‘top-down’ and ‘bottom-up’ approaches. Local enterprise and experimentation can greatly assist policy development and delivery.
- E13. Relu projects are identifying ways to strengthen policy and delivery mechanisms. Training is needed to develop farmers’ skills in delivering agri-environment objectives. New policy options are needed to secure the *long-term* provision of services (e.g. the purchase of easements, sale-and-leaseback schemes, the use of tendering approaches, offering higher annual payments in return for longer management commitments, and ‘habitat banking’). Securing collaborative action between land managers will also often be critical, especially where action is needed at a ‘landscape’ scale. The approach of setting the levels of agri-environment incentives in relation to the income foregone from production also merits review. Greater use of econometric models in policy-making is also suggested.
- E14. Section 5 also considers the risks which could frustrate the necessary changes in mindsets, policies and processes needed to rise to the challenge of securing integrated land management using an ecosystems approach. These include fundamentalism, and a series of potential failures – to look ahead, to escape from the status quo, to collaborate, to develop the necessary knowledge and skills, or to build in resilience to external shocks.

Making the most of Relu research

- E15. Section 6 reviews how a wide range of interests - from policy-makers, through researchers and funders, to land managers and rural communities - could make best use of the outputs of Relu research. There is a strong need for greater integration across disciplinary, geographical, and institutional boundaries. There are also important opportunities for Relu and others to foster greater dialogue and exchange of knowledge between policy-makers and researchers, in the interests of securing integrated land management.

1. INTRODUCTION

How the report has come about

- 1.1 The UK research councils' Rural Economy and Land Use Programme (Relu) was launched in 2003 to carry out interdisciplinary research into the multiple challenges facing rural areas. The programme is an unprecedented collaboration between three Research Councils - Economic and Social (ESRC), Biotechnology and Biological Sciences (BBSRC), and Natural Environment (NERC). It has a budget of £24 million, with additional funding provided by the Scottish Government and the Department for Environment, Food and Rural Affairs (Defra). Relu brings together 65 projects and involves 360 researchers from over 40 disciplines and 50 institutions. It is furthering the development of science within a policy context - enabling both to learn from each other. An important aim is to help policy-makers and practitioners think creatively about the challenges facing the UK countryside.
- 1.2 Relu covers diverse areas, from restoring trust in food chains, and tackling plant and animal disease in socially-acceptable ways, to developing land-management techniques to deal with climate change, and managing land and water use for sustainable water catchments. In 2007, heightened political interest in land use issues, across the UK, led to the establishment of a collaborative study, funded by the Research Councils, Defra, the Scottish Government and the Commission for Rural Communities: Vicki Swales and I were appointed in autumn 2007, as 'Consultant Land Use Analysts', to identify lessons and challenges for policy emerging from selected Relu projects. Since then we have worked closely together to understand the projects and identify their potential policy contributions.
- 1.3 The Relu Director's Office asked us to visit the 20 Relu projects listed in **Annex 1** (from more than 60 which touch on land use). Vicki Swales and I met the principal researchers and team members between January and May 2008. We found that most of the projects were in their early stages: while five have now been completed, seven are due to report in 2009, seven in 2010 and one in 2011. It is clear from our discussions with researchers that the projects have great potential to generate valuable results, if they are not already doing so. This paper accordingly explores both existing achievements and future promise.
- 1.4 The study followed a rigorous process. A 'Discussion paper', setting out four broad 'land-use challenges' and seven 'cross-cutting issues' was circulated to the projects beforehand to stimulate discussion. Following the round of visits to the projects, and after consulting the researchers on a draft, we prepared a further 'Challenge paper'. This 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?
- 1.5 The 'Challenge paper' provided a focus for discussions with policy-makers in a range of Departments, Agencies and Voluntary bodies across the UK. Links were also made with the Government Foresight Project on 'Land Use Futures', which is exploring how land use in the UK could change over the next 50 years. The Challenge paper was also subject to a Relu web-based consultation and attracted over 30 valuable responses. These are listed in **Annex 2**. Further inputs came from the Relu online 'Land Use Debate' in Science Week in March 2008, which attracted some 100 contributions.
- 1.6 We are very grateful for all the information and help which we have received from these diverse sources over the last year. All these inputs have been taken into account in producing our reports. We have also benefited from the guidance provided by the Relu Director's Office, our Advisory Group and the Relu People and Rural Environment Forum. This report sets out my findings and conclusions at a strategic level for the UK as a whole. Vicki Swales has prepared a parallel report which focuses on Scotland. Both reports are independent assessments for Relu - they are not formal Relu 'position statements'.

Who the report is for and what it is trying to achieve

- 1.7 The report sets individual Relu research projects within a wider policy context, showing how the projects can contribute to policy, and equally how policy can contribute to the projects. The framework provided by the report is also intended to stimulate further thinking and debate among all those concerned with UK land use. Relu research is challenging current attitudes and approaches in many areas of rural policy and practice, some of which are controversial. The report may accordingly make uncomfortable reading for some.
- 1.8 Several distinct communities have a potential interest in this report. It has been drafted deliberately so as to be accessible and useful to all of them in the following ways:
- **Policy-makers (including policy-influencers):** illuminating policy challenges from Relu research and providing a route-map to facilitate connections and dialogue.
 - **Researchers:** indicating how research, effectively communicated, can assist policy-makers, and flagging up questions for consideration in continuing research.
 - **Rural communities (including rural businesses):** reviewing areas of research relevant to the future and identifying how communities can get involved and benefit.
 - **Research funders:** identifying issues for consideration in future programmes and underlining the benefits of interdisciplinarity.
- 1.9 Section 2 of this report articulates the overall challenge: 'securing integrated land management using an ecosystems approach'. Sections 3, 4 and 5 in turn assess how to set objectives for integrated land management, how to govern it, and how to deliver it. Section 6 indicates how everyone can draw on Relu Programme. The potential contributions of Relu projects are indicated in each section.
- 1.10 This report is a contribution to a continuing debate. Further inputs are welcomed, whether from policy-makers, academics, or rural communities alike, and will feed in to the Programme's continuing work. Please e-mail contributions to relu@ncl.ac.uk.

2. THE LAND-USE CHALLENGE

The context for UK land use

- 2.1 Diverse drivers at different political levels interact to set the policy context for UK land use. The market for the goods and services provided by land is plainly dominant. The volumes and value of inputs, raw commodities, and finished outputs traded within and between each part of the UK, the EU, and more widely, are substantial. However, the influence of global, EU and national policies should not be underestimated. But for this intervention, sustained in various forms for at least 60 years in the UK, the countryside would look very different.
- 2.2 The current economic situation adds to the uncertainty which always surrounds natural systems affected by climate and weather. Uncertainty over the length of the current recession, whether it will turn into a depression, or represents a fundamental shift in global economies, will sap confidence and affect investment across the economy as a whole - including the rural economy. For example, the President of the National Farmers' Union has recently stated that, while demand for food should remain steady, 'the production of home-grown goods could plummet in 2009'. Many farmers report some real threats to their businesses. 'The credit squeeze is making a major dent in producers' confidence in dealing with the high costs of farm inputs like animal feed, fertiliser and diesel' (NFU 2009).
- 2.3 The reform of policies for World Trade could have significant impacts on global markets for farm commodities, with impacts in turn on prices for UK produce. The enlargement of the EU has led to pressure to divert resources from agriculture to other areas of greater social need: it seems unlikely that agriculture will continue to dominate the EU budget to the extent it has done in recent decades. The Common Agricultural Policy is itself continually changing. The UK Government is committed 'to a system where - by 2020 - public funds are used only for public goods that the market cannot deliver, in particular environmental benefits' (Defra 2007a). Although the recent 'Health Check' has drawn back from earlier proposals to transfer resources away from income support towards payment for public goods and wider rural development initiatives, it offers little certainty about the policies which will apply beyond 2013, when a further round of policy adjustment is due.
- 2.4 Markets are also likely to be affected by environmental shocks, both chronic and acute. Floods, droughts, storms and disease outbreaks can all dramatically disrupt global food markets. Climate change looks set to add to the difficulties of producing food - and feeding growing populations - in marginal areas. The Millennium Development goals are also relevant here. Policies to mitigate and adapt to climate change - especially those which stimulate the development of renewable feedstocks and energy sources - are already affecting land use. There are continuing pressures to develop land for housing and infrastructure. Concerns over losses of biodiversity, and nutrient enrichment of the environment, are growing. Technological developments continue apace: in precision farming, irrigation, food harvesting and storage, plant and livestock breeding (both conventional and transgenic), waste management, and pollution control.
- 2.5 The decision-making framework for UK land managers is full of uncertainty. The external drivers are continually changing and also interact with internal motivations which can vary significantly with the nature of the business and the stages of the family cycle. Land managers, keen to maintain the value of their property, will need to review their strategies. Some critical questions for land managers include:
- Should they stick to their existing enterprises, invest in new technology to reduce costs, or diversify into new on-farm or off-farm enterprises?
 - Can anything be assumed about the future willingness of governments to pay for non-market services, such as the provision of biodiversity, landscape, and flood management?

- Will there be any form of income support for EU farmers post 2013?
- Will the public allow - or resist - new technologies?
- Will external environmental pressures lead to the prohibition of certain land management activities and even entire enterprises in some places?

A framework for analysis and action

- 2.6 Land managers in these uncertain times need to plan and make decisions about the use and management of land which will realise their own business and personal expectations. At the same time, policy-makers also wish to ensure that those decisions are aligned with the wider needs of society from land. A framework is needed which will enable both these private sector and public sector objectives to be secured. One such framework is offered by the 'ecosystem services' approach (Defra 2007b).
- 2.7 This framework provided the basis for the international Millennium Ecosystem Assessment (<http://www.maweb.org/>) and has been endorsed in the UK Sustainable Development Strategy (HM Government 2005). An ecosystems approach is essentially about 'adopting a new way of thinking and working, by shifting the focus of our policy-making and delivery away from looking at natural environment policies in separate 'silos' - e.g. air, water, soil, biodiversity - and towards a more holistic or integrated approach based on whole ecosystems; and seeking to ensure that the value of ecosystem services is fully reflected in policy- and decision-making' (Defra 2007b).
- 2.8 An 'ecological system' comprises living and non-living elements within an interdependent system. 'Ecosystem services' are the 'valuable benefits that a healthy environment provides for people, either directly or indirectly'. The term is deliberately inclusive. Four broad types of ecosystem service are usually recognised:
- **Provisioning services** - products obtained from ecosystems, including food, fibre (e.g. timber, cotton, woodfuel), fresh water, game, biodiversity, genetic resources, biochemicals, natural medicines and pharmaceuticals.
 - **Regulating services** - benefits obtained from the regulation of natural processes, including: the regulation of air quality, climate, flooding and erosion; water purification; disease and pest control; pollination; and buffering pollution.
 - **Cultural services** - the non-material benefits people obtain through spiritual enrichment, cognitive development, reflection, recreation and aesthetic enjoyment.
 - **Supporting services** - the services that are necessary for the production of all other ecosystem services, including soil formation, photosynthesis, primary production, nutrient cycling and water cycling.
- 2.9 The ecosystem approach cuts across 'services' which are fully tradable (e.g. food, fibre, fuel), tradable to some extent (e.g. game and agri-environment services purchased by the state), or not-tradable (e.g. landscape beauty, and biodiversity). Some services are co-products of land management practices driven by the market (e.g. intensive farming creates a productive and highly managed landscape). However, many services are unlikely to be delivered without some public intervention (e.g. farmers without livestock may be unwilling to continue to trim hedges). Equally, is it right that land managers are not specifically rewarded for providing some very highly-valued by-products (e.g. the renowned beauty, biodiversity and recreational opportunities of farmed landscapes in UK National Parks)? There are practical challenges in determining the relative roles of the market and public intervention in securing the desired level of any specific service.

- 2.10 The ecosystem approach has several valuable features (Defra 2007b). It emphasises the need for a more holistic approach to policy-making and delivery which recognises that land provides economic, social and environmental services alike. Hence land should not be conceived as existing simply 'to provide food' or 'to protect our environment'. It serves diverse purposes which should all be regarded as legitimate and fully reflected in decision-making. The approach also recognises that real environmental limits must be respected if the ability of land to deliver a wide range of ecosystem services is to be safeguarded. Defra (2007b) also see the ecosystem approach as promoting adaptive management of the environment to respond to changing conditions, including climate change.
- 2.11 Taking a 'more holistic approach' requires a distinct mindset - one which will be new to many of those concerned about the use of land. Can farmers, used to seeing themselves as 'food producers' conceive themselves instead as 'integrated land managers' who provide 'ecosystem services'? The ecosystem approach means accepting the possibility that regardless of its current main use, or uses, any area of land has the potential to deliver a very wide range of services (such as food, flood management, biodiversity, or recreation). It also may mean accepting a higher degree of 'multifunctional' land use than hitherto. However, there are limits to the extent to which multifunctionality can be pursued without impairing the delivery of one or more of the services involved. For example, there are well-known trade-offs to be made between crop productivity and diversity of wildlife.

Challenges posed by the ecosystems approach

- 2.12 The shifts in attitudes required by adopting the ecosystem approach pose significant challenges for some long-standing policy concepts and mechanisms. These are often sectoral, focus on one interest in land to the exclusion of others, and emphasise land use segregation rather than multifunctionality. For example, local development plans for many years treated all land other than that zoned for development as undifferentiated 'white land', regardless of its value for food, forestry, biodiversity, or other services. Attempts to distinguish between different grades of agricultural land have led to the planning concept of 'Best and Most Versatile land'. Yet this focuses purely on the food-producing potential of land, ignoring the other ecosystem services which farmland can provide.
- 2.13 As environmental legislation has developed, additional one-dimensional designations have been added to the planners' maps, including Areas of Outstanding Natural Beauty for landscape, National Parks for landscape and recreation, and Sites of Special Scientific Interest for biodiversity. These designations have in turn been supported by their own sets of single-purpose policies and delivery mechanisms. The literature contains many articles on the failure of policy-makers to take a more integrated approach to these designations, recognising that each will delineate areas which are of interest from diverse environmental viewpoints (and also from cultural and economic perspectives). Recent legislation has added wider purposes to many of these designations, but still in a piecemeal way. It is difficult to characterise any as an example of a 'holistic' approach.
- 2.14 The government argues that 'embedding the ecosystem approach' will deliver varied benefits. These include 'more effective delivery of our environmental outcomes' and 'better-informed decisions that take full account of environmental impacts'. The approach is also seen as offering opportunities for 'better prioritisation and more efficient use of our resources', and 'more effective communications and greater awareness of the value of the natural environment and ecosystem services' (Defra 2007b). Set against the background of a distinctly *sectoral* approach firmly embedded in substantial bodies of legislation, policy and practice throughout the UK, it will be a major challenge to deliver these benefits.

Articulating the overall challenge

- 2.15 The ecosystems approach offers a practical framework for analysis. Indeed, all the Relu projects covered by this study have adopted it implicitly, if not explicitly. However, as a challenge to those making and delivery policy, 'embedding an ecosystems approach' in itself does not convey the nature and magnitude of the task. Indeed, our discussions with

stakeholders indicate that the use of the term 'ecosystem' leads some mistakenly to believe that the approach is concerned solely with environmental services, impacts and outcomes. In fact, the inclusion of the full range of productive services from land - food, fibre, fuel, and so on - indicates that the approach, at least in theory, is holistic. Hence economic and social interests must also be fully considered - within the context of environmental limits.

2.16 Against this background I suggest that the overall land-use challenge for the UK is '**securing integrated land management using an ecosystems approach**'. Articulating the challenge in this way indicates what using an ecosystems approach may help us deliver, and underlines the need to consider economic, social and environmental needs in an integrated way, rather than in isolation. The following sections consider what this challenge might mean in practice, and how Relu projects contribute to tackling it:

- Section 3 focuses on setting objectives for integrated land management.
- Section 4 considers how to reach the best decisions, in the interests of society, about which ecosystem services should in practice be delivered where.
- Section 5 focuses on how integrated land management can be effectively and efficiently delivered through the interplay between policy mechanisms within a market economy, and a robust property rights framework.

3. SETTING OBJECTIVES FOR INTEGRATED LAND MANAGEMENT

Understanding the potential of land

- 3.1 Relu projects will help us to understand better what range of services could potentially be provided from land and how they interact. This is particularly important for emerging services which have not been widely recognised or sought in the past. For example, the *Energy Crops*, *Anaerobic Digestion*, *Floodplains* and *Sustainable Uplands* projects will help show how the provision of energy crops, generation of on-farm energy from crop and livestock 'wastes', water management, and carbon storage services, respectively, can be integrated with other more traditional farming and conservation activities.
- 3.2 For example, our understanding of the science surrounding the conditions in which land acts as a net source or sink for carbon is still imperfect. 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 reducing carbon losses through erosion. Similarly, grasslands are much more extensive than peatlands but their potential role as carbon stores is also poorly understood. If existing rough grazing land and permanent pasture were to be ploughed up on a large scale, the impacts on carbon budgets could be significant.
- 3.3 The impacts of different land management practices on different services are also being examined. For example, the *Hill Farming*, *Biodiverse Farming* and *Agri-environment* projects are assessing how land management practices affect biodiversity. The projects are also studying the extent to which different services can be provided as co-products, and the points at which trade-offs between services have to be made. The *Organic* project will compare selected economic, social and environmental attributes of paired 'organic' and 'conventional' farms. 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.
- 3.4 While Relu projects are examining diverse farming systems, they are all working within the framework of the crop, grass and livestock varieties now available. None is considering, for example, the extensive growing of genetically-modified crops, as seen in the USA. 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. There is certainly scope to understand better and exploit the 'background' adaptability of crops to their environment. There may also be scope to introduce transgenic effects.
- 3.5 The projects will not present 'blueprints' for future land use. But they should help show how the pattern of land use might change to create a landscape which provides a wider range of ecosystem services than hitherto. Several of the projects are modelling different land use-scenarios and inviting feedback from land managers and wider communities (e.g. *Energy Crops*, *Sustainable Uplands*, *Catchment Management* and *Water Framework Directive*). The sorts of shifts which can be envisaged include:
- **Changing the extent and mix of specific land uses** (e.g. the balance between agriculture, forestry, wetlands and other uses).
 - **Adjusting management practices** (e.g. more unsprayed field margins) to foster increased biodiversity and reduce threats to water from diffuse pollution.
 - **Adopting new technology** (e.g. 'precision' farming techniques and new varieties of crops, grasses or trees produced through traditional or novel breeding techniques).

- **Introducing crops or livestock which are relatively new to the UK** (e.g. novel biomass crops, soya, tea, new breeds of livestock).
- **Restoring or 're-wilding' habitats** (e.g. by converting arable land to downland, removing livestock from upland grasslands to enable regeneration of heather moorland and woodland, or reintroducing species to their former ranges).
- **Bringing previously-developed, derelict or idled (set-aside) land back into productive use** - to deliver a range of services, not necessarily food alone.
- **Deliberately investing in managing land for diverse purposes** - e.g. creating woodland to mitigate flood flows, provide wood fuel, and enhance biodiversity or creating new wetlands for water storage, biodiversity and recreational use.

Understanding how ecosystem services are valued

- 3.6 Valuation issues immediately arise in determining which ecosystem services to seek, and where. The diverse values which society places on different services are reflected in current market interventions and environmental legislation, and in associated policy and funding measures. These incentivise specific services, or regulate damaging activities. For example, food production has long been valued more highly than biodiversity, landscape beauty, water quality or other services; this is still reflected in the current relative balance of funding for Single Farm Payments and agri-environment schemes. A shift in priorities between different services would be expected to result in a shift in such relationships.
- 3.7 Recently, the Water Framework Directive has placed a high value on the 'good ecological quality' of water, and requires Member States to develop and implement Programmes of Measures to deliver this aim across the EU. Similarly, the designation of a Site of Special Scientific Interest indicates that the land within it is highly valued for its biodiversity and/or geodiversity. The designation is supported by measures to regulate potentially-damaging changes in land management and/or encourage appropriate positive management, to meet national targets for the conservation status of the land. Agri-environment schemes offer incentives to encourage particular management practices not necessarily restricted to areas formally designated in some particular context, but often targeted at them.
- 3.8 Some Relu projects are informing practical approaches to valuation by investigating the preferences of different stakeholder groups for different actions to tackle future challenges. This work will contribute to the policy debate about how much weight should be given to different services, and how current weightings in policy might accordingly change. The *Sustainable Uplands* project, for example, is throwing light on the value to society of restoring peatlands to enhance services such as the regulation of water flows, provision of wildlife habitats, carbon storage, and the extensive production of livestock and game.
- 3.9 Other Relu projects are adopting a more theoretical approach to valuation. For example, the *Water Framework Directive* project will apply innovative techniques to attempt to value the likely benefits of improving outdoor water quality through changes in land management. However, it is widely recognised that valuation techniques for non-market benefits have weaknesses, and are better used to inform rather than determine decisions. A pragmatic suggestion is that the 'appropriate value' to place on any desired service is that which brings about whatever specific action or change in behaviour is required. Hence, society should ask not 'What is the value of clean water?' but rather 'How much will it cost (in regulatory effort, incentives, or through other means), to persuade land managers (and others) to change their mindsets and adopt practices which deliver clean water?'

Challenging the spatial and temporal scale of planning

- 3.10 Relu projects are illuminating many questions around the spatial and temporal scales on which land management objectives are set and ecosystem services are delivered. The projects are conducting field-work at a wide range of spatial scales:
- Within-field (e.g. *Biodiverse Farming, Agri-environment*)
 - Field scale (e.g. *Hill Farming*)
 - Farm-scale (e.g. *Energy Crops, Anaerobic Digestion*)
 - Groups of farms (e.g. *Livestock Waste, Organic Farming*) or estates (e.g. *Deer*)
 - Single catchments (e.g. *Community Catchment Management*)
 - Multiple catchments and river basins (e.g. *Floodplains, Catchment Management, Knowledge Controversies, Water Framework Directive*)
 - Localities, such as local authority areas (e.g. *Local Food*)
 - Landscapes, such as heathlands and forests (e.g. *Animal Disease Risks*) and rivers and stillwaters (e.g. *Angling*)
 - 'Rural' administrative areas, as distinct from their 'urban' counterparts (*Inequalities*)
 - Regions and nations (e.g. *Nutrition, Local Food, Catchment Management*)
- 3.11 The ecosystem approach can theoretically be applied at any spatial scale, from local to global. However, the ability to assess the extent to which diverse services are being delivered, or could be, at any one scale, is highly constrained by the availability of relevant data. For example, a picture of plant distribution nationally can be gained from an atlas compiled on a 10-kilometre grid, but this will be no guide to the distribution of any one species on a 1-kilometre grid. A single adverse water quality reading in the lower reaches of a major river may be enough to label the entire river basin as 'polluted' - but will give no clue as to the specific catchments, or sub-catchments, from which the pollution originates.
- 3.12 It is important to recognise that different spatial scales are relevant for planning and securing the delivery of different services: while marsh fritillary butterflies require sensitive management of vegetation at a field scale, golden eagles require a mix of habitats at a landscape scale; river catchments are appropriate for studying services related to water, but less so for food production or biodiversity; the local authority areas often used for Local Biodiversity Action Plans, do not always fit well with the distribution of habitats. Some services are now being considered at a regional scale, alongside strategic planning for housing, infrastructure, etc. A 'landscape-scale approach' is being urged to facilitate adaptation to climate change (e.g. East of England Biodiversity Forum 2008).
- 3.13 Care will need to be exercised in establishing the extent to which results obtained from Relu projects can be applied at scales other than those at which they were collected. Recognising this challenge, some projects have deliberately brought data sets together at different scales (e.g. *Biodiverse Farming* will set project data on birds at a field scale in the context of data sets on farmland birds gathered through national volunteer surveys). A review of issues of spatial scale across all the Relu land-use projects might be instructive.
- 3.14 Whatever the spatial scale at which objectives are set for different land services, under current administrative arrangements, the scale at which they will be *funded* is essentially that of a territory (England, Wales, Scotland, Northern Ireland), region (e.g. Government Regions in England), or local authority (e.g. county or district). Given the evident mis-match

between administrative areas and the natural environment, collaboration between 'authorities' will be needed to optimise the delivery of ecosystem services. The implementation of the Water Framework Directive, which requires an approach based on river basins and catchments, will test the ability of administrative bodies to work together across their boundaries. Similar challenges arise in relation to the funding and management of Habitats Directive sites, and to the development of landscape-scale habitat 'corridors'.

- 3.15 Similarly, within the current property rights framework, the scale at which land services will be *delivered* is essentially that of the land holding (whether a 'house with land', a farm, or an estate), because this is the level at which practical responsibility for managing land is exercised. Significant challenges arise in securing the delivery of ecosystem services where the areas involved extend beyond individual land holdings. For example, the health of a river will depend on the practices adopted by thousands of riparian owners. Several Relu projects are providing insights into the willingness of land managers to collaborate in delivering ecosystem services, and the mechanisms needed to encourage them to do so.
- 3.16 The time-frame on which the Relu projects are focused is inevitably bounded by their funding arrangements - typically for a three year project. However, project findings may be relevant long into the future, and some are feeding into policy processes which themselves have a long-term perspective. The Water Framework Directive sets milestones for improvements in the water environment through successive rounds of implementation to 2027 (e.g. the *Catchment Management*, *Community Catchment Management*, and *Water Framework Directive* projects). Similarly, the Climate Change Act sets targets for 2050 (e.g. *Anaerobic Digestion*, *Energy Crops*). Strategies for flood risk management are increasingly being developed over 100-year timescales (e.g. *Floodplains*, *Knowledge Controversies*). Some projects are identifying lessons from the past to inform future policy. For example, the *Floodplains* project is re-examining agricultural flood defence schemes, previously studied by the research team in the 1980s, with the aim of identifying and explaining changes in land and water management that have occurred over the last 40 years.

Understanding the motivations of land managers

- 3.17 Land managers - including farmers, foresters and estate owners - have a critical role to play in delivering ecosystem services. It is important to understand their characteristics, attitudes, motivations and interests, and how these are changing. Recent research has revealed that farmers are heterogeneous and that social and cultural influences are just as important as attitudinal and structural factors in determining motivations (Dwyer *et al* 2007). For example, it would be wrong to characterise all land managers as farmers simply seeking to sustain family businesses by producing marketable crops or livestock; these are only one part of the mix. Family farmers (whether tenants or owner-occupiers) have been joined in recent years by major agribusinesses, and many contractors. Other important groups of land managers include those producing for niche markets or for ethical reasons (e.g. organic farming), equine enterprises, 'lifestyle' entrants focused on shooting or amenity, and conservation bodies acquiring land for its existing conservation value or future potential. Farming will be part of their portfolio - but with relatively small commodity outputs.
- 3.18 Nearly all the Relu projects are working directly with land managers - with samples ranging from just a few individuals to 50 or more. All the projects are emphasising the diversity of these populations, even within a single valley or sub-catchment. The characterisations of land managers which these projects produce will be of interest in their own right and contribute to a growing body of work on segmentation of farmer types and farming styles (e.g. Slee *et al* 2006, and Garforth and Rehman 2007). But the projects are not merely describing land managers. They are also using diverse approaches to discover and understand how they make decisions in testing circumstances. This work could offer important steers for policy-makers. For example, how do land managers weigh up their alternatives and determine a way forward in response to changes in Single Farm Payments, increased regulation, or a 'bull' market for food and biomass?

- 3.19 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 in livestock-farming areas.
- 3.20 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.
- 3.21 The *Biodiverse Farming* and *Water Framework Directive* projects are modelling economically-optimal actions and then asking farmers why they deviate from these. This will inform questions such as 'What measures will achieve targets for farmland bird populations?' The importance of farmer motivations is illustrated by the finding that farmers who also enjoy shooting partridges tend to allow much weedier fields. The *Catchment Management* project is modelling the costs and benefits of changing farming practices to produce a healthy river environment, also contrasting rational theory and real practice. The *Nutrition* project is adapting the Reading University 'Land Use Allocation Model' to recognise that farmland provides wider services beyond commodity production alone.

The benefits of better understanding

- 3.22 Better understanding of land-managers and their decision-making frameworks will benefit policy in several ways. For example, Relu projects will provide insights into the critical considerations which 'tip the balance' in favour of one course of action rather than another, and indicate the relative extent to which market and policy drivers are important in key decisions. This knowledge will help in designing and implementing incentive schemes and regulations; and in identifying needs for advice and training to support adjustment. This work could also help inform current work by Defra to develop a typology of farm types to complement previous work to segment consumers into several different 'types'.
- 3.23 This improved understanding may also assist politicians in providing a clearer sense of national direction for land managers in the UK. 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.'
- 3.24 These observations suggest an unmet need for strategic leadership. To what extent can or should this be provided? The Strategy for Sustainable Farming and Food (Defra, 2002) described the challenge facing agriculture in various ways: '...to create fresh prosperity...to preserve and enhance our environment and contribute to stable rural communities...in other words...to rebuild a food and farming industry which is sustainable'. Yet the focus of this strategy now seems rather narrow, particularly in putting 'farming' and 'farmers' (rather than 'land managers' more widely) at the centre of land management. The ecosystem approach recognises food production as a vital service - but it is only one of many services which society seeks from land. Land management is needed to deliver these services, but not always primarily through farming to produce food.

- 3.25 Ministers have recently stressed that farming should serve diverse objectives. For example: 'we want for farming and from farming...an industry that: is profitable and competitive in the market, both domestically and internationally; is known for the quality, safety, and environmental and animal welfare standards of the food and other products it makes; embraces its environmental responsibilities - tackling climate change, managing carbon, water and the soil, and encouraging biodiversity - and sees all of those things as essential to its long term economic success, rather than a threat to it; works together in partnership to meet the challenges it faces, in which responsibility for decisions affecting it and the costs of managing those risks are fairly shared...; an industry that is, above all, innovative, self-reliant, successful, and confident about its future...' (Defra 2008).
- 3.26 In his most recent speech to farmers, the Defra Secretary of State implies that farmers who are confused about the direction of farming perhaps need to think more holistically. 'The idea that protecting our soil, our water, our habitats, our landscape and the very climate on which all of these depend, and encouraging production, are in competition with each other is to miss the point completely. Why? Because our long-term food security depends on looking after those things.' He suggests that there are important opportunities for farmers in 'finding new ways to cut greenhouse gases, developing new sustainable farming techniques, [and] increasing production by investing in the future...The UK has pioneered agricultural revolutions in the past, and we should be leading this revolution too. Producing food in a sustainable way *is* the future for British agriculture' (Defra 2009).
- 3.27 If the statement 'producing food in a sustainable way *is* the future for British agriculture' is broadened to stress integrated management of a wider range of ecosystem services, to include a wider range of land managers, beyond farmers, and to refer to the UK, rather than just Britain, the overall policy 'steer' might then be: 'The future for UK land managers lies in delivering the full range of ecosystem services in a sustainable and integrated way'.

4. GOVERNING INTEGRATED LAND MANAGEMENT

Making the right decisions

- 4.1 Identifying the *potential* for land to deliver different ecosystem services to society is essentially a technical exercise. It means stepping back from current or recent land use and considering what range of services could realistically be delivered, given appropriate management. Determining *priorities* for any one area - which services should actually be delivered there to meet society's needs - is quite another matter. Any such decision is the sum of interactions between the market, land managers, and policy-makers - which includes all those potentially able to influence these decisions. The decisions can often be contested. For example, land managers often argue that their freedom to exercise their property rights is being infringed unduly by environmental restrictions. Equally, others argue that land managers are not being adequately encouraged, or required, to change management practices to deliver valued services more effectively.
- 4.2 Complications arise because priorities will alter over time, in response to new pressures, hence priorities agreed today may be far from appropriate in 2020, 2050 or 2100. For example, the priority accorded to home-grown food production has see-sawed over the last 150 years, between self-sufficiency and reliance on imports. As recently as 1979, the Government produced a White Paper entitled 'Food from our own Resources'. In contrast, the Defra Strategy (2002) states that 'The UK is now 75% self-sufficient in food production - a higher figure than in the 1950s. But in an increasingly globalised world the pursuit of self-sufficiency for its own sake is no longer regarded as either necessary or desirable...the Government will continue to assert...that the best way of ensuring food security is through improved trading relationships, rather than a drive for self-sufficiency'.
- 4.3 The debate over whether the UK should invest more strongly in food production - given global population growth and the diversion of arable land from food crops to the production of biofuels, has intensified (e.g. RSPB 2008, Defra 2009). Equally, should tree crops be encouraged as sources of biomass and sustainable construction materials or discouraged because they will add stress to water resources in a dryer climate? The complications are multiplied when the debate is localised. It will often be possible to argue that a particular land service would be delivered more effectively elsewhere (e.g. 'my land should be safeguarded for food production - not wetland creation'). One area where these conflicts come into sharp focus is on the coast (e.g. 'should this cliff be allowed to erode, with the loss of farmland and houses, to provide sediment to contribute to natural flood defences along the coast?').

Involving the right people in decisions about land services

- 4.4 Stakeholder involvement in 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 affected by or who 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'). Greater emphasis on 'participation' is increasingly seen as desirable.
- 4.5 The potential benefits and difficulties of stakeholder engagement need to be better understood. Participatory processes can build consensus and can also help stakeholders learn to live with differences. Understanding issues and sensitivities from the perspective of those affected by them should in theory help to align policy more effectively with real experience and aspirations and lead to better-quality and more sustainable decisions. While there is growing consensus over best practice in participation, embedding this in public policy processes poses several challenges. For example, stakeholders are numerous but the public resources available to 'engage' them are constrained. Policy-makers may also fear a loss of control and having to commit themselves to implement and resource the unknown outcomes of a participatory process. These processes have also

been subject to some criticism for creating consultation fatigue, and cynicism, and disproportionately empowering minorities with vested interests.

- 4.6 Our discussions with policy-makers underline concern that centralised policy-making bodies cannot by themselves solve the land-use challenges that the UK now faces. There is a perceived need to enable and empower local action, but also a concern that grass-roots initiatives are being constrained by bureaucracy and institutional barriers. Various Relu projects are throwing light on how decisions about priorities for delivering ecosystem services could be managed better. All are emphasising the value of greater dialogue, involvement and collaborative working. In particular, they are considering who should be involved in the decision-making process alongside land managers, when, and how.
- 4.7 Several projects are illuminating who the actors are, what motivates them, and how they respond to particular dilemmas. The *Deer*, *Sustainable Uplands* and *Floodplains* projects are using techniques such as Social Network Analysis and Stakeholder Analysis to examine complex inter-relationships between stakeholders. The *Community Catchment Management* project is underlining the importance of understanding locally-grounded knowledge. The project challenges a deterministic view of the world in which policy interventions lead to logical land management responses which in turn deliver expected environmental outcomes. The team's 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. Greater understanding of stakeholder inter-relationships, and of how local communities respond to policy initiatives, may help policy-makers avoid perverse effects and unintended outcomes.
- 4.8 There appear to be benefits from involving 'non-experts' in policy processes, using methods which integrate scientific knowledge with local experience. The *Knowledge Controversies*, *Sustainable Uplands*, *Floodplains*, *Livestock Waste* and *Catchment Management* projects suggest that drawing on local knowledge and insights will help speed up and improve policy decisions and delivery. This is not to say that expert knowledge should be dismissed, particularly in seeking to resolve technical issues. The report of the Ryedale Research Group (2008), produced as part of the *Knowledge Controversies* project, documents a case-study which demonstrates the tangible benefits of promoting constructive and informed dialogue between scientific 'experts' and local actors.
- 4.9 One area in which local communities have sometimes rejected official 'science-based solutions' relates to flood-risk challenges. The *Knowledge Controversies* project suggests that it is not enough for scientists simply to analyse data from traditional sources and present a 'preferred solution'. The process will be much more likely to win local support and legitimacy if modellers seek out and draw on detailed, and often long-term, local records and observations (e.g. about which areas flood first). The models can then to an extent be co-created, and the scientists can 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 similarly using 'participatory GIS' to integrate stakeholder and scientific knowledge to inform negotiations about managing wild deer. For example, ecological models were refined by drawing on knowledge provided by deer-stalkers. This work is also relevant to other 'common-pool' resources.
- 4.10 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. This project raises the issue of whether inequality matters if those who, objectively, are relatively worse off, do not recognise this or have actively chosen to put up with it. The *Water Framework Directive* and *Floodplains* projects are exploring the relative costs and benefits of land-use change for rural and urban communities. The projects raise interesting questions. For example:

- Should rural land managers be paid now to provide water management services and thereby reduce downstream urban flooding?
- Should rural land managers who have benefited over many years from state investment in historic drainage schemes - which turned functional floodplains into highly-productive farmland - be required now to reinstate those floodplains at their own cost?
- If urban flooding is substantially caused by run-off from built surfaces should not sustainable water management solutions be sought within urban areas themselves?

Methods of engaging stakeholders

- 4.11 The *Livestock Wastes* project has emphasised the importance of selecting effective approaches to engagement. 'Speaking the right language' and using familiar tools is very important. For example, the research team 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. The Scottish Environment Protection Agency has indicated an interest in adopting this tool in expanding its work to tackle diffuse pollution. The Woodland Trust has also successfully used annotated aerial photographs with land managers. The *Livestock Wastes* research team found that 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 much less effective.
- 4.12 The *Knowledge Controversies* project suggests that using intermediaries with no vested interest to lead engagement work can build confidence among stakeholders and deliver better outcomes. This may help to overcome cynicism about token consultations where public responses are largely ignored. People may be more willing to engage with an independent party than with officials, particularly over controversial issues. By acting as a facilitator, catalyst, mediator and broker, the intermediary can gain feedback which would not otherwise have been possible. This approach could perhaps be more widely used.
- 4.13 Land managers can be difficult to engage in discussion with other stakeholders. The *Angling* project shows that they are not unique in this respect. '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. Members of any specific angling club may live far away from the waters they fish. Many anglers are not affiliated to any particular body - and no one body can claim to represent all anglers. Consulting them necessarily involves complex negotiations through diverse routes. Likewise, it can be difficult to engage non-traditional 'lifestyle' farmers in agri-environment policy. They may not be affiliated to, or represented effectively by, the main farming organisations.
- 4.14 Numerous issues arise in determining which stakeholders to involve. Who has the right to determine whether one group or another should be contacted? Are the stakeholders representative? Some groups may claim to represent many, but in fact represent only a few, or promote a single 'party line', when their members actually hold more diverse views. Issues of equity also arise. Arrangements for involving stakeholders in rural policy matters are seen by some as exclusive, cosmetic, or with a scope which has been deliberately restricted, so that only minor concerns can be raised. These observations suggest a need to find new and better ways to tap wider - especially local - perspectives on land use.
- 4.15 Some Relu projects are testing innovative 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. The *Water Framework Directive* project has used large sample surveys to assess public perceptions and preferences on land-use issues. The *Livestock Wastes* project convened a citizens' jury to deliberate on the diverse

social and economic issues raised by microbial pollution. This exercise produced an equally diverse range of practical suggestions for action (Relu 2008).

- 4.16 The *E. Coli*, *Livestock Waste*, and *Animal Disease Risks* projects are studying stakeholder perceptions of risk - and demonstrating that *how* messages about risk are communicated to the public is critical. For example, The *Energy Crops* project has surveyed people's attitudes to energy crops, finding that local people are more concerned about associated power plant infrastructure and the potential for increased noise and road traffic than the crops themselves. These findings suggest that *national* consultations on policy could usefully be complemented by studies of how *local* communities view issues in order to better understand the context-specific nature of debates over land.

5. DELIVERING INTEGRATED LAND MANAGEMENT

Tackling 'market failure'

- 5.1 It is widely accepted that governments should intervene in markets only where there is 'market failure'. This has diverse causes, relating to access to information, transaction costs, market structures (e.g. dominant suppliers or buyers), and uneven access to resources, among others. For example, farmers may adopt damaging land management practices where the market provides no financial incentive to maintain a positive benefit (e.g. landscape beauty, clean water), nor penalty to discourage a negative impact (e.g. a despoiled landscape, polluted water).
- 5.2 Relu projects are throwing light on various aspects of the mechanisms and tools for delivering integrated land management. Mechanisms to tackle the failure of the market to deliver public goods, or to resolve market failures which impinge on issues of equity, social inclusion and quality of life, include: providing information (e.g. practical decision tools), advice, and training; promoting voluntary agreements; imposing regulations; developing economic instruments (taxes, levies, incentives); and creating new markets (e.g. for emissions trading). Finding the best mix of actions to internalise these 'externalities' is a continuing challenge. The difficulties are accentuated by the diversity of enterprises run by some 300,000 UK land managers with differing characteristics, attitudes, and objectives. Policies which fail to understand and take account of these differences are likely to fail.

Promoting integrated policy-making and delivery

- 5.3 The use of an interdisciplinary approach to research has been a strong and enduring feature of the Relu programme. The research teams bring together researchers from diverse disciplines and fields of study within them to focus on challenges. This means, for example, that natural science issues, whether over energy generation, waste management, biodiversity, or water quality, are being examined firmly within the social and economic contexts in which they arise. All the research teams we met welcomed the added insights which different perspectives, research tools, and approaches are contributing to their ability to investigate and understand specific research (and/or policy) questions.
- 5.4 The need for greater integration in policy-making is also becoming apparent. For example, Catchment Sensitive Farming Initiatives have been focused on areas affected by high phosphate levels, without exploiting links to Nitrate Vulnerable Zone initiatives. Similarly, an initial focus in agri-environment schemes on conservation benefits means that opportunities to tackle diffuse pollution may have been missed. Integrating conservation objectives into schemes initially focused on tackling diffuse pollution might have been easier, and more effective, in meeting policy goals in both these areas.
- 5.5 The *Floodplains* project is examining how to balance multiple roles for floodplains, taking account of different stakeholder interests and valuations. The findings suggest that current rural land use policy is often fragmented, inadequately targeted and dominated by short-term thinking. An integrated approach to policy-making should maximise synergies between policy areas and avoid unintended impacts (Posthumus *et al* 2008). It should also seek to reconcile short-term and long-term objectives. This is fully consistent with the more holistic approach to policy-making and delivery of the ecosystem approach (Defra 2007b).
- 5.6 Much progress has been made in integrating the interests of biodiversity, landscape and the protection of water, soil and air resources into land-use policy in recent years. A current challenge is to build climate change mitigation and adaptation into legislative frameworks developed before there was widespread realisation of the implications of climate change. For example, many sites designated under the Habitats Directives may not be able to support their valuable species and habitats under a changed climate (e.g. too wet, too hot), or under changed conditions (e.g. saltwater inundation of freshwater coastal marshes). The focus may need to shift from simply protecting these sites to creating new habitats elsewhere. If legislation is not flexible enough to accommodate the necessary changes, it

may need to be amended. In seeking this integration, one challenge will be to minimise, and manage effectively, the possible trade-offs with other ecosystem services.

- 5.7 Similar policy adjustments may also be needed in other areas. For example, water tables are lowered to a far greater extent in the UK than in comparable areas in the Netherlands, potentially incurring undue energy costs, and even limiting productivity in dry years (*Floodplains*). Such established practices may need to change to allow water tables to rise, under a changed climate. Likewise, other established practices (e.g. the timing of grazing periods and manure applications), standard prescriptions, and regulatory requirements (e.g. for cross compliance) may also need to be reviewed in the light of a changing climate. More generally, while landlord-tenant legislation now enables both parties to make agreements relating to a range of business activities on tenanted land, it does not impose specific requirements on either party in relation to the environment. Should this change?
- 5.8 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. It seems odd that energy policy gives Liquefied Petroleum Gas (from fossil fuel) a strong price advantage over Biogas (from renewable sources). Equally, it has only recently been decided that manures treated by anaerobic digestion will no longer be regarded as waste when used as a fertiliser - and accordingly that the costly requirements of waste regulation need no longer apply to them (Defra 2009). Taking an integrated approach to policy-making means identifying and rectifying quickly any such perverse policy interactions.
- 5.9 Similarly, 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. The *Energy Crops* project suggests that it is the infrastructure surrounding biomass plants which is of most concern to the public. This indicates the need to think small and local in this area. Proofing mechanisms perhaps need to be put in place to avoid creating barriers within current policies to meeting government objectives for managing climate change.

Learning more from international perspectives

- 5.10 Several Relu projects are tapping international perspectives (e.g. *Catchment Management*, *Energy Crops* and *Water Framework Directive*). Many countries are bound by the same global conventions (e.g. on Biodiversity and Climate Change), if not also European legislation (e.g. the Common Agricultural Policy, and Directives on Water, Habitats, and Nitrate) and face similar policy challenges. Intuitively there may be opportunities to benefit from thinking and experience outside the UK, even where the legislative, institutional and/or cultural frameworks differ. For example, other countries adopt a different balance between regulation and voluntary action, use novel mechanisms to secure ecosystem services (e.g. easements, covenants and tendering approaches), and devolve responsibility to more local levels than in the UK. Requiring future Government proposals for land use to be accompanied by a review of how other countries are dealing with the same issues might be one way to help policy-makers draw more effectively on such experience.
- 5.11 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 Strategy for Sustainable Farming and Food (Defra 2002). 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. 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.

Integrating 'top-down' and 'bottom-up' approaches

- 5.12 Our discussions with policy-makers have suggested that more emphasis is needed on complementing centralised policy-making with action to encourage and support local innovation in tackling land-use challenges. For example, is it realistic to expect a single agri-environment scheme, developed on a national basis, to deliver the specific services required in any one locality? The devolution of much policy responsibility to the Scottish and Welsh Assembly Governments may place these institutions in a better position than the UK Government to work more closely with local communities. In England, the parallel would be to devolve greater responsibility to the Regional Development Agencies, and the Regional offices of national agencies, to work with local communities to prioritise ecosystem services and develop local solutions. These could then be reflected in Regional Spatial and Economic Strategies. Planning for biodiversity, for example, is increasingly taking place at this level (East of England Biodiversity Forum 2008).
- 5.13 An even more significant change would be to devolve responsibility for securing integrated land management (and the concomitant powers and resources) further still to individual local authorities (e.g. at county or district scale). In so doing, it would be important to foster collaboration between authorities, across boundaries, to ensure that the planning and delivery of different services took place at an appropriate scale. In this respect, local authorities generally could learn from the approach adopted in National Parks to foster conservation and recreation across several local authority areas (though it might be possible to secure the same ends with less-formal governance arrangements). Steps along this route could include equipping all local authorities with the levels of resources provided to National Park Authorities to support recreation and conservation objectives; and making greater use of 'participatory budgeting' to enable local communities to fund local priorities.
- 5.14 The need for change is being underlined by the experience of several Relu projects. There are risks of a mismatch between top-down strategic planning and bottom-up decision-making and delivery. The *Deer* project highlights the difficulties at local level of implementing multiple national policies and suggests that getting local deer managers and government agency staff together at the outset of policy implementation would lead to better relationships and outcomes. 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. The *Nutrition* project suggests that national policies to promote a healthier diet with less red meat, if more rigorously pursued, could impact severely on remote localities dominated by beef and sheep enterprises, damaging both the economy (through loss of output and employment), and the environment (through undergrazing of valued habitats).
- 5.15 Several organisations have suggested that government should pilot new approaches at a local scale, building on past successes, including integrated rural development schemes and agri-environment schemes in the 1980s, and Community Forests and the National Forest in the 1990s. Some local authorities have already been making innovative use of rural development funds. For example, one unitary Council is proposing to set up a series of 'Rural Environment Forums', each covering about 20 parishes. The Forums will foster dialogue between local stakeholders (residents, farmers, countryside users) and officials from relevant public agencies (Environment Agency, Natural England, Forestry Commission, and the Council). The aim is to provide opportunities for consultation and participation in decision-making processes which will enhance the capacity of local communities to 'own' environmental management in their areas.
- 5.16 Several Relu projects have engaged local stakeholders from the voluntary sector. The sector is well-placed to bridge the divide between top-down and bottom-up approaches. For

example, the National Trust, Royal Society for the Protection of Birds (RSPB) and Wildlife Trusts all deliver public policy objectives over their own land and through partnerships with others. Their land-holdings give them an important stake in the local economy, society and environment alongside the public sector and private land managers. The RSPB provides an advisory service for farmers on farmland birds, drawing on the practical experimentation and demonstration work undertaken on its own holdings. Similarly, River Restoration Trusts have successfully funded the fencing of riverbanks to exclude livestock, delivering multiple benefits for fisheries and biodiversity and improved fishing rents. These organisations complement such local action with diverse analyses of policy issues and recommendations for change (e.g. RSPB 2008 and a series of reports produced for the National Trust: Cowell 2006, Green Balance 2008, and University of Essex 2008).

Providing information and advice to support land management decisions

- 5.17 Relu projects promise to deliver a range of practical decision-support tools which can help land managers determine how best to deliver particular ecosystem services. For example, the *Livestock Wastes* project has developed a 'kite' tool to help farmers to assess where the most serious and difficult risks lie in managing livestock wastes, and to mitigate these more effectively and efficiently (Relu 2008). The tool has four components, each mapped on a scale of 1-10 on its own axis: the microbial burden (e.g. how manures are applied to land); transfer potential (risks associated with topography - such as slope); infrastructure (e.g. farm manure storage capacity); and socio-economic obstacles which limit the land manager's ability and desire to manage risk (e.g. levels of training). The resulting shape of the 'kite' polygon produced by mapping the risks indicates, in a very straightforward way, the overall level of risk, and where mitigating actions might best be targeted.
- 5.18 Several projects are identifying important gaps in understanding among land managers and rural communities over land management issues. The *Livestock Wastes* project, for example, has raised awareness of the potential impacts of livestock farming on levels of pathogenic micro-organisms in watercourses, and in turn on the health of swimmers using nearby beaches. This is a new angle on the whole area of 'farming and health' - where the usual focus is on food quality. Similarly, the *Deer* project has helped local people to understand 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. Filling such gaps in understanding will help enable land managers and stakeholders to own, and act on, land-use challenges.
- 5.19 The *Agri-environment* project is taking this work a step further. It has created a baseline of data on farmers' environmental knowledge, history of environmental management, and attitudes. The project is then assessing farmers' ability to create flower-rich field margins by comparing the outcomes where one group of farmers receives training, and the other does not. The project suggests that farming for wildlife is difficult and requires strong motivation and investment in advice, training and practical demonstration. It should not be assumed that land managers necessarily possess the requisite skills to deliver specific services. The policy implication is that agri-environment schemes may need to put more funding into knowledge exchange and training to develop skills than into incentives potentially yielding better environmental results, but on fewer hectares overall.

Using voluntary agreements

- 5.20 Agri-environment schemes are a key mechanism for influencing land management across the UK. The schemes are designed to deliver baseline protection of environmental resources and more sophisticated land management for species, habitats and landscapes. However, while they may promise much, the schemes have been criticised for not always achieving their objectives or providing value for money. Given their pervasiveness, it is not surprising that several Relu projects are dealing with land managed under such schemes, including *Catchment Management*, *Agri-environment*, *Biodiverse Farming*, *Water Framework Directive* and *Sustainable Uplands*. These projects will deliver important insights into the operation, effectiveness, and future development of the schemes.

- 5.21 Our discussions have highlighted the challenge of securing the *long-term* provision of public goods and services through agri-environment schemes. At present, agreements typically operate for five-year or ten-year periods. When they end, there is no obligation on either side to renew the agreement. This offers advantages to both parties: the state avoids an enduring financial commitment, and land managers avoid restricting their options for the future use of the land. Equally, though, the state risks losing the benefits purchased (e.g. habitat recreation, landscape protection, reduced nutrient levels in water, or public access), and the land manager risks losing a secure flow of income.
- 5.22 The need for measures to secure long-term benefits may intensify as the timescales for planning the delivery of various environmental services lengthen. For example, the Water Framework Directive sets milestones for improvements in water management through to 2027. An agri-environment agreement which secures improvements in water quality between 2015 and 2021, but not thereafter, will not bring the permanent improvement sought. Equally, the Climate Change Act sets targets for reductions in greenhouse gas emissions by 2050: is it prudent to use public resources to invest in carbon-reduction measures now if the benefits cannot be guaranteed beyond the first five-year agreement? It also makes little sense to invest in developing land which will be exposed to rapidly escalating risks of flooding as indicated by flood risk management strategies which look forward to 2100. Public policies perhaps need to adopt the perspective of those estate owners who in setting objectives tend to focus on the needs of the generation after next.
- 5.23 International experience suggests that there are various ways to secure long-term benefits through land management agreements. For example, 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 report by Green Balance (2008) reviews a range of these mechanisms. One option might be to link the *annual* payment to the length of the commitment (e.g. to pay £100 per hectare per year for a 10-year agreement, and £110 per hectare per year for a 20-year agreement). Another option might be for the state, or voluntary bodies such as the National Trust, to purchase land and lease it back to the former owner (or new tenants) under restrictive conditions at appropriate rents. This might also be an option for eroding coastlines, to ease adjustment for existing property owners who face losing their land and/or homes to the sea.
- 5.24 A further challenge is to secure collaborative action between land managers where action on one holding alone, or scattered holdings across any area, will not be enough to deliver any one or more ecosystem services. Traditionally some form of designation has been used to target resources to groups of holdings. For example, management agreements have been made available to managers of Sites of Special Scientific Interest, and agri-environment funding was originally targeted on farms within designated Environmentally Sensitive Areas. Recently, initiatives have been targeted flexibly, without using formal designations (e.g. Catchment Sensitive Farming Delivery Initiatives). Another example is provided by negotiated agreements under which water suppliers pay land managers to deliver specific ecosystem services in water-gathering areas. This is the focus of research in several EU countries (Brouwer *et al* 2003).
- 5.25 One mechanism to secure collaboration could be to offer a financial incentive, such as a 'collaboration' bonus, where more than a defined minimum proportion of land, or of land managers, within a specific targeted area (e.g. a SSSI, valley, or sub-catchment) is entered into an agri-environment scheme. However, the *Deer* project suggests that this may not always work: their choice experiments have shown that deer managers are strongly averse to enforced collaboration and may not respond to incentives to encourage it. 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. The way in which collaboration is encouraged, especially the *process* of dialogue and negotiation, may be as

important as any specific benefit gained from incentives or access to advice or training. An earlier Relu project describes examples of successful collaborative agri-environment initiatives among groups of farmers in the Netherlands (Franks and McGloin 2006).

- 5.26 If voluntary approaches fail to secure the voluntary support of individual land managers, or the necessary minimum degree of collaboration between them, regulation may be the only effective alternative. 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 (Defra 2007c). However, any such approaches are likely to be introduced alongside voluntary agreements under agri-environment schemes, and other advisory initiatives, not as substitutes for them.
- 5.27 Relu projects also underline the need to avoid unintended or unexpected outcomes from agri-environment schemes. For example, the *Community Catchment Management* project suggests that a net environmental loss can result if schemes to extensify practices in one area lead to intensification elsewhere. There are also tensions 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 *Agri-environment* project is showing that management prescriptions may not lead to the desired outcomes where farmers are not sufficiently engaged with the aims of the policy in the first place.
- 5.28 One issue, from our discussions, is the extent to which ecosystem services, as purchased through agri-environment schemes, can be valued financially in their own right, rather than in comparison with food production. EU legislation currently requires agri-environment payments to be calculated on the basis of the income foregone by adopting the specified land management practices. This seems unbalanced, given that food is valued by the market without necessarily taking account of the resulting environmental costs (e.g. erosion, water pollution) and benefits (e.g. landscape beauty, biodiversity). It also seems out of step with the ecosystem approach, which values all services from land in their own right, not as adjuncts to, or competitors with, food production alone.

Creating new markets

- 5.29 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 to assess realistically how far food markets can drive the delivery of ecosystem services.
- 5.30 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. Research through the *Sustainable Uplands* project 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. The 'Carbon Reduction and Investment Techniques for Yorkshire and the Humber' (CREDIT) initiative is now seeking to develop a carbon-offsetting scheme for local businesses.
- 5.31 'Habitat banking' – the restoration, creation or enhancement of habitats to compensate for development impacts elsewhere - may be a further means of using a market mechanism to secure long-term environmental land management benefits, encourage collaboration between land managers, or secure beneficial change at a landscape scale. The concept involves developers purchasing credits from a 'bank' which uses these to fund the purchase and management of land (or agreements with land managers to the same ends) to yield long-term environmental gains. Habitat banking has been operating for some 30 years in

the USA, where some estimates suggest the market is worth more than \$1.5 billion annually. It is now being promoted in the EU. Further policy development is required to enable this mechanism to operate effectively in the UK (Wilkinson and Hill 2008).

Models, assessment tools and indicators

- 5.32 Recent increases in computing power have enabled the development of sophisticated models and allied approaches in studying ecosystem services. For example, 'spatial technologies, scenarios, indicators and multicriteria analysis are increasingly being used to enable improved integration for sustainable catchment management' (Macleod *et al* 2007). Relu projects are modelling interactions between land use, the economy, land managers and the environment. Six projects are working on farm production modelling alone.
- 5.33 Key challenges in relation to modelling include:
- The choice of modelling scale (field, enterprise, farm, catchment, regional, national).
 - The relationships between models at different scales, and scaling-up model outputs from local scales to regional and national scales.
 - The effective exploitation of spatial technologies (Geographical Information Systems) (e.g. to develop interactive tools to explore actions and impacts with stakeholders).
 - The immense variation between farms and environmental conditions (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 local 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.
 - Being explicit about the assumptions which underlie models, whether related to land use, behaviour, policy, or other variables.
- 5.34 Relu work is challenging 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).
- 5.35 Important opportunities to advance policy-making may be being missed by a failure to tap the potential of econometric models to understand the world and inform policy proposals, and to recognise that modelling is more about understanding *uncertainty* than delivering *certain* answers. In particular, there may be scope to build on the work of the Relu projects which are including carbon in their modelling work (e.g. *Water Framework Directive, Floodplains, Sustainable Uplands*), to model what a landscape managed primarily to capture, store and release carbon would look like. This might help to establish the relative weight to be given to these services, and illuminate trade-offs with other services.

- 5.36 Techniques for Sustainability Appraisal and Life-Cycle Assessment are being used and developed by Relu projects to help understand conflicts and trade-offs between different ecosystem services. The *Energy Crops* project is developing a framework for Sustainability Appraisal for short-rotation coppice and *Miscanthus* crops. This will help evaluate the full range of consequences of shifting land use towards biomass production. The *Local Food* project is illustrating how integrated Life-Cycle Assessment can inform the debate over the merits of locally-grown and imported food. There is potential to use both techniques more widely. For example, applying them to *existing* land uses might indicate that it is not only 'new' developments that may be unsustainable. Equally, embedding life-cycle assessment approaches into land-use policy-making could usefully provide a more rounded *global* economic, social and environmental view of the impacts of local actions.
- 5.37 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. This work will assist in developing new and more meaningful indicators to help assess the performance of policy interventions.

Risks that may frustrate change

- 5.38 Rising to the land-use challenge of 'securing integrated land management using an ecosystems approach' will require change in mindsets, policies and processes alike. The risks which could frustrate the necessary change are diverse:
- **Fundamentalism**: Fundamentalism can lead to sectoral approaches where one interest is set against another and neither is served well. Arguing that any one interest must always come first (e.g. 'food production', or 'conservation of biodiversity') runs counter to the emphasis placed by the ecosystem approach on a holistic approach which treats all aspirations for land as equally legitimate and worthy of consideration.
 - **Failure to look ahead**: Short-termism - whether of vision, commitment, strategy or delivery - makes it difficult to consider effectively the needs of future generations and to take decisions today which will keep options open for the future. Equally, care needs to be taken to avoid promoting particular land uses now which in practice may prove increasingly difficult to sustain under a changed climate in say 50 years' time (e.g. current designations may be unsustainable because it will simply not be possible for the species or habitats to survive within them under changed climatic conditions). Reconciling short-term and long-term objectives is a significant challenge.
 - **Failure to escape from the status quo**: The countryside today reflects the combined impacts of 60 years of public policy intervention - it would look very different if national and EU support for land management had not been provided over that time. The status quo need not dictate the pattern for the future. We should not shy away from 'thinking out of the box' in determining how best to secure integrated land management. Showing people how the landscape has changed in the past - and developing scenarios which show how it might look in the future - may help ease this process.
 - **Failure to collaborate**: To be effective, the delivery of different ecosystem services will need to be done at the scale which is most appropriate to the specific service. This will very rarely coincide with an administrative unit (whether a territory, region, or local authority). Failure to initiate collaboration and to manage public resources (funding, and people) and other interventions (e.g. consultation, and regulation) will lead to piecemeal

and inconsistent results. Equally, failure to encourage collaboration at the local level among groups of land managers will have a similar effect.

- **Failure to develop the necessary knowledge and skills**: Integrated land management is not necessarily intuitive. If it is to become a reality, significant investment will be needed by both the private and the public sectors in sustaining and developing the knowledge and skills of the current - and future - generations of land managers.
- **Failure to build in resilience to external shocks**: Outbreaks of disease, extreme weather, economic shocks, and international conflicts, will always test any system. Their impacts could be exacerbated by continuing climate change (e.g. is it wise to seek to connect woodland habitats given a future heightened risk of forest fires?). The Foot and Mouth epidemic of 2001 indicated how the impacts can be far-reaching. Such risks need to be assessed, and taken into account in policy-making and delivery.

6. MAKING THE MOST OF RELU RESEARCH

- 6.1 This study has drawn on a range of source materials: information on the 20 selected Relu projects, discussions with their research teams, discussions with key players in the 'policy community', detailed responses to our 'Challenge paper' from a wider range of organisations and individuals, and inputs from our sponsors, among others. This section considers how these various contributors can best make use of Relu research.
- 6.2 The need for *integration* across disciplinary boundaries, geographical boundaries and institutional boundaries has been stressed by many of those we have met throughout this study. The interdisciplinary approach of the Relu projects needs to be matched by an interdisciplinary approach to developing and implementing policy itself. In our discussions there were numerous calls for thinking, organisations and initiatives to be better 'joined-up'. This in turn requires better networking of information about what initiatives have already been taken or are planned. This will help everyone to avoid 'reinventing wheels'.
- 6.3 We have also heard concerns about the robustness of the knowledge base and our ability to access knowledge to inform policy. This may not have been assisted by devolution to national territories, and within England to the Regions, the shake-up of the statutory agencies in England, the recent 'slimming' of Defra, and a reduction in the range of academic institutions working on land use issues. There is a risk, for example, that 'institutional memories' will be lost, so that lessons learned at the time in dealing with past crises are not available – and acted upon - in the future, so the same mistakes are made. This concern perhaps underlines the need to ensure that the outputs of Relu research are effectively collated and made widely available. Improving the links between repositories of relevant research funded by UK and territorial Departments, the Research Councils, the UK Agencies' Rural Affairs Group, and others would also be helpful.
- 6.4 Relu projects provide a valuable resource for policy-makers. They offer insights into diverse policy questions, models to support policy analysis, and information and decision tools to assist land managers. Increased dialogue between policy-makers and Relu researchers will help policy-makers review their assumptions, consider novel perspectives, and obtain valuable new evidence. Similarly, greater dialogue will help researchers to understand the specific questions to which policy-makers need answers, and to frame their outputs in ways which are relevant to policy. Relu projects could also inform work to develop new approaches to land-use challenges by providing a basis for designing pilot projects.
- 6.5 A recent review of how science and policy interact has highlighted cultural and institutional factors which affect these relationships (The Knowledge Bridge 2005). For example, while scientists aim for 'new and valid knowledge, rigorous research, publication in academic literature, and additional research funding', policy-makers aim to 'respond to political priorities, balance interests and values in policy-making, cope with events, and manage resources'. There are differences too in the way in which each group measures success, communicates, and views interaction with others and 'relevance'. More widespread understanding of these factors would assist mutual understanding and improve dialogue.
- 6.6 The Relu programme itself is fostering better dialogue between researchers and policy-makers in diverse ways at UK, territorial, regional and local levels. Requiring projects to distil findings relevant to policy-makers in a series of 'Policy and Practice Notes' will help policy-makers absorb and act on the outputs of research (e.g. Relu 2008). It would also be useful to highlight to specific policy people those projects which may be of particular interest to them, and similarly to identify for researchers specific policy-makers likely to have an interest in their work. Setting Relu projects in the context of wider research programmes on land use would also be a valuable contribution to ensuring effective knowledge exchange. The approach adopted by the 'Integrating Water and Agricultural Management' initiative, supported by Defra, might offer a model for further efforts to improve knowledge exchange on land use in general.

- 6.7 For rural businesses, the Relu projects prompt wider awareness of the potential of land to deliver a wider range of ecosystem services to meet society's needs. Delivering this will require a change of mindset, particularly among land managers, to realise the potential of land to deliver different mixes of services to those apparent today. It will also require changes to existing policy mechanisms and tools, within the wider market. The projects also underline the value of much closer engagement between policy-makers, land managers and rural communities to bring local expertise to bear on national challenges.
- 6.8 For research funders, the projects underline the value of interdisciplinarity and of taking a UK view of land-use issues. Interdisciplinarity benefits research through the interplay of different disciplines and perspectives. It is also critical for the policy-makers, because it sets science within a social and economic context, providing a holistic view which relates well to the real world in which policy has to be developed and implemented. It is also striking that Relu projects appear to have much wider relevance across the UK - well beyond the particular territory or region in which they are located. While the governance arrangements for research funding and policy may vary, the core issues seem very similar. The implication is that projects should be conceived and funded on a UK basis, not repeated in each territory in turn. Indeed, there will often be value in conceiving and developing projects on a north European basis, with neighbouring countries, or more widely still.
- 6.9 Research reports often conclude with 'suggestions for further research'. In this case, many of the Relu projects have yet to deliver their findings, so it would be premature to suggest what the next generation of research issues might include. Our discussions with policy-makers have indicated a desire to see more applied agricultural research. The importance of taking a holistic approach to research, so as to capture wider benefits which arise from specific policies (e.g. where work undertaken primarily to benefit water management and biodiversity also improves carbon storage) has also been stressed.
- 6.10 Particular suggestions for applied research include:
- Managing inputs more efficiently – linking to general Government policies to improve resource efficiency.
 - Helping land managers reduce emissions of methane and nitrous oxide.
 - Investigating future new crops.
 - Investigating the health of honey bee populations (taking account of the impacts of climate change and parasites).
 - Comparing, through an integrated assessment, conventional farming and minimum tillage with buffer zones. This would need to cover all aspects of terrestrial, soil and aquatic biodiversity, water quality and soil erosion; current work tends to focus on single parameters only. This sort of approach would support the future development of agri-environment schemes alongside high-output food production.
- 6.11 These suggestions relate well to the priorities recently highlighted by the Defra Secretary of State: '...lessening harmful greenhouse gases and water pollution produced by farming and food processing, as well as looking at ways of adapting to climate change where plant breeding – including new varieties – will be very important.' One specific priority, through a five-year research project, is to 'explore how we can provide food efficiently whilst at the same time minimising adverse effects on soil, water and biodiversity.' The project will test approaches on different types of farms and catchments and deliver information on practical measures which land managers can adopt (Defra 2009).

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ANNEX 1: RELU PROJECTS REVIEWED

Details of the 20 projects are provided below in order of expected completion date, with their short title (used solely for reference purposes in this paper), long title, and the planned 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

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 Trill, University of Reading **Email:** w.b.trill@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

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 CO₂ 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

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

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

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

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

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, 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

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

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

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

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

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

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

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

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

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

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

ANNEX 2: CONSULTEES AND RESPONDENTS TO THE RELU CONSULTATION

The following organisations and individuals are thanked for their inputs to this report, whether through meetings or written contributions. All contributions have been taken into account in writing this report, but the findings and conclusions are those of the author alone.

| Organisation | Main contact |
|---|---|
| Bangor University | Professor Colin Price |
| Campaign to Protect Rural England (CPRE) | Tom Oliver |
| Catchment Science Centre, University of Sheffield (Farmer) | Professor Bob Harris Mark Tinsley |
| Commission for Rural Communities (CRC) | Peter Carruthers |
| Contributors to the RELU 'Great Land Use Debate' | Anne Liddon |
| Country Land and Business Association (CLA) | Professor Allan Buckwell |
| Countryside and Community Research Institute (CCRI) | Dr Julie Ingram |
| CPLAN | Dr Jan Dick |
| Cranfield University | Dr Peter Howsam |
| Department for Environment, Food and Rural Affairs (Defra) | Dr Peter Costigan, Alastair Johnson, Andrea Sylvester |
| East Riding of Yorkshire Council | Graham Chapman |
| Flood Hazard Research Centre, University of Middlesex | Christophe Viavattene |
| Foresight Land Use Futures Project (Geneticist) | Nicola O'Connor Peter Crisp |
| Institute of Grassland and Environmental Research | Dr Kit Macleod |
| Marks & Spencer plc | David Gregory |
| National Farmers' Union of England and Wales | Dr Andrew Clark |
| National Trust | Tony Burton |
| Natural England (Nuffield Scholar) | Sarah Olney Louise Manning |
| Relu People and the Rural Environment Forum | Professor Philip Lowe |
| Relu Project Advisory Group | Jeremy Phillipson |
| Royal Society for the Protection of Birds (RSPB) | Dr Mark Avery, Alice Hardiman |
| Rural Affairs Group of the UK Agencies | Brian Pawson |
| Scottish Environment Protection Agency (SEPA) | Janice Milne |
| Scottish Government | Maggie Gill, Caspian Richards |
| Southern Uplands Partnership | Pip Tabor |
| Syngenta AG | Dr Peter Sutton |
| University of Manchester | Professor Derek Yalden |
| University of Newcastle | Professor David Harvey |
| Welsh Assembly Government | Chris Lea |
| Woodland Trust | Mike Townsend |